

**Project No. 10-95A**

**TOUGHNESS REQUIREMENTS FOR HEAT-AFFECTED  
ZONES OF WELDED STRUCTURAL STEELS FOR  
HIGHWAY BRIDGES**

**FINAL REPORT APPENDICES**

**Prepared for  
NCHRP  
Transportation Research Board**

**of**

**The National Academies of Sciences, Engineering, and Medicine**

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## APPENDIX A

## Tabulated CVN Values

| Plate and Weldment        | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|---------------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| Pilot Study<br>Base Metal | Base Metal | 1/4T  | L-T         | PS1      | -51.1 (-60.0)             | 75.1 (55.4)                   |
|                           |            |       |             | PS2      | -51.1 (-60.0)             | 70.5 (52.0)                   |
|                           |            |       |             | PS3      | -34.4 (-30.0)             | 112 (82.5)                    |
|                           |            |       |             | PS4      | -34.4 (-30.0)             | 104 (77.0)                    |
|                           |            |       |             | PS5      | -17.8 (0.00)              | 139 (103)                     |
|                           |            |       |             | PS6      | -17.8 (0.00)              | 147 (108)                     |
|                           |            |       |             | PS7      | 4.44 (40.0)               | 172 (127)                     |
|                           |            |       |             | PS8      | 4.44 (40.0)               | 240 (177)                     |
|                           |            |       |             | PS9      | 21.1 (70.0)               | 248 (183)                     |
|                           |            |       |             | PS10     | 21.1 (70.0)               | 258 (190)                     |
|                           |            |       |             | PS11     | -80.0 (-112)              | 8.73 (6.44)                   |
|                           |            |       |             | PS12     | -80.0 (-112)              | 4.23 (3.12)                   |
|                           |            |       |             | PS13     | -51.1 (-60.0)             | 56.7 (41.8)                   |
|                           |            |       |             | PS14     | -51.1 (-60.0)             | 13.8 (10.2)                   |
|                           |            |       |             | PS15     | -51.1 (-60.0)             | 62.2 (45.9)                   |
|                           |            |       |             | PS16     | -34.4 (-30.0)             | 91.1 (67.2)                   |
|                           |            |       |             | PS17     | -34.4 (-30.0)             | 93.7 (69.1)                   |
|                           |            |       |             | PS18     | -34.4 (-30.0)             | 87.7 (64.7)                   |
| Pilot Study<br>SAW        | Base Metal | 1/2T  | L-T         | PS64     | -51.1 (-60.0)             | 8.16 (6.02)                   |
|                           |            |       |             | PS65     | -51.1 (-60.0)             | 10.4 (7.69)                   |
|                           |            |       |             | PS66     | -51.1 (-60.0)             | 8.54 (6.30)                   |
|                           |            |       |             | PS67     | -34.4 (-30.0)             | 20.8 (15.3)                   |
|                           |            |       |             | PS68     | -34.4 (-30.0)             | 15.8 (11.7)                   |
|                           |            |       |             | PS69     | -34.4 (-30.0)             | 42.4 (31.3)                   |
|                           | Weld Metal | 1/4T  | L-T         | PS19     | -51.1 (-60.0)             | 15.0 (11.1)                   |
|                           |            |       |             | PS20     | -51.1 (-60.0)             | 45.1 (33.3)                   |
|                           |            |       |             | PS21     | -28.9 (-20.0)             | 36.2 (41.5)                   |
|                           |            |       |             | PS22     | -28.9 (-20.0)             | 116 (85.2)                    |
|                           |            |       |             | PS23     | -17.8 (0.00)              | 60.1 (44.4)                   |
|                           |            |       |             | PS24     | -17.8 (0.00)              | 114 (84.1)                    |
|                           |            |       |             | PS25     | -51.1 (-60.0)             | 33.4 (24.6)                   |
|                           |            |       |             | PS26     | -28.9 (-20.0)             | 113 (83.4)                    |
|                           |            |       |             | PS27     | -17.8 (0.00)              | 52.0 (38.4)                   |
|                           | Weld Metal | 1/2T  | L-T         | PS70     | -51.1 (-60.0)             | 14.3 (10.5)                   |
|                           |            |       |             | PS71     | -51.1 (-60.0)             | 16.5 (12.2)                   |
|                           |            |       |             | PS72     | -51.1 (-60.0)             | 15.3 (11.3)                   |
|                           |            |       |             | PS73     | -28.9 (-20.0)             | 37.1 (27.4)                   |
|                           |            |       |             | PS74     | -28.9 (-20.0)             | 79.9 (58.9)                   |
|                           |            |       |             | PS75     | -28.9 (-20.0)             | 88.8 (65.5)                   |

| Plate and Weldment | Location | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|----------|-------|-------------|----------|---------------------------|-------------------------------|
| Pilot Study SAW    | FL       | 1/4T  | L-T         | PS28     | -51.1 (-60.0)             | 57.2 (42.2)                   |
|                    |          |       |             | PS29     | -51.1 (-60.0)             | 44.1 (32.5)                   |
|                    |          |       |             | PS30     | -34.4 (-30.0)             | 53.4 (39.4)                   |
|                    |          |       |             | PS31     | -34.4 (-30.0)             | 90.4 (66.7)                   |
|                    |          |       |             | PS32     | -17.8 (0.00)              | 114 (84.4)                    |
|                    |          |       |             | PS33     | -17.8 (0.00)              | 106 (77.9)                    |
|                    |          |       |             | PS34     | 4.44 (40.0)               | 107 (78.9)                    |
|                    |          |       |             | PS35     | 4.44 (40.0)               | 160 (118)                     |
|                    |          |       |             | PS36     | -80.0 (-112)              | 39.8 (29.4)                   |
|                    |          |       |             | PS37     | -80.0 (-112)              | 17.8 (13.2)                   |
|                    |          |       |             | PS38     | 21.1 (70.0)               | 123 (90.6)                    |
|                    |          |       |             | PS39     | 21.1 (70.0)               | 148 (109)                     |
|                    |          |       |             | PS40     | -51.1 (-60.0)             | 44.4 (32.7)                   |
|                    |          |       |             | PS41     | -51.1 (-60.0)             | 78.1 (57.6)                   |
|                    |          |       |             | PS42     | -51.1 (-60.0)             | 46.1 (34.0)                   |
|                    |          |       |             | PS43     | -34.4 (-30.0)             | 69.8 (51.5)                   |
|                    |          |       |             | PS44     | -34.4 (-30.0)             | 63.4 (46.8)                   |
|                    |          |       |             | PS45     | -34.4 (-30.0)             | 109 (80.4)                    |
|                    | FL + 1   | 1/4T  | L-T         | PS46     | -51.1 (-60.0)             | 35.2 (26.0)                   |
|                    |          |       |             | PS47     | -51.1 (-60.0)             | 181 (134)                     |
|                    |          |       |             | PS48     | -51.1 (-60.0)             | 113 (83.5)                    |
|                    |          |       |             | PS49     | -34.4 (-30.0)             | 137 (101)                     |
|                    |          |       |             | PS50     | -34.4 (-30.0)             | 154 (113)                     |
|                    | FL + 2   | 1/4T  | L-T         | PS51     | -34.4 (-30.0)             | 142 (105)                     |
|                    |          |       |             | PS52     | -51.1 (-60.0)             | 21.1 (15.5)                   |
|                    |          |       |             | PS53     | -51.1 (-60.0)             | 10.6 (7.83)                   |
|                    |          |       |             | PS54     | -51.1 (-60.0)             | 119 (87.8)                    |
|                    |          |       |             | PS55     | -34.4 (-30.0)             | 168 (124)                     |
|                    |          |       |             | PS56     | -34.4 (-30.0)             | 130 (95.9)                    |
|                    |          |       |             | PS57     | -34.4 (-30.0)             | 108 (79.8)                    |
|                    | FL       | 1/4T  | L-S         | PS58     | -51.1 (-60.0)             | 102 (75.0)                    |
|                    |          |       |             | PS59     | -51.1 (-60.0)             | 70.9 (52.3)                   |
|                    |          |       |             | PS60     | -51.1 (-60.0)             | 37.1 (27.4)                   |
|                    |          |       |             | PS61     | -34.4 (-30.0)             | 79.3 (58.5)                   |
|                    |          |       |             | PS62     | -34.4 (-30.0)             | 75.2 (55.4)                   |
|                    | FL       | 1/2T  | L-T         | PS63     | -34.4 (-30.0)             | 71.7 (52.9)                   |
|                    |          |       |             | PS76     | -51.1 (-60.0)             | 95.5 (70.4)                   |
|                    |          |       |             | PS77     | -51.1 (-60.0)             | 99.4 (73.3)                   |
|                    |          |       |             | PS78     | -51.1 (-60.0)             | 39.6 (29.2)                   |
|                    |          |       |             | PS79     | -34.4 (-30.0)             | 75.5 (55.7)                   |
|                    |          |       |             | PS80     | -34.4 (-30.0)             | 104 (76.5)                    |
|                    |          |       |             | PS81     | -34.4 (-30.0)             | 94.0 (69.3)                   |
|                    |          |       |             | PS82     | -51.1 (-60.0)             | 137 (101)                     |
|                    |          |       |             | PS83     | -51.1 (-60.0)             | 156 (115)                     |
|                    | FL + 1   | 1/2T  | L-T         | PS84     | -51.1 (-60.0)             | 207 (153)                     |
|                    |          |       |             | PS85     | -34.4 (-30.0)             | 148 (109)                     |
|                    |          |       |             | PS86     | -34.4 (-30.0)             | 178 (131)                     |
|                    |          |       |             | PS87     | -34.4 (-30.0)             | 179 (132)                     |
|                    |          |       |             | PS88     | -51.1 (-60.0)             | 13.0 (9.59)                   |
|                    | FL + 2   | 1/2T  | L-T         | PS89     | -51.1 (-60.0)             | 4.14 (3.05)                   |
|                    |          |       |             | PS90     | -51.1 (-60.0)             | 52.6 (38.8)                   |
|                    |          |       |             | PS91     | -34.4 (-30.0)             | 8.73 (6.44)                   |
|                    |          |       |             | PS92     | -34.4 (-30.0)             | 17.7 (13.1)                   |
|                    |          |       |             | PS93     | -34.4 (-30.0)             | 23.0 (17.0)                   |

| Plate and Weldment  | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|---------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| Pilot Study<br>FCAW | Weld Metal | 1/4T  | L-T         | PF1      | -51.1 (-60.0)             | 27.2 (20.1)                   |
|                     |            |       |             | PF2      | -51.1 (-60.0)             | 32.5 (24.0)                   |
|                     |            |       |             | PF3      | -28.9 (-20.0)             | 39.1 (28.8)                   |
|                     |            |       |             | PF4      | -28.9 (-20.0)             | 30.8 (22.7)                   |
|                     |            |       |             | PF5      | -17.8 (0.00)              | 46.5 (34.3)                   |
|                     |            |       |             | PF6      | -17.8 (0.00)              | 43.9 (32.4)                   |
|                     |            |       |             | PF7      | -51.1 (-60.0)             | 25.8 (19.1)                   |
|                     |            |       |             | PF8      | -28.9 (-20.0)             | 36.9 (27.2)                   |
|                     |            |       |             | PF9      | -17.8 (0.00)              | 55.2 (40.7)                   |
|                     | FL         | 1/4T  | L-T         | PF10     | -51.1 (-60.0)             | 27.3 (20.2)                   |
|                     |            |       |             | PF11     | -51.1 (-60.0)             | 38.0 (28.1)                   |
|                     |            |       |             | PF12     | -34.4 (-30.0)             | 32.9 (24.3)                   |
|                     |            |       |             | PF13     | -34.4 (-30.0)             | 49.3 (36.3)                   |
|                     |            |       |             | PF14     | -17.8 (0.00)              | 52.9 (39.0)                   |
|                     |            |       |             | PF15     | -17.8 (0.00)              | 36.3 (26.8)                   |
|                     |            |       |             | PF16     | 4.44 (40.0)               | 66.7 (49.2)                   |
|                     |            |       |             | PF17     | 4.44 (40.0)               | 45.7 (33.7)                   |
|                     |            |       |             | PF18     | -80.0 (-112)              | 9.48 (6.99)                   |
|                     |            |       |             | PF19     | -80.0 (-112)              | 10.1 (7.48)                   |
|                     |            |       |             | PF20     | 21.1 (70.0)               | 59.9 (44.2)                   |
|                     |            |       |             | PF21     | 21.1 (70.0)               | 65.7 (48.5)                   |
|                     |            |       |             | PF22     | -51.1 (-60.0)             | 33.3 (24.6)                   |
|                     |            |       |             | PF23     | -51.1 (-60.0)             | 18.0 (13.3)                   |
|                     |            |       |             | PF24     | -51.1 (-60.0)             | 24.4 (18.0)                   |
|                     |            |       |             | PF25     | -34.4 (-30.0)             | 32.4 (23.9)                   |
|                     |            |       |             | PF26     | -34.4 (-30.0)             | 38.3 (28.3)                   |
|                     |            |       |             | PF27     | -34.4 (-30.0)             | 34.1 (25.2)                   |
| Pilot Study<br>GMAW | Weld Metal | 1/4T  | L-T         | PG1      | -51.1 (-60.0)             | 55.9 (41.2)                   |
|                     |            |       |             | PG2      | -51.1 (-60.0)             | 67.3 (49.6)                   |
|                     |            |       |             | PG3      | -28.9 (-20.0)             | 62.6 (46.2)                   |
|                     |            |       |             | PG4      | -28.9 (-20.0)             | 103 (76.2)                    |
|                     |            |       |             | PG5      | -17.8 (0.00)              | 108 (80.0)                    |
|                     |            |       |             | PG6      | -17.8 (0.00)              | 145 (107)                     |
|                     |            |       |             | PG7      | -51.1 (-60.0)             | 49.6 (36.6)                   |
|                     |            |       |             | PG8      | -28.9 (-20.0)             | 107 (79.3)                    |
|                     |            |       |             | PG9      | -17.8 (0.00)              | 103 (75.8)                    |
|                     | FL         | 1/4T  | L-T         | PG10     | -51.1 (-60.0)             | 60.4 (44.5)                   |
|                     |            |       |             | PG11     | -51.1 (-60.0)             | 69.6 (51.3)                   |
|                     |            |       |             | PG12     | -34.4 (-30.0)             | 84.1 (62.0)                   |
|                     |            |       |             | PG13     | -34.4 (-30.0)             | 84.8 (62.5)                   |
|                     |            |       |             | PG14     | -17.8 (0.00)              | 69.3 (51.1)                   |
|                     |            |       |             | PG15     | -17.8 (0.00)              | 110 (81.0)                    |
|                     |            |       |             | PG16     | 4.44 (40.0)               | 178 (131)                     |
|                     |            |       |             | PG17     | 4.44 (40.0)               | 150 (110)                     |
|                     |            |       |             | PG18     | -80.0 (-112)              | 14.1 (10.4)                   |
|                     |            |       |             | PG19     | -80.0 (-112)              | 28.5 (21.1)                   |
|                     |            |       |             | PG20     | 21.1 (70.0)               | 200 (147)                     |
|                     |            |       |             | PG21     | 21.1 (70.0)               | 171 (126)                     |
|                     |            |       |             | PG22     | -51.1 (-60.0)             | 64.5 (47.6)                   |
|                     |            |       |             | PG23     | -51.1 (-60.0)             | 44.1 (32.5)                   |
|                     |            |       |             | PG24     | -51.1 (-60.0)             | 63.4 (46.8)                   |
|                     |            |       |             | PG25     | -34.4 (-30.0)             | 83.6 (61.7)                   |
|                     |            |       |             | PG26     | -34.4 (-30.0)             | 65.4 (48.2)                   |
|                     |            |       |             | PG27     | -34.4 (-30.0)             | 84.3 (62.2)                   |



| Plate and Weldment  | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|---------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| Pilot Study<br>SMAW | Weld Metal | 1/4T  | L-T         | PH1      | -51.1 (-60.0)             | 32.6 (24.0)                   |
|                     |            |       |             | PH2      | -51.1 (-60.0)             | 95.1 (70.2)                   |
|                     |            |       |             | PH3      | -28.9 (-20.0)             | 57.9 (42.7)                   |
|                     |            |       |             | PH4      | -28.9 (-20.0)             | 151 (111)                     |
|                     |            |       |             | PH5      | -17.8 (0.00)              | 65.0 (47.9)                   |
|                     |            |       |             | PH6      | -17.8 (0.00)              | 167 (124)                     |
|                     |            |       |             | PH7      | -51.1 (-60.0)             | 32.4 (23.9)                   |
|                     |            |       |             | PH8      | -28.9 (-20.0)             | 127 (94.0)                    |
|                     |            |       |             | PH9      | -17.8 (0.00)              | 31.4 (23.1)                   |
|                     | FL         | 1/4T  | L-T         | PH10     | -51.1 (-60.0)             | 54.9 (40.5)                   |
|                     |            |       |             | PH11     | -51.1 (-60.0)             | 12.9 (9.52)                   |
|                     |            |       |             | PH12     | -34.4 (-30.0)             | 83.9 (61.9)                   |
|                     |            |       |             | PH13     | -34.4 (-30.0)             | 42.4 (31.3)                   |
|                     |            |       |             | PH14     | -17.8 (0.00)              | 73.0 (53.9)                   |
|                     |            |       |             | PH15     | -17.8 (0.00)              | 42.1 (31.0)                   |
|                     |            |       |             | PH16     | 4.44 (40.0)               | 57.1 (42.1)                   |
|                     |            |       |             | PH17     | 4.44 (40.0)               | 67.9 (50.1)                   |
|                     |            |       |             | PH18     | -80.0 (-112)              | 46.5 (34.3)                   |
|                     |            |       |             | PH19     | -80.0 (-112)              | 18.6 (13.7)                   |
|                     |            |       |             | PH20     | 21.1 (70.0)               | 92.2 (68.0)                   |
|                     |            |       |             | PH21     | 21.1 (70.0)               | 199 (146)                     |
|                     |            |       |             | PH22     | -51.1 (-60.0)             | 15.3 (11.3)                   |
|                     |            |       |             | PH23     | -51.1 (-60.0)             | 35.7 (26.3)                   |
|                     |            |       |             | PH24     | -51.1 (-60.0)             | 28.0 (20.7)                   |
|                     |            |       |             | PH25     | -34.4 (-30.0)             | 88.5 (65.3)                   |
|                     |            |       |             | PH26     | -34.4 (-30.0)             | 71.6 (52.8)                   |
|                     |            |       |             | PH27     | -34.4 (-30.0)             | 78.9 (58.2)                   |
| 51A<br>Base Metal   | Base Metal | 1/4T  | L-T         | AB-1     | -80.0 (-112)              | 17.6 (13.0)                   |
|                     |            |       |             | AB-2     | -80.0 (-112)              | 35.6 (26.2)                   |
|                     |            |       |             | AB-3     | -80.0 (-112)              | 5.26 (3.88)                   |
|                     |            |       |             | AB-4     | -67.8 (-90.0)             | 104 (76.8)                    |
|                     |            |       |             | AB-5     | -67.8 (-90.0)             | 33.7 (24.9)                   |
|                     |            |       |             | AB-6     | -67.8 (-90.0)             | 11.4 (8.39)                   |
|                     |            |       |             | AB-7     | -51.1 (-60.0)             | 67.2 (49.5)                   |
|                     |            |       |             | AB-8     | -51.1 (-60.0)             | 233 (172)                     |
|                     |            |       |             | AB-9     | -51.1 (-60.0)             | 131 (96.5)                    |
|                     |            |       |             | AB-10    | -34.4 (-30.0)             | 150 (111)                     |
|                     |            |       |             | AB-11    | -34.4 (-30.0)             | 146 (108)                     |
|                     |            |       |             | AB-12    | -34.4 (-30.0)             | 88.0 (64.9)                   |
|                     |            |       |             | AB-13    | -17.8 (0.00)              | 391 (289)                     |
|                     |            |       |             | AB-14    | -17.8 (0.00)              | 383 (282)                     |
|                     |            |       |             | AB-15    | -17.8 (0.00)              | 400 (295)                     |
|                     |            |       |             | AB-16    | -26.1 (-15.0)             | 321 (237)                     |
|                     |            |       |             | AB-17    | -26.1 (-15.0)             | 199 (147)                     |
|                     |            |       |             | AB-18    | -26.1 (-15.0)             | 354 (261)                     |
|                     |            |       |             | AB-19    | 4.44 (40.0)               | 403 (297)                     |
|                     |            |       |             | AB-20    | 4.44 (40.0)               | 400 (295)                     |
|                     |            |       |             | AB-21    | 4.44 (40.0)               | 405 (298)                     |
|                     |            |       |             | AB-22    | -51.1 (-60.0)             | 145 (107)                     |
|                     |            |       |             | AB-23    | -34.4 (-30.0)             | 216 (160)                     |
|                     |            |       |             | AB-24    | -26.1 (-15.0)             | 373 (275)                     |
|                     |            |       |             | AB-25    | -34.4 (-30.0)             | 183 (135)                     |
|                     | Base Metal | 1/4T  | L-S         | AB-26    | -34.4 (-30.0)             | 198 (146)                     |
|                     |            |       |             | AB-27    | -34.4 (-30.0)             | 140 (103)                     |

| Plate and Weldment | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| 51A<br>Base Metal  | Base Metal | 1/2T  | L-T         | AB-28    | -34.4 (-30.0)             | 17.8 (13.2)                   |
|                    |            |       |             | AB-29    | -34.4 (-30.0)             | 18.9 (13.9)                   |
|                    |            |       |             | AB-30    | -34.4 (-30.0)             | 119 (87.7)                    |
| 51A<br>ESW-NG      | Weld Metal | 1/4T  | L-T         | AE-1     | -28.9 (-20.0)             | 27.1 (20.0)                   |
|                    |            |       |             | AE-2     | -28.9 (-20.0)             | 23.3 (17.2)                   |
|                    |            |       |             | AE-3     | -28.9 (-20.0)             | 31.2 (23.0)                   |
|                    |            |       |             | AE-4     | -17.8 (0.00)              | 40.3 (29.7)                   |
|                    |            |       |             | AE-5     | -17.8 (0.00)              | 32.9 (24.3)                   |
|                    |            |       |             | AE-6     | -17.8 (00.0)              | 43.2 (31.9)                   |
|                    | FL         | 1/4T  | L-T         | AE-7     | -51.1 (-60.0)             | 8.82 (6.51)                   |
|                    |            |       |             | AE-8     | -51.1 (-60.0)             | 13.4 (9.88)                   |
|                    |            |       |             | AE-9     | -51.1 (-60.0)             | 14.2 (10.4)                   |
|                    |            |       |             | AE-10    | -34.4 (-30.0)             | 10.2 (7.55)                   |
|                    |            |       |             | AE-11    | -34.4 (-30.0)             | 17.3 (12.8)                   |
|                    |            |       |             | AE-12    | -34.4 (-30.0)             | 22.5 (16.6)                   |
|                    |            |       |             | AE-13    | -34.4 (-30.0)             | 11.9 (8.81)                   |
|                    |            |       |             | AE-14    | -17.8 (0.00)              | 12.6 (9.31)                   |
|                    |            |       |             | AE-15    | -17.8 (0.00)              | 28.8 (21.3)                   |
|                    |            |       |             | AE-16    | -17.8 (0.00)              | 25.6 (18.9)                   |
|                    | FL + 1     | 1/4T  | L-T         | AE-17    | -51.1 (-60.0)             | 11.1 (8.18)                   |
|                    |            |       |             | AE-18    | -51.1 (-60.0)             | 7.22 (5.33)                   |
|                    |            |       |             | AE-19    | -51.1 (-60.0)             | 11.7 (8.61)                   |
|                    |            |       |             | AE-20    | -34.4 (-30.0)             | 11.9 (8.74)                   |
|                    |            |       |             | AE-21    | -34.4 (-30.0)             | 9.19 (6.78)                   |
|                    |            |       |             | AE-22    | -34.4 (-30.0)             | 15.1 (11.1)                   |
|                    |            |       |             | AE-23    | -34.4 (-30.0)             | 10.6 (7.83)                   |
|                    |            |       |             | AE-24    | -17.8 (0.00)              | 11.9 (8.75)                   |
|                    |            |       |             | AE-25    | -17.8 (0.00)              | 20.4 (15.0)                   |
|                    |            |       |             | AE-26    | -17.8 (0.00)              | 9.20 (6.78)                   |
|                    | FL + 2     | 1/4T  | L-T         | AE-27    | -51.1 (-60.0)             | 8.16 (6.02)                   |
|                    |            |       |             | AE-28    | -51.1 (-60.0)             | 10.8 (7.97)                   |
|                    |            |       |             | AE-29    | -51.1 (-60.0)             | 20.4 (15.0)                   |
|                    |            |       |             | AE-30    | -34.4 (-30.0)             | 6.28 (4.63)                   |
|                    |            |       |             | AE-31    | -34.4 (-30.0)             | 20.1 (14.8)                   |
|                    |            |       |             | AE-32    | -34.4 (-30.0)             | 9.67 (7.13)                   |
|                    |            |       |             | AE-33    | -34.4 (-30.0)             | 12.1 (8.95)                   |
|                    |            |       |             | AE-34    | -17.8 (0.00)              | 11.5 (8.46)                   |
|                    |            |       |             | AE-35    | -17.8 (0.00)              | 12.9 (9.52)                   |
|                    |            |       |             | AE-36    | -17.8 (0.00)              | 14.7 (10.9)                   |
|                    | FL         | 1/4T  | L-S         | AE-37    | -34.4 (-30.0)             | 12.0 (8.88)                   |
|                    |            |       |             | AE-38    | -34.4 (-30.0)             | 35.1 (25.9)                   |
|                    |            |       |             | AE-39    | -34.4 (-30.0)             | 21.4 (15.8)                   |
|                    | FL         | 1/2T  | L-T         | AE-40    | -34.4 (-30.0)             | 23.6 (17.4)                   |
|                    |            |       |             | AE-41    | -34.4 (-30.0)             | 74.6 (55.0)                   |
|                    |            |       |             | AE-42    | -34.4 (-30.0)             | 25.8 (19.0)                   |
|                    |            |       |             | AE-43    | -34.4 (-30.0)             | 30.7 (22.7)                   |
|                    | FL         | 1/2T  | L-S         | AE-44    | -34.4 (-30.0)             | 8.72 (6.43)                   |
|                    |            |       |             | AE-45    | -34.4 (-30.0)             | 16.5 (12.1)                   |
|                    |            |       |             | AE-46    | -34.4 (-30.0)             | 17.5 (12.9)                   |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 51A<br>ESW-NG      | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | AE-47    | -51.1 (-60.0)             | 215 (158)                     |
|                    |                        |       |             | AE-48    | -51.1 (-60.0)             | 190 (140)                     |
|                    |                        |       |             | AE-49    | -51.1 (-60.0)             | 158 (116)                     |
|                    |                        |       |             | AE-50    | -34.4 (-30.0)             | 255 (188)                     |
|                    |                        |       |             | AE-51    | -34.4 (-30.0)             | 226 (166)                     |
|                    |                        |       |             | AE-52    | -34.4 (-30.0)             | 282 (208)                     |
|                    |                        |       |             | AE-53    | -17.8 (0.00)              | 294 (217)                     |
|                    |                        |       |             | AE-54    | -17.8 (0.00)              | 230 (170)                     |
|                    |                        |       |             | AE-55    | -17.8 (0.00)              | 317 (234)                     |
|                    |                        |       |             | AE-56    | -34.4 (-30.0)             | 214 (158)                     |
|                    |                        |       |             | AE-57    | -17.8 (0.00)              | 276 (204)                     |
|                    |                        |       |             | AE-58    | -17.8 (0.00)              | 309 (228)                     |
| 51A<br>S80-10      | Weld Metal             | 1/4T  | L-T         | AH-1     | -28.9 (-20.0)             | 84.4 (62.3)                   |
|                    |                        |       |             | AH-2     | -28.9 (-20.0)             | 55.1 (40.7)                   |
|                    |                        |       |             | AH-3     | -28.9 (-20.0)             | 75.7 (55.9)                   |
|                    |                        |       |             | AH-4     | -17.8 (0.00)              | 97.8 (72.1)                   |
|                    |                        |       |             | AH-5     | -17.8 (0.00)              | 86.2 (63.5)                   |
|                    |                        |       |             | AH-6     | -17.8 (0.00)              | 92.6 (68.3)                   |
|                    | FL                     | 1/4T  | L-T         | AH-7     | -51.1 (-60.0)             | 36.0 (26.5)                   |
|                    |                        |       |             | AH-8     | -51.1 (-60.0)             | 19.0 (14.0)                   |
|                    |                        |       |             | AH-9     | -51.1 (-60.0)             | 14.4 (10.7)                   |
|                    |                        |       |             | AH-10    | -34.4 (-30.0)             | 42.1 (31.0)                   |
|                    |                        |       |             | AH-11    | -34.4 (-30.0)             | 62.6 (46.2)                   |
|                    |                        |       |             | AH-12    | -34.4 (-30.0)             | 22.7 (16.8)                   |
|                    |                        |       |             | AH-13    | -34.4 (-30.0)             | 36.0 (26.5)                   |
|                    |                        |       |             | AH-14    | -17.8 (0.00)              | 61.6 (45.4)                   |
|                    |                        |       |             | AH-15    | -17.8 (0.00)              | 93.7 (69.1)                   |
|                    |                        |       |             | AH-16    | -17.8 (0.00)              | 39.3 (29.0)                   |
|                    | FL + 1                 | 1/4T  | L-T         | AH-17    | -51.1 (-60.0)             | 33.3 (24.6)                   |
|                    |                        |       |             | AH-18    | -51.1 (-60.0)             | 35.0 (25.8)                   |
|                    |                        |       |             | AH-19    | -51.1 (-60.0)             | 17.7 (13.1)                   |
|                    |                        |       |             | AH-20    | -34.4 (-30.0)             | 65.9 (48.6)                   |
|                    |                        |       |             | AH-21    | -34.4 (-30.0)             | 63.3 (46.7)                   |
|                    |                        |       |             | AH-22    | -34.4 (-30.0)             | 91.9 (67.8)                   |
|                    |                        |       |             | AH-23    | -34.4 (-30.0)             | 55.8 (41.1)                   |
|                    |                        |       |             | AH-24    | -17.8 (0.00)              | 53.6 (39.6)                   |
|                    |                        |       |             | AH-25    | -17.8 (0.00)              | 94.6 (69.7)                   |
|                    |                        |       |             | AH-26    | -17.8 (0.00)              | 40.9 (30.2)                   |
|                    | FL + 2                 | 1/4T  | L-T         | AH-27    | -51.1 (-60.0)             | 141 (104)                     |
|                    |                        |       |             | AH-28    | -51.1 (-60.0)             | 154 (114)                     |
|                    |                        |       |             | AH-29    | -51.1 (-60.0)             | 23.9 (17.7)                   |
|                    |                        |       |             | AH-30    | -34.4 (-30.0)             | 163 (120)                     |
|                    |                        |       |             | AH-31    | -34.4 (-30.0)             | 105 (77.1)                    |
|                    |                        |       |             | AH-32    | -34.4 (-30.0)             | 80.3 (59.2)                   |
|                    |                        |       |             | AH-33    | -34.4 (-30.0)             | 151 (111)                     |
|                    |                        |       |             | AH-34    | -17.8 (0.00)              | 105 (77.6)                    |
|                    |                        |       |             | AH-35    | -17.8 (0.00)              | 187 (138)                     |
|                    |                        |       |             | AH-36    | -17.8 (0.00)              | 154 (114)                     |
|                    | FL                     | 1/4T  | L-S         | AH-37    | -34.4 (-30.0)             | 42.0 (31.0)                   |
|                    |                        |       |             | AH-38    | -34.4 (-30.0)             | 50.9 (37.6)                   |
|                    |                        |       |             | AH-39    | -34.4 (-30.0)             | 19.8 (14.6)                   |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 51A<br>S80-10      | FL                     | 1/2T  | L-T         | AH-40    | -34.4 (-30.0)             | 15.5 (11.4)                   |
|                    |                        |       |             | AH-41    | -34.4 (-30.0)             | 23.6 (17.4)                   |
|                    |                        |       |             | AH-42    | -34.4 (-30.0)             | 26.0 (19.2)                   |
|                    |                        |       |             | AH-43    | -34.4 (-30.0)             | 22.3 (16.5)                   |
|                    | FL                     | 1/2T  | L-S         | AH-44    | -34.4 (-30.0)             | 121 (89.1)                    |
|                    |                        |       |             | AH-45    | -34.4 (-30.0)             | 62.0 (45.7)                   |
|                    |                        |       |             | AH-46    | -34.4 (-30.0)             | 17.9 (13.2)                   |
|                    |                        |       |             | AH-47    | -51.1 (-60.0)             | 32.1 (23.7)                   |
|                    |                        |       |             | AH-48    | -51.1 (-60.0)             | 135 (99.9)                    |
|                    |                        |       |             | AH-49    | -51.1 (-60.0)             | 120 (88.1)                    |
|                    |                        |       |             | AH-50    | -34.4 (-30.0)             | 182 (134)                     |
|                    |                        |       |             | AH-51    | -34.4 (-30.0)             | 185 (136)                     |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | AH-52    | -34.4 (-30.0)             | 369 (272)                     |
|                    |                        |       |             | AH-53    | -17.8 (0.00)              | 369 (272)                     |
|                    |                        |       |             | AH-54    | -17.8 (0.00)              | 172 (127)                     |
|                    |                        |       |             | AH-55    | -17.8 (0.00)              | 380 (280)                     |
|                    |                        |       |             | AH-56    | -34.4 (-30.0)             | 363 (268)                     |
|                    |                        |       |             | AH-57    | -17.8 (0.00)              | 330 (243)                     |
|                    |                        |       |             | AH-58    | -17.8 (0.00)              | 387 (285)                     |
|                    |                        |       |             | AH-59    | -17.8 (0.00)              | 387 (285)                     |
| 51A<br>S40-30      | Weld Metal             | 1/4T  | L-T         | AL-1     | -28.9 (-20.0)             | 33.2 (24.5)                   |
|                    |                        |       |             | AL-2     | -28.9 (-20.0)             | 62.8 (46.3)                   |
|                    |                        |       |             | AL-3     | -28.9 (-20.0)             | 43.7 (32.2)                   |
|                    |                        |       |             | AL-4     | -17.8 (0.00)              | 108 (79.6)                    |
|                    |                        |       |             | AL-5     | -17.8 (0.00)              | 65.2 (48.1)                   |
|                    |                        |       |             | AL-6     | -17.8 (0.00)              | 97.8 (72.1)                   |
|                    | FL                     | 1/4T  | L-T         | AL-7     | -51.1 (-60.0)             | 28.4 (20.9)                   |
|                    |                        |       |             | AL-8     | -51.1 (-60.0)             | 41.8 (30.8)                   |
|                    |                        |       |             | AL-9     | -51.1 (-60.0)             | 32.4 (23.9)                   |
|                    |                        |       |             | AL-10    | -34.4 (-30.0)             | 50.5 (37.3)                   |
|                    |                        |       |             | AL-11    | -34.4 (-30.0)             | 43.7 (32.3)                   |
|                    |                        |       |             | AL-12    | -34.4 (-30.0)             | 45.3 (33.4)                   |
|                    |                        |       |             | AL-13    | -34.4 (-30.0)             | 126 (92.7)                    |
|                    |                        |       |             | AL-14    | -17.8 (0.00)              | 92.7 (68.4)                   |
|                    |                        |       |             | AL-15    | -17.8 (0.00)              | 73.0 (53.9)                   |
|                    |                        |       |             | AL-16    | -17.8 (0.00)              | 75.5 (55.7)                   |
|                    |                        |       |             | AL-17    | -51.1 (-60.0)             | 118 (87.3)                    |
|                    |                        |       |             | AL-18    | -51.1 (-60.0)             | 17.8 (13.2)                   |
|                    |                        |       |             | AL-19    | -51.1 (-60.0)             | 34.2 (25.2)                   |
|                    |                        |       |             | AL-20    | -34.4 (-30.0)             | 47.6 (35.1)                   |
|                    | FL + 1                 | 1/4T  | L-T         | AL-21    | -34.4 (-30.0)             | 38.6 (28.5)                   |
|                    |                        |       |             | AL-22    | -34.4 (-30.0)             | 95.2 (70.2)                   |
|                    |                        |       |             | AL-23    | -34.4 (-30.0)             | 66.2 (48.9)                   |
|                    |                        |       |             | AL-24    | -17.8 (0.00)              | 164 (121)                     |
|                    |                        |       |             | AL-25    | -17.8 (0.00)              | 135 (99.3)                    |
|                    |                        |       |             | AL-26    | -17.8 (0.00)              | 98.9 (72.9)                   |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 51A<br>S40-30      | FL + 2                 | 1/4T  | L-T         | AL-27    | -51.1 (-60.0)             | 18.6<br>(13.7)                |
|                    |                        |       |             | AL-28    | -51.1 (-60.0)             | 33.2<br>(24.5)                |
|                    |                        |       |             | AL-29    | -51.1 (-60.0)             | 34.3<br>(25.3)                |
|                    |                        |       |             | AL-30    | -34.4 (-30.0)             | 59.6<br>(43.9)                |
|                    |                        |       |             | AL-31    | -34.4 (-30.0)             | 113<br>(83.5)                 |
|                    |                        |       |             | AL-32    | -34.4 (-30.0)             | 82.7<br>(61.0)                |
|                    |                        |       |             | AL-33    | -34.4 (-30.0)             | 49.9<br>(36.8)                |
|                    |                        |       |             | AL-34    | -17.8 (0.00)              | 96.9<br>(71.4)                |
|                    |                        |       |             | AL-35    | -17.8 (0.00)              | 94.0<br>(69.3)                |
|                    |                        |       |             | AL-36    | -17.8 (0.00)              | 72.6<br>(53.5)                |
|                    | FL                     | 1/4T  | L-S         | AL-37    | -34.4 (-30.0)             | 131<br>(96.4)                 |
|                    |                        |       |             | AL-38    | -34.4 (-30.0)             | 123<br>(90.7)                 |
|                    |                        |       |             | AL-39    | -34.4 (-30.0)             | 121<br>(89.4)                 |
|                    | FL                     | 1/2T  | L-T         | AL-40    | -34.4 (-30.0)             | 174 (129)                     |
|                    |                        |       |             | AL-41    | -34.4 (-30.0)             | 95.4<br>(70.4)                |
|                    |                        |       |             | AL-42    | -34.4 (-30.0)             | 125<br>(92.0)                 |
|                    |                        |       |             | AL-43    | -34.4 (-30.0)             | 81.9<br>(60.4)                |
|                    | FL                     | 1/2T  | L-S         | AL-44    | -34.4 (-30.0)             | 50.9<br>(37.6)                |
|                    |                        |       |             | AL-45    | -34.4 (-30.0)             | 336 (248)                     |
|                    |                        |       |             | AL-46    | -34.4 (-30.0)             | 44.8<br>(33.0)                |
|                    | HAZ Adj. Base<br>Metal | 1/4T  | L-T         | AL-47    | -51.1 (-60.0)             | 95.4<br>(70.3)                |
|                    |                        |       |             | AL-48    | -51.1 (-60.0)             | 134<br>(98.5)                 |
|                    |                        |       |             | AL-49    | -51.1 (-60.0)             | 54.2<br>(40.0)                |
|                    |                        |       |             | AL-50    | -34.4 (-30.0)             | 147 (109)                     |
|                    |                        |       |             | AL-51    | -34.4 (-30.0)             | 114<br>(83.8)                 |
|                    |                        |       |             | AL-52    | -34.4 (-30.0)             | 274 (202)                     |
|                    |                        |       |             | AL-53    | -17.8 (0.00)              | 190 (140)                     |
|                    |                        |       |             | AL-54    | -17.8 (0.00)              | 401 (296)                     |
|                    |                        |       |             | AL-55    | -17.8 (0.00)              | 172 (127)                     |
|                    |                        |       |             | AL-56    | -34.4 (-30.0)             | 360 (266)                     |
|                    |                        |       |             | AL-57    | -17.8 (0.00)              | 133<br>(98.1)                 |
|                    |                        |       |             | AL-58    | -17.8 (0.00)              | 397 (293)                     |

| Plate and Weldment | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| 51B<br>Base Metal  | Base Metal | 1/4T  | L-T         | BB-1     | -80.0 (-112)              | 6.38<br>(4.70)                |
|                    |            |       |             | BB-2     | -80.0 (-112)              | 9.39<br>(6.92)                |
|                    |            |       |             | BB-3     | -80.0 (-112)              | 6.56<br>(4.84)                |
|                    |            |       |             | BB-4     | -67.8 (-90.0)             | 12.7<br>(9.38)                |
|                    |            |       |             | BB-5     | -67.8 (-90.0)             | 17.3<br>(12.7)                |
|                    |            |       |             | BB-6     | -67.8 (-90.0)             | 10.9<br>(8.04)                |
|                    |            |       |             | BB-7     | -51.1 (-60.0)             | 9.77<br>(7.20)                |
|                    |            |       |             | BB-8     | -51.1 (-60.0)             | 8.91<br>(6.58)                |
|                    |            |       |             | BB-9     | -51.1 (-60.0)             | 18.7<br>(13.8)                |
|                    |            |       |             | BB-10    | -34.4 (-30.0)             | 8.73<br>(6.44)                |
|                    |            |       |             | BB-11    | -34.4 (-30.0)             | 17.4<br>(12.8)                |
|                    |            |       |             | BB-12    | -34.4 (-30.0)             | 27.8<br>(20.5)                |
|                    |            |       |             | BB-13    | -17.8 (0.00)              | 35.8<br>(26.4)                |
|                    |            |       |             | BB-14    | -17.8 (0.00)              | 90.6<br>(66.8)                |
|                    |            |       |             | BB-15    | -17.8 (0.00)              | 54.5<br>(40.2)                |
|                    |            |       |             | BB-16    | 4.44 (40.0)               | 61.9<br>(45.6)                |
|                    |            |       |             | BB-17    | 4.44 (40.0)               | 29.4<br>(21.7)                |
|                    |            |       |             | BB-18    | 4.44 (40.0)               | 111<br>(81.7)                 |
|                    |            |       |             | BB-19    | 21.1 (70.0)               | 178 (132)                     |
|                    |            |       |             | BB-20    | 21.1 (70.0)               | 140 (103)                     |
|                    |            |       |             | BB-21    | 21.1 (70.0)               | 124<br>(91.5)                 |
|                    |            |       |             | BB-22    | 60.0 (140)                | 195 (144)                     |
|                    |            |       |             | BB-23    | 60.0 (140)                | 239 (176)                     |
|                    |            |       |             | BB-24    | 60.0 (140)                | 187 (138)                     |
| 51B<br>Base Metal  | Base Metal | 1/4T  | L-S         | BB-25    | -17.8 (0.00)              | 38.8<br>(28.6)                |
|                    |            |       |             | BB-26    | -17.8 (0.00)              | 26.3<br>(19.4)                |
|                    |            |       |             | BB-27    | -17.8 (0.00)              | 61.3<br>(45.2)                |
|                    | Base Metal | 1/2T  | L-T         | BB-28    | -17.8 (0.00)              | 39.4<br>(29.0)                |
|                    |            |       |             | BB-29    | -17.8 (0.00)              | 22.8<br>(16.9)                |
|                    |            |       |             | BB-30    | -17.8 (0.00)              | 30.1<br>(22.2)                |

| Plate and Weldment | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| 51B<br>ESW-NG      | Weld Metal | 1/4T  | L-T         | BE-1     | -28.9 (-20.0)             | 41.9<br>(30.9)                |
|                    |            |       |             | BE-2     | -28.9 (-20.0)             | 34.7<br>(25.6)                |
|                    |            |       |             | BE-3     | -28.9 (-20.0)             | 45.0<br>(33.2)                |
|                    |            |       |             | BE-4     | -17.8 (0.00)              | 50.1<br>(37.0)                |
|                    |            |       |             | BE-5     | -17.8 (0.00)              | 53.1<br>(39.2)                |
|                    |            |       |             | BE-6     | -17.8 (0.00)              | 69.6<br>(51.3)                |
|                    | FL         | 1/4T  | L-T         | BE-7     | -51.1 (-60.0)             | 16.1<br>(11.9)                |
|                    |            |       |             | BE-8     | -51.1 (-60.0)             | 9.67<br>(7.13)                |
|                    |            |       |             | BE-9     | -51.1 (-60.0)             | 8.07<br>(5.95)                |
|                    |            |       |             | BE-10    | -34.4 (-30.0)             | 13.9<br>(10.2)                |
|                    |            |       |             | BE-11    | -34.4 (-30.0)             | 11.1<br>(8.18)                |
|                    |            |       |             | BE-12    | -34.4 (-30.0)             | 24.9<br>(18.4)                |
|                    |            |       |             | BE-13    | -34.4 (-30.0)             | 11.9<br>(8.81)                |
|                    |            |       |             | BE-14    | -17.8 (0.00)              | 30.6<br>(22.5)                |
|                    |            |       |             | BE-15    | -17.8 (0.00)              | 29.9<br>(22.0)                |
|                    |            |       |             | BE-16    | -17.8 (0.00)              | 51.9<br>(38.3)                |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 51B<br>ESW-NG      | FL + 1                 | 1/4T  | L-T         | BE-17    | -51.1 (-60.0)             | 8.82 (6.51)                   |
|                    |                        |       |             | BE-18    | -51.1 (-60.0)             | 7.22 (5.33)                   |
|                    |                        |       |             | BE-19    | -51.1 (-60.0)             | 9.58 (7.06)                   |
|                    |                        |       |             | BE-20    | -34.4 (-30.0)             | 9.67 (7.13)                   |
|                    |                        |       |             | BE-21    | -34.4 (-30.0)             | 7.12 (5.25)                   |
|                    |                        |       |             | BE-22    | -34.4 (-30.0)             | 11.4 (8.39)                   |
|                    |                        |       |             | BE-23    | -34.4 (-30.0)             | 15.8 (11.6)                   |
|                    |                        |       |             | BE-24    | -17.8 (0.00)              | 20.3 (15.0)                   |
|                    |                        |       |             | BE-25    | -17.8 (0.00)              | 15.1 (11.2)                   |
|                    |                        |       |             | BE-26    | -17.8 (0.00)              | 10.7 (7.90)                   |
|                    | FL + 2                 | 1/4T  | L-T         | BE-27    | -51.1 (-60.0)             | 7.22 (5.33)                   |
|                    |                        |       |             | BE-28    | -51.1 (-60.0)             | 7.31 (5.39)                   |
|                    |                        |       |             | BE-29    | -51.1 (-60.0)             | 7.03 (5.19)                   |
|                    |                        |       |             | BE-30    | -34.4 (-30.0)             | 8.06 (5.95)                   |
|                    |                        |       |             | BE-31    | -34.4 (-30.0)             | 10.7 (7.90)                   |
|                    |                        |       |             | BE-32    | -34.4 (-30.0)             | 11.9 (8.81)                   |
|                    |                        |       |             | BE-33    | -34.4 (-30.0)             | 9.29 (6.85)                   |
|                    |                        |       |             | BE-34    | -17.8 (0.00)              | 13.6 (10.0)                   |
|                    |                        |       |             | BE-35    | -17.8 (0.00)              | 12.1 (8.96)                   |
|                    |                        |       |             | BE-36    | -17.8 (0.00)              | 8.82 (6.51)                   |
|                    | FL                     | 1/4T  | L-S         | BE-37    | -17.8 (0.00)              | 72.7 (53.6)                   |
|                    |                        |       |             | BE-38    | -17.8 (0.00)              | 33.8 (24.9)                   |
|                    |                        |       |             | BE-39    | -17.8 (0.00)              | 78.0 (57.5)                   |
|                    | FL                     | 1/2T  | L-T         | BE-40    | -17.8 (0.00)              | 12.8 (9.45)                   |
|                    |                        |       |             | BE-41    | -17.8 (0.00)              | 22.1 (16.3)                   |
|                    |                        |       |             | BE-42    | -17.8 (0.00)              | 16.6 (12.2)                   |
|                    |                        |       |             | BE-43    | -17.8 (0.00)              | 48.0 (35.4)                   |
|                    | FL                     | 1/2T  | L-S         | BE-44    | -17.8 (0.00)              | 37.1 (27.4)                   |
|                    |                        |       |             | BE-45    | -17.8 (0.00)              | 10.8 (7.97)                   |
|                    |                        |       |             | BE-46    | -17.8 (0.00)              | 69.8 (51.5)                   |
|                    |                        |       |             | BE-47    | -51.1 (-60.0)             | 13.6 (10.0)                   |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | BE-48    | -51.1 (-60.0)             | 13.3 (9.80)                   |
|                    |                        |       |             | BE-49    | -51.1 (-60.0)             | 18.1 (13.4)                   |
|                    |                        |       |             | BE-50    | -34.4 (-30.0)             | 14.2 (10.4)                   |
|                    |                        |       |             | BE-51    | -34.4 (-30.0)             | 21.6 (15.9)                   |
|                    |                        |       |             | BE-52    | -34.4 (-30.0)             | 48.7 (35.9)                   |
|                    |                        |       |             | BE-53    | -17.8 (0.00)              | 21.6 (15.9)                   |
|                    |                        |       |             | BE-54    | -17.8 (0.00)              | 58.5 (43.1)                   |
|                    |                        |       |             | BE-55    | -17.8 (0.00)              | 37.5 (27.7)                   |
|                    |                        |       |             | BE-56    | 4.44 (40.0)               | 164 (121)                     |
|                    |                        |       |             | BE-57    | 4.44 (40.0)               | 94.9 (70.0)                   |
|                    |                        |       |             | BE-58    | 4.44 (40.0)               | 127 (93.8)                    |
| 51B<br>S80-10      | Weld Metal             | 1/4T  | L-T         | BH-1     | -28.9 (-20.0)             | 28.2 (20.8)                   |
|                    |                        |       |             | BH-2     | -28.9 (-20.0)             | 61.3 (45.2)                   |
|                    |                        |       |             | BH-3     | -28.9 (-20.0)             | 63.9 (47.1)                   |
|                    |                        |       |             | BH-4     | -17.8 (0.00)              | 56.9 (42.0)                   |
|                    |                        |       |             | BH-5     | -17.8 (0.00)              | 73.3 (54.0)                   |
|                    |                        |       |             | BH-6     | -17.8 (0.00)              | 55.7 (41.1)                   |



| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 51B<br>S80-10      | FL                     | 1/4T  | L-T         | BH-7     | -51.1 (-60.0)             | 23.0 (17.0)                   |
|                    |                        |       |             | BH-8     | -51.1 (-60.0)             | 12.3 (9.10)                   |
|                    |                        |       |             | BH-9     | -51.1 (-60.0)             | 18.0 (13.3)                   |
|                    |                        |       |             | BH-10    | -34.4 (-30.0)             | 92.0 (67.8)                   |
|                    |                        |       |             | BH-11    | -34.4 (-30.0)             | 67.0 (49.4)                   |
|                    |                        |       |             | BH-12    | -34.4 (-30.0)             | 22.7 (16.8)                   |
|                    |                        |       |             | BH-13    | -34.4 (-30.0)             | 26.3 (19.4)                   |
|                    |                        |       |             | BH-14    | -17.8 (0.00)              | 98.9 (72.9)                   |
|                    |                        |       |             | BH-15    | -17.8 (0.00)              | 55.0 (40.6)                   |
|                    |                        |       |             | BH-16    | -17.8 (0.00)              | 269 (198)                     |
|                    |                        |       |             | BH-17    | -51.1 (-60.0)             | 91.7 (67.6)                   |
|                    |                        |       |             | BH-18    | -51.1 (-60.0)             | 26.1 (19.3)                   |
|                    |                        |       |             | BH-19    | -51.1 (-60.0)             | 21.7 (16.0)                   |
|                    |                        |       |             | BH-20    | -34.4 (-30.0)             | 37.7 (27.8)                   |
|                    |                        |       |             | BH-21    | -34.4 (-30.0)             | 84.9 (62.6)                   |
|                    |                        |       |             | BH-22    | -34.4 (-30.0)             | 81.1 (59.8)                   |
|                    | FL + 1                 | 1/4T  | L-T         | BH-23    | -34.4 (-30.0)             | 36.3 (26.7)                   |
|                    |                        |       |             | BH-24    | -17.8 (0.00)              | 96.9 (71.4)                   |
|                    |                        |       |             | BH-25    | -17.8 (0.00)              | 85.0 (62.7)                   |
|                    |                        |       |             | BH-26    | -17.8 (0.00)              | 63.7 (47.0)                   |
|                    |                        |       |             | BH-27    | -51.1 (-60.0)             | 18.1 (13.4)                   |
|                    |                        |       |             | BH-28    | -51.1 (-60.0)             | 34.0 (25.1)                   |
|                    |                        |       |             | BH-29    | -51.1 (-60.0)             | 49.0 (36.2)                   |
|                    |                        |       |             | BH-30    | -34.4 (-30.0)             | 16.2 (11.9)                   |
|                    |                        |       |             | BH-31    | -34.4 (-30.0)             | 53.0 (39.1)                   |
|                    |                        |       |             | BH-32    | -34.4 (-30.0)             | 25.0 (18.5)                   |
|                    |                        |       |             | BH-33    | -34.4 (-30.0)             | 177 (130)                     |
|                    |                        |       |             | BH-34    | -17.8 (0.00)              | 129 (95.3)                    |
|                    |                        |       |             | BH-35    | -17.8 (0.00)              | 221 (163)                     |
|                    |                        |       |             | BH-36    | -17.8 (0.00)              | 227 (167)                     |
|                    |                        |       |             | BH-37    | -17.8 (0.00)              | 110 (80.9)                    |
|                    | FL                     | 1/4T  | L-S         | BH-38    | -17.8 (0.00)              | 76.6 (56.5)                   |
|                    |                        |       |             | BH-39    | -17.8 (0.00)              | 208 (153.4)                   |
|                    |                        |       |             | BH-40    | -17.8 (0.00)              | 56.9 (41.9)                   |
|                    | FL                     | 1/2T  | L-T         | BH-41    | -17.8 (0.00)              | 72.7 (53.6)                   |
|                    |                        |       |             | BH-42    | -17.8 (0.00)              | 127 (93.7)                    |
|                    |                        |       |             | BH-43    | -17.8 (0.00)              | 79.9 (58.9)                   |
|                    |                        |       |             | BH-44    | -17.8 (0.00)              | 134 (98.5)                    |
|                    | FL                     | 1/2T  | L-S         | BH-45    | -17.8 (0.00)              | 43.4 (32.0)                   |
|                    |                        |       |             | BH-46    | -17.8 (0.00)              | 119 (87.7)                    |
|                    |                        |       |             | BH-47    | -51.1 (-60.0)             | 8.73 (6.44)                   |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | BH-48    | -51.1 (-60.0)             | 15.4 (11.4)                   |
|                    |                        |       |             | BH-49    | -51.1 (-60.0)             | 13.1 (9.66)                   |
|                    |                        |       |             | BH-50    | -34.4 (-30.0)             | 13.3 (9.80)                   |
|                    |                        |       |             | BH-51    | -34.4 (-30.0)             | 23.8 (17.6)                   |
|                    |                        |       |             | BH-52    | -34.4 (-30.0)             | 30.1 (22.2)                   |
|                    |                        |       |             | BH-53    | -17.8 (0.00)              | 37.2 (27.4)                   |
|                    |                        |       |             | BH-54    | -17.8 (0.00)              | 65.5 (48.3)                   |
|                    |                        |       |             | BH-55    | -17.8 (0.00)              | 36.6 (27.0)                   |
|                    |                        |       |             | BH-56    | 4.44 (40.0)               | 80.8 (59.6)                   |
|                    |                        |       |             | BH-57    | 4.44 (40.0)               | 124 (91.1)                    |
|                    |                        |       |             | BH-58    | 4.44 (40.0)               | 37.0 (27.3)                   |

| Plate and Weldment | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| 51B<br>S40-30      | Weld Metal | 1/4T  | L-T         | BL-1     | -28.9 (-20.0)             | 68.8 (50.8)                   |
|                    |            |       |             | BL-2     | -28.9 (-20.0)             | 55.9 (41.2)                   |
|                    |            |       |             | BL-3     | -28.9 (-20.0)             | 48.1 (35.5)                   |
|                    |            |       |             | BL-4     | -17.8 (0.00)              | 70.5 (52.0)                   |
|                    |            |       |             | BL-5     | -17.8 (0.00)              | 66.2 (48.8)                   |
|                    |            |       |             | BL-6     | -17.8 (0.00)              | 90.2 (66.5)                   |
|                    | FL         | 1/4T  | L-T         | BL-7     | -51.1 (-60.0)             | 21.2 (15.6)                   |
|                    |            |       |             | BL-8     | -51.1 (-60.0)             | 37.5 (27.7)                   |
|                    |            |       |             | BL-9     | -51.1 (-60.0)             | 63.6 (46.9)                   |
|                    |            |       |             | BL-10    | -34.4 (-30.0)             | 24.6 (18.2)                   |
|                    |            |       |             | BL-11    | -34.4 (-30.0)             | 20.1 (14.8)                   |
|                    |            |       |             | BL-12    | -34.4 (-30.0)             | 131 (96.5)                    |
|                    |            |       |             | BL-13    | -34.4 (-30.0)             | 66.6 (49.1)                   |
|                    |            |       |             | BL-14    | -17.8 (0.00)              | 210 (155)                     |
|                    |            |       |             | BL-15    | -17.8 (0.00)              | 80.7 (59.5)                   |
|                    |            |       |             | BL-16    | -17.8 (0.00)              | 123 (91.0)                    |
|                    | FL + 1     | 1/4T  | L-T         | BL-17    | -51.1 (-60.0)             | 164 (121)                     |
|                    |            |       |             | BL-18    | -51.1 (-60.0)             | 46.6 (34.4)                   |
|                    |            |       |             | BL-19    | -51.1 (-60.0)             | 72.0 (53.1)                   |
|                    |            |       |             | BL-20    | -34.4 (-30.0)             | 72.5 (53.4)                   |
|                    |            |       |             | BL-21    | -34.4 (-30.0)             | 56.1 (41.4)                   |
|                    |            |       |             | BL-22    | -34.4 (-30.0)             | 19.4 (14.3)                   |
|                    |            |       |             | BL-23    | -34.4 (-30.0)             | 285 (211)                     |
|                    |            |       |             | BL-24    | -17.8 (0.00)              | 94.0 (69.3)                   |
|                    |            |       |             | BL-25    | -17.8 (0.00)              | 157 (116)                     |
|                    |            |       |             | BL-26    | -17.8 (0.00)              | 104 (76.6)                    |
|                    | FL + 2     | 1/4T  | L-T         | BL-27    | -51.1 (-60.0)             | 168 (124)                     |
|                    |            |       |             | BL-28    | -51.1 (-60.0)             | 39.1 (28.8)                   |
|                    |            |       |             | BL-29    | -51.1 (-60.0)             | 26.1 (19.3)                   |
|                    |            |       |             | BL-30    | -34.4 (-30.0)             | 192 (142)                     |
|                    |            |       |             | BL-31    | -34.4 (-30.0)             | 45.7 (33.7)                   |
|                    |            |       |             | BL-32    | -34.4 (-30.0)             | 99.5 (73.4)                   |
|                    |            |       |             | BL-33    | -34.4 (-30.0)             | 348 (257)                     |
|                    |            |       |             | BL-34    | -17.8 (0.00)              | 92.8 (68.5)                   |
|                    |            |       |             | BL-35    | -17.8 (0.00)              | 31.8 (23.4)                   |
|                    |            |       |             | BL-36    | -17.8 (0.00)              | 31.9 (23.5)                   |
|                    | FL         | 1/4T  | L-S         | BL-37    | -17.8 (0.00)              | 67.3 (49.7)                   |
|                    |            |       |             | BL-38    | -17.8 (0.00)              | 97.9 (72.2)                   |
|                    |            |       |             | BL-39    | -17.8 (0.00)              | 72.1 (53.2)                   |
|                    | FL         | 1/2T  | L-T         | BL-40    | -17.8 (0.00)              | 118 (87.0)                    |
|                    |            |       |             | BL-41    | -17.8 (0.00)              | 83.8 (61.8)                   |
|                    |            |       |             | BL-42    | -17.8 (0.00)              | 100 (74.1)                    |
|                    |            |       |             | BL-43    | -17.8 (0.00)              | 100 (74.1)                    |
|                    | FL         | 1/2T  | L-S         | BL-44    | -17.8 (0.00)              | 106 (77.9)                    |
|                    |            |       |             | BL-45    | -17.8 (0.00)              | 63.9 (47.2)                   |
|                    |            |       |             | BL-46    | -17.8 (0.00)              | 117 (86.2)                    |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 51B<br>S40-30      | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | BL-47    | -51.1 (-60.0)             | 7.78 (5.74)                   |
|                    |                        |       |             | BL-48    | -51.1 (-60.0)             | 7.13 (5.26)                   |
|                    |                        |       |             | BL-49    | -51.1 (-60.0)             | 7.22 (5.33)                   |
|                    |                        |       |             | BL-50    | -34.4 (-30.0)             | 10.5 (7.76)                   |
|                    |                        |       |             | BL-51    | -34.4 (-30.0)             | 9.77 (7.20)                   |
|                    |                        |       |             | BL-52    | -34.4 (-30.0)             | 13.5 (9.95)                   |
|                    |                        |       |             | BL-53    | -17.8 (0.00)              | 36.2 (26.7)                   |
|                    |                        |       |             | BL-54    | -17.8 (0.00)              | 42.7 (31.5)                   |
|                    |                        |       |             | BL-55    | -17.8 (0.00)              | 44.0 (32.4)                   |
|                    |                        |       |             | BL-56    | 4.44 (40.0)               | 68.5 (50.5)                   |
|                    |                        |       |             | BL-57    | 4.44 (40.0)               | 89.6 (66.1)                   |
|                    |                        |       |             | BL-58    | 4.44 (40.0)               | 63.1 (46.5)                   |
| 53A<br>Base Metal  | Base Metal             | 1/4T  | L-T         | CB-1     | -67.8 (-90.0)             | 10.3 (7.62)                   |
|                    |                        |       |             | CB-2     | -67.8 (-90.0)             | 121 (89.1)                    |
|                    |                        |       |             | CB-3     | -67.8 (-90.0)             | 9.67 (7.13)                   |
|                    |                        |       |             | CB-4     | -51.1 (-60.0)             | 51.7 (38.1)                   |
|                    |                        |       |             | CB-5     | -51.1 (-60.0)             | 153 (113)                     |
|                    |                        |       |             | CB-6     | -51.1 (-60.0)             | 430 (317)                     |
|                    |                        |       |             | CB-7     | -34.4 (-30.0)             | 423 (312)                     |
|                    |                        |       |             | CB-8     | -34.4 (-30.0)             | 428 (316)                     |
|                    |                        |       |             | CB-9     | -34.4 (-30.0)             | 432 (319)                     |
|                    |                        |       |             | CB-10    | -80.0 (-112)              | 13.5 (9.95)                   |
|                    |                        |       |             | CB-11    | -80.0 (-112)              | 17.2 (12.7)                   |
|                    |                        |       |             | CB-12    | -80.0 (-112)              | 60.9 (44.9)                   |
|                    |                        |       |             | CB-13    | -51.1 (-60.0)             | 430 (317)                     |
|                    |                        |       |             | CB-14    | -51.1 (-60.0)             | 8.63 (6.37)                   |
|                    |                        |       |             | CB-15    | -51.1 (-60.0)             | 437 (322)                     |
|                    |                        |       |             | CB-16    | -67.8 (-90.0)             | 436 (322)                     |
|                    |                        |       |             | CB-17    | -67.8 (-90.0)             | 438 (323)                     |
|                    |                        |       |             | CB-18    | -80.0 (-112)              | 7.03 (5.18)                   |
|                    |                        |       |             | CB-19    | -80.0 (-112)              | 6.00 (4.42)                   |
|                    |                        |       |             | CB-20    | -67.8 (-90.0)             | 39.5 (29.1)                   |
|                    |                        |       |             | CB-21    | -51.1 (-60.0)             | 436 (321)                     |
|                    |                        |       |             | CB-22    | -67.8 (-90.0)             | 23.4 (17.3)                   |
|                    |                        |       |             | CB-23    | -51.1 (-60.0)             | 220 (162)                     |
|                    |                        |       |             | CB-24    | -34.4 (-30.0)             | 428 (315)                     |
|                    | Base Metal             | 1/4T  | L-S         | CB-25    | -67.8 (-90.0)             | 438 (323)                     |
|                    |                        |       |             | CB-26    | -67.8 (-90.0)             | 435 (321)                     |
|                    |                        |       |             | CB-27    | -67.8 (-90.0)             | 18.0 (13.3)                   |
|                    | Base Metal             | 1/2T  | L-T         | CB-28    | -67.8 (-90.0)             | 12.4 (9.17)                   |
|                    |                        |       |             | CB-29    | -67.8 (-90.0)             | 7.41 (5.46)                   |
|                    |                        |       |             | CB-30    | -67.8 (-90.0)             | 6.66 (4.91)                   |
| 53A<br>ESW-NG      | Weld Metal             | 1/4T  | L-T         | CE-1     | -28.9 (-20.0)             | 27.5 (20.3)                   |
|                    |                        |       |             | CE-2     | -28.9 (-20.0)             | 22.4 (16.5)                   |
|                    |                        |       |             | CE-3     | -28.9 (-20.0)             | 71.5 (52.7)                   |
|                    |                        |       |             | CE-4     | -17.8 (0.00)              | 89.7 (66.2)                   |
|                    |                        |       |             | CE-5     | -17.8 (0.00)              | 66.1 (48.7)                   |
|                    |                        |       |             | CE-6     | -17.8 (0.00)              | 41.7 (30.7)                   |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 53A<br>ESW-NG      | FL                     | 1/4T  | L-T         | CE-7     | -51.1 (-60.0)             | 7.13 (5.26)                   |
|                    |                        |       |             | CE-8     | -51.1 (-60.0)             | 14.4 (10.6)                   |
|                    |                        |       |             | CE-9     | -51.1 (-60.0)             | 7.31 (5.39)                   |
|                    |                        |       |             | CE-10    | -34.4 (-30.0)             | 29.2 (21.6)                   |
|                    |                        |       |             | CE-11    | -34.4 (-30.0)             | 32.3 (23.8)                   |
|                    |                        |       |             | CE-12    | -34.4 (-30.0)             | 23.7 (17.5)                   |
|                    |                        |       |             | CE-13    | -34.4 (-30.0)             | 21.3 (15.7)                   |
|                    |                        |       |             | CE-14    | -17.8 (0.00)              | 26.3 (19.4)                   |
|                    |                        |       |             | CE-15    | -17.8 (0.00)              | 26.4 (19.5)                   |
|                    |                        |       |             | CE-16    | -17.8 (0.00)              | 37.4 (27.6)                   |
|                    |                        |       |             | CE-17    | -51.1 (-60.0)             | 9.48 (6.99)                   |
|                    |                        |       |             | CE-18    | -51.1 (-60.0)             | 7.41 (5.46)                   |
|                    |                        |       |             | CE-19    | -51.1 (-60.0)             | 7.50 (5.53)                   |
|                    |                        |       |             | CE-20    | -34.4 (-30.0)             | 8.07 (5.95)                   |
|                    |                        |       |             | CE-21    | -34.4 (-30.0)             | 11.1 (8.18)                   |
|                    |                        |       |             | CE-22    | -34.4 (-30.0)             | 6.56 (4.84)                   |
|                    | FL + 1                 | 1/4T  | L-T         | CE-23    | -34.4 (-30.0)             | 7.78 (5.74)                   |
|                    |                        |       |             | CE-24    | -17.8 (0.00)              | 16.4 (12.1)                   |
|                    |                        |       |             | CE-25    | -17.8 (0.00)              | 14.0 (10.3)                   |
|                    |                        |       |             | CE-26    | -17.8 (0.00)              | 12.6 (9.31)                   |
|                    |                        |       |             | CE-27    | -51.1 (-60.0)             | 10.0 (7.34)                   |
|                    |                        |       |             | CE-28    | -51.1 (-60.0)             | 10.1 (7.48)                   |
|                    |                        |       |             | CE-29    | -51.1 (-60.0)             | 7.31 (5.39)                   |
|                    |                        |       |             | CE-30    | -34.4 (-30.0)             | 11.1 (8.18)                   |
|                    |                        |       |             | CE-31    | -34.4 (-30.0)             | 10.7 (7.90)                   |
|                    |                        |       |             | CE-32    | -34.4 (-30.0)             | 13.4 (9.88)                   |
|                    |                        |       |             | CE-33    | -34.4 (-30.0)             | 8.73 (6.44)                   |
|                    |                        |       |             | CE-34    | -17.8 (0.00)              | 20.2 (14.9)                   |
|                    |                        |       |             | CE-35    | -17.8 (0.00)              | 17.8 (13.2)                   |
|                    |                        |       |             | CE-36    | -17.8 (0.00)              | 11.0 (8.11)                   |
|                    |                        |       |             | CE-37    | -34.4 (-30.0)             | 22.6 (16.6)                   |
|                    | FL                     | 1/4T  | L-S         | CE-38    | -34.4 (-30.0)             | 36.3 (26.8)                   |
|                    |                        |       |             | CE-39    | -34.4 (-30.0)             | 9.67 (7.13)                   |
|                    |                        |       |             | CE-40    | -34.4 (-30.0)             | 5.44 (4.01)                   |
|                    | FL                     | 1/2T  | L-T         | CE-41    | -34.4 (-30.0)             | 24.7 (18.2)                   |
|                    |                        |       |             | CE-42    | -34.4 (-30.0)             | 53.5 (39.5)                   |
|                    |                        |       |             | CE-43    | -34.4 (-30.0)             | 12.6 (9.31)                   |
|                    |                        |       |             | CE-44    | -34.4 (-30.0)             | 5.16 (3.81)                   |
|                    | FL                     | 1/2T  | L-S         | CE-45    | -34.4 (-30.0)             | 8.54 (6.30)                   |
|                    |                        |       |             | CE-46    | -34.4 (-30.0)             | 8.25 (6.09)                   |
|                    |                        |       |             | CE-47    | -51.1 (-60.0)             | 438 (323)                     |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | CE-48    | -51.1 (-60.0)             | 38.7 (28.5)                   |
|                    |                        |       |             | CE-49    | -51.1 (-60.0)             | 436 (322)                     |
|                    |                        |       |             | CE-50    | -34.4 (-30.0)             | 432 (319)                     |
|                    |                        |       |             | CE-51    | -34.4 (-30.0)             | 435 (321)                     |
|                    |                        |       |             | CE-52    | -34.4 (-30.0)             | 432 (318)                     |
|                    |                        |       |             | CE-53    | -67.8 (-90.0)             | 227 (168)                     |
|                    |                        |       |             | CE-54    | -67.8 (-90.0)             | 128 (94.2)                    |
|                    |                        |       |             | CE-55    | -67.8 (-90.0)             | 249 (183)                     |
|                    |                        |       |             | CE-56    | -80.0 (-112)              | 207 (153)                     |
|                    |                        |       |             | CE-57    | -80.0 (-112)              | 22.8 (16.9)                   |
|                    |                        |       |             | CE-58    | -80.0 (-112)              | 11.5 (8.46)                   |

| Plate and Weldment | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| 53A<br>S80-10      | Weld Metal | 1/4T  | L-T         | CH-1     | -28.9 (-20.0)             | 20.5 (15.1)                   |
|                    |            |       |             | CH-2     | -28.9 (-20.0)             | 24.4 (18.0)                   |
|                    |            |       |             | CH-3     | -28.9 (-20.0)             | 21.5 (15.8)                   |
|                    |            |       |             | CH-4     | -17.8 (0.00)              | 35.5 (26.2)                   |
|                    |            |       |             | CH-5     | -17.8 (0.00)              | 45.8 (33.8)                   |
|                    |            |       |             | CH-6     | -17.8 (0.00)              | 40.7 (30.0)                   |
|                    | FL         | 1/4T  | L-T         | CH-7     | -51.1 (-60.0)             | 21.7 (16.0)                   |
|                    |            |       |             | CH-8     | -51.1 (-60.0)             | 64.2 (47.3)                   |
|                    |            |       |             | CH-9     | -51.1 (-60.0)             | 25.0 (18.5)                   |
|                    |            |       |             | CH-10    | -51.1 (-60.0)             | 25.1 (18.5)                   |
|                    |            |       |             | CH-11    | -67.8 (-90.0)             | 12.7 (9.38)                   |
|                    |            |       |             | CH-12    | -67.8 (-90.0)             | 18.5 (13.7)                   |
|                    |            |       |             | CH-13    | -67.8 (-90.0)             | 37.4 (27.6)                   |
|                    |            |       |             | CH-14    | -34.4 (-30.0)             | 48.0 (35.4)                   |
|                    |            |       |             | CH-15    | -34.4 (-30.0)             | 94.1 (69.4)                   |
|                    |            |       |             | CH-16    | -34.4 (-30.0)             | 48.2 (35.5)                   |
|                    | FL + 1     | 1/4T  | L-T         | CH-17    | -51.1 (-60.0)             | 25.9 (19.1)                   |
|                    |            |       |             | CH-18    | -51.1 (-60.0)             | 468 (345)                     |
|                    |            |       |             | CH-19    | -51.1 (-60.0)             | 37.4 (27.6)                   |
|                    |            |       |             | CH-20    | -51.1 (-60.0)             | 476 (351)                     |
|                    |            |       |             | CH-21    | -67.8 (-90.0)             | 27.9 (20.6)                   |
|                    |            |       |             | CH-22    | -67.8 (-90.0)             | 463 (341)                     |
|                    |            |       |             | CH-23    | -67.8 (-90.0)             | 23.3 (17.2)                   |
|                    |            |       |             | CH-24    | -34.4 (-30.0)             | 478 (353)                     |
|                    |            |       |             | CH-25    | -34.4 (-30.0)             | 265 (196)                     |
|                    |            |       |             | CH-26    | -34.4 (-30.0)             | 490 (362)                     |
|                    | FL + 2     | 1/4T  | L-T         | CH-27    | -51.1 (-60.0)             | 450 (332)                     |
|                    |            |       |             | CH-28    | -51.1 (-60.0)             | 102 (75.4)                    |
|                    |            |       |             | CH-29    | -51.1 (-60.0)             | 353 (260)                     |
|                    |            |       |             | CH-30    | -51.1 (-60.0)             | 204 (150)                     |
|                    |            |       |             | CH-31    | -67.8 (-90.0)             | 474 (349)                     |
|                    |            |       |             | CH-32    | -67.8 (-90.0)             | 393 (290)                     |
|                    |            |       |             | CH-33    | -67.8 (-90.0)             | 356 (263)                     |
|                    |            |       |             | CH-34    | -34.4 (-30.0)             | 487 (359)                     |
|                    |            |       |             | CH-35    | -34.4 (-30.0)             | 463 (342)                     |
|                    |            |       |             | CH-36    | -34.4 (-30.0)             | 468 (345)                     |
|                    | FL         | 1/4T  | L-S         | CH-37    | -51.1 (-60.0)             | 27.1 (20.0)                   |
|                    |            |       |             | CH-38    | -51.1 (-60.0)             | 124 (91.4)                    |
|                    |            |       |             | CH-39    | -51.1 (-60.0)             | 36.9 (27.2)                   |
|                    | FL         | 1/2T  | L-T         | CH-40    | -51.1 (-60.0)             | 11.2 (8.25)                   |
|                    |            |       |             | CH-41    | -51.1 (-60.0)             | 17.1 (12.6)                   |
|                    |            |       |             | CH-42    | -51.1 (-60.0)             | 8.16 (6.02)                   |
|                    |            |       |             | CH-43    | -51.1 (-60.0)             | 18.2 (13.4)                   |
|                    | FL         | 1/2T  | L-S         | CH-44    | -51.1 (-60.0)             | 32.7 (24.1)                   |
|                    |            |       |             | CH-45    | -51.1 (-60.0)             | 182 (135)                     |
|                    |            |       |             | CH-46    | -51.1 (-60.0)             | 116 (85.8)                    |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 53A<br>S80-10      | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | CH-47    | -51.1 (-60.0)             | 437 (323)                     |
|                    |                        |       |             | CH-48    | -51.1 (-60.0)             | 440 (325)                     |
|                    |                        |       |             | CH-49    | -51.1 (-60.0)             | 52.9 (39.0)                   |
|                    |                        |       |             | CH-50    | -34.4 (-30.0)             | 432 (319)                     |
|                    |                        |       |             | CH-51    | -34.4 (-30.0)             | 436 (322)                     |
|                    |                        |       |             | CH-52    | -34.4 (-30.0)             | 436 (322)                     |
|                    |                        |       |             | CH-53    | -67.8 (-90.0)             | 8.82 (6.51)                   |
|                    |                        |       |             | CH-54    | -67.8 (-90.0)             | 34.2 (25.2)                   |
|                    |                        |       |             | CH-55    | -67.8 (-90.0)             | 181 (134)                     |
|                    |                        |       |             | CH-56    | -80.0 (-112)              | 3.77 (2.78)                   |
|                    |                        |       |             | CH-57    | -80.0 (-112)              | 7.78 (5.74)                   |
|                    |                        |       |             | CH-58    | -80.0 (-112)              | 28.9 (21.3)                   |
| 53A<br>S40-30      | Weld Metal             | 1/4T  | L-T         | CL-1     | -28.9 (-20.0)             | 38.6 (28.4)                   |
|                    |                        |       |             | CL-2     | -28.9 (-20.0)             | 25.6 (18.9)                   |
|                    |                        |       |             | CL-3     | -28.9 (-20.0)             | 20.0 (14.7)                   |
|                    |                        |       |             | CL-4     | -17.8 (0.00)              | 97.5 (71.9)                   |
|                    |                        |       |             | CL-5     | -17.8 (0.00)              | 34.3 (25.3)                   |
|                    |                        |       |             | CL-6     | -17.8 (0.00)              | 98.4 (72.6)                   |
|                    | FL                     | 1/4T  | L-T         | CL-7     | -51.1 (-60.0)             | 42.4 (31.3)                   |
|                    |                        |       |             | CL-8     | -51.1 (-60.0)             | 52.2 (38.5)                   |
|                    |                        |       |             | CL-9     | -51.1 (-60.0)             | 14.9 (11.0)                   |
|                    |                        |       |             | CL-10    | -51.1 (-60.0)             | 35.4 (26.1)                   |
|                    |                        |       |             | CL-11    | -67.8 (-90.0)             | 9.29 (6.85)                   |
|                    |                        |       |             | CL-12    | -67.8 (-90.0)             | 18.2 (13.4)                   |
|                    |                        |       |             | CL-13    | -67.8 (-90.0)             | 10.4 (7.69)                   |
|                    |                        |       |             | CL-14    | -34.4 (-30.0)             | 50.9 (37.5)                   |
|                    |                        |       |             | CL-15    | -34.4 (-30.0)             | 37.8 (27.9)                   |
|                    |                        |       |             | CL-16    | -34.4 (-30.0)             | 39.6 (29.2)                   |
|                    | FL + 1                 | 1/4T  | L-T         | CL-17    | -51.1 (-60.0)             | 509 (375)                     |
|                    |                        |       |             | CL-18    | -51.1 (-60.0)             | 139 (103)                     |
|                    |                        |       |             | CL-19    | -51.1 (-60.0)             | 517 (382)                     |
|                    |                        |       |             | CL-20    | -51.1 (-60.0)             | 297 (219)                     |
|                    |                        |       |             | CL-21    | -67.8 (-90.0)             | 138 (102)                     |
|                    |                        |       |             | CL-22    | -67.8 (-90.0)             | 20.0 (14.7)                   |
|                    |                        |       |             | CL-23    | -67.8 (-90.0)             | 497 (367)                     |
|                    |                        |       |             | CL-24    | -34.4 (-30.0)             | 118 (87.0)                    |
|                    |                        |       |             | CL-25    | -34.4 (-30.0)             | 484 (357)                     |
|                    |                        |       |             | CL-26    | -34.4 (-30.0)             | 140 (103)                     |
|                    | FL + 2                 | 1/4T  | L-T         | CL-27    | -51.1 (-60.0)             | 54.3 (40.0)                   |
|                    |                        |       |             | CL-28    | -51.1 (-60.0)             | 20.1 (14.8)                   |
|                    |                        |       |             | CL-29    | -51.1 (-60.0)             | 155 (114)                     |
|                    |                        |       |             | CL-30    | -51.1 (-60.0)             | 147 (109)                     |
|                    |                        |       |             | CL-31    | -67.8 (-90.0)             | 31.0 (22.8)                   |
|                    |                        |       |             | CL-32    | -67.8 (-90.0)             | 33.4 (24.6)                   |
|                    |                        |       |             | CL-33    | -67.8 (-90.0)             | 9.58 (7.06)                   |
|                    |                        |       |             | CL-34    | -34.4 (-30.0)             | 469 (346)                     |
|                    |                        |       |             | CL-35    | -34.4 (-30.0)             | 476 (351)                     |
|                    |                        |       |             | CL-36    | -34.4 (-30.0)             | 459 (339)                     |
|                    | FL                     | 1/4T  | L-S         | CL-37    | -51.1 (-60.0)             | 25.2 (18.6)                   |
|                    |                        |       |             | CL-38    | -51.1 (-60.0)             | 490 (361)                     |
|                    |                        |       |             | CL-39    | -51.1 (-60.0)             | 184 (136)                     |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 53A<br>S40-30      | FL                     | 1/2T  | L-T         | CL-40    | -51.1 (-60.0)             | 30.2 (22.2)                   |
|                    |                        |       |             | CL-41    | -51.1 (-60.0)             | 21.0 (15.5)                   |
|                    |                        |       |             | CL-42    | -51.1 (-60.0)             | 39.3 (29.0)                   |
|                    |                        |       |             | CL-43    | -51.1 (-60.0)             | 35.3 (26.0)                   |
|                    | FL                     | 1/2T  | L-S         | CL-44    | -51.1 (-60.0)             | 16.1 (11.9)                   |
|                    |                        |       |             | CL-45    | -51.1 (-60.0)             | 34.1 (25.2)                   |
|                    |                        |       |             | CL-46    | -51.1 (-60.0)             | 304 (224)                     |
|                    |                        |       |             | CL-47    | -51.1 (-60.0)             | 141 (104)                     |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | CL-48    | -51.1 (-60.0)             | 439 (323)                     |
|                    |                        |       |             | CL-49    | -51.1 (-60.0)             | 12.7 (9.38)                   |
|                    |                        |       |             | CL-50    | -34.4 (-30.0)             | 438 (323)                     |
|                    |                        |       |             | CL-51    | -34.4 (-30.0)             | 428 (316)                     |
|                    |                        |       |             | CL-52    | -34.4 (-30.0)             | 429 (316)                     |
|                    |                        |       |             | CL-53    | -67.8 (-90.0)             | 11.1 (8.18)                   |
|                    |                        |       |             | CL-54    | -67.8 (-90.0)             | 7.88 (5.81)                   |
|                    |                        |       |             | CL-55    | -67.8 (-90.0)             | 7.88 (5.81)                   |
|                    |                        |       |             | CL-56    | -80.0 (-112)              | 10.8 (7.97)                   |
|                    |                        |       |             | CL-57    | -80.0 (-112)              | 4.14 (3.05)                   |
| 53B<br>Base Metal  | Base Metal             | 1/4T  | L-T         | CL-58    | -80.0 (-112)              | 72.3 (53.3)                   |
|                    |                        |       |             | DB-1     | -67.8 (-90.0)             | 10.6 (7.83)                   |
|                    |                        |       |             | DB-2     | -67.8 (-90.0)             | 16.9 (12.4)                   |
|                    |                        |       |             | DB-3     | -67.8 (-90.0)             | 7.60 (5.60)                   |
|                    |                        |       |             | DB-4     | -51.1 (-60.0)             | 80.7 (59.5)                   |
|                    |                        |       |             | DB-5     | -51.1 (-60.0)             | 73.0 (53.9)                   |
|                    |                        |       |             | DB-6     | -51.1 (-60.0)             | 90.4 (66.7)                   |
|                    |                        |       |             | DB-7     | -34.4 (-30.0)             | 131 (96.3)                    |
|                    |                        |       |             | DB-8     | -34.4 (-30.0)             | 130 (96.2)                    |
|                    |                        |       |             | DB-9     | -34.4 (-30.0)             | 110 (81.4)                    |
|                    |                        |       |             | DB-10    | -17.8 (0.00)              | 154 (114)                     |
|                    |                        |       |             | DB-11    | -17.8 (0.00)              | 164 (121)                     |
|                    |                        |       |             | DB-12    | -17.8 (0.00)              | 136 (101)                     |
|                    |                        |       |             | DB-13    | 4.44 (40.0)               | 202 (149)                     |
|                    |                        |       |             | DB-14    | 4.44 (40.0)               | 180 (133)                     |
|                    |                        |       |             | DB-15    | 4.44 (40.0)               | 201 (148)                     |
|                    |                        |       |             | DB-16    | 21.1 (70.0)               | 264 (195)                     |
|                    |                        |       |             | DB-17    | 21.1 (70.0)               | 270 (199)                     |
|                    |                        |       |             | DB-18    | 21.1 (70.0)               | 202 (149)                     |
|                    |                        |       |             | DB-19    | 60.0 (140)                | 248 (183)                     |
|                    |                        |       |             | DB-20    | 60.0 (140)                | 237 (175)                     |
|                    |                        |       |             | DB-21    | 60.0 (140)                | 274 (202)                     |
|                    |                        |       |             | DB-22    | -51.1 (-60.0)             | 11.0 (8.11)                   |
|                    |                        |       |             | DB-23    | -34.4 (-30.0)             | 83.0 (61.2)                   |
|                    |                        |       |             | DB-24    | -17.8 (0.00)              | 153 (113)                     |
|                    | Base Metal             | 1/4T  | L-S         | DB-25    | -34.4 (-30.0)             | 133 (97.8)                    |
|                    |                        |       |             | DB-26    | -34.4 (-30.0)             | 123 (91.1)                    |
|                    |                        |       |             | DB-27    | -34.4 (-30.0)             | 119 (88.1)                    |
|                    | Base Metal             | 1/2T  | L-T         | DB-28    | -34.4 (-30.0)             | 44.1 (32.5)                   |
|                    |                        |       |             | DB-29    | -34.4 (-30.0)             | 36.5 (26.9)                   |
|                    |                        |       |             | DB-30    | -34.4 (-30.0)             | 21.9 (16.1)                   |

| Plate and Weldment | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| 53B<br>ESW-NG      | Weld Metal | 1/4T  | L-T         | DE-1     | -28.9 (-20.0)             | 55.8 (41.2)                   |
|                    |            |       |             | DE-2     | -28.9 (-20.0)             | 77.8 (57.4)                   |
|                    |            |       |             | DE-3     | -28.9 (-20.0)             | 98.0 (72.3)                   |
|                    |            |       |             | DE-4     | -17.8 (0.00)              | 99.8 (73.6)                   |
|                    |            |       |             | DE-5     | -17.8 (0.00)              | 102 (75.3)                    |
|                    |            |       |             | DE-6     | -17.8 (0.00)              | 78.3 (57.8)                   |
|                    | FL         | 1/4T  | L-T         | DE-7     | -51.1 (-60.0)             | 11.5 (8.46)                   |
|                    |            |       |             | DE-8     | -51.1 (-60.0)             | 10.6 (7.83)                   |
|                    |            |       |             | DE-9     | -51.1 (-60.0)             | 23.6 (17.4)                   |
|                    |            |       |             | DE-10    | -34.4 (-30.0)             | 17.3 (12.7)                   |
|                    |            |       |             | DE-11    | -34.4 (-30.0)             | 20.3 (15.0)                   |
|                    |            |       |             | DE-12    | -34.4 (-30.0)             | 18.4 (13.6)                   |
|                    |            |       |             | DE-13    | -34.4 (-30.0)             | 9.01 (6.64)                   |
|                    |            |       |             | DE-14    | -17.8 (0.00)              | 47.4 (34.9)                   |
|                    |            |       |             | DE-15    | -17.8 (0.00)              | 36.2 (26.7)                   |
|                    |            |       |             | DE-16    | -17.8 (0.00)              | 82.6 (60.9)                   |
|                    | FL + 1     | 1/4T  | L-T         | DE-17    | -51.1 (-60.0)             | 7.97 (5.88)                   |
|                    |            |       |             | DE-18    | -51.1 (-60.0)             | 10.1 (7.48)                   |
|                    |            |       |             | DE-19    | -51.1 (-60.0)             | 13.3 (9.80)                   |
|                    |            |       |             | DE-20    | -34.4 (-30.0)             | 24.3 (17.9)                   |
|                    |            |       |             | DE-21    | -34.4 (-30.0)             | 13.6 (10.0)                   |
|                    |            |       |             | DE-22    | -34.4 (-30.0)             | 19.7 (14.5)                   |
|                    |            |       |             | DE-23    | -34.4 (-30.0)             | 25.7 (19.0)                   |
|                    |            |       |             | DE-24    | -17.8 (0.00)              | 23.6 (17.4)                   |
|                    |            |       |             | DE-25    | -17.8 (0.00)              | 19.3 (14.2)                   |
|                    |            |       |             | DE-26    | -17.8 (0.00)              | 11.5 (8.46)                   |
|                    | FL + 2     | 1/4T  | L-T         | DE-27    | -51.1 (-60.0)             | 12.8 (9.45)                   |
|                    |            |       |             | DE-28    | -51.1 (-60.0)             | 16.6 (12.2)                   |
|                    |            |       |             | DE-29    | -51.1 (-60.0)             | 6.28 (4.63)                   |
|                    |            |       |             | DE-30    | -34.4 (-30.0)             | 11.7 (8.61)                   |
|                    |            |       |             | DE-31    | -34.4 (-30.0)             | 11.5 (8.46)                   |
|                    |            |       |             | DE-32    | -34.4 (-30.0)             | 11.2 (8.25)                   |
|                    |            |       |             | DE-33    | -34.4 (-30.0)             | 17.8 (13.2)                   |
|                    |            |       |             | DE-34    | -17.8 (0.00)              | 36.0 (26.5)                   |
|                    |            |       |             | DE-35    | -17.8 (0.00)              | 79.9 (58.9)                   |
|                    |            |       |             | DE-36    | -17.8 (0.00)              | 37.8 (27.9)                   |
|                    | FL         | 1/4T  | L-S         | DE-37    | -17.8 (0.00)              | 34.2 (25.2)                   |
|                    |            |       |             | DE-38    | -17.8 (0.00)              | 18.2 (13.4)                   |
|                    |            |       |             | DE-39    | -17.8 (0.00)              | 38.1 (28.1)                   |
|                    | FL         | 1/2T  | L-T         | DE-40    | -17.8 (0.00)              | 9.77 (7.20)                   |
|                    |            |       |             | DE-41    | -17.8 (0.00)              | 8.54 (6.30)                   |
|                    |            |       |             | DE-42    | -17.8 (0.00)              | 51.6 (38.1)                   |
|                    |            |       |             | DE-43    | -17.8 (0.00)              | 20.4 (15.0)                   |
|                    | FL         | 1/2T  | L-S         | DE-44    | -17.8 (0.00)              | 24.1 (17.8)                   |
|                    |            |       |             | DE-45    | -17.8 (0.00)              | 18.4 (13.6)                   |
|                    |            |       |             | DE-46    | -17.8 (0.00)              | 27.5 (20.3)                   |



| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 53B<br>ESW-NG      | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | DE-47    | -51.1 (-60.0)             | 35.0 (25.8)                   |
|                    |                        |       |             | DE-48    | -51.1 (-60.0)             | 92.7 (68.4)                   |
|                    |                        |       |             | DE-49    | -51.1 (-60.0)             | 6.75 (4.98)                   |
|                    |                        |       |             | DE-50    | -34.4 (-30.0)             | 16.8 (12.4)                   |
|                    |                        |       |             | DE-51    | -34.4 (-30.0)             | 86.0 (63.5)                   |
|                    |                        |       |             | DE-52    | -34.4 (-30.0)             | 25.5 (18.8)                   |
|                    |                        |       |             | DE-53    | -17.8 (0.00)              | 146 (108)                     |
|                    |                        |       |             | DE-54    | -17.8 (0.00)              | 156 (115)                     |
|                    |                        |       |             | DE-55    | -17.8 (0.00)              | 127 (93.7)                    |
|                    |                        |       |             | DE-56    | 4.44 (40.0)               | 208 (154)                     |
|                    |                        |       |             | DE-57    | 4.44 (40.0)               | 193 (142)                     |
|                    |                        |       |             | DE-58    | 4.44 (40.0)               | 195 (144)                     |
| 53B<br>S80-10      | Weld Metal             | 1/4T  | L-T         | DH-1     | -28.9 (-20.0)             | 67.5 (49.8)                   |
|                    |                        |       |             | DH-2     | -28.9 (-20.0)             | 35.0 (25.8)                   |
|                    |                        |       |             | DH-3     | -28.9 (-20.0)             | 75.8 (55.9)                   |
|                    |                        |       |             | DH-4     | -17.8 (0.00)              | 54.4 (40.1)                   |
|                    |                        |       |             | DH-5     | -17.8 (0.00)              | 98.4 (72.6)                   |
|                    |                        |       |             | DH-6     | -17.8 (0.00)              | 61.3 (45.2)                   |
|                    | FL                     | 1/4T  | L-T         | DH-7     | -51.1 (-60.0)             | 28.8 (21.3)                   |
|                    |                        |       |             | DH-8     | -51.1 (-60.0)             | 23.2 (17.1)                   |
|                    |                        |       |             | DH-9     | -51.1 (-60.0)             | 25.2 (18.6)                   |
|                    |                        |       |             | DH-10    | -34.4 (-30.0)             | 89.4 (65.9)                   |
|                    |                        |       |             | DH-11    | -34.4 (-30.0)             | 33.6 (24.8)                   |
|                    |                        |       |             | DH-12    | -34.4 (-30.0)             | 93.2 (68.7)                   |
|                    |                        |       |             | DH-13    | -34.4 (-30.0)             | 33.3 (24.6)                   |
|                    |                        |       |             | DH-14    | -17.8 (0.00)              | 130 (96.1)                    |
|                    |                        |       |             | DH-15    | -17.8 (0.00)              | 139 (102)                     |
|                    |                        |       |             | DH-16    | -17.8 (0.00)              | 67.9 (50.1)                   |
|                    | FL + 1                 | 1/4T  | L-T         | DH-17    | -51.1 (-60.0)             | 208 (153)                     |
|                    |                        |       |             | DH-18    | -51.1 (-60.0)             | 146 (107)                     |
|                    |                        |       |             | DH-19    | -51.1 (-60.0)             | 199 (146)                     |
|                    |                        |       |             | DH-20    | -34.4 (-30.0)             | 204 (150)                     |
|                    |                        |       |             | DH-21    | -34.4 (-30.0)             | 202 (149)                     |
|                    |                        |       |             | DH-22    | -34.4 (-30.0)             | 213 (157)                     |
|                    |                        |       |             | DH-23    | -34.4 (-30.0)             | 197 (145)                     |
|                    |                        |       |             | DH-24    | -17.8 (0.00)              | 295 (218)                     |
|                    |                        |       |             | DH-25    | -17.8 (0.00)              | 217 (160)                     |
|                    |                        |       |             | DH-26    | -17.8 (0.00)              | 180 (133)                     |
|                    | FL + 2                 | 1/4T  | L-T         | DH-27    | -51.1 (-60.0)             | 215 (159)                     |
|                    |                        |       |             | DH-28    | -51.1 (-60.0)             | 324 (239)                     |
|                    |                        |       |             | DH-29    | -51.1 (-60.0)             | 171 (126)                     |
|                    |                        |       |             | DH-30    | -34.4 (-30.0)             | 296 (218)                     |
|                    |                        |       |             | DH-31    | -34.4 (-30.0)             | 188 (139)                     |
|                    |                        |       |             | DH-32    | -34.4 (-30.0)             | 239 (176)                     |
|                    |                        |       |             | DH-33    | -34.4 (-30.0)             | 243 (179)                     |
|                    |                        |       |             | DH-34    | -17.8 (0.00)              | 393 (290)                     |
|                    |                        |       |             | DH-35    | -17.8 (0.00)              | 186 (137)                     |
|                    |                        |       |             | DH-36    | -17.8 (0.00)              | 381 (281)                     |
|                    | FL                     | 1/4T  | L-S         | DH-37    | -34.4 (-30.0)             | 51.0 (37.6)                   |
|                    |                        |       |             | DH-38    | -34.4 (-30.0)             | 95.1 (70.2)                   |
|                    |                        |       |             | DH-39    | -34.4 (-30.0)             | 104 (76.8)                    |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 53B<br>S80-10      | FL                     | 1/2T  | L-T         | DH-40    | -34.4 (-30.0)             | 31.3 (23.1)                   |
|                    |                        |       |             | DH-41    | -34.4 (-30.0)             | 66.1 (48.7)                   |
|                    |                        |       |             | DH-42    | -34.4 (-30.0)             | 34.9 (25.8)                   |
|                    |                        |       |             | DH-43    | -34.4 (-30.0)             | 16.6 (12.2)                   |
|                    | FL                     | 1/2T  | L-S         | DH-44    | -34.4 (-30.0)             | 26.3 (19.4)                   |
|                    |                        |       |             | DH-45    | -34.4 (-30.0)             | 26.2 (19.3)                   |
|                    |                        |       |             | DH-46    | -34.4 (-30.0)             | 24.1 (17.8)                   |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | DH-47    | -51.1 (-60.0)             | 79.5 (58.6)                   |
|                    |                        |       |             | DH-48    | -51.1 (-60.0)             | 22.8 (16.9)                   |
|                    |                        |       |             | DH-49    | -51.1 (-60.0)             | 16.9 (12.4)                   |
|                    |                        |       |             | DH-50    | -34.4 (-30.0)             | 101 (74.3)                    |
|                    |                        |       |             | DH-51    | -34.4 (-30.0)             | 124 (91.8)                    |
|                    |                        |       |             | DH-52    | -34.4 (-30.0)             | 88.7 (65.4)                   |
|                    |                        |       |             | DH-53    | -17.8 (0.00)              | 146 (108)                     |
|                    |                        |       |             | DH-54    | -17.8 (0.00)              | 164 (121)                     |
|                    |                        |       |             | DH-55    | -17.8 (0.00)              | 156 (115)                     |
|                    |                        |       |             | DH-56    | 4.44 (40.0)               | 188 (139)                     |
|                    |                        |       |             | DH-57    | 4.44 (40.0)               | 255 (188)                     |
|                    |                        |       |             | DH-58    | 4.44 (40.0)               | 178 (132)                     |
| 53B<br>S40-30      | Weld Metal             | 1/4T  | L-T         | DL-1     | -28.9 (-20.0)             | 15.5 (11.4)                   |
|                    |                        |       |             | DL-2     | -28.9 (-20.0)             | 28.4 (21.0)                   |
|                    |                        |       |             | DL-3     | -28.9 (-20.0)             | 15.0 (11.1)                   |
|                    |                        |       |             | DL-4     | -17.8 (0.00)              | 48.6 (35.9)                   |
|                    |                        |       |             | DL-5     | -17.8 (0.00)              | 18.6 (13.7)                   |
|                    |                        |       |             | DL-6     | -17.8 (0.00)              | 71.6 (52.8)                   |
|                    | FL                     | 1/4T  | L-T         | DL-7     | -51.1 (-60.0)             | 14.4 (10.6)                   |
|                    |                        |       |             | DL-8     | -51.1 (-60.0)             | 9.67 (7.13)                   |
|                    |                        |       |             | DL-9     | -51.1 (-60.0)             | 32.9 (24.3)                   |
|                    |                        |       |             | DL-10    | -34.4 (-30.0)             | 17.2 (12.7)                   |
|                    |                        |       |             | DL-11    | -34.4 (-30.0)             | 36.2 (26.7)                   |
|                    |                        |       |             | DL-12    | -34.4 (-30.0)             | 51.0 (37.6)                   |
|                    |                        |       |             | DL-13    | -34.4 (-30.0)             | 28.4 (21.0)                   |
|                    |                        |       |             | DL-14    | -17.8 (0.00)              | 132 (97.6)                    |
|                    |                        |       |             | DL-15    | -17.8 (0.00)              | 27.6 (20.4)                   |
|                    |                        |       |             | DL-16    | -17.8 (0.00)              | 59.5 (43.9)                   |
|                    | FL + 1                 | 1/4T  | L-T         | DL-17    | -51.1 (-60.0)             | 86.6 (63.9)                   |
|                    |                        |       |             | DL-18    | -51.1 (-60.0)             | 116 (85.8)                    |
|                    |                        |       |             | DL-19    | -51.1 (-60.0)             | 72.7 (53.6)                   |
|                    |                        |       |             | DL-20    | -34.4 (-30.0)             | 106 (78.2)                    |
|                    |                        |       |             | DL-21    | -34.4 (-30.0)             | 127 (93.7)                    |
|                    |                        |       |             | DL-22    | -34.4 (-30.0)             | 199 (147)                     |
|                    |                        |       |             | DL-23    | -34.4 (-30.0)             | 87.6 (64.6)                   |
|                    |                        |       |             | DL-24    | -17.8 (0.00)              | 110 (81.4)                    |
|                    |                        |       |             | DL-25    | -17.8 (0.00)              | 155 (114)                     |
|                    |                        |       |             | DL-26    | -17.8 (0.00)              | 123 (91.1)                    |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 53B<br>S40-30      | FL + 2                 | 1/4T  | L-T         | DL-27    | -51.1 (-60.0)             | 33.3 (24.6)                   |
|                    |                        |       |             | DL-28    | -51.1 (-60.0)             | 183 (135)                     |
|                    |                        |       |             | DL-29    | -51.1 (-60.0)             | 26.7 (19.7)                   |
|                    |                        |       |             | DL-30    | -34.4 (-30.0)             | 172 (127)                     |
|                    |                        |       |             | DL-31    | -34.4 (-30.0)             | 160 (118)                     |
|                    |                        |       |             | DL-32    | -34.4 (-30.0)             | 232 (171)                     |
|                    |                        |       |             | DL-33    | -34.4 (-30.0)             | 200 (147)                     |
|                    |                        |       |             | DL-34    | -17.8 (0.00)              | 198 (146)                     |
|                    |                        |       |             | DL-35    | -17.8 (0.00)              | 196 (144)                     |
|                    |                        |       |             | DL-36    | -17.8 (0.00)              | 275 (203)                     |
|                    | FL                     | 1/4T  | L-S         | DL-37    | -34.4 (-30.0)             | 99.2 (73.2)                   |
|                    |                        |       |             | DL-38    | -34.4 (-30.0)             | 52.1 (38.5)                   |
|                    |                        |       |             | DL-39    | -34.4 (-30.0)             | 54.3 (40.0)                   |
|                    | FL                     | 1/2T  | L-T         | DL-40    | -34.4 (-30.0)             | 74.1 (54.6)                   |
|                    |                        |       |             | DL-41    | -34.4 (-30.0)             | 62.9 (46.4)                   |
|                    |                        |       |             | DL-42    | -34.4 (-30.0)             | 43.8 (32.3)                   |
|                    |                        |       |             | DL-43    | -34.4 (-30.0)             | 62.2 (45.9)                   |
|                    |                        |       |             | DL-44    | -34.4 (-30.0)             | 147 (108)                     |
|                    | FL                     | 1/2T  | L-S         | DL-45    | -34.4 (-30.0)             | 65.0 (47.9)                   |
|                    |                        |       |             | DL-46    | -34.4 (-30.0)             | 62.6 (46.2)                   |
|                    |                        |       |             | DL-47    | -51.1 (-60.0)             | 50.8 (37.4)                   |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | DL-48    | -51.1 (-60.0)             | 33.5 (24.7)                   |
|                    |                        |       |             | DL-49    | -51.1 (-60.0)             | 115 (84.5)                    |
|                    |                        |       |             | DL-50    | -34.4 (-30.0)             | 102 (75.1)                    |
|                    |                        |       |             | DL-51    | -34.4 (-30.0)             | 109 (80.3)                    |
|                    |                        |       |             | DL-52    | -34.4 (-30.0)             | 113 (83.7)                    |
|                    |                        |       |             | DL-53    | -17.8 (0.00)              | 168 (124)                     |
|                    |                        |       |             | DL-54    | -17.8 (0.00)              | 211 (156)                     |
|                    |                        |       |             | DL-55    | -17.8 (0.00)              | 154 (114)                     |
|                    |                        |       |             | DL-56    | 4.44 (40.0)               | 266 (196)                     |
|                    |                        |       |             | DL-57    | 4.44 (40.0)               | 185 (137)                     |
|                    |                        |       |             | DL-58    | 4.44 (40.0)               | 232 (171)                     |

| Plate and Weldment | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| 71A<br>Base Metal  | Base Metal | 1/4T  | L-T         | FB-1     | -67.8 (-90.0)             | 154 (114)                     |
|                    |            |       |             | FB-2     | -67.8 (-90.0)             | 141 (104)                     |
|                    |            |       |             | FB-3     | -67.8 (-90.0)             | 168 (124)                     |
|                    |            |       |             | FB-4     | -51.1 (-60.0)             | 191 (141)                     |
|                    |            |       |             | FB-5     | -51.1 (-60.0)             | 184 (135)                     |
|                    |            |       |             | FB-6     | -51.1 (-60.0)             | 160 (118)                     |
|                    |            |       |             | FB-7     | -34.4 (-30.0)             | 234 (173)                     |
|                    |            |       |             | FB-8     | -34.4 (-30.0)             | 224 (165)                     |
|                    |            |       |             | FB-9     | -34.4 (-30.0)             | 203 (150)                     |
|                    |            |       |             | FB-10    | -17.8 (0.00)              | 238 (175)                     |
|                    |            |       |             | FB-11    | -17.8 (0.00)              | 213 (157)                     |
|                    |            |       |             | FB-12    | -17.8 (0.00)              | 280 (206)                     |
|                    |            |       |             | FB-13    | 4.44 (40.0)               | 283 (209)                     |
|                    |            |       |             | FB-14    | 4.44 (40.0)               | 331 (244)                     |
|                    |            |       |             | FB-15    | 4.44 (40.0)               | 291 (214)                     |
|                    |            |       |             | FB-16    | -80.0 (-112)              | 178 (131)                     |
|                    |            |       |             | FB-17    | -80.0 (-112)              | 155 (115)                     |
|                    |            |       |             | FB-18    | -80.0 (-112)              | 145 (107)                     |
|                    |            |       |             | FB-19    | 21.1 (70.0)               | 271 (200)                     |
|                    |            |       |             | FB-20    | 21.1 (70.0)               | 384 (284)                     |
|                    |            |       |             | FB-21    | 21.1 (70.0)               | 314 (231)                     |
|                    |            |       |             | FB-22    | 37.8 (100)                | 285 (210)                     |
|                    |            |       |             | FB-23    | 60.0 (140)                | 330 (243)                     |
|                    |            |       |             | FB-24    | 60.0 (140)                | 296 (219)                     |
| 71A<br>ESW-NG      | Base Metal | 1/4T  | L-S         | FB-25    | -34.4 (-30.0)             | 241 (177)                     |
|                    |            |       |             | FB-26    | -34.4 (-30.0)             | 284 (209)                     |
|                    |            |       |             | FB-27    | -34.4 (-30.0)             | 271 (200)                     |
|                    | Base Metal | 1/2T  | L-T         | FB-28    | -34.4 (-30.0)             | 197 (145)                     |
|                    |            |       |             | FB-29    | -34.4 (-30.0)             | 171 (126)                     |
|                    |            |       |             | FB-30    | -34.4 (-30.0)             | 205 (151)                     |
|                    | Weld Metal | 1/4T  | L-T         | FE-1     | -28.9 (-20.0)             | 68.3 (50.3)                   |
|                    |            |       |             | FE-2     | -28.9 (-20.0)             | 35.5 (26.2)                   |
|                    |            |       |             | FE-3     | -28.9 (-20.0)             | 47.1 (34.8)                   |
|                    |            |       |             | FE-4     | -17.8 (0.00)              | 52.6 (38.8)                   |
|                    |            |       |             | FE-5     | -17.8 (0.00)              | 61.9 (45.6)                   |
|                    |            |       |             | FE-6     | -17.8 (0.00)              | 66.8 (49.3)                   |
|                    | FL         | 1/4T  | L-T         | FE-7     | -51.1 (-60.0)             | 13.0 (9.59)                   |
|                    |            |       |             | FE-8     | -51.1 (-60.0)             | 18.2 (13.4)                   |
|                    |            |       |             | FE-9     | -51.1 (-60.0)             | 17.7 (13.1)                   |
|                    |            |       |             | FE-10    | -34.4 (-30.0)             | 24.1 (17.8)                   |
|                    |            |       |             | FE-11    | -34.4 (-30.0)             | 33.0 (24.3)                   |
|                    |            |       |             | FE-12    | -34.4 (-30.0)             | 25.1 (18.5)                   |
|                    |            |       |             | FE-13    | -34.4 (-30.0)             | 30.9 (22.8)                   |
|                    |            |       |             | FE-14    | -17.8 (0.00)              | 84.0 (61.9)                   |
|                    |            |       |             | FE-15    | -17.8 (0.00)              | 52.6 (38.8)                   |
|                    |            |       |             | FE-16    | -17.8 (0.00)              | 34.0 (25.1)                   |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 71A<br>ESW-NG      | FL + 1                 | 1/4T  | L-T         | FE-17    | -51.1 (-60.0)             | 13.1 (9.66)                   |
|                    |                        |       |             | FE-18    | -51.1 (-60.0)             | 13.2 (9.73)                   |
|                    |                        |       |             | FE-19    | -51.1 (-60.0)             | 19.9 (14.7)                   |
|                    |                        |       |             | FE-20    | -34.4 (-30.0)             | 18.2 (13.4)                   |
|                    |                        |       |             | FE-21    | -34.4 (-30.0)             | 14.9 (11.0)                   |
|                    |                        |       |             | FE-22    | -34.4 (-30.0)             | 34.2 (25.2)                   |
|                    |                        |       |             | FE-23    | -34.4 (-30.0)             | 33.0 (24.3)                   |
|                    |                        |       |             | FE-24    | -17.8 (0.00)              | 37.0 (27.3)                   |
|                    |                        |       |             | FE-25    | -17.8 (0.00)              | 28.8 (21.3)                   |
|                    |                        |       |             | FE-26    | -17.8 (0.00)              | 18.8 (13.9)                   |
|                    | FL + 2                 | 1/4T  | L-T         | FE-27    | -51.1 (-60.0)             | 6.19 (4.57)                   |
|                    |                        |       |             | FE-28    | -51.1 (-60.0)             | 14.8 (10.9)                   |
|                    |                        |       |             | FE-29    | -51.1 (-60.0)             | 13.2 (9.73)                   |
|                    |                        |       |             | FE-30    | -34.4 (-30.0)             | 11.0 (8.11)                   |
|                    |                        |       |             | FE-31    | -34.4 (-30.0)             | 25.6 (18.9)                   |
|                    |                        |       |             | FE-32    | -34.4 (-30.0)             | 11.5 (8.46)                   |
|                    |                        |       |             | FE-33    | -34.4 (-30.0)             | 21.6 (15.9)                   |
|                    |                        |       |             | FE-34    | -17.8 (0.00)              | 13.0 (9.59)                   |
|                    |                        |       |             | FE-35    | -17.8 (0.00)              | 21.1 (15.5)                   |
|                    |                        |       |             | FE-36    | -17.8 (0.00)              | 16.9 (12.4)                   |
|                    | FL                     | 1/4T  | L-S         | FE-37    | -34.4 (-30.0)             | 20.6 (15.2)                   |
|                    |                        |       |             | FE-38    | -34.4 (-30.0)             | 47.5 (35.1)                   |
|                    |                        |       |             | FE-39    | -34.4 (-30.0)             | 16.9 (12.4)                   |
|                    | FL                     | 1/2T  | L-T         | FE-40    | -34.4 (-30.0)             | 17.4 (12.9)                   |
|                    |                        |       |             | FE-41    | -34.4 (-30.0)             | 17.4 (12.9)                   |
|                    |                        |       |             | FE-42    | -34.4 (-30.0)             | 13.8 (10.2)                   |
|                    |                        |       |             | FE-43    | -34.4 (-30.0)             | 9.95 (7.34)                   |
|                    | FL                     | 1/2T  | L-S         | FE-44    | -34.4 (-30.0)             | 17.3 (12.8)                   |
|                    |                        |       |             | FE-45    | -34.4 (-30.0)             | 13.8 (10.2)                   |
|                    |                        |       |             | FE-46    | -34.4 (-30.0)             | 18.6 (13.7)                   |
|                    |                        |       |             | FE-47    | -51.1 (-60.0)             | 158 (117)                     |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | FE-48    | -51.1 (-60.0)             | 154 (113)                     |
|                    |                        |       |             | FE-49    | -51.1 (-60.0)             | 169 (124)                     |
|                    |                        |       |             | FE-50    | -34.4 (-30.0)             | 207 (153)                     |
|                    |                        |       |             | FE-51    | -34.4 (-30.0)             | 206 (152)                     |
|                    |                        |       |             | FE-52    | -34.4 (-30.0)             | 196 (144)                     |
|                    |                        |       |             | FE-53    | -17.8 (0.00)              | 257 (189)                     |
|                    |                        |       |             | FE-54    | -17.8 (0.00)              | 243 (179)                     |
|                    |                        |       |             | FE-55    | -17.8 (0.00)              | 226 (166)                     |
|                    |                        |       |             | FE-56    | 4.44 (40.0)               | 333 (245)                     |
|                    |                        |       |             | FE-57    | 4.44 (40.0)               | 276 (204)                     |
|                    |                        |       |             | FE-58    | 4.44 (40.0)               | 278 (205)                     |
| 71A<br>S80-10      | Weld Metal             | 1/4T  | L-T         | FH-1     | -28.9 (-20.0)             | 114 (84.2)                    |
|                    |                        |       |             | FH-2     | -28.9 (-20.0)             | 85.7 (63.2)                   |
|                    |                        |       |             | FH-3     | -28.9 (-20.0)             | 120 (88.2)                    |
|                    |                        |       |             | FH-4     | -17.8 (0.00)              | 170 (125)                     |
|                    |                        |       |             | FH-5     | -17.8 (0.00)              | 141 (104)                     |
|                    |                        |       |             | FH-6     | -17.8 (0.00)              | 138 (102)                     |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 71A<br>S80-10      | FL                     | 1/4T  | L-T         | FH-7     | -51.1 (-60.0)             | 39.5 (29.1)                   |
|                    |                        |       |             | FH-8     | -51.1 (-60.0)             | 133 (98.2)                    |
|                    |                        |       |             | FH-9     | -51.1 (-60.0)             | 29.9 (22.0)                   |
|                    |                        |       |             | FH-10    | -34.4 (-30.0)             | 137 (101)                     |
|                    |                        |       |             | FH-11    | -34.4 (-30.0)             | 50.5 (37.3)                   |
|                    |                        |       |             | FH-12    | -34.4 (-30.0)             | 126 (92.6)                    |
|                    |                        |       |             | FH-13    | -34.4 (-30.0)             | 50.7 (37.4)                   |
|                    |                        |       |             | FH-14    | -17.8 (0.00)              | 192 (141)                     |
|                    |                        |       |             | FH-15    | -17.8 (0.00)              | 63.3 (46.7)                   |
|                    |                        |       |             | FH-16    | -17.8 (0.00)              | 184 (136)                     |
|                    |                        |       |             | FH-17    | -51.1 (-60.0)             | 28.4 (21.0)                   |
|                    |                        |       |             | FH-18    | -51.1 (-60.0)             | 71.4 (52.6)                   |
|                    |                        |       |             | FH-19    | -51.1 (-60.0)             | 32.7 (24.1)                   |
|                    |                        |       |             | FH-20    | -34.4 (-30.0)             | 86.0 (63.4)                   |
|                    |                        |       |             | FH-21    | -34.4 (-30.0)             | 54.3 (40.0)                   |
|                    |                        |       |             | FH-22    | -34.4 (-30.0)             | 153 (113)                     |
|                    | FL + 1                 | 1/4T  | L-T         | FH-23    | -34.4 (-30.0)             | 45.1 (33.3)                   |
|                    |                        |       |             | FH-24    | -17.8 (0.00)              | 176 (129)                     |
|                    |                        |       |             | FH-25    | -17.8 (0.00)              | 100 (74.1)                    |
|                    |                        |       |             | FH-26    | -17.8 (0.00)              | 187 (138)                     |
|                    |                        |       |             | FH-27    | -51.1 (-60.0)             | 31.1 (22.9)                   |
|                    |                        |       |             | FH-28    | -51.1 (-60.0)             | 25.0 (18.5)                   |
|                    |                        |       |             | FH-29    | -51.1 (-60.0)             | 32.1 (23.7)                   |
|                    |                        |       |             | FH-30    | -34.4 (-30.0)             | 198 (146)                     |
|                    |                        |       |             | FH-31    | -34.4 (-30.0)             | 44.1 (32.5)                   |
|                    |                        |       |             | FH-32    | -34.4 (-30.0)             | 173 (127)                     |
|                    |                        |       |             | FH-33    | -34.4 (-30.0)             | 83.4 (61.5)                   |
|                    |                        |       |             | FH-34    | -17.8 (0.00)              | 211 (156)                     |
|                    |                        |       |             | FH-35    | -17.8 (0.00)              | 120 (88.2)                    |
|                    |                        |       |             | FH-36    | -17.8 (0.00)              | 170 (125)                     |
|                    |                        |       |             | FH-37    | -34.4 (-30.0)             | 28.6 (21.1)                   |
|                    | FL                     | 1/4T  | L-S         | FH-38    | -34.4 (-30.0)             | 100 (73.8)                    |
|                    |                        |       |             | FH-39    | -34.4 (-30.0)             | 32.3 (23.8)                   |
|                    |                        |       |             | FH-40    | -34.4 (-30.0)             | 34.5 (25.5)                   |
|                    | FL                     | 1/2T  | L-T         | FH-41    | -34.4 (-30.0)             | 41.2 (30.4)                   |
|                    |                        |       |             | FH-42    | -34.4 (-30.0)             | 67.5 (49.8)                   |
|                    |                        |       |             | FH-43    | -34.4 (-30.0)             | 51.8 (38.2)                   |
|                    |                        |       |             | FH-44    | -34.4 (-30.0)             | 53.5 (39.5)                   |
|                    | FL                     | 1/2T  | L-S         | FH-45    | -34.4 (-30.0)             | 219 (162)                     |
|                    |                        |       |             | FH-46    | -34.4 (-30.0)             | 204 (151)                     |
|                    |                        |       |             | FH-47    | -51.1 (-60.0)             | 170 (125)                     |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | FH-48    | -51.1 (-60.0)             | 181 (134)                     |
|                    |                        |       |             | FH-49    | -51.1 (-60.0)             | 175 (129)                     |
|                    |                        |       |             | FH-50    | -34.4 (-30.0)             | 201 (148)                     |
|                    |                        |       |             | FH-51    | -34.4 (-30.0)             | 275 (203)                     |
|                    |                        |       |             | FH-52    | -34.4 (-30.0)             | 224 (165)                     |
|                    |                        |       |             | FH-53    | -17.8 (0.00)              | 284 (210)                     |
|                    |                        |       |             | FH-54    | -17.8 (0.00)              | 304 (224)                     |
|                    |                        |       |             | FH-55    | -17.8 (0.00)              | 239 (176)                     |
|                    |                        |       |             | FH-56    | 4.44 (40.0)               | 340 (251)                     |
|                    |                        |       |             | FH-57    | 4.44 (40.0)               | 297 (219)                     |
|                    |                        |       |             | FH-58    | 4.44 (40.0)               | 319 (235)                     |

| Plate and Weldment | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| 71A<br>S40-30      | Weld Metal | 1/4T  | L-T         | FL-1     | -28.9 (-20.0)             | 109 (80.5)                    |
|                    |            |       |             | FL-2     | -28.9 (-20.0)             | 129 (94.8)                    |
|                    |            |       |             | FL-3     | -28.9 (-20.0)             | 110 (80.9)                    |
|                    |            |       |             | FL-4     | -17.8 (0.00)              | 129 (94.8)                    |
|                    |            |       |             | FL-5     | -17.8 (0.00)              | 111 (81.6)                    |
|                    |            |       |             | FL-6     | -17.8 (0.00)              | 127 (93.8)                    |
|                    | FL         | 1/4T  | L-T         | FL-7     | -51.1 (-60.0)             | 39.1 (28.8)                   |
|                    |            |       |             | FL-8     | -51.1 (-60.0)             | 126 (93.0)                    |
|                    |            |       |             | FL-9     | -51.1 (-60.0)             | 74.7 (55.1)                   |
|                    |            |       |             | FL-10    | -34.4 (-30.0)             | 211 (156)                     |
|                    |            |       |             | FL-11    | -34.4 (-30.0)             | 66.2 (48.9)                   |
|                    |            |       |             | FL-12    | -34.4 (-30.0)             | 146 (108)                     |
|                    |            |       |             | FL-13    | -34.4 (-30.0)             | 68.2 (50.3)                   |
|                    |            |       |             | FL-14    | -17.8 (0.00)              | 112 (83.0)                    |
|                    |            |       |             | FL-15    | -17.8 (0.00)              | 103 (75.8)                    |
|                    |            |       |             | FL-16    | -17.8 (0.00)              | 150 (110)                     |
|                    | FL + 1     | 1/4T  | L-T         | FL-17    | -51.1 (-60.0)             | 39.0 (28.7)                   |
|                    |            |       |             | FL-18    | -51.1 (-60.0)             | 103 (75.7)                    |
|                    |            |       |             | FL-19    | -51.1 (-60.0)             | 33.1 (24.4)                   |
|                    |            |       |             | FL-20    | -34.4 (-30.0)             | 189 (139)                     |
|                    |            |       |             | FL-21    | -34.4 (-30.0)             | 93.8 (69.2)                   |
|                    |            |       |             | FL-22    | -34.4 (-30.0)             | 184 (136)                     |
|                    |            |       |             | FL-23    | -34.4 (-30.0)             | 66.5 (49.0)                   |
|                    |            |       |             | FL-24    | -17.8 (0.00)              | 256 (189)                     |
|                    |            |       |             | FL-25    | -17.8 (0.00)              | 143 (106)                     |
|                    |            |       |             | FL-26    | -17.8 (0.00)              | 203 (150)                     |
|                    | FL + 2     | 1/4T  | L-T         | FL-27    | -51.1 (-60.0)             | 78.4 (57.9)                   |
|                    |            |       |             | FL-28    | -51.1 (-60.0)             | 215 (158)                     |
|                    |            |       |             | FL-29    | -51.1 (-60.0)             | 36.8 (27.1)                   |
|                    |            |       |             | FL-30    | -34.4 (-30.0)             | 200 (147)                     |
|                    |            |       |             | FL-31    | -34.4 (-30.0)             | 91.7 (67.7)                   |
|                    |            |       |             | FL-32    | -34.4 (-30.0)             | 226 (167)                     |
|                    |            |       |             | FL-33    | -34.4 (-30.0)             | 107 (79.1)                    |
|                    |            |       |             | FL-34    | -17.8 (0.00)              | 204 (150)                     |
|                    |            |       |             | FL-35    | -17.8 (0.00)              | 163 (120)                     |
|                    |            |       |             | FL-36    | -17.8 (0.00)              | 193 (142)                     |
|                    | FL         | 1/4T  | L-S         | FL-37    | -34.4 (-30.0)             | 47.3 (34.9)                   |
|                    |            |       |             | FL-38    | -34.4 (-30.0)             | 18.7 (13.8)                   |
|                    |            |       |             | FL-39    | -34.4 (-30.0)             | 83.3 (61.4)                   |
|                    | FL         | 1/2T  | L-T         | FL-40    | -34.4 (-30.0)             | 104 (76.7)                    |
|                    |            |       |             | FL-41    | -34.4 (-30.0)             | 130 (95.8)                    |
|                    |            |       |             | FL-42    | -34.4 (-30.0)             | 178 (132)                     |
|                    | FL         | 1/2T  | L-S         | FL-43    | -34.4 (-30.0)             | 71.9 (53.0)                   |
|                    |            |       |             | FL-44    | -34.4 (-30.0)             | 66.0 (48.7)                   |
|                    |            |       |             | FL-45    | -34.4 (-30.0)             | 62.2 (45.9)                   |
|                    |            |       |             | FL-46    | -34.4 (-30.0)             | 92.6 (68.3)                   |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 71A<br>S40-30      | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | FL-47    | -51.1 (-60.0)             | 197 (145)                     |
|                    |                        |       |             | FL-48    | -51.1 (-60.0)             | 177 (130)                     |
|                    |                        |       |             | FL-49    | -51.1 (-60.0)             | 206 (152)                     |
|                    |                        |       |             | FL-50    | -34.4 (-30.0)             | 229 (169)                     |
|                    |                        |       |             | FL-51    | -34.4 (-30.0)             | 192 (142)                     |
|                    |                        |       |             | FL-52    | -34.4 (-30.0)             | 204 (150)                     |
|                    |                        |       |             | FL-53    | -17.8 (0.00)              | 236 (174)                     |
|                    |                        |       |             | FL-54    | -17.8 (0.00)              | 303 (224)                     |
|                    |                        |       |             | FL-55    | -17.8 (0.00)              | 276 (203)                     |
|                    |                        |       |             | FL-56    | 4.44 (40.0)               | 327 (241)                     |
|                    |                        |       |             | FL-57    | 4.44 (40.0)               | 340 (251)                     |
|                    |                        |       |             | FL-58    | 4.44 (40.0)               | 303 (224)                     |
| 71B<br>Base Metal  | Base Metal             | 1/4T  | L-T         | GB-1     | -67.8 (-90.0)             | 147 (108)                     |
|                    |                        |       |             | GB-2     | -67.8 (-90.0)             | 90.1 (66.4)                   |
|                    |                        |       |             | GB-3     | -67.8 (-90.0)             | 88.0 (64.9)                   |
|                    |                        |       |             | GB-4     | -51.1 (-60.0)             | 130 (96.2)                    |
|                    |                        |       |             | GB-5     | -51.1 (-60.0)             | 170 (125)                     |
|                    |                        |       |             | GB-6     | -51.1 (-60.0)             | 160 (118)                     |
|                    |                        |       |             | GB-7     | -34.4 (-30.0)             | 203 (150)                     |
|                    |                        |       |             | GB-8     | -34.4 (-30.0)             | 143 (105)                     |
|                    |                        |       |             | GB-9     | -34.4 (-30.0)             | 172 (127)                     |
|                    |                        |       |             | GB-10    | -17.8 (0.00)              | 219 (161)                     |
|                    |                        |       |             | GB-11    | -17.8 (0.00)              | 213 (157)                     |
|                    |                        |       |             | GB-12    | -17.8 (0.00)              | 229 (169)                     |
|                    |                        |       |             | GB-13    | 4.44 (40.0)               | 309 (228)                     |
|                    |                        |       |             | GB-14    | 4.44 (40.0)               | 266 (196)                     |
|                    |                        |       |             | GB-15    | 4.44 (40.0)               | 281 (207)                     |
|                    |                        |       |             | GB-16    | 21.1 (70.0)               | 273 (201)                     |
|                    |                        |       |             | GB-17    | 21.1 (70.0)               | 301 (222)                     |
|                    |                        |       |             | GB-18    | 21.1 (70.0)               | 284 (210)                     |
|                    |                        |       |             | GB-19    | -80.0 (-112)              | 34.1 (25.2)                   |
|                    |                        |       |             | GB-20    | -80.0 (-112)              | 83.2 (61.4)                   |
|                    |                        |       |             | GB-21    | -80.0 (-112)              | 54.1 (39.9)                   |
|                    |                        |       |             | GB-22    | -51.1 (-60.0)             | 127 (93.8)                    |
|                    |                        |       |             | GB-23    | -34.4 (-30.0)             | 87.3 (64.4)                   |
|                    |                        |       |             | GB-24    | -17.8 (0.00)              | 238 (175)                     |
|                    | Base Metal             | 1/4T  | L-S         | GB-25    | -34.4 (-30.0)             | 376 (277)                     |
|                    |                        |       |             | GB-26    | -34.4 (-30.0)             | 226 (167)                     |
|                    |                        |       |             | GB-27    | -34.4 (-30.0)             | 217 (160)                     |
|                    | Base Metal             | 1/2T  | L-T         | GB-28    | -34.4 (-30.0)             | 198 (146)                     |
|                    |                        |       |             | GB-29    | -34.4 (-30.0)             | 130 (95.7)                    |
|                    |                        |       |             | GB-30    | -34.4 (-30.0)             | 157 (116)                     |
| 71B<br>ESW-NG      | Weld Metal             | 1/4T  | L-T         | GE-1     | -28.9 (-20.0)             | 26.0 (19.2)                   |
|                    |                        |       |             | GE-2     | -28.9 (-20.0)             | 29.1 (21.5)                   |
|                    |                        |       |             | GE-3     | -28.9 (-20.0)             | 79.9 (58.9)                   |
|                    |                        |       |             | GE-4     | -17.8 (0.00)              | 108 (79.3)                    |
|                    |                        |       |             | GE-5     | -17.8 (0.00)              | 102 (75.2)                    |
|                    |                        |       |             | GE-6     | -17.8 (0.00)              | 83.2 (61.4)                   |



| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 71B<br>ESW-NG      | FL                     | 1/4T  | L-T         | GE-7     | -51.1 (-60.0)             | 14.7 (10.9)                   |
|                    |                        |       |             | GE-8     | -51.1 (-60.0)             | 19.2 (14.2)                   |
|                    |                        |       |             | GE-9     | -51.1 (-60.0)             | 20.5 (15.1)                   |
|                    |                        |       |             | GE-10    | -34.4 (-30.0)             | 19.0 (14.0)                   |
|                    |                        |       |             | GE-11    | -34.4 (-30.0)             | 24.3 (17.9)                   |
|                    |                        |       |             | GE-12    | -34.4 (-30.0)             | 15.1 (11.2)                   |
|                    |                        |       |             | GE-13    | -34.4 (-30.0)             | 17.8 (13.2)                   |
|                    |                        |       |             | GE-14    | -17.8 (0.00)              | 25.8 (19.1)                   |
|                    |                        |       |             | GE-15    | -17.8 (0.00)              | 28.5 (21.1)                   |
|                    |                        |       |             | GE-16    | -17.8 (0.00)              | 29.2 (21.6)                   |
|                    | FL + 1                 | 1/4T  | L-T         | GE-17    | -51.1 (-60.0)             | 20.0 (14.7)                   |
|                    |                        |       |             | GE-18    | -51.1 (-60.0)             | 9.58 (7.06)                   |
|                    |                        |       |             | GE-19    | -51.1 (-60.0)             | 20.6 (15.2)                   |
|                    |                        |       |             | GE-20    | -34.4 (-30.0)             | 30.8 (22.7)                   |
|                    |                        |       |             | GE-21    | -34.4 (-30.0)             | 29.2 (21.6)                   |
|                    |                        |       |             | GE-22    | -34.4 (-30.0)             | 20.0 (14.7)                   |
|                    |                        |       |             | GE-23    | -34.4 (-30.0)             | 17.2 (12.7)                   |
|                    |                        |       |             | GE-24    | -17.8 (0.00)              | 67.9 (50.1)                   |
|                    |                        |       |             | GE-25    | -17.8 (0.00)              | 23.8 (17.6)                   |
|                    |                        |       |             | GE-26    | -17.8 (0.00)              | 59.4 (43.8)                   |
|                    | FL + 2                 | 1/4T  | L-T         | GE-27    | -51.1 (-60.0)             | 10.4 (7.69)                   |
|                    |                        |       |             | GE-28    | -51.1 (-60.0)             | 14.9 (11.0)                   |
|                    |                        |       |             | GE-29    | -51.1 (-60.0)             | 18.7 (13.8)                   |
|                    |                        |       |             | GE-30    | -34.4 (-30.0)             | 30.7 (22.6)                   |
|                    |                        |       |             | GE-31    | -34.4 (-30.0)             | 32.4 (23.9)                   |
|                    |                        |       |             | GE-32    | -34.4 (-30.0)             | 22.3 (16.4)                   |
|                    |                        |       |             | GE-33    | -34.4 (-30.0)             | 44.8 (33.1)                   |
|                    |                        |       |             | GE-34    | -17.8 (0.00)              | 63.0 (46.4)                   |
|                    |                        |       |             | GE-35    | -17.8 (0.00)              | 47.0 (34.7)                   |
|                    |                        |       |             | GE-36    | -17.8 (0.00)              | 63.9 (47.1)                   |
|                    | FL                     | 1/4T  | L-S         | GE-37    | -17.8 (0.00)              | 22.7 (16.7)                   |
|                    |                        |       |             | GE-38    | -17.8 (0.00)              | 37.3 (27.5)                   |
|                    |                        |       |             | GE-39    | -17.8 (0.00)              | 49.5 (36.5)                   |
|                    | FL                     | 1/2T  | L-T         | GE-40    | -17.8 (0.00)              | 46.7 (34.5)                   |
|                    |                        |       |             | GE-41    | -17.8 (0.00)              | 17.0 (12.5)                   |
|                    |                        |       |             | GE-42    | -17.8 (0.00)              | 15.8 (11.7)                   |
|                    |                        |       |             | GE-43    | -17.8 (0.00)              | 47.9 (35.3)                   |
|                    | FL                     | 1/2T  | L-S         | GE-44    | -17.8 (0.00)              | 68.9 (50.8)                   |
|                    |                        |       |             | GE-45    | -17.8 (0.00)              | 54.1 (39.9)                   |
|                    |                        |       |             | GE-46    | -17.8 (0.00)              | 78.0 (57.5)                   |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | GE-47    | -51.1 (-60.0)             | 185 (136)                     |
|                    |                        |       |             | GE-48    | -51.1 (-60.0)             | 156 (115)                     |
|                    |                        |       |             | GE-49    | -51.1 (-60.0)             | 76.3 (56.3)                   |
|                    |                        |       |             | GE-50    | -34.4 (-30.0)             | 197 (145)                     |
|                    |                        |       |             | GE-51    | -34.4 (-30.0)             | 161 (119)                     |
|                    |                        |       |             | GE-52    | -34.4 (-30.0)             | 212 (156)                     |
|                    |                        |       |             | GE-53    | -17.8 (0.00)              | 229 (169)                     |
|                    |                        |       |             | GE-54    | -17.8 (0.00)              | 235 (174)                     |
|                    |                        |       |             | GE-55    | -17.8 (0.00)              | 209 (154)                     |
|                    |                        |       |             | GE-56    | -34.4 (-30.0)             | 201 (148)                     |
|                    |                        |       |             | GE-57    | -34.4 (-30.0)             | 184 (136)                     |
|                    |                        |       |             | GE-58    | -34.4 (-30.0)             | 224 (165)                     |

| Plate and Weldment | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| 71B<br>S80-10      | Weld Metal | 1/4T  | L-T         | GH-1     | -28.9 (-20.0)             | 133 (98.2)                    |
|                    |            |       |             | GH-2     | -28.9 (-20.0)             | 224 (165)                     |
|                    |            |       |             | GH-3     | -28.9 (-20.0)             | 211 (156)                     |
|                    |            |       |             | GH-4     | -17.8 (0.00)              | 166 (123)                     |
|                    |            |       |             | GH-5     | -17.8 (0.00)              | 167 (123)                     |
|                    |            |       |             | GH-6     | -17.8 (0.00)              | 171 (126)                     |
|                    | FL         | 1/4T  | L-T         | GH-7     | -51.1 (-60.0)             | 100 (74.1)                    |
|                    |            |       |             | GH-8     | -51.1 (-60.0)             | 25.2 (18.6)                   |
|                    |            |       |             | GH-9     | -51.1 (-60.0)             | 23.0 (17.0)                   |
|                    |            |       |             | GH-10    | -34.4 (-30.0)             | 25.1 (18.5)                   |
|                    |            |       |             | GH-11    | -34.4 (-30.0)             | 65.0 (47.9)                   |
|                    |            |       |             | GH-12    | -34.4 (-30.0)             | 39.0 (28.7)                   |
|                    |            |       |             | GH-13    | -34.4 (-30.0)             | 54.4 (40.1)                   |
|                    |            |       |             | GH-14    | -17.8 (0.00)              | 63.9 (47.1)                   |
|                    |            |       |             | GH-15    | -17.8 (0.00)              | 35.3 (26.0)                   |
|                    |            |       |             | GH-16    | -17.8 (0.00)              | 85.5 (63.0)                   |
|                    | FL + 1     | 1/4T  | L-T         | GH-17    | -51.1 (-60.0)             | 128 (94.3)                    |
|                    |            |       |             | GH-18    | -51.1 (-60.0)             | 169 (125)                     |
|                    |            |       |             | GH-19    | -51.1 (-60.0)             | 34.3 (25.3)                   |
|                    |            |       |             | GH-20    | -34.4 (-30.0)             | 90.2 (66.5)                   |
|                    |            |       |             | GH-21    | -34.4 (-30.0)             | 127 (94.0)                    |
|                    |            |       |             | GH-22    | -34.4 (-30.0)             | 94.4 (69.7)                   |
|                    |            |       |             | GH-23    | -34.4 (-30.0)             | 21.9 (16.1)                   |
|                    |            |       |             | GH-24    | -17.8 (0.00)              | 87.2 (64.3)                   |
|                    |            |       |             | GH-25    | -17.8 (0.00)              | 192 (141)                     |
|                    |            |       |             | GH-26    | -17.8 (0.00)              | 183 (135)                     |
|                    | FL + 2     | 1/4T  | L-T         | GH-27    | -51.1 (-60.0)             | 158 (117)                     |
|                    |            |       |             | GH-28    | -51.1 (-60.0)             | 60.9 (44.9)                   |
|                    |            |       |             | GH-29    | -51.1 (-60.0)             | 103 (76.1)                    |
|                    |            |       |             | GH-30    | -34.4 (-30.0)             | 133 (98.4)                    |
|                    |            |       |             | GH-31    | -34.4 (-30.0)             | 39.1 (28.8)                   |
|                    |            |       |             | GH-32    | -34.4 (-30.0)             | 216 (159)                     |
|                    |            |       |             | GH-33    | -34.4 (-30.0)             | 237 (175)                     |
|                    |            |       |             | GH-34    | -17.8 (0.00)              | 225 (166)                     |
|                    |            |       |             | GH-35    | -17.8 (0.00)              | 50.6 (37.4)                   |
|                    |            |       |             | GH-36    | -17.8 (0.00)              | 183 (135)                     |
|                    | FL         | 1/4T  | L-S         | GH-37    | -34.4 (-30.0)             | 107 (79.2)                    |
|                    |            |       |             | GH-38    | -34.4 (-30.0)             | 105 (77.1)                    |
|                    |            |       |             | GH-39    | -34.4 (-30.0)             | 117 (86.5)                    |
|                    | FL         | 1/2T  | L-T         | GH-40    | -34.4 (-30.0)             | 159 (117)                     |
|                    |            |       |             | GH-41    | -34.4 (-30.0)             | 179 (132)                     |
|                    |            |       |             | GH-42    | -34.4 (-30.0)             | 199 (147)                     |
|                    |            |       |             | GH-43    | -34.4 (-30.0)             | 152 (112)                     |
|                    | FL         | 1/2T  | L-S         | GH-44    | -34.4 (-30.0)             | 155 (114)                     |
|                    |            |       |             | GH-45    | -34.4 (-30.0)             | 207 (153)                     |
|                    |            |       |             | GH-46    | -34.4 (-30.0)             | 198 (146)                     |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 71B<br>S80-10      | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | GH-47    | -51.1 (-60.0)             | 227 (168)                     |
|                    |                        |       |             | GH-48    | -51.1 (-60.0)             | 206 (152)                     |
|                    |                        |       |             | GH-49    | -51.1 (-60.0)             | 205 (151)                     |
|                    |                        |       |             | GH-50    | -34.4 (-30.0)             | 197 (146)                     |
|                    |                        |       |             | GH-51    | -34.4 (-30.0)             | 224 (165)                     |
|                    |                        |       |             | GH-52    | -34.4 (-30.0)             | 301 (222)                     |
|                    |                        |       |             | GH-53    | -17.8 (0.00)              | 249 (184)                     |
|                    |                        |       |             | GH-54    | -17.8 (0.00)              | 227 (168)                     |
|                    |                        |       |             | GH-55    | -17.8 (0.00)              | 269 (199)                     |
|                    |                        |       |             | GH-56    | -34.4 (-30.0)             | 258 (190)                     |
|                    |                        |       |             | GH-57    | -34.4 (-30.0)             | 226 (167)                     |
|                    |                        |       |             | GH-58    | -34.4 (-30.0)             | 240 (177)                     |
| 71B<br>S40-30      | Weld Metal             | 1/4T  | L-T         | GL-1     | -28.9 (-20.0)             | 143 (105)                     |
|                    |                        |       |             | GL-2     | -28.9 (-20.0)             | 171 (126)                     |
|                    |                        |       |             | GL-3     | -28.9 (-20.0)             | 170 (126)                     |
|                    |                        |       |             | GL-4     | -17.8 (0.00)              | 181 (133)                     |
|                    |                        |       |             | GL-5     | -17.8 (0.00)              | 189 (139)                     |
|                    |                        |       |             | GL-6     | -17.8 (0.00)              | 192 (142)                     |
|                    | FL                     | 1/4T  | L-T         | GL-7     | -51.1 (-60.0)             | 109 (80.3)                    |
|                    |                        |       |             | GL-8     | -51.1 (-60.0)             | 146 (108)                     |
|                    |                        |       |             | GL-9     | -51.1 (-60.0)             | 99.3 (73.3)                   |
|                    |                        |       |             | GL-10    | -34.4 (-30.0)             | 69.0 (50.9)                   |
|                    |                        |       |             | GL-11    | -34.4 (-30.0)             | 83.0 (61.2)                   |
|                    |                        |       |             | GL-12    | -34.4 (-30.0)             | 51.7 (38.1)                   |
|                    |                        |       |             | GL-13    | -34.4 (-30.0)             | 223 (164)                     |
|                    |                        |       |             | GL-14    | -17.8 (0.00)              | 214 (158)                     |
|                    |                        |       |             | GL-15    | -17.8 (0.00)              | 259 (191)                     |
|                    |                        |       |             | GL-16    | -17.8 (0.00)              | 206 (152)                     |
|                    | FL + 1                 | 1/4T  | L-T         | GL-17    | -51.1 (-60.0)             | 165 (121)                     |
|                    |                        |       |             | GL-18    | -51.1 (-60.0)             | 198 (146)                     |
|                    |                        |       |             | GL-19    | -51.1 (-60.0)             | 164 (121)                     |
|                    |                        |       |             | GL-20    | -34.4 (-30.0)             | 197 (145)                     |
|                    |                        |       |             | GL-21    | -34.4 (-30.0)             | 177 (131)                     |
|                    |                        |       |             | GL-22    | -34.4 (-30.0)             | 194 (143)                     |
|                    |                        |       |             | GL-23    | -34.4 (-30.0)             | 182 (134)                     |
|                    |                        |       |             | GL-24    | -17.8 (0.00)              | 145 (107)                     |
|                    |                        |       |             | GL-25    | -17.8 (0.00)              | 203 (150)                     |
|                    |                        |       |             | GL-26    | -17.8 (0.00)              | 211 (156)                     |
|                    | FL + 2                 | 1/4T  | L-T         | GL-27    | -51.1 (-60.0)             | 169 (125)                     |
|                    |                        |       |             | GL-28    | -51.1 (-60.0)             | 105 (77.7)                    |
|                    |                        |       |             | GL-29    | -51.1 (-60.0)             | 176 (130)                     |
|                    |                        |       |             | GL-30    | -34.4 (-30.0)             | 181 (134)                     |
|                    |                        |       |             | GL-31    | -34.4 (-30.0)             | 215 (158)                     |
|                    |                        |       |             | GL-32    | -34.4 (-30.0)             | 181 (134)                     |
|                    |                        |       |             | GL-33    | -34.4 (-30.0)             | 181 (134)                     |
|                    |                        |       |             | GL-34    | -17.8 (0.00)              | 232 (171)                     |
|                    |                        |       |             | GL-35    | -17.8 (0.00)              | 216 (159)                     |
|                    |                        |       |             | GL-36    | -17.8 (0.00)              | 203 (149)                     |
|                    | FL                     | 1/4T  | L-S         | GL-37    | -34.4 (-30.0)             | 202 (149)                     |
|                    |                        |       |             | GL-38    | -34.4 (-30.0)             | 223 (164)                     |
|                    |                        |       |             | GL-39    | -34.4 (-30.0)             | 153 (113)                     |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 71B<br>S40-30      | FL                     | 1/2T  | L-T         | GL-40    | -34.4 (-30.0)             | 145 (107)                     |
|                    |                        |       |             | GL-41    | -34.4 (-30.0)             | 135 (100)                     |
|                    |                        |       |             | GL-42    | -34.4 (-30.0)             | 172 (127)                     |
|                    |                        |       |             | GL-43    | -34.4 (-30.0)             | 35.0 (25.8)                   |
|                    | FL                     | 1/2T  | L-S         | GL-44    | -34.4 (-30.0)             | 94.4 (69.7)                   |
|                    |                        |       |             | GL-45    | -34.4 (-30.0)             | 175 (129)                     |
|                    |                        |       |             | GL-46    | -34.4 (-30.0)             | 307 (226)                     |
|                    |                        |       |             | GL-47    | -51.1 (-60.0)             | 166 (122)                     |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | GL-48    | -51.1 (-60.0)             | 247 (182)                     |
|                    |                        |       |             | GL-49    | -51.1 (-60.0)             | 177 (131)                     |
|                    |                        |       |             | GL-50    | -34.4 (-30.0)             | 199 (146)                     |
|                    |                        |       |             | GL-51    | -34.4 (-30.0)             | 220 (162)                     |
|                    |                        |       |             | GL-52    | -34.4 (-30.0)             | 255 (188)                     |
|                    |                        |       |             | GL-53    | -17.8 (0.00)              | 240 (177)                     |
|                    |                        |       |             | GL-54    | -17.8 (0.00)              | 288 (213)                     |
|                    |                        |       |             | GL-55    | -17.8 (0.00)              | 216 (160)                     |
|                    |                        |       |             | GL-56    | -34.4 (-30.0)             | 195 (144)                     |
|                    |                        |       |             | GL-57    | -34.4 (-30.0)             | 221 (163)                     |
| 73A<br>Base Metal  | Base Metal             | 1/4T  | L-T         | GL-58    | -34.4 (-30.0)             | 211 (156)                     |
|                    |                        |       |             | JB-1     | -67.8 (-90)               | 163 (120)                     |
|                    |                        |       |             | JB-2     | -67.8 (-90)               | 174 (128)                     |
|                    |                        |       |             | JB-3     | -67.8 (-90)               | 150 (111)                     |
|                    |                        |       |             | JB-4     | -51.1 (-60)               | 172 (127)                     |
|                    |                        |       |             | JB-5     | -51.1 (-60)               | 164 (121)                     |
|                    |                        |       |             | JB-6     | -51.1 (-60)               | 236 (174)                     |
|                    |                        |       |             | JB-7     | -34.4 (-30)               | 188 (138)                     |
|                    |                        |       |             | JB-8     | -34.4 (-30)               | 193 (142)                     |
|                    |                        |       |             | JB-9     | -34.4 (-30)               | 225 (166)                     |
|                    |                        |       |             | JB-10    | -17.8 (0)                 | 215 (158)                     |
|                    |                        |       |             | JB-11    | -17.8 (0)                 | 278 (205)                     |
|                    |                        |       |             | JB-12    | -17.8 (0)                 | 279 (206)                     |
|                    |                        |       |             | JB-13    | 4.4 (40)                  | 301 (222)                     |
|                    |                        |       |             | JB-14    | 4.4 (40)                  | 275 (203)                     |
|                    |                        |       |             | JB-15    | 4.4 (40)                  | 304 (224)                     |
|                    |                        |       |             | JB-16    | 21.1 (70)                 | 278 (205)                     |
|                    |                        |       |             | JB-17    | 21.1 (70)                 | 277 (204)                     |
|                    |                        |       |             | JB-18    | 21.1 (70)                 | 278 (205)                     |
|                    |                        |       |             | JB-19    | -80 (-112)                | 118 (87.2)                    |
|                    |                        |       |             | JB-20    | -80 (-112)                | 70.9 (52.3)                   |
|                    |                        |       |             | JB-21    | -80 (-112)                | 140 (104)                     |
|                    |                        |       |             | JB-22    | -51.1 (-60)               | 186 (138)                     |
|                    |                        |       |             | JB-23    | -34.4 (-30)               | 220 (162)                     |
|                    |                        |       |             | JB-24    | -17.8 (0)                 | 259 (191)                     |
|                    | Base Metal             | 1/4T  | L-S         | JB-25    | -34.4 (-30)               | 268 (197)                     |
|                    |                        |       |             | JB-26    | -34.4 (-30)               | 207 (152)                     |
|                    |                        |       |             | JB-27    | -34.4 (-30)               | 174 (128)                     |
|                    | Base Metal             | 1/2T  | L-T         | JB-28    | -34.4 (-30)               | 48.6 (35.9)                   |
|                    |                        |       |             | JB-29    | -34.4 (-30)               | 21.4 (15.8)                   |
|                    |                        |       |             | JB-30    | -34.4 (-30)               | 16.0 (11.8)                   |

| Plate and Weldment | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| 73A<br>ESW-NG      | Weld Metal | 1/4T  | L-T         | JE-1     | -28.9 (-20.0)             | 31.1 (22.9)                   |
|                    |            |       |             | JE-2     | -28.9 (-20.0)             | 28.0 (20.7)                   |
|                    |            |       |             | JE-3     | -28.9 (-20.0)             | 42.6 (31.4)                   |
|                    |            |       |             | JE-4     | -17.8 (0.00)              | 28.9 (21.3)                   |
|                    |            |       |             | JE-5     | -17.8 (0.00)              | 35.5 (26.2)                   |
|                    |            |       |             | JE-6     | -17.8 (0.00)              | 53.0 (39.1)                   |
|                    | FL         | 1/4T  | L-T         | JE-7     | -51.1 (-60.0)             | 25.2 (18.6)                   |
|                    |            |       |             | JE-8     | -51.1 (-60.0)             | 14.4 (10.7)                   |
|                    |            |       |             | JE-9     | -51.1 (-60.0)             | 26.6 (19.6)                   |
|                    |            |       |             | JE-10    | -34.4 (-30.0)             | 9.29 (6.85)                   |
|                    |            |       |             | JE-11    | -34.4 (-30.0)             | 9.48 (6.99)                   |
|                    |            |       |             | JE-12    | -34.4 (-30.0)             | 28.6 (21.1)                   |
|                    |            |       |             | JE-13    | -34.4 (-30.0)             | 32.7 (24.1)                   |
|                    |            |       |             | JE-14    | -17.8 (0.00)              | 15.9 (11.7)                   |
|                    |            |       |             | JE-15    | -17.8 (0.00)              | 27.8 (20.5)                   |
|                    |            |       |             | JE-16    | -17.8 (0.00)              | 19.7 (14.5)                   |
|                    | FL + 1     | 1/4T  | L-T         | JE-17    | -51.1 (-60.0)             | 10.2 (7.55)                   |
|                    |            |       |             | JE-18    | -51.1 (-60.0)             | 9.29 (6.85)                   |
|                    |            |       |             | JE-19    | -51.1 (-60.0)             | 6.94 (5.12)                   |
|                    |            |       |             | JE-20    | -34.4 (-30.0)             | 11.6 (8.54)                   |
|                    |            |       |             | JE-21    | -34.4 (-30.0)             | 7.13 (5.26)                   |
|                    |            |       |             | JE-22    | -34.4 (-30.0)             | 9.86 (7.27)                   |
|                    |            |       |             | JE-23    | -34.4 (-30.0)             | 12.4 (9.17)                   |
|                    |            |       |             | JE-24    | -17.8 (0.00)              | 16.4 (12.1)                   |
|                    |            |       |             | JE-25    | -17.8 (0.00)              | 19.9 (14.7)                   |
|                    |            |       |             | JE-26    | -17.8 (0.00)              | 12.9 (9.52)                   |
|                    | FL + 2     | 1/4T  | L-T         | JE-27    | -51.1 (-60.0)             | 8.44 (6.23)                   |
|                    |            |       |             | JE-28    | -51.1 (-60.0)             | 6.28 (4.63)                   |
|                    |            |       |             | JE-29    | -51.1 (-60.0)             | 6.66 (4.91)                   |
|                    |            |       |             | JE-30    | -34.4 (-30.0)             | 8.44 (6.23)                   |
|                    |            |       |             | JE-31    | -34.4 (-30.0)             | 9.96 (7.34)                   |
|                    |            |       |             | JE-32    | -34.4 (-30.0)             | 10.1 (7.41)                   |
|                    |            |       |             | JE-33    | -34.4 (-30.0)             | 6.10 (4.50)                   |
|                    |            |       |             | JE-34    | -17.8 (0.00)              | 10.7 (7.90)                   |
|                    |            |       |             | JE-35    | -17.8 (0.00)              | 8.63 (6.37)                   |
|                    |            |       |             | JE-36    | -17.8 (0.00)              | 10.6 (7.83)                   |
|                    | FL         | 1/4T  | L-S         | JE-37    | -34.4 (-30.0)             | 16.3 (12.0)                   |
|                    |            |       |             | JE-38    | -34.4 (-30.0)             | 16.4 (12.1)                   |
|                    |            |       |             | JE-39    | -34.4 (-30.0)             | 7.78 (5.74)                   |
|                    | FL         | 1/2T  | L-T         | JE-40    | -34.4 (-30.0)             | 12.3 (9.10)                   |
|                    |            |       |             | JE-41    | -34.4 (-30.0)             | 8.63 (6.37)                   |
|                    |            |       |             | JE-42    | -34.4 (-30.0)             | 23.5 (17.4)                   |
|                    |            |       |             | JE-43    | -34.4 (-30.0)             | 6.94 (5.12)                   |
|                    | FL         | 1/2T  | L-S         | JE-44    | -34.4 (-30.0)             | 9.10 (6.71)                   |
|                    |            |       |             | JE-45    | -34.4 (-30.0)             | 7.29 (5.37)                   |
|                    |            |       |             | JE-46    | -34.4 (-30.0)             | 9.77 (7.20)                   |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 73A<br>ESW-NG      | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | JE-47    | -51.1 (-60.0)             | 196 (145)                     |
|                    |                        |       |             | JE-48    | -51.1 (-60.0)             | 157 (115)                     |
|                    |                        |       |             | JE-49    | -51.1 (-60.0)             | 146 (108)                     |
|                    |                        |       |             | JE-50    | -34.4 (-30.0)             | 236 (174)                     |
|                    |                        |       |             | JE-51    | -34.4 (-30.0)             | 188 (139)                     |
|                    |                        |       |             | JE-52    | -34.4 (-30.0)             | 242 (179)                     |
|                    |                        |       |             | JE-53    | -17.8 (0.00)              | 219 (162)                     |
|                    |                        |       |             | JE-54    | -17.8 (0.00)              | 264 (195)                     |
|                    |                        |       |             | JE-55    | -17.8 (0.00)              | 268 (198)                     |
|                    |                        |       |             | JE-56    | -51.1 (-60.0)             | 129 (94.8)                    |
|                    |                        |       |             | JE-57    | -34.4 (-30.0)             | 183 (135)                     |
|                    |                        |       |             | JE-58    | -17.8 (0.00)              | 280 (206)                     |
| 73A<br>S80-10      | Weld Metal             | 1/4T  | L-T         | JH-1     | -28.9 (-20.0)             | 111 (81.9)                    |
|                    |                        |       |             | JH-2     | -28.9 (-20.0)             | 123 (90.9)                    |
|                    |                        |       |             | JH-3     | -28.9 (-20.0)             | 92.9 (68.5)                   |
|                    |                        |       |             | JH-4     | -17.8 (0.00)              | 149 (110)                     |
|                    |                        |       |             | JH-5     | -17.8 (0.00)              | 138 (102)                     |
|                    |                        |       |             | JH-6     | -17.8 (0.00)              | 166 (123)                     |
|                    | FL                     | 1/4T  | L-T         | JH-7     | -51.1 (-60.0)             | 27.1 (20.0)                   |
|                    |                        |       |             | JH-8     | -51.1 (-60.0)             | 31.5 (23.2)                   |
|                    |                        |       |             | JH-9     | -51.1 (-60.0)             | 104 (77.0)                    |
|                    |                        |       |             | JH-10    | -34.4 (-30.0)             | 136 (101)                     |
|                    |                        |       |             | JH-11    | -34.4 (-30.0)             | 125 (91.9)                    |
|                    |                        |       |             | JH-12    | -34.4 (-30.0)             | 170 (125)                     |
|                    |                        |       |             | JH-13    | -34.4 (-30.0)             | 73.7 (54.4)                   |
|                    |                        |       |             | JH-14    | -17.8 (0.00)              | 80.6 (59.4)                   |
|                    |                        |       |             | JH-15    | -17.8 (0.00)              | 93.6 (69.1)                   |
|                    |                        |       |             | JH-16    | -17.8 (0.00)              | 161 (119)                     |
|                    | FL + 1                 | 1/4T  | L-T         | JH-17    | -51.1 (-60.0)             | 99.3 (73.3)                   |
|                    |                        |       |             | JH-18    | -51.1 (-60.0)             | 117 (85.9)                    |
|                    |                        |       |             | JH-19    | -51.1 (-60.0)             | 138 (101)                     |
|                    |                        |       |             | JH-20    | -34.4 (-30.0)             | 208 (153)                     |
|                    |                        |       |             | JH-21    | -34.4 (-30.0)             | 189 (139)                     |
|                    |                        |       |             | JH-22    | -34.4 (-30.0)             | 129 (95.4)                    |
|                    |                        |       |             | JH-23    | -34.4 (-30.0)             | 118 (87.3)                    |
|                    |                        |       |             | JH-24    | -17.8 (0.00)              | 97.7 (72.1)                   |
|                    |                        |       |             | JH-25    | -17.8 (0.00)              | 196 (145)                     |
|                    |                        |       |             | JH-26    | -17.8 (0.00)              | 205 (151)                     |
|                    | FL + 2                 | 1/4T  | L-T         | JH-27    | -51.1 (-60.0)             | 89.6 (66.1)                   |
|                    |                        |       |             | JH-28    | -51.1 (-60.0)             | 147 (109)                     |
|                    |                        |       |             | JH-29    | -51.1 (-60.0)             | 110 (80.9)                    |
|                    |                        |       |             | JH-30    | -34.4 (-30.0)             | 210 (155)                     |
|                    |                        |       |             | JH-31    | -34.4 (-30.0)             | 154 (113)                     |
|                    |                        |       |             | JH-32    | -34.4 (-30.0)             | 147 (109)                     |
|                    |                        |       |             | JH-33    | -34.4 (-30.0)             | 222 (163)                     |
|                    |                        |       |             | JH-34    | -17.8 (0.00)              | 236 (174)                     |
|                    |                        |       |             | JH-35    | -17.8 (0.00)              | 137 (101)                     |
|                    |                        |       |             | JH-36    | -17.8 (0.00)              | 235 (173)                     |
|                    | FL                     | 1/4T  | L-S         | JH-37    | -34.4 (-30.0)             | 207 (152)                     |
|                    |                        |       |             | JH-38    | -34.4 (-30.0)             | 58.8 (43.4)                   |
|                    |                        |       |             | JH-39    | -34.4 (-30.0)             | 116 (85.3)                    |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 73A<br>S80-10      | FL                     | 1/2T  | L-T         | JH-40    | -34.4 (-30.0)             | 24.3 (17.9)                   |
|                    |                        |       |             | JH-41    | -34.4 (-30.0)             | 164 (121)                     |
|                    |                        |       |             | JH-42    | -34.4 (-30.0)             | 90.2 (66.5)                   |
|                    |                        |       |             | JH-43    | -34.4 (-30.0)             | 129 (95.5)                    |
|                    | FL                     | 1/2T  | L-S         | JH-44    | -34.4 (-30.0)             | 215 (158)                     |
|                    |                        |       |             | JH-45    | -34.4 (-30.0)             | 151 (111)                     |
|                    |                        |       |             | JH-46    | -34.4 (-30.0)             | 187 (138)                     |
|                    |                        |       |             | JH-47    | -51.1 (-60.0)             | 133 (98.1)                    |
|                    |                        |       |             | JH-48    | -51.1 (-60.0)             | 122 (89.8)                    |
|                    |                        |       |             | JH-49    | -51.1 (-60.0)             | 136 (100)                     |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | JH-50    | -34.4 (-30.0)             | 163 (120)                     |
|                    |                        |       |             | JH-51    | -34.4 (-30.0)             | 258 (190)                     |
|                    |                        |       |             | JH-52    | -34.4 (-30.0)             | 143 (106)                     |
|                    |                        |       |             | JH-53    | -17.8 (0.00)              | 205 (152)                     |
|                    |                        |       |             | JH-54    | -17.8 (0.00)              | 205 (151)                     |
|                    |                        |       |             | JH-55    | -17.8 (0.00)              | 203 (149)                     |
|                    |                        |       |             | JH-56    | -51.1 (-60.0)             | 150 (111)                     |
|                    |                        |       |             | JH-57    | -34.4 (-30.0)             | 164 (121)                     |
|                    |                        |       |             | JH-58    | -17.8 (0.00)              | 191 (141)                     |
|                    |                        |       |             | JL-1     | -28.9 (-20.0)             | 142 (105)                     |
| 73A<br>S40-30      | Weld Metal             | 1/4T  | L-T         | JL-2     | -28.9 (-20.0)             | 149 (110)                     |
|                    |                        |       |             | JL-3     | -28.9 (-20.0)             | 156 (115)                     |
|                    |                        |       |             | JL-4     | -17.8 (0.00)              | 150 (111)                     |
|                    |                        |       |             | JL-5     | -17.8 (0.00)              | 159 (117)                     |
|                    |                        |       |             | JL-6     | -17.8 (0.00)              | 167 (123)                     |
|                    |                        |       |             | JL-7     | -51.1 (-60.0)             | 54.5 (40.2)                   |
|                    | FL                     | 1/4T  | L-T         | JL-8     | -51.1 (-60.0)             | 95.4 (70.3)                   |
|                    |                        |       |             | JL-9     | -51.1 (-60.0)             | 103 (76.3)                    |
|                    |                        |       |             | JL-10    | -34.4 (-30.0)             | 129 (95.1)                    |
|                    |                        |       |             | JL-11    | -34.4 (-30.0)             | 265 (195)                     |
|                    |                        |       |             | JL-12    | -34.4 (-30.0)             | 127 (93.4)                    |
|                    |                        |       |             | JL-13    | -34.4 (-30.0)             | 226 (167)                     |
|                    |                        |       |             | JL-14    | -17.8 (0.00)              | 160 (118)                     |
|                    |                        |       |             | JL-15    | -17.8 (0.00)              | 181 (133)                     |
|                    |                        |       |             | JL-16    | -17.8 (0.00)              | 259 (191)                     |
|                    |                        |       |             | JL-17    | -51.1 (-60.0)             | 198 (146)                     |
|                    |                        |       |             | JL-18    | -51.1 (-60.0)             | 147 (109)                     |
|                    |                        |       |             | JL-19    | -51.1 (-60.0)             | 231 (170)                     |
|                    |                        |       |             | JL-20    | -34.4 (-30.0)             | 178 (132)                     |
|                    | FL + 1                 | 1/4T  | L-T         | JL-21    | -34.4 (-30.0)             | 225 (166)                     |
|                    |                        |       |             | JL-22    | -34.4 (-30.0)             | 184 (135)                     |
|                    |                        |       |             | JL-23    | -34.4 (-30.0)             | 262 (193)                     |
|                    |                        |       |             | JL-24    | -17.8 (0.00)              | 266 (197)                     |
|                    |                        |       |             | JL-25    | -17.8 (0.00)              | 292 (216)                     |
|                    |                        |       |             | JL-26    | -17.8 (0.00)              | 239 (176)                     |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 73A<br>S40-30      | FL + 2                 | 1/4T  | L-T         | JL-27    | -51.1 (-60.0)             | 63.5 (46.9)                   |
|                    |                        |       |             | JL-28    | -51.1 (-60.0)             | 132 (97.3)                    |
|                    |                        |       |             | JL-29    | -51.1 (-60.0)             | 140 (103)                     |
|                    |                        |       |             | JL-30    | -34.4 (-30.0)             | 158 (117)                     |
|                    |                        |       |             | JL-31    | -34.4 (-30.0)             | 153 (113)                     |
|                    |                        |       |             | JL-32    | -34.4 (-30.0)             | 134 (98.9)                    |
|                    |                        |       |             | JL-33    | -34.4 (-30.0)             | 110 (81.1)                    |
|                    |                        |       |             | JL-34    | -17.8 (0.00)              | 192 (141)                     |
|                    |                        |       |             | JL-35    | -17.8 (0.00)              | 205 (151)                     |
|                    |                        |       |             | JL-36    | -17.8 (0.00)              | 233 (172)                     |
|                    | FL                     | 1/4T  | L-S         | JL-37    | -34.4 (-30.0)             | 226 (167)                     |
|                    |                        |       |             | JL-38    | -34.4 (-30.0)             | 85.8 (63.3)                   |
|                    |                        |       |             | JL-39    | -34.4 (-30.0)             | 224 (165)                     |
|                    | FL                     | 1/2T  | L-T         | JL-40    | -34.4 (-30.0)             | 120 (88.6)                    |
|                    |                        |       |             | JL-41    | -34.4 (-30.0)             | 130 (96.2)                    |
|                    |                        |       |             | JL-42    | -34.4 (-30.0)             | 207 (152)                     |
|                    |                        |       |             | JL-43    | -34.4 (-30.0)             | 143 (106)                     |
|                    | FL                     | 1/2T  | L-S         | JL-44    | -34.4 (-30.0)             | 210 (155)                     |
|                    |                        |       |             | JL-45    | -34.4 (-30.0)             | 138 (102)                     |
|                    |                        |       |             | JL-46    | -34.4 (-30.0)             | 129 (94.9)                    |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | JL-47    | -51.1 (-60.0)             | 136 (101)                     |
|                    |                        |       |             | JL-48    | -51.1 (-60.0)             | 133 (98.2)                    |
|                    |                        |       |             | JL-49    | -51.1 (-60.0)             | 128 (94.5)                    |
|                    |                        |       |             | JL-50    | -34.4 (-30.0)             | 117 (85.9)                    |
|                    |                        |       |             | JL-51    | -34.4 (-30.0)             | 165 (122)                     |
|                    |                        |       |             | JL-52    | -34.4 (-30.0)             | 204 (151)                     |
|                    |                        |       |             | JL-53    | -17.8 (0.00)              | 196 (145)                     |
|                    |                        |       |             | JL-54    | -17.8 (0.00)              | 239 (176)                     |
|                    |                        |       |             | JL-55    | -17.8 (0.00)              | 212 (157)                     |
|                    |                        |       |             | JL-56    | -51.1 (-60.0)             | 156 (115)                     |
|                    |                        |       |             | JL-57    | -34.4 (-30.0)             | 166 (122)                     |
|                    |                        |       |             | JL-58    | -17.8 (0.00)              | 189 (139)                     |



| Plate and Weldment | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| 73B<br>Base Metal  | Base Metal | 1/4T  | L-T         | KB-1     | -67.8 (-90.0)             | 150 (110)                     |
|                    |            |       |             | KB-2     | -67.8 (-90.0)             | 127 (93.4)                    |
|                    |            |       |             | KB-3     | -67.8 (-90.0)             | 154 (114)                     |
|                    |            |       |             | KB-4     | -51.1 (-60.0)             | 196 (145)                     |
|                    |            |       |             | KB-5     | -51.1 (-60.0)             | 217 (160)                     |
|                    |            |       |             | KB-6     | -51.1 (-60.0)             | 202 (149)                     |
|                    |            |       |             | KB-7     | -34.4 (-30.0)             | 187 (138)                     |
|                    |            |       |             | KB-8     | -34.4 (-30.0)             | 281 (207)                     |
|                    |            |       |             | KB-9     | -34.4 (-30.0)             | 210 (155)                     |
|                    |            |       |             | KB-10    | -17.8 (0.00)              | 267 (197)                     |
|                    |            |       |             | KB-11    | -17.8 (0.00)              | 287 (212)                     |
|                    |            |       |             | KB-12    | -17.8 (0.00)              | 276 (204)                     |
|                    |            |       |             | KB-13    | 4.44 (40.0)               | 338 (250)                     |
|                    |            |       |             | KB-14    | 4.44 (40.0)               | 312 (230)                     |
|                    |            |       |             | KB-15    | 4.44 (40.0)               | 286 (211)                     |
|                    |            |       |             | KB-16    | 21.1 (70.0)               | 341 (251)                     |
|                    |            |       |             | KB-17    | 21.1 (70.0)               | 333 (246)                     |
|                    |            |       |             | KB-18    | 21.1 (70.0)               | 282 (208)                     |
|                    |            |       |             | KB-19    | -80.0 (-112)              | 169 (124)                     |
|                    |            |       |             | KB-20    | -80.0 (-112)              | 143 (105)                     |
|                    |            |       |             | KB-21    | -80.0 (-112)              | 129 (95.2)                    |
|                    |            |       |             | KB-22    | -51.1 (-60.0)             | 190 (140)                     |
|                    |            |       |             | KB-23    | -34.4 (-30.0)             | 202 (149)                     |
|                    |            |       |             | KB-24    | -17.8 (0.00)              | 275 (203)                     |
| 73B<br>ESW-NG      | Base Metal | 1/4T  | L-S         | KB-25    | -34.4 (-30.0)             | 184 (136)                     |
|                    |            |       |             | KB-26    | -34.4 (-30.0)             | 193 (143)                     |
|                    |            |       |             | KB-27    | -34.4 (-30.0)             | 224 (165)                     |
|                    | Base Metal | 1/2T  | L-T         | KB-28    | -34.4 (-30.0)             | 58.9 (43.5)                   |
|                    |            |       |             | KB-29    | -34.4 (-30.0)             | 136 (100)                     |
|                    |            |       |             | KB-30    | -34.4 (-30.0)             | 22.1 (16.3)                   |
|                    | Weld Metal | 1/4T  | L-T         | KE-1     | -28.9 (-20.0)             | 87.3 (64.4)                   |
|                    |            |       |             | KE-2     | -28.9 (-20.0)             | 101 (74.7)                    |
|                    |            |       |             | KE-3     | -28.9 (-20.0)             | 95.2 (70.3)                   |
|                    |            |       |             | KE-4     | -17.8 (0.00)              | 87.9 (64.8)                   |
|                    |            |       |             | KE-5     | -17.8 (0.00)              | 161 (118)                     |
|                    |            |       |             | KE-6     | -17.8 (0.00)              | 140 (103)                     |
|                    | FL         | 1/4T  | L-T         | KE-7     | -51.1 (-60.0)             | 8.16 (6.02)                   |
|                    |            |       |             | KE-8     | -51.1 (-60.0)             | 6.00 (4.43)                   |
|                    |            |       |             | KE-9     | -51.1 (-60.0)             | 10.5 (7.76)                   |
|                    |            |       |             | KE-10    | -34.4 (-30.0)             | 12.7 (9.38)                   |
|                    |            |       |             | KE-11    | -34.4 (-30.0)             | 12.3 (9.10)                   |
|                    |            |       |             | KE-12    | -34.4 (-30.0)             | 10.9 (8.04)                   |
|                    |            |       |             | KE-13    | -34.4 (-30.0)             | 14.8 (10.9)                   |
|                    |            |       |             | KE-14    | -17.8 (0.00)              | 18.2 (13.4)                   |
|                    |            |       |             | KE-15    | -17.8 (0.00)              | 8.82 (6.51)                   |
|                    |            |       |             | KE-16    | -17.8 (0.00)              | 9.01 (6.64)                   |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 73B<br>ESW-NG      | FL + 1                 | 1/4T  | L-T         | KE-17    | -51.1 (-60.0)             | 9.67 (7.13)                   |
|                    |                        |       |             | KE-18    | -51.1 (-60.0)             | 6.47 (4.77)                   |
|                    |                        |       |             | KE-19    | -51.1 (-60.0)             | 10.8 (7.97)                   |
|                    |                        |       |             | KE-20    | -34.4 (-30.0)             | 17.7 (13.1)                   |
|                    |                        |       |             | KE-21    | -34.4 (-30.0)             | 15.0 (11.1)                   |
|                    |                        |       |             | KE-22    | -34.4 (-30.0)             | 14.0 (10.3)                   |
|                    |                        |       |             | KE-23    | -34.4 (-30.0)             | 14.3 (10.5)                   |
|                    |                        |       |             | KE-24    | -17.8 (0.00)              | 9.96 (7.34)                   |
|                    |                        |       |             | KE-25    | -17.8 (0.00)              | 13.4 (9.88)                   |
|                    |                        |       |             | KE-26    | -17.8 (0.00)              | 25.5 (18.8)                   |
|                    | FL + 2                 | 1/4T  | L-T         | KE-27    | -51.1 (-60.0)             | 14.0 (10.3)                   |
|                    |                        |       |             | KE-28    | -51.1 (-60.0)             | 10.8 (7.97)                   |
|                    |                        |       |             | KE-29    | -51.1 (-60.0)             | 10.8 (7.97)                   |
|                    |                        |       |             | KE-30    | -34.4 (-30.0)             | 10.2 (7.55)                   |
|                    |                        |       |             | KE-31    | -34.4 (-30.0)             | 14.2 (10.4)                   |
|                    |                        |       |             | KE-32    | -34.4 (-30.0)             | 18.4 (13.6)                   |
|                    |                        |       |             | KE-33    | -34.4 (-30.0)             | 9.39 (6.92)                   |
|                    |                        |       |             | KE-34    | -17.8 (0.00)              | 33.0 (24.3)                   |
|                    |                        |       |             | KE-35    | -17.8 (0.00)              | 17.2 (12.7)                   |
|                    |                        |       |             | KE-36    | -17.8 (0.00)              | 35.7 (26.3)                   |
|                    | FL                     | 1/4T  | L-S         | KE-37    | -17.8 (0.00)              | 53.0 (39.1)                   |
|                    |                        |       |             | KE-38    | -17.8 (0.00)              | 12.4 (9.17)                   |
|                    |                        |       |             | KE-39    | -17.8 (0.00)              | 14.7 (10.9)                   |
|                    | FL                     | 1/2T  | L-T         | KE-40    | -17.8 (0.00)              | 19.6 (14.5)                   |
|                    |                        |       |             | KE-41    | -17.8 (0.00)              | 8.91 (6.58)                   |
|                    |                        |       |             | KE-42    | -17.8 (0.00)              | 14.8 (10.9)                   |
|                    |                        |       |             | KE-43    | -17.8 (0.00)              | 26.9 (19.9)                   |
|                    | FL                     | 1/2T  | L-S         | KE-44    | -17.8 (0.00)              | 15.3 (11.3)                   |
|                    |                        |       |             | KE-45    | -17.8 (0.00)              | 20.4 (15.0)                   |
|                    |                        |       |             | KE-46    | -17.8 (0.00)              | 31.8 (23.4)                   |
|                    |                        |       |             | KE-47    | -51.1 (-60.0)             | 199 (147)                     |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | KE-48    | -51.1 (-60.0)             | 160 (118)                     |
|                    |                        |       |             | KE-49    | -51.1 (-60.0)             | 148 (109)                     |
|                    |                        |       |             | KE-50    | -34.4 (-30.0)             | 178 (131)                     |
|                    |                        |       |             | KE-51    | -34.4 (-30.0)             | 171 (126)                     |
|                    |                        |       |             | KE-52    | -34.4 (-30.0)             | 191 (141)                     |
|                    |                        |       |             | KE-53    | -17.8 (0.00)              | 184 (136)                     |
|                    |                        |       |             | KE-54    | -17.8 (0.00)              | 201 (149)                     |
|                    |                        |       |             | KE-55    | -17.8 (0.00)              | 192 (142)                     |
|                    |                        |       |             | KE-56    | 4.44 (40.0)               | 257 (190)                     |
|                    |                        |       |             | KE-57    | 4.44 (40.0)               | 254 (188)                     |
|                    |                        |       |             | KE-58    | 4.44 (40.0)               | 280 (206)                     |
| 73B<br>S80-10      | Weld Metal             | 1/4T  | L-T         | KH-1     | -28.9 (-20.0)             | 187 (138)                     |
|                    |                        |       |             | KH-2     | -28.9 (-20.0)             | 162 (119)                     |
|                    |                        |       |             | KH-3     | -28.9 (-20.0)             | 162 (120)                     |
|                    |                        |       |             | KH-4     | -17.8 (0.00)              | 168 (124)                     |
|                    |                        |       |             | KH-5     | -17.8 (0.00)              | 197 (145)                     |
|                    |                        |       |             | KH-6     | -17.8 (0.00)              | 185 (136)                     |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 73B<br>S80-10      | FL                     | 1/4T  | L-T         | KH-7     | -51.1 (-60.0)             | 155 (114)                     |
|                    |                        |       |             | KH-8     | -51.1 (-60.0)             | 197 (146)                     |
|                    |                        |       |             | KH-9     | -51.1 (-60.0)             | 38.4 (28.4)                   |
|                    |                        |       |             | KH-10    | -34.4 (-30.0)             | 178 (131)                     |
|                    |                        |       |             | KH-11    | -34.4 (-30.0)             | 117 (86.6)                    |
|                    |                        |       |             | KH-12    | -34.4 (-30.0)             | 254 (188)                     |
|                    |                        |       |             | KH-13    | -34.4 (-30.0)             | 203 (150)                     |
|                    |                        |       |             | KH-14    | -17.8 (0.00)              | 188 (138)                     |
|                    |                        |       |             | KH-15    | -17.8 (0.00)              | 202 (149)                     |
|                    |                        |       |             | KH-16    | -17.8 (0.00)              | 172 (127)                     |
|                    |                        |       |             | KH-17    | -51.1 (-60.0)             | 190 (140)                     |
|                    |                        |       |             | KH-18    | -51.1 (-60.0)             | 144 (106)                     |
|                    |                        |       |             | KH-19    | -51.1 (-60.0)             | 165 (122)                     |
|                    |                        |       |             | KH-20    | -34.4 (-30.0)             | 368 (271)                     |
|                    |                        |       |             | KH-21    | -34.4 (-30.0)             | 312 (230)                     |
|                    |                        |       |             | KH-22    | -34.4 (-30.0)             | 208 (153)                     |
|                    | FL + 1                 | 1/4T  | L-T         | KH-23    | -34.4 (-30.0)             | 231 (170)                     |
|                    |                        |       |             | KH-24    | -17.8 (0.00)              | 446 (329)                     |
|                    |                        |       |             | KH-25    | -17.8 (0.00)              | 295 (218)                     |
|                    |                        |       |             | KH-26    | -17.8 (0.00)              | 461 (340)                     |
|                    |                        |       |             | KH-27    | -51.1 (-60.0)             | 206 (152)                     |
|                    |                        |       |             | KH-28    | -51.1 (-60.0)             | 177 (130)                     |
|                    |                        |       |             | KH-29    | -51.1 (-60.0)             | 115 (84.9)                    |
|                    |                        |       |             | KH-30    | -34.4 (-30.0)             | 221 (163)                     |
|                    |                        |       |             | KH-31    | -34.4 (-30.0)             | 215 (159)                     |
|                    |                        |       |             | KH-32    | -34.4 (-30.0)             | 212 (156)                     |
|                    |                        |       |             | KH-33    | -34.4 (-30.0)             | 218 (161)                     |
|                    |                        |       |             | KH-34    | -17.8 (0.00)              | 260 (192)                     |
|                    |                        |       |             | KH-35    | -17.8 (0.00)              | 202 (149)                     |
|                    |                        |       |             | KH-36    | -17.8 (0.00)              | 284 (209)                     |
|                    |                        |       |             | KH-37    | -34.4 (-30.0)             | 203 (150)                     |
|                    | FL                     | 1/4T  | L-S         | KH-38    | -34.4 (-30.0)             | 202 (149)                     |
|                    |                        |       |             | KH-39    | -34.4 (-30.0)             | 186 (137)                     |
|                    |                        |       |             | KH-40    | -34.4 (-30.0)             | 138 (102)                     |
|                    | FL                     | 1/2T  | L-T         | KH-41    | -34.4 (-30.0)             | 115 (85.1)                    |
|                    |                        |       |             | KH-42    | -34.4 (-30.0)             | 64.0 (47.2)                   |
|                    |                        |       |             | KH-43    | -34.4 (-30.0)             | 90.5 (66.8)                   |
|                    | FL                     | 1/2T  | L-S         | KH-44    | -34.4 (-30.0)             | 211 (155)                     |
|                    |                        |       |             | KH-45    | -34.4 (-30.0)             | 252 (186)                     |
|                    |                        |       |             | KH-46    | -34.4 (-30.0)             | 166 (123)                     |
|                    | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | KH-47    | -51.1 (-60.0)             | 179 (132)                     |
|                    |                        |       |             | KH-48    | -51.1 (-60.0)             | 172 (127)                     |
|                    |                        |       |             | KH-49    | -51.1 (-60.0)             | 178 (131)                     |
|                    |                        |       |             | KH-50    | -34.4 (-30.0)             | 197 (146)                     |
|                    |                        |       |             | KH-51    | -34.4 (-30.0)             | 184 (136)                     |
|                    |                        |       |             | KH-52    | -34.4 (-30.0)             | 238 (176)                     |
|                    |                        |       |             | KH-53    | -17.8 (0.00)              | 284 (209)                     |
|                    |                        |       |             | KH-54    | -17.8 (0.00)              | 295 (218)                     |
|                    |                        |       |             | KH-55    | -17.8 (0.00)              | 272 (201)                     |
|                    |                        |       |             | KH-56    | 4.44 (40.0)               | 294 (217)                     |
|                    |                        |       |             | KH-57    | 4.44 (40.0)               | 262 (193)                     |
|                    |                        |       |             | KH-58    | 4.44 (40.0)               | 266 (196)                     |

| Plate and Weldment | Location   | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------|-------|-------------|----------|---------------------------|-------------------------------|
| 73B<br>S40-30      | Weld Metal | 1/4T  | L-T         | KL-1     | -28.9 (-20.0)             | 134 (99.2)                    |
|                    |            |       |             | KL-2     | -28.9 (-20.0)             | 110 (81.0)                    |
|                    |            |       |             | KL-3     | -28.9 (-20.0)             | 141 (104)                     |
|                    |            |       |             | KL-4     | -17.8 (0.00)              | 176 (130)                     |
|                    |            |       |             | KL-5     | -17.8 (0.00)              | 159 (117)                     |
|                    |            |       |             | KL-6     | -17.8 (0.00)              | 131 (96.9)                    |
|                    | FL         | 1/4T  | L-T         | KL-7     | -51.1 (-60.0)             | 116 (85.2)                    |
|                    |            |       |             | KL-8     | -51.1 (-60.0)             | 104 (77.0)                    |
|                    |            |       |             | KL-9     | -51.1 (-60.0)             | 131 (96.6)                    |
|                    |            |       |             | KL-10    | -34.4 (-30.0)             | 59.8 (44.1)                   |
|                    |            |       |             | KL-11    | -34.4 (-30.0)             | 161 (118)                     |
|                    |            |       |             | KL-12    | -34.4 (-30.0)             | 201 (148)                     |
|                    |            |       |             | KL-13    | -34.4 (-30.0)             | 294 (217)                     |
|                    |            |       |             | KL-14    | -17.8 (0.00)              | 239 (176)                     |
|                    |            |       |             | KL-15    | -17.8 (0.00)              | 181 (134)                     |
|                    |            |       |             | KL-16    | -17.8 (0.00)              | 195 (144)                     |
|                    | FL + 1     | 1/4T  | L-T         | KL-17    | -51.1 (-60.0)             | 234 (173)                     |
|                    |            |       |             | KL-18    | -51.1 (-60.0)             | 262 (193)                     |
|                    |            |       |             | KL-19    | -51.1 (-60.0)             | 237 (175)                     |
|                    |            |       |             | KL-20    | -34.4 (-30.0)             | 319 (236)                     |
|                    |            |       |             | KL-21    | -34.4 (-30.0)             | 219 (162)                     |
|                    |            |       |             | KL-22    | -34.4 (-30.0)             | 403 (297)                     |
|                    |            |       |             | KL-23    | -34.4 (-30.0)             | 475 (351)                     |
|                    |            |       |             | KL-24    | -17.8 (0.00)              | 211 (156)                     |
|                    |            |       |             | KL-25    | -17.8 (0.00)              | 444 (328)                     |
|                    |            |       |             | KL-26    | -17.8 (0.00)              | 349 (258)                     |
|                    | FL + 2     | 1/4T  | L-T         | KL-27    | -51.1 (-60.0)             | 96.6 (71.3)                   |
|                    |            |       |             | KL-28    | -51.1 (-60.0)             | 91.6 (67.5)                   |
|                    |            |       |             | KL-29    | -51.1 (-60.0)             | 149 (110)                     |
|                    |            |       |             | KL-30    | -34.4 (-30.0)             | 166 (123)                     |
|                    |            |       |             | KL-31    | -34.4 (-30.0)             | 176 (130)                     |
|                    |            |       |             | KL-32    | -34.4 (-30.0)             | 149 (110)                     |
|                    |            |       |             | KL-33    | -34.4 (-30.0)             | 159 (118)                     |
|                    |            |       |             | KL-34    | -17.8 (0.00)              | 197 (145)                     |
|                    |            |       |             | KL-35    | -17.8 (0.00)              | 236 (174)                     |
|                    |            |       |             | KL-36    | -17.8 (0.00)              | 244 (180)                     |
|                    | FL         | 1/4T  | L-S         | KL-37    | -34.4 (-30.0)             | 286 (211)                     |
|                    |            |       |             | KL-38    | -34.4 (-30.0)             | 147 (109)                     |
|                    |            |       |             | KL-39    | -34.4 (-30.0)             | 80.2 (59.2)                   |
|                    | FL         | 1/2T  | L-T         | KL-40    | -34.4 (-30.0)             | 155 (114)                     |
|                    |            |       |             | KL-41    | -34.4 (-30.0)             | 70.9 (52.3)                   |
|                    |            |       |             | KL-42    | -34.4 (-30.0)             | 105 (77.1)                    |
|                    | FL         | 1/2T  | L-S         | KL-43    | -34.4 (-30.0)             | 341 (252)                     |
|                    |            |       |             | KL-44    | -34.4 (-30.0)             | 39.4 (29.0)                   |
|                    |            |       |             | KL-45    | -34.4 (-30.0)             | 191 (141)                     |
|                    |            |       |             | KL-46    | -34.4 (-30.0)             | 291 (214)                     |

| Plate and Weldment | Location               | Depth | Orientation | Specimen | Test Temperature, °C (°F) | CVN Impact Energy, J (ft-lbf) |
|--------------------|------------------------|-------|-------------|----------|---------------------------|-------------------------------|
| 73B<br>S40-30      | HAZ Adj.<br>Base Metal | 1/4T  | L-T         | KL-47    | -51.1 (-60.0)             | 140 (103)                     |
|                    |                        |       |             | KL-48    | -51.1 (-60.0)             | 171 (126)                     |
|                    |                        |       |             | KL-49    | -51.1 (-60.0)             | 159 (117)                     |
|                    |                        |       |             | KL-50    | -34.4 (-30.0)             | 188 (139)                     |
|                    |                        |       |             | KL-51    | -34.4 (-30.0)             | 174 (128)                     |
|                    |                        |       |             | KL-52    | -34.4 (-30.0)             | 172 (127)                     |
|                    |                        |       |             | KL-53    | -17.8 (0.00)              | 217 (160)                     |
|                    |                        |       |             | KL-54    | -17.8 (0.00)              | 195 (144)                     |
|                    |                        |       |             | KL-55    | -17.8 (0.00)              | 263 (194)                     |
|                    |                        |       |             | KL-56    | 4.44 (40.0)               | 290 (214)                     |
|                    |                        |       |             | KL-57    | 4.44 (40.0)               | 310 (229)                     |
|                    |                        |       |             | KL-58    | 4.44 (40.0)               | 289 (213)                     |

## APPENDIX B

Tabulated 1T K<sub>Jc</sub> Values

| Data Set                            | Specimen | Test Temperature,<br>°C (°F) | 1T K <sub>Jc</sub> ,<br>MPa√m (ksi√in) | Censoring | T <sub>075scrn</sub> ,<br>°C (°F) |
|-------------------------------------|----------|------------------------------|--|-----------|-----------------------------------|
| Pilot Study<br>BM - Static          | PS-96    | -36.0 (-32.8)                | 123 (112)                              | -         | -26.6 (-<br>15.8)                 |
|                                     | PS-97    | -44.4 (-47.9)                | 57.9 (52.7)                            | -         |                                   |
|                                     | PS-98    | -34.6 (-30.3)                | 91.0 (82.8)                            | -         |                                   |
|                                     | PS-99    | -31.6 (-24.9)                | 48.5 (44.1)                            | -         |                                   |
|                                     | PS-100   | -26.8 (-16.2)                | 84.8 (77.2)                            | -         |                                   |
|                                     | PS-101   | -24.3 (-11.7)                | 120 (109)                              | -         |                                   |
| Pilot Study<br>BM -<br>Intermediate | PS-103   | -40.0 (-40.0)                | 33.6 (30.6)                            | -         | -9.66<br>(14.6)                   |
|                                     | PS-104   | -24.0 (-11.2)                | 69.4 (63.1)                            | -         |                                   |
|                                     | PS-105   | -24.0 (-11.2)                | 99.5 (90.6)                            | -         |                                   |
|                                     | PS-1     | -15.0 (5.00)                 | 111 (101)                              | -         |                                   |
|                                     | PS-2     | -15.0 (5.00)                 | 107 (97.3)                             | -         |                                   |
| Pilot Study<br>FCAW FL              | PF-1     | -17.8 (0.00)                 | 219 (174)                              | -         | -                                 |
| 51A-BM                              | 51A-BM-1 | -37.9 (-36.2)                | 36.6 (33.3)                            | -         | -45.5 (-<br>50.0)                 |
|                                     | 51A-BM-2 | -25.0 (-13.0)                | 166 (151)                              | -         |                                   |
|                                     | 51A-BM-3 | -30.0 (-22.0)                | 37.1 (33.7)                            | -         |                                   |
|                                     | 51A-BM-4 | -25.0 (-13.0)                | 120 (109)                              | -         |                                   |
|                                     | 51A-BM-5 | -25.0 (-13.0)                | 95.8 (87.2)                            | -         |                                   |
|                                     | 51A-BM-6 | -25.0 (-13.0)                | 228 (207)                              | -         |                                   |
|                                     | 51A-BM-7 | -37.9 (-36.2)                | 277 (252)                              | Limit     |                                   |
|                                     | 51A-BM-8 | -37.9 (-36.2)                | 80.0 (72.8)                            | -         |                                   |
| 51A-E                               | 51A-E-1  | -17.8 (0.00)                 | 36.0 (32.7)                            | -         | 25.9<br>(78.5)                    |
|                                     | 51A-E-2  | -17.8 (0.00)                 | 41.3 (37.6)                            | -         |                                   |
|                                     | 51A-E-3  | 4.44 (40.0)                  | 101 (91.7)                             | -         |                                   |
|                                     | 51A-E-4  | 4.44 (40.0)                  | 58.8 (53.5)                            | -         |                                   |
|                                     | 51A-E-5  | 24.4 (75.9)                  | 101 (91.7)                             | -         |                                   |
|                                     | 51A-E-6  | 22.6 (72.7)                  | 116 (105)                              | -         |                                   |
|                                     | 51A-E-7  | 23.0 (73.4)                  | 119 (108)                              | -         |                                   |
|                                     | 51A-E-8  | 4.44 (40.0)                  | 83.5 (76.0)                            | -         |                                   |
|                                     | 51A-E-9  | 24.0 (75.2)                  | 91.3 (83.1)                            | -         |                                   |
|                                     | 51A-E-10 | -17.8 (0.00)                 | 58.1 (52.9)                            | -         |                                   |
|                                     | 51A-E-11 | 23.5 (74.3)                  | 70.1 (63.8)                            | -         |                                   |
|                                     | 51A-E-12 | 4.44 (40.0)                  | 94.9 (86.4)                            | -         |                                   |

| Data Set   | Specimen      | Test Temperature, °C (°F) | 1T K <sub>IC</sub> , MPa√m (ksi√in) | Censoring | T <sub>075scrn</sub> , °C (°F) |
|------------|---------------|---------------------------|-------------------------------------|-----------|--------------------------------|
| 51A-S80-10 | 51A-S80-10-1  | -51.1 (-60.0)             | 56.3 (51.3)                         | -         | -33.0 (-27.4)                  |
|            | 51A-S80-10-2  | -34.4 (-30.0)             | 79.4 (72.3)                         | -         |                                |
|            | 51A-S80-10-3  | -17.8 (0.00)              | 144 (131)                           | -         |                                |
|            | 51A-S80-10-4  | -17.8 (0.00)              | 130 (118)                           | -         |                                |
|            | 51A-S80-10-5  | -34.4 (-30.0)             | 67.7 (61.6)                         | -         |                                |
|            | 51A-S80-10-6  | -23.3 (-10.0)             | 74.0 (67.3)                         | -         |                                |
|            | 51A-S80-10-7  | -23.3 (-10.0)             | 123 (112)                           | -         |                                |
|            | 51A-S80-10-8  | -17.8 (0.00)              | 96.1 (87.5)                         | -         |                                |
|            | 51A-S80-10-9  | -23.3 (-10.0)             | 183 (167)                           | -         |                                |
|            | 51A-S80-10-10 | -34.4 (-30.0)             | 124 (112)                           | -         |                                |
|            | 51A-S80-10-11 | -51.1 (-60.0)             | 53.6 (48.7)                         | -         |                                |
|            | 51A-S80-10-12 | -51.1 (-60.0)             | 97.6 (88.8)                         | -         |                                |
| 51A-S40-30 | 51A-S40-30-1  | -51.1 (-60.0)             | 227 (207)                           | -         | -58.7 (-73.7)                  |
|            | 51A-S40-30-2  | -51.1 (-60.0)             | 163 (148)                           | -         |                                |
|            | 51A-S40-30-3  | -80.0 (-112)              | 69.8 (63.5)                         | -         |                                |
|            | 51A-S40-30-4  | -80.0 (-112)              | 22.1 (20.1)                         | -         |                                |
|            | 51A-S40-30-5  | -51.1 (-60.0)             | 238 (217)                           | -         |                                |
|            | 51A-S40-30-6  | -80.0 (-112)              | 29.6 (26.9)                         | -         |                                |
|            | 51A-S40-30-7  | -65.0 (-85.0)             | 73.0 (66.4)                         | -         |                                |
|            | 51A-S40-30-8  | -65.0 (-85.0)             | 48.4 (44.0)                         | -         |                                |
|            | 51A-S40-30-9  | -65.0 (-85.0)             | 96.9 (88.2)                         | -         |                                |
| 51B-BM     | 51A-S40-30-12 | -80.0 (-112)              | 82.1 (74.7)                         | -         | -38.3 (-36.9)                  |
|            | 51B-BM-1      | 0.00 (32.0)               | 216 (197)                           | -         |                                |
|            | 51B-BM-2      | -10.0 (14.0)              | 185 (168)                           | -         |                                |
|            | 51B-BM-3      | -20.0 (-4.00)             | 216 (197)                           | -         |                                |
|            | 51B-BM-4      | -40.0 (-40.0)             | 108 (98.4)                          | -         |                                |
|            | 51B-BM-5      | -40.0 (-40.0)             | 64.2 (58.4)                         | -         |                                |
|            | 51B-BM-6      | -40.0 (-40.0)             | 38.2 (34.7)                         | -         |                                |
|            | 51B-BM-7      | -40.0 (-40.0)             | 23.9 (21.7)                         | -         |                                |
| 51B-E      | 51B-BM-8      | -20.0 (-4.00)             | 63.4 (57.7)                         | -         | 15.1 (59.1)                    |
|            | 51B-E-1       | -17.8 (0.00)              | 40.7 (37.0)                         | -         |                                |
|            | 51B-E-2       | -17.8 (0.00)              | 91.4 (83.2)                         | -         |                                |
|            | 51B-E-3       | -17.8 (0.00)              | 57.6 (52.4)                         | -         |                                |
|            | 51B-E-4       | 4.44 (40.0)               | 144 (131)                           | -         |                                |
|            | 51B-E-5       | 4.44 (40.0)               | 86.9 (79.1)                         | -         |                                |
|            | 51B-E-6       | 4.44 (40.0)               | 57.1 (52.0)                         | -         |                                |
|            | 51B-E-7       | 4.44 (40.0)               | 135 (122)                           | -         |                                |
|            | 51B-E-8       | -12.2 (10.0)              | 58.0 (52.8)                         | -         |                                |
|            | 51B-E-9       | -12.2 (10.0)              | 60.3 (54.9)                         | -         |                                |
|            | 51B-E-10      | -12.2 (10.0)              | 42.4 (38.6)                         | -         |                                |
| 51B-S80-10 | 51B-E-11      | -17.8 (0.00)              | 67.8 (61.7)                         | -         | -23.6 (-10.5)                  |
|            | 51B-S80-10-1  | -51.1 (-60.0)             | 44.0 (40.1)                         | -         |                                |
|            | 51B-S80-10-2  | -34.4 (-30.0)             | 59.5 (54.2)                         | -         |                                |
|            | 51B-S80-10-3  | -12.2 (10.0)              | 118 (107)                           | -         |                                |
|            | 51B-S80-10-4  | -12.2 (10.0)              | 47.4 (43.2)                         | -         |                                |
|            | 51B-S80-10-5  | -17.8 (0.00)              | 88.7 (80.8)                         | -         |                                |
|            | 51B-S80-10-6  | 4.44 (40.0)               | 185 (168)                           | -         |                                |
|            | 51B-S80-10-7  | -12.2 (10.0)              | 106 (96.4)                          | -         |                                |
|            | 51B-S80-10-8  | -17.8 (0.00)              | 229 (208)                           | -         |                                |
|            | 51B-S80-10-9  | -34.4 (-30.0)             | 107 (97.4)                          | -         |                                |
|            | 51B-S80-10-10 | -17.8 (0.00)              | 94.3 (85.8)                         | -         |                                |
|            | 51B-S80-10-11 | -34.4 (-30.0)             | 81.6 (74.3)                         | -         |                                |
|            | 51B-S80-10-12 | -51.1 (-60.0)             | 92.4 (84.1)                         | -         |                                |

| Data Set   | Specimen      | Test Temperature, °C (°F) | 1T K <sub>IC</sub> , MPa√m (ksi√in) | Censoring    | T <sub>075scrn</sub> , °C (°F) |
|------------|---------------|---------------------------|-------------------------------------|--------------|--------------------------------|
| 51B-S40-30 | 51B-S40-30-1  | -51.1 (-60.0)             | 89.2 (81.2)                         | -            | -45.8 (-50.4)                  |
|            | 51B-S40-30-2  | -51.1 (-60.0)             | 73.3 (66.7)                         | -            |                                |
|            | 51B-S40-30-4  | -34.4 (-30.0)             | 102 (92.5)                          | -            |                                |
|            | 51B-S40-30-5  | -34.4 (-30.0)             | 252 (229)                           | -            |                                |
|            | 51B-S40-30-6  | -51.1 (-60.0)             | 52.7 (47.9)                         | -            |                                |
|            | 51B-S40-30-7  | -34.4 (-30.0)             | 156 (142)                           | -            |                                |
|            | 51B-S40-30-8  | -65.0 (-85.0)             | 55.3 (50.3)                         | -            |                                |
|            | 51B-S40-30-9  | -65.0 (-85.0)             | 27.0 (24.6)                         | -            |                                |
|            | 51B-S40-30-10 | -34.4 (-30.0)             | 131 (119)                           | -            |                                |
|            | 51B-S40-30-11 | -51.1 (-60.0)             | 117 (106)                           | -            |                                |
|            | 51B-S40-30-12 | -65.0 (-85.0)             | 87.9 (80.0)                         | -            |                                |
| 53A-BM     | 53A-BM-1      | -50.0 (-58.0)             | 149 (135)                           | -            | -93.8 (-137)                   |
|            | 53A-BM-2      | -50.0 (-58.0)             | 134 (122)                           | -            |                                |
|            | 53A-BM-3      | -60.0 (-76.0)             | 94.3 (85.8)                         | -            |                                |
|            | 53A-BM-4      | -60.0 (-76.0)             | 284 (258)                           | Limit        |                                |
|            | 53A-BM-5      | -60.0 (-76.0)             | 155 (141)                           | -            |                                |
|            | 53A-BM-6      | -70.0 (-94.0)             | 192 (175)                           | -            |                                |
|            | 53A-BM-7      | -80.0 (-112)              | 144 (131)                           | -            |                                |
|            | 53A-BM-8      | -80.0 (-112)              | 28.6 (26.0)                         | -            |                                |
| 53A-E      | 53A-E-1       | -34.4 (-30.0)             | 31.2 (28.4)                         | -            | 51.1 (124)                     |
|            | 53A-E-2       | -17.8 (0.00)              | 37.8 (34.4)                         | -            |                                |
|            | 53A-E-3       | 4.44 (40.0)               | 67.3 (61.2)                         | -            |                                |
|            | 53A-E-4       | 4.44 (40.0)               | 61.9 (56.3)                         | -            |                                |
|            | 53A-E-5       | 24.4 (75.9)               | 72.2 (65.7)                         | -            |                                |
|            | 53A-E-6       | 24.4 (75.9)               | 50.4 (45.9)                         | -            |                                |
|            | 53A-E-7       | 23.7 (74.7)               | 43.5 (39.6)                         | -            |                                |
|            | 53A-E-8       | 24.3 (75.7)               | 45.1 (41.0)                         | -            |                                |
|            | 53A-E-9       | 24.3 (75.7)               | 167 (152)                           | -            |                                |
|            | 53A-E-10      | 24.5 (76.1)               | 167 (152)                           | Crack Growth |                                |
|            | 53A-E-12      | 4.44 (40.0)               | 42.2 (38.4)                         | -            |                                |
| 53A-S80-10 | 53A-S80-10-1  | -51.1 (-60.0)             | 39.2 (35.7)                         | -            | 9.51 (49.1)                    |
|            | 53A-S80-10-2  | -34.4 (-30.0)             | 63.0 (57.4)                         | -            |                                |
|            | 53A-S80-10-3  | -23.3 (-10.0)             | 87.5 (79.7)                         | -            |                                |
|            | 53A-S80-10-4  | -12.2 (10.0)              | 32.3 (29.4)                         | -            |                                |
|            | 53A-S80-10-5  | 4.44 (40.0)               | 110 (99.7)                          | -            |                                |
|            | 53A-S80-10-6  | -12.2 (10.0)              | 74.4 (67.8)                         | -            |                                |
|            | 53A-S80-10-7  | 4.44 (40.0)               | 99.6 (90.6)                         | -            |                                |
|            | 53A-S80-10-8  | 4.44 (40.0)               | 108 (98.6)                          | -            |                                |
|            | 53A-S80-10-9  | -17.8 (0.00)              | 79.0 (71.9)                         | -            |                                |
|            | 53A-S80-10-10 | -34.4 (-30.0)             | 47.9 (43.6)                         | -            |                                |
|            | 53A-S80-10-11 | 4.44 (40.0)               | 84.1 (76.5)                         | -            |                                |
|            | 53A-S80-10-12 | -17.8 (0.00)              | 79.0 (71.9)                         | -            |                                |
| 53A-S40-30 | 53A-S40-30-2  | -34.4 (-30.0)             | 74.4 (67.7)                         | -            | -16.0 (3.21)                   |
|            | 53A-S40-30-4  | -23.3 (-10.0)             | 86.9 (79.1)                         | -            |                                |
|            | 53A-S40-30-6  | 4.44 (40.0)               | 99.8 (90.9)                         | -            |                                |
|            | 53A-S40-30-8  | 4.44 (40.0)               | 182 (166)                           | -            |                                |
|            | 53A-S40-30-10 | -17.8 (0.00)              | 119 (109)                           | -            |                                |
|            | 53A-S40-30-12 | -17.8 (0.00)              | 46.9 (42.7)                         | -            |                                |



| Data Set         | Specimen      | Test Temperature, °C (°F) | 1T K <sub>Jc</sub> , MPa√m (ksi√in) | Censoring    | T <sub>075sern</sub> , °C (°F) |
|------------------|---------------|---------------------------|-------------------------------------|--------------|--------------------------------|
| 53B-BM           | 53B-BM-1      | -40.0 (-40.0)             | 110 (99.6)                          | -            | -35.4 (-31.7)                  |
|                  | 53B-BM-2      | -40.0 (-40.0)             | 88.3 (80.3)                         | -            |                                |
|                  | 53B-BM-3      | -40.0 (-40.0)             | 88.7 (80.7)                         | -            |                                |
|                  | 53B-BM-4      | -40.0 (-40.0)             | 119 (108)                           | -            |                                |
|                  | 53B-BM-5      | -40.0 (-40.0)             | 118 (107)                           | -            |                                |
|                  | 53B-BM-6      | -40.0 (-40.0)             | 98.4 (89.6)                         | -            |                                |
|                  | 53B-BM-7      | -40.0 (-40.0)             | 38.2 (34.8)                         | -            |                                |
|                  | 53B-BM-8      | -40.0 (-40.0)             | 87.2 (79.4)                         | -            |                                |
| 53B-E            | 53B-E-1       | -17.8 (0.00)              | 47.0 (42.8)                         | -            | 16.0 (60.8)                    |
|                  | 53B-E-2       | -17.8 (0.00)              | 31.8 (29.0)                         | -            |                                |
|                  | 53B-E-3       | 4.44 (40.0)               | 42.4 (38.5)                         | -            |                                |
|                  | 53B-E-4       | 23.3 (73.9)               | 86.7 (78.9)                         | -            |                                |
|                  | 53B-E-9       | 24.2 (75.6)               | 122 (111)                           | -            |                                |
|                  | 53B-E-10      | 24.1 (75.4)               | 142 (129)                           | -            |                                |
|                  | 53B-E-11      | 24.2 (75.6)               | 134 (122)                           | -            |                                |
|                  | 53B-E-12      | 4.44 (40.0)               | 114 (104)                           | -            |                                |
| 53B-E 3mm Offset | 53B-E-5       | 24.4 (75.9)               | 230 (209)                           | -            | -42.8 (-45.0)                  |
|                  | 53B-E-6       | 24.4 (75.9)               | 247 (224)                           | -            |                                |
|                  | 53B-E-7       | 4.44 (40.0)               | 258 (235)                           | -            |                                |
|                  | 53B-E-8       | 4.44 (40.0)               | 235 (214)                           | -            |                                |
| 53B-S80-10       | 53B-S80-10-3  | -34.4 (-30.0)             | 105 (95.8)                          | -            | -27.2 (-17.0)                  |
|                  | 53B-S80-10-4  | -51.1 (-60.0)             | 76.4 (69.5)                         | -            |                                |
|                  | 53B-S80-10-5  | -51.1 (-60.0)             | 55.4 (50.4)                         | -            |                                |
|                  | 53B-S80-10-7  | -34.4 (-30.0)             | 98.3 (89.4)                         | -            |                                |
|                  | 53B-S80-10-8  | -34.4 (-30.0)             | 105 (95.8)                          | Crack Growth |                                |
|                  | 53B-S80-10-11 | -51.1 (-60.0)             | 65.5 (59.7)                         | -            |                                |
|                  | 53B-S80-10-12 | -51.1 (-60.0)             | 77.0 (70.1)                         | -            |                                |
| 53B-S40-30       | 53B-S40-30-5  | -34.4 (-30.0)             | 103 (93.9)                          | -            | -60.7 (-77.3)                  |
|                  | 53B-S40-30-7  | -34.4 (-30.0)             | 135 (123)                           | -            |                                |
|                  | 53B-S40-30-8  | -51.1 (-60.0)             | 181 (165)                           | -            |                                |
|                  | 53B-S40-30-9  | -65.0 (-85.0)             | 56.1 (51.0)                         | -            |                                |
|                  | 53B-S40-30-10 | -65.0 (-85.0)             | 114 (104)                           | -            |                                |
|                  | 53B-S40-30-11 | -51.1 (-60.0)             | 85.5 (77.8)                         | -            |                                |
|                  | 53B-S40-30-12 | -51.1 (-60.0)             | 135 (123)                           | -            |                                |
| 71A-BM           | 71A-BM-1      | -70.0 (-94.0)             | 103 (93.8)                          | -            | -87.1 (-125)                   |
|                  | 71A-BM-2      | -70.0 (-94.0)             | 149 (136)                           | -            |                                |
|                  | 71A-BM-3      | -80.0 (-112)              | 333 (303)                           | -            |                                |
|                  | 71A-BM-4      | -100.0 (-148)             | 29.8 (27.1)                         | -            |                                |
|                  | 71A-BM-5      | -80.0 (-112)              | 16.1 (14.6)                         | -            |                                |
|                  | 71A-BM-6      | -70.0 (-94.0)             | 44.9 (40.8)                         | -            |                                |
|                  | 71A-BM-7      | -60.0 (-76.0)             | 151 (137)                           | -            |                                |
|                  | 71A-BM-8      | -60.0 (-76.0)             | 319 (290)                           | -            |                                |
| 71A-E            | 71A-E-1       | -34.4 (-30.0)             | 141 (128)                           | Crack Growth | 15.3 (59.5)                    |
|                  | 71A-E-2       | -51.1 (-60.0)             | 23.1 (21.0)                         | -            |                                |
|                  | 71A-E-3       | -34.4 (-30.0)             | 48.4 (44.1)                         | -            |                                |
|                  | 71A-E-4       | -34.4 (-30.0)             | 31.5 (28.7)                         | -            |                                |
|                  | 71A-E-5       | 24.4 (75.9)               | 126 (115)                           | -            |                                |
|                  | 71A-E-6       | 24.4 (75.9)               | 128 (117)                           | -            |                                |
|                  | 71A-E-7       | -17.8 (0.00)              | 76.6 (69.7)                         | -            |                                |
|                  | 71A-E-8       | -17.8 (0.00)              | 43.4 (39.5)                         | -            |                                |
|                  | 71A-E-9       | -17.8 (0.00)              | 66.6 (60.6)                         | -            |                                |
|                  | 71A-E-10      | 4.44 (40.0)               | 97.4 (88.7)                         | -            |                                |
|                  | 71A-E-11      | 4.44 (40.0)               | 142 (129)                           | -            |                                |
|                  | 71A-E-12      | -17.8 (0.00)              | 42.4 (38.6)                         | -            |                                |

| Data Set   | Specimen      | Test Temperature, °C (°F) | 1T K <sub>IC</sub> , MPa√m (ksi√in) | Censoring | T <sub>075scrn</sub> , °C (°F) |
|------------|---------------|---------------------------|-------------------------------------|-----------|--------------------------------|
| 71A-S80-10 | 71A-S80-10-3  | -51.1 (-60.0)             | 110 (100)                           | -         | -44.0 (-47.2)                  |
|            | 71A-S80-10-4  | -51.1 (-60.0)             | 119 (108)                           | -         |                                |
|            | 71A-S80-10-5  | -51.1 (-60.0)             | 92.5 (84.2)                         | -         |                                |
|            | 71A-S80-10-9  | -65.0 (-85.0)             | 24.9 (22.6)                         | -         |                                |
|            | 71A-S80-10-10 | -34.4 (-30.0)             | 55.5 (50.5)                         | -         |                                |
| 71A-S40-30 | 71A-S40-30-5  | -51.1 (-60.0)             | 170 (155)                           | -         | -77.6 (-108)                   |
|            | 71A-S40-30-6  | -80.0 (-112)              | 83.9 (76.3)                         | -         |                                |
|            | 71A-S40-30-7  | -80.0 (-112)              | 44.4 (40.4)                         | -         |                                |
|            | 71A-S40-30-8  | -51.1 (-60.0)             | 145 (132)                           | -         |                                |
|            | 71A-S40-30-9  | -51.1 (-60.0)             | 221 (201)                           | -         |                                |
| 71B-BM     | 71B-BM-1      | -60.0 (-76.0)             | 144 (131)                           | -         | -48.7 (-55.7)                  |
|            | 71B-BM-2      | -80.0 (-112)              | 45.6 (41.5)                         | -         |                                |
|            | 71B-BM-3      | -70.0 (-94.0)             | 68.2 (62.1)                         | -         |                                |
|            | 71B-BM-4      | -65.0 (-85.0)             | 86.6 (78.8)                         | -         |                                |
|            | 71B-BM-5      | -65.0 (-85.0)             | 81.7 (74.4)                         | -         |                                |
|            | 71B-BM-6      | -60.0 (-76.0)             | 71.6 (65.1)                         | -         |                                |
|            | 71B-BM-7      | -60.0 (-76.0)             | 125 (113)                           | -         |                                |
|            | 71B-BM-8      | -60.0 (-76.0)             | 88.4 (80.5)                         | -         |                                |
| 71B-E      | 71B-E-1       | -17.8 (0.00)              | 34.5 (31.4)                         | -         | 35.0 (94.9)                    |
|            | 71B-E-2       | -17.8 (0.00)              | 96.4 (87.7)                         | -         |                                |
|            | 71B-E-3       | -17.8 (0.00)              | 37.8 (34.4)                         | -         |                                |
|            | 71B-E-4       | 4.44 (40.0)               | 126 (114)                           | -         |                                |
|            | 71B-E-5       | 24.4 (75.9)               | 146 (133)                           | -         |                                |
|            | 71B-E-6       | 4.44 (40.0)               | 128 (116)                           | -         |                                |
|            | 71B-E-7       | 24.4 (75.9)               | 81.9 (74.6)                         | -         |                                |
|            | 71B-E-8       | 23.9 (75.0)               | 60.3 (54.9)                         | -         |                                |
|            | 71B-E-9       | 4.44 (40.0)               | 24.9 (22.7)                         | -         |                                |
|            | 71B-E-10      | 4.44 (40.0)               | 38.0 (34.6)                         | -         |                                |
|            | 71B-E-11      | 4.44 (40.0)               | 38.8 (35.3)                         | -         |                                |
|            | 71B-E-12      | 4.44 (40.0)               | 75.7 (68.9)                         | -         |                                |
| 71B-S80-10 | 71B-S80-10-1  | -51.1 (-60.0)             | 42.2 (38.4)                         | -         | -23.8 (-10.8)                  |
|            | 71B-S80-10-2  | -34.4 (-30.0)             | 33.4 (30.4)                         | -         |                                |
|            | 71B-S80-10-3  | -17.8 (0.00)              | 154 (140)                           | -         |                                |
|            | 71B-S80-10-5  | -17.8 (0.00)              | 131 (119)                           | -         |                                |
|            | 71B-S80-10-6  | -34.4 (-30.0)             | 49.7 (45.2)                         | -         |                                |
|            | 71B-S80-10-7  | -17.8 (0.00)              | 167 (152)                           | -         |                                |
|            | 71B-S80-10-8  | -34.4 (-30.0)             | 97.0 (88.2)                         | -         |                                |
|            | 71B-S80-10-9  | -17.8 (0.00)              | 50.6 (46.0)                         | -         |                                |
|            | 71B-S80-10-10 | -34.4 (-30.0)             | 100.4 (91.3)                        | -         |                                |
|            | 71B-S80-10-11 | -51.1 (-60.0)             | 49.7 (45.3)                         | -         |                                |
| 71B-S40-30 | 71B-S40-30-1  | -51.1 (-60.0)             | 43.1 (39.2)                         | -         | -61.7 (-79.1)                  |
|            | 71B-S40-30-2  | -34.4 (-30.0)             | 171 (155)                           | -         |                                |
|            | 71B-S40-30-4  | -34.4 (-30.0)             | 113 (103)                           | -         |                                |
|            | 71B-S40-30-5  | -51.1 (-60.0)             | 155 (141)                           | -         |                                |
|            | 71B-S40-30-6  | -51.1 (-60.0)             | 167 (152)                           | -         |                                |
|            | 71B-S40-30-8  | -65.0 (-85.0)             | 78.3 (71.2)                         | -         |                                |
|            | 71B-S40-30-9  | -65.0 (-85.0)             | 68.5 (62.4)                         | -         |                                |
|            | 71B-S40-30-10 | -65.0 (-85.0)             | 88.8 (80.8)                         | -         |                                |
|            | 71B-S40-30-11 | -51.1 (-60.0)             | 99.7 (90.7)                         | -         |                                |
|            | 71B-S40-30-12 | -51.1 (-60.0)             | 137 (125)                           | -         |                                |

| Data Set   | Specimen      | Test Temperature, °C (°F) | 1T K <sub>IC</sub> , MPa√m (ksi√in) | Censoring | T <sub>075scrn</sub> , °C (°F) |
|------------|---------------|---------------------------|-------------------------------------|-----------|--------------------------------|
| 73A-BM     | 73A-BM-1      | -70.0 (-94.0)             | 96.1 (87.4)                         | -         | -93.8 (-137)                   |
|            | 73A-BM-2      | -70.0 (-94.0)             | 140 (127)                           | -         |                                |
|            | 73A-BM-3      | -80.0 (-112)              | 142 (129)                           | -         |                                |
|            | 73A-BM-4      | -80.0 (-112)              | 65.4 (59.6)                         | -         |                                |
|            | 73A-BM-5      | -80.0 (-112)              | 111 (101)                           | -         |                                |
|            | 73A-BM-6      | -80.0 (-112)              | 265 (241)                           | -         |                                |
|            | 73A-BM-7      | -80.0 (-112)              | 63.9 (58.1)                         | -         |                                |
|            | 73A-BM-8      | -80.0 (-112)              | 201 (183)                           | -         |                                |
| 73A-E      | 73A-E-1       | -17.8 (0.00)              | 39.4 (35.9)                         | -         | 41.5 (107)                     |
|            | 73A-E-2       | -17.8 (0.00)              | 34.9 (31.7)                         | -         |                                |
|            | 73A-E-3       | 4.44 (40.0)               | 64.1 (58.3)                         | -         |                                |
|            | 73A-E-4       | 24.4 (75.9)               | 109.1 (99.2)                        | -         |                                |
|            | 73A-E-5       | 24.4 (75.9)               | 91.3 (83.1)                         | -         |                                |
|            | 73A-E-6       | 24.4 (75.9)               | 123 (112)                           | -         |                                |
|            | 73A-E-7       | 4.44 (40.0)               | 75.7 (68.9)                         | -         |                                |
|            | 73A-E-8       | 24.4 (75.9)               | 62.3 (56.7)                         | -         |                                |
|            | 73A-E-9       | 24.4 (75.9)               | 45.0 (41.0)                         | -         |                                |
|            | 73A-E-10      | 4.44 (40.0)               | 29.7 (27.0)                         | -         |                                |
|            | 73A-E-11      | 24.4 (75.9)               | 66.0 (60.0)                         | -         |                                |
|            | 73A-E-12      | 24.4 (75.9)               | 72.4 (65.9)                         | -         |                                |
| 73A-S80-10 | 73A-S80-10-1  | -51.1 (-60.0)             | 132 (120)                           | -         | -49.0 (-56.2)                  |
|            | 73A-S80-10-4  | -51.1 (-60.0)             | 59.6 (54.2)                         | -         |                                |
|            | 73A-S80-10-5  | -80.0 (-112)              | 50.6 (46.1)                         | -         |                                |
|            | 73A-S80-10-8  | -51.1 (-60.0)             | 78.9 (71.8)                         | -         |                                |
|            | 73A-S80-10-11 | -51.1 (-60.0)             | 115 (105)                           | -         |                                |
| 73A-S40-30 | 73A-S40-30-1  | -51.1 (-60.0)             | 202 (184)                           | -         | -87.8 (-126)                   |
|            | 73A-S40-30-5  | -80.0 (-112)              | 74.7 (67.9)                         | -         |                                |
|            | 73A-S40-30-6  | -51.1 (-60.0)             | 139 (126)                           | -         |                                |
|            | 73A-S40-30-7  | -80.0 (-112)              | 236 (215)                           | -         |                                |
|            | 73A-S40-30-9  | -65.0 (-85.0)             | 149 (136)                           | -         |                                |
|            | 73A-S40-30-11 | -51.1 (-60.0)             | 85.3 (77.6)                         | -         |                                |
| 73B-BM     | 73B-BM-1      | -70.0 (-94.0)             | 304 (277)                           | -         | -121 (-187)                    |
|            | 73B-BM-2      | -90.0 (-130)              | 181 (165)                           | -         |                                |
|            | 73B-BM-3      | -100.0 (-148)             | 198 (180)                           | -         |                                |
|            | 73B-BM-4      | -110.0 (-166)             | 23.6 (21.5)                         | -         |                                |
|            | 73B-BM-5      | -110.0 (-166)             | 152 (139)                           | -         |                                |
|            | 73B-BM-6      | -110.0 (-166)             | 117 (107)                           | -         |                                |
|            | 73B-BM-7      | -110.0 (-166)             | 81.3 (74.0)                         | -         |                                |
|            | 73B-BM-8      | -110.0 (-166)             | 24.0 (21.8)                         | -         |                                |
| 73B-E      | 73B-E-1       | -17.8 (0.00)              | 66.5 (60.5)                         | -         | -7.54 (18.4)                   |
|            | 73B-E-2       | -17.8 (0.00)              | 48.0 (43.7)                         | -         |                                |
|            | 73B-E-3       | 4.44 (40.0)               | 78.5 (71.4)                         | -         |                                |
|            | 73B-E-4       | 4.44 (40.0)               | 177 (161)                           | -         |                                |
|            | 73B-E-5       | 23.3 (73.9)               | 161 (146)                           | -         |                                |
|            | 73B-E-6       | 4.44 (40.0)               | 117 (106)                           | -         |                                |
|            | 73B-E-7       | 24.4 (75.9)               | 202 (184)                           | -         |                                |
|            | 73B-E-8       | -12.2 (10.0)              | 72.9 (66.3)                         | -         |                                |
|            | 73B-E-9       | -12.2 (10.0)              | 119 (108)                           | -         |                                |
|            | 73B-E-10      | 24.4 (75.9)               | 134 (122)                           | -         |                                |
|            | 73B-E-11      | -17.8 (0.00)              | 46.2 (42.0)                         | -         |                                |
|            | 73B-E-12      | -12.2 (10.0)              | 177 (161)                           | -         |                                |

| Data Set   | Specimen     | Test Temperature, °C (°F) | 1T K <sub>Jc</sub> , MPa√m (ksi√in) | Censoring | T <sub>075scrn</sub> , °C (°F) |
|------------|--------------|---------------------------|-------------------------------------|-----------|--------------------------------|
| 73B-S80-10 | 73B-S80-10-1 | -51.1 (-60.0)             | 120 (110)                           | -         | -55.0 (-67.0)                  |
|            | 73B-S80-10-2 | -51.1 (-60.0)             | 174 (158)                           | -         |                                |
|            | 73B-S80-10-4 | -80.0 (-112)              | 40.4 (36.8)                         | -         |                                |
|            | 73B-S80-10-5 | -51.1 (-60.0)             | 84.1 (76.5)                         | -         |                                |
|            | 73B-S80-10-6 | -51.1 (-60.0)             | 113 (103)                           | -         |                                |
| 73B-S40-30 | 73B-S40-30-1 | -51.1 (-60.0)             | 209 (190)                           | -         | -75.5 (-104)                   |
|            | 73B-S40-30-2 | -51.1 (-60.0)             | 220 (200)                           | -         |                                |
|            | 73B-S40-30-4 | -80.0 (-112)              | 41.9 (38.1)                         | -         |                                |
|            | 73B-S40-30-5 | -51.1 (-60.0)             | 96.7 (88.0)                         | -         |                                |
|            | 73B-S40-30-6 | -80.0 (-112)              | 99.7 (90.7)                         | -         |                                |
|            | 73B-S40-30-8 | -80.0 (-112)              | 25.2 (23.0)                         | -         |                                |

## APPENDIX C

# Weld Procedure Specifications



| Weld Procedure Specification  |           | A709 50W 1" - Pilot Study - SAW   |                 |      |                 |            |          |
|---|-----------|---|-----------------|------|-----------------|------------|----------|
| Material Specification:   |           | ASTM A709 Gr. 50W / AASHTO M270 Gr. 50W   |                 |      |                 |            |          |
| Welding Process:  |           | SAW   |                 |      |                 |            |          |
| Manual or Machine:  |           | Auto-Machine  |                 |      |                 |            |          |
| Weld Position:  |           | Flat  |                 |      |                 |            |          |
| Filler Metal Specification:   |           | AWS A5.17   |                 |      |                 |            |          |
| Filler Metal Classification:  |           | EM12K-H8  |                 |      |                 |            |          |
| Filler Metal Manufacturer:  |           | Lincoln   |                 |      |                 |            |          |
| Trade Name:   |           | "Lincoln L-61"  |                 |      |                 |            |          |
| Flux:   |           | F7A2 "Lincoln 860" (Neutral Flux)   |                 |      |                 |            |          |
| Root Treatment:   |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |                 |            |          |
| Preheat and Interpass Temperature:  |           | Max: 450°F (230°C)<br>Min: 70°F (20°C)  |                 |      |                 |            |          |
| Postheat Treatment:   |           | None  |                 |      |                 |            |          |
| Joint Geometry  |           |   |                 |      |                 |            |          |
| Double bevel groove weld  |           |   |                 |      |                 |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 1''$<br>$f = 1/8''$ |           |   |                 |      |                 |            |          |
| (Reference: AWS D1.5 Figure 2.4)  |           |   |                 |      |                 |            |          |
| Pass No.  | Weld Type | Electrode Size<br>(number)  | Welding Current |      | Travel<br>Speed | Heat Input | Polarity |
|   |           |   | Volts           | Amps |                 |            |          |
| ALL   | GROOVE    | 3/32" (single)  | 30              | 250  | 13 IPM          | 32 kJ/in.  | DCEP     |
| Comments:   |           |   |                 |      |                 |            |          |
| Approved By:  |           | Signed:   |                 |      | Date:           |            |          |



| Weld Procedure Specification  |           | A709 50W 1" - Pilot Study - FCAW  |                 |      |                 |            |          |
|---|-----------|---|-----------------|------|-----------------|------------|----------|
| Material Specification:   |           | ASTM A709 Gr. 50W / AASHTO M270 Gr. 50W   |                 |      |                 |            |          |
| Welding Process:  |           | FCAW  |                 |      |                 |            |          |
| Manual or Machine:  |           | Auto-Machine  |                 |      |                 |            |          |
| Weld Position:  |           | Flat  |                 |      |                 |            |          |
| Filler Metal Specification:   |           | AWS A5.20   |                 |      |                 |            |          |
| Filler Metal Classification:  |           | E70T-1  |                 |      |                 |            |          |
| Filler Metal Manufacturer:  |           | Lincoln   |                 |      |                 |            |          |
| Trade Name:   |           | "Lincoln Outershield 70"  |                 |      |                 |            |          |
| Shielding Gas:  |           | CO <sub>2</sub> (40 CFH)  |                 |      |                 |            |          |
| Root Treatment:   |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |                 |            |          |
| Preheat and Interpass Temperature:  |           | Max: 450°F (230°C)<br>Min: 70°F (20°C)  |                 |      |                 |            |          |
| Postheat Treatment:   |           | None  |                 |      |                 |            |          |
| Joint Geometry  |           |   |                 |      |                 |            |          |
| Double bevel groove weld  |           |   |                 |      |                 |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 1''$<br>$f = 1/8''$ |           |   |                 |      |                 |            |          |
| (Reference: AWS D1.5 Figure 2.4)  |           |   |                 |      |                 |            |          |
| Pass No.  | Weld Type | Electrode Size<br>(number)  | Welding Current |      | Travel<br>Speed | Heat Input | Polarity |
|   |           |   | Volts           | Amps |                 |            |          |
| ALL   | GROOVE    | 5/64" (single)  | 30              | 315  | 14 IPM          | 32 kJ/in.  | DCEP     |
| Comments:   |           |   |                 |      |                 |            |          |
| Approved By:  |           | Signed:   |                 |      | Date:           |            |          |



| Weld Procedure Specification  |           | A709 50W 1" - Pilot Study - GMAW  |                 |      |                 |            |          |
|---|-----------|---|-----------------|------|-----------------|------------|----------|
| Material Specification:   |           | ASTM A709 Gr. 50W / AASHTO M270 Gr. 50W   |                 |      |                 |            |          |
| Welding Process:  |           | GMAW  |                 |      |                 |            |          |
| Manual or Machine:  |           | Auto-Machine  |                 |      |                 |            |          |
| Weld Position:  |           | Flat  |                 |      |                 |            |          |
| Filler Metal Specification:   |           | AWS A5.18   |                 |      |                 |            |          |
| Filler Metal Classification:  |           | ER70S-6   |                 |      |                 |            |          |
| Filler Metal Manufacturer:  |           | Lincoln   |                 |      |                 |            |          |
| Trade Name:   |           | "Lincoln Superarc L-56"   |                 |      |                 |            |          |
| Shielding Gas:  |           | Argon (90%) CO <sub>2</sub> (10%) (40 CFH)  |                 |      |                 |            |          |
| Root Treatment:   |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |                 |            |          |
| Preheat and Interpass Temperature:  |           | Max: 450°F (230°C)<br>Min: 70°F (20°C)  |                 |      |                 |            |          |
| Postheat Treatment:   |           | None  |                 |      |                 |            |          |
| Joint Geometry  |           |   |                 |      |                 |            |          |
| Double bevel groove weld  |           |   |                 |      |                 |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 1''$<br>$f = 1/8''$ |           |   |                 |      |                 |            |          |
| (Reference: AWS D1.5 Figure 2.4)  |           |   |                 |      |                 |            |          |
| Pass No.  | Weld Type | Electrode Size<br>(number)  | Welding Current |      | Travel<br>Speed | Heat Input | Polarity |
|   |           |   | Volts           | Amps |                 |            |          |
| ALL   | GROOVE    | 0.045" (single)   | 27              | 300  | 12 IPM          | 32 kJ/in.  | DCEP     |
| Comments:   |           |   |                 |      |                 |            |          |
| Approved By:  |           | Signed:   |                 |      | Date:           |            |          |





| Weld Procedure Specification  |           | A709 50W 1" - Pilot Study - SMAW  |                 |      |                 |            |          |
|---|-----------|---|-----------------|------|-----------------|------------|----------|
| Material Specification:   |           | ASTM A709 Gr. 50W / AASHTO M270 Gr. 50W   |                 |      |                 |            |          |
| Welding Process:  |           | SMAW  |                 |      |                 |            |          |
| Manual or Machine:  |           | Manual  |                 |      |                 |            |          |
| Weld Position:  |           | Flat  |                 |      |                 |            |          |
| Filler Metal Specification:   |           | AWS A5.1  |                 |      |                 |            |          |
| Filler Metal Classification:  |           | ER7018 - H4R  |                 |      |                 |            |          |
| Filler Metal Manufacturer:  |           | Lincoln   |                 |      |                 |            |          |
| Trade Name:   |           | "Lincoln LH 70"   |                 |      |                 |            |          |
| Shielding Gas:  |           | N/A   |                 |      |                 |            |          |
| Root Treatment:   |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |                 |            |          |
| Preheat and Interpass Temperature:  |           | Max: 450°F (230°C)<br>Min: 70°F (20°C)  |                 |      |                 |            |          |
| Postheat Treatment:   |           | None  |                 |      |                 |            |          |
| Joint Geometry  |           |   |                 |      |                 |            |          |
| Double bevel groove weld  |           |   |                 |      |                 |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 1''$<br>$f = 1/8''$ |           |   |                 |      |                 |            |          |
| (Reference: AWS D1.5 Figure 2.4)  |           |   |                 |      |                 |            |          |
| Pass No.  | Weld Type | Electrode Size<br>(number)  | Welding Current |      | Travel<br>Speed | Heat Input | Polarity |
|   |           |   | Volts           | Amps |                 |            |          |
| ALL   | GROOVE    | 3/16" (single)  | 26              | 230  | 9 IPM           | 32 kJ/in.  | DCEP     |
| Comments:   |           |   |                 |      |                 |            |          |
| Approved By:  |           | Signed:   |                 |      | Date:           |            |          |



|   |  |  |   |
|---|--|--|---|
| <b>Weld Procedure Specification</b>   |  | <b>A709 50W 1.00" - 51A-E - ESW-NG</b>   |   |
| <b>Joint Design Used: Square butt - narrow gap</b>  |  |  |   |
| <b>Joint Preparation:</b>   |  | <b>Position:</b>   |   |
| Plate surfaces inside weld joint as well as 1" (25 mm) on either side of joint to be free of mill scale, rust, or other contaminants. |  | Vertical - up  |   |
| <b>Base Metals:</b>   |  | <b>Electrical Characteristics:</b>   |   |
| Material Spec.: <u>ASTM A709 (AASHTO M270)</u>  |  | Current: <u>DC</u>   |   |
| Type or Grade: <u>50W (345W)</u>  |  | Polarity: <u>Reverse (EP)</u> Wire Feed Speed: <u>134 ipm</u>                              |   |
| Thickness: <u>1" (25mm)</u>   |  | (REF. T4.7) <u>target 34</u>   |   |
|   |  | Voltage: <u>(range 33-37)</u>  |   |
| <b>Filler Metals:</b>   |  | <b>Technique:</b>  |   |
| AWS Spec./ Class.: <u>A5.25 / EW - TG</u>   |  | Dist. Edge shoe to Elect. Guide: <u>5/16"</u>  |   |
| Electrode Manuf.: <u>Arcmatic Integrated Systems</u>  |  | Dist. Shoe to center of guide: <u>5/8"</u>   |   |
| Trade Name: <u>VertaSlag VMC-105</u>  |  | Elect. Separation (mult. Elect.): <u>N/A</u>   |   |
| Electrode Diameter: <u>3/32" (2.4mm)</u>  |  | Starting sump value: <u>17 grams</u>   |   |
| Number of Electrodes: <u>1</u>  |  | Initial Flux Feed: <u>40 grams</u>   |   |
| Flux: <u>VertaSlag VF-106</u>   |  | In-Weld flux feed rate: <u>15 grams/min.</u>   |   |
| Flux Manufacturer: <u>Arcmatic Integrated Systems</u>   |  | Target travel speed: <u>2 1/2 ipm</u>  |   |
|   |  | Travel speed range: <u>2 1/4 thru 3 1/8 ipm</u>  |   |
|   |  | Root Opening: <u>3/4" (+/- 1/8")</u>   |   |
|   |  | Oscillation: <u>None</u>   |   |
| <b>Consumable Guides:</b>   |  | <b>Retaining Shoes:</b>  |   |
| Material Composition: <u>Conforms to Annex I</u>  |  | Material Spec.: <u>Copper</u>  |   |
| Guide hole diamtere: <u>1/8"</u>  |  | Water Flow (gal./min.): <u>4 gal./min.</u>   |   |
| Guide tube width: <u>5/8"</u>   |  | Single sided shoe only plumbed in series. Water transfer to opposite weld side prohibited. |   |
| <b>Cooling Shoes Configuration</b>  | <b>Sealing Material</b>                          |  | <b>Weld Joint Detail</b>                                |
| <p>0.192<br/>0.06<br/>90°</p> <p>Serration pitch depth = 0.06"</p> <p>Serration vee angle = 90°</p>                                   | Trade Name: <u>Stop Leak RSL-101</u>             |  | <p>3/4" (+/- 1/8")</p> <p>* 3" MIN. NOT LESS THAN T</p> |
|   | Manufacturer: <u>Arcmatic Integrated Systems</u> |  |   |
|   | <b>Accessories</b>                               |  |   |
|   | Trade Name: <u>Alumna Tape (1/16" or 1/8")</u>   |  |   |
|   | Manufacturer: <u>Arcmatic Integrated Systems</u> |  |   |
|   | Trade Name: <u>Insulator Buttons</u>             |  |   |
|   | Manufacturer: <u>Arcmatic Integrated Systems</u> |  |   |
| Comments:   |  |  |   |
| Approved By:  | Signed:  |  | Date:   |



| Weld Procedure Specification   |           | A709 50W 1" - 51A-S10 - SAW High Heat   |                 |      |                 |            |          |
|--|-----------|---|-----------------|------|-----------------|------------|----------|
| Material Specification:  |           | ASTM A709 Gr. 50W / AASHTO M270 Gr. 50W   |                 |      |                 |            |          |
| Welding Process:   |           | SAW   |                 |      |                 |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |                 |            |          |
| Weld Position:   |           | Flat  |                 |      |                 |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |                 |            |          |
| Filler Metal Classification:   |           | EM12K-H8  |                 |      |                 |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |                 |            |          |
| Trade Name:  |           | "Lincoln L-61"  |                 |      |                 |            |          |
| Flux:  |           | F7A2 "Lincoln 960" (Neutral Flux)   |                 |      |                 |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |                 |            |          |
| Preheat and Interpass Temperature:   |           | Max: 350°F (175°C)<br>Min: 275°F (135°C)  |                 |      |                 |            |          |
| Postheat Treatment:  |           | None  |                 |      |                 |            |          |
| Joint Geometry   |           |   |                 |      |                 |            |          |
| Double bevel groove weld   |           |   |                 |      |                 |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 1''$<br>$f = 3/8''$                  |           |   |                 |      |                 |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |                 |            |          |
| Pass No.   | Weld Type | Electrode Size<br>(number)  | Welding Current |      | Travel<br>Speed | Heat Input | Polarity |
|  |           |   | Volts           | Amps |                 |            |          |
| ALL  | GROOVE    | 3/32" (single)  | 34              | 620  | 15 IPM          | 80 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 10°C/s |           |   |                 |      |                 |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:           |            |          |



| Weld Procedure Specification   |           | A709 50W 1" - 51A-S30 - SAW Low Heat  |                 |      |                 |            |          |
|--|-----------|---|-----------------|------|-----------------|------------|----------|
| Material Specification:  |           | ASTM A709 Gr. 50W / AASHTO M270 Gr. 50W   |                 |      |                 |            |          |
| Welding Process:   |           | SAW   |                 |      |                 |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |                 |            |          |
| Weld Position:   |           | Flat  |                 |      |                 |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |                 |            |          |
| Filler Metal Classification:   |           | EM12K-H8  |                 |      |                 |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |                 |            |          |
| Trade Name:  |           | "Lincoln L-61"  |                 |      |                 |            |          |
| Flux:  |           | F7A2 "Lincoln 960" (Neutral Flux)   |                 |      |                 |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |                 |            |          |
| Preheat and Interpass Temperature:   |           | Max: 450°F (230°C)<br>Min: 350°F (175°C)  |                 |      |                 |            |          |
| Postheat Treatment:  |           | None  |                 |      |                 |            |          |
| Joint Geometry   |           |   |                 |      |                 |            |          |
| Double bevel groove weld   |           |   |                 |      |                 |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 1''$<br>$f = 1/8''$                  |           |   |                 |      |                 |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |                 |            |          |
| Pass No.   | Weld Type | Electrode Size<br>(number)  | Welding Current |      | Travel<br>Speed | Heat Input | Polarity |
|  |           |   | Volts           | Amps |                 |            |          |
| ALL  | GROOVE    | 3/32" (single)  | 30              | 430  | 18 IPM          | 40 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 30°C/s |           |   |                 |      |                 |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:           |            |          |



|   |  |  |   |
|---|--|--|---|
| <b>Weld Procedure Specification</b>   |  | <b>A709 50W 1.00" - 51B-E - ESW-NG</b>   |   |
| <b>Joint Design Used: Square butt - narrow gap</b>  |  |  |   |
| <b>Joint Preparation:</b>   |  | <b>Position:</b>   |   |
| Plate surfaces inside weld joint as well as 1" (25 mm) on either side of joint to be free of mill scale, rust, or other contaminants. |  | Vertical - up  |   |
| <b>Base Metals:</b>   |  | <b>Electrical Characteristics:</b>   |   |
| Material Spec.: <u>ASTM A709 (AASHTO M270)</u>  |  | Current: <u>DC</u>   |   |
| Type or Grade: <u>50W (345W)</u>  |  | Polarity: <u>Reverse (EP)</u> Wire Feed Speed: <u>134 ipm</u>                              |   |
| Thickness: <u>1" (25mm)</u>   |  | (REF. T4.7) <u>target 34</u>   |   |
|   |  | Voltage: <u>(range 33-37)</u>  |   |
| <b>Filler Metals:</b>   |  | <b>Technique:</b>  |   |
| AWS Spec./ Class.: <u>A5.25 / EW - TG</u>   |  | Dist. Edge shoe to Elect. Guide: <u>5/16"</u>  |   |
| Electrode Manuf.: <u>Arcmatic Integrated Systems</u>  |  | Dist. Shoe to center of guide: <u>5/8"</u>   |   |
| Trade Name: <u>VertaSlag VMC-105</u>  |  | Elect. Separation (mult. Elect.): <u>N/A</u>   |   |
| Electrode Diameter: <u>3/32" (2.4mm)</u>  |  | Starting sump value: <u>17 grams</u>   |   |
| Number of Electrodes: <u>1</u>  |  | Initial Flux Feed: <u>40 grams</u>   |   |
| Flux: <u>VertaSlag VF-106</u>   |  | In-Weld flux feed rate: <u>15 grams/min.</u>   |   |
| Flux Manufacturer: <u>Arcmatic Integrated Systems</u>   |  | Target travel speed: <u>2 1/2 ipm</u>  |   |
|   |  | Travel speed range: <u>2 1/4 thru 3 1/8 ipm</u>  |   |
|   |  | Root Opening: <u>3/4" (+/- 1/8")</u>   |   |
|   |  | Oscillation: <u>None</u>   |   |
| <b>Consumable Guides:</b>   |  | <b>Retaining Shoes:</b>  |   |
| Material Composition: <u>Conforms to Annex I</u>  |  | Material Spec.: <u>Copper</u>  |   |
| Guide hole diamtere: <u>1/8"</u>  |  | Water Flow (gal./min.): <u>4 gal./min.</u>   |   |
| Guide tube width: <u>5/8"</u>   |  | Single sided shoe only plumbed in series. Water transfer to opposite weld side prohibited. |   |
| <b>Cooling Shoes Configuration</b>  | <b>Sealing Material</b>                          |  | <b>Weld Joint Detail</b>                                |
| <p>0.192<br/>0.06<br/>90°</p> <p>Serration pitch depth = 0.06"</p> <p>Serration vee angle = 90°</p>                                   | Trade Name: <u>Stop Leak RSL-101</u>             |  |   |
|   | Manufacturer: <u>Arcmatic Integrated Systems</u> |  |   |
|   | <b>Accessories</b>                               |  |   |
|   | Trade Name: <u>Alumna Tape (1/16" or 1/8")</u>   |  |   |
|   | Manufacturer: <u>Arcmatic Integrated Systems</u> |  | <p>3/4" (+/- 1/8")</p> <p>* 3" MIN. NOT LESS THAN T</p> |
|   | Trade Name: <u>Insulator Buttons</u>             |  |   |
|   | Manufacturer: <u>Arcmatic Integrated Systems</u> |  |   |
|   |  |  |   |
| Comments:   |  |  |   |
| Approved By:  | Signed:  |  | Date:   |



| Weld Procedure Specification   |           | A709 50W 1" - 51B-S10 - SAW High Heat   |                 |      |                 |            |          |
|--|-----------|---|-----------------|------|-----------------|------------|----------|
| Material Specification:  |           | ASTM A709 Gr. 50W / AASHTO M270 Gr. 50W   |                 |      |                 |            |          |
| Welding Process:   |           | SAW   |                 |      |                 |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |                 |            |          |
| Weld Position:   |           | Flat  |                 |      |                 |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |                 |            |          |
| Filler Metal Classification:   |           | EM12K-H8  |                 |      |                 |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |                 |            |          |
| Trade Name:  |           | "Lincoln L-61"  |                 |      |                 |            |          |
| Flux:  |           | F7A2 "Lincoln 960" (Neutral Flux)   |                 |      |                 |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |                 |            |          |
| Preheat and Interpass Temperature:   |           | Max: 350°F (175°C)<br>Min: 275°F (135°C)  |                 |      |                 |            |          |
| Postheat Treatment:  |           | None  |                 |      |                 |            |          |
| Joint Geometry   |           |   |                 |      |                 |            |          |
| Double bevel groove weld   |           |   |                 |      |                 |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 1''$<br>$f = 3/8''$                  |           |   |                 |      |                 |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |                 |            |          |
| Pass No.   | Weld Type | Electrode Size<br>(number)  | Welding Current |      | Travel<br>Speed | Heat Input | Polarity |
|  |           |   | Volts           | Amps |                 |            |          |
| ALL  | GROOVE    | 3/32" (single)  | 34              | 620  | 15 IPM          | 80 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 10°C/s |           |   |                 |      |                 |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:           |            |          |



| Weld Procedure Specification   |           | A709 50W 1" - 51B-S30 - SAW Low Heat  |                 |      |                 |            |          |
|--|-----------|---|-----------------|------|-----------------|------------|----------|
| Material Specification:  |           | ASTM A709 Gr. 50W / AASHTO M270 Gr. 50W   |                 |      |                 |            |          |
| Welding Process:   |           | SAW   |                 |      |                 |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |                 |            |          |
| Weld Position:   |           | Flat  |                 |      |                 |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |                 |            |          |
| Filler Metal Classification:   |           | EM12K-H8  |                 |      |                 |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |                 |            |          |
| Trade Name:  |           | "Lincoln L-61"  |                 |      |                 |            |          |
| Flux:  |           | F7A2 "Lincoln 960" (Neutral Flux)   |                 |      |                 |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |                 |            |          |
| Preheat and Interpass Temperature:   |           | Max: 450°F (230°C)<br>Min: 350°F (175°C)  |                 |      |                 |            |          |
| Postheat Treatment:  |           | None  |                 |      |                 |            |          |
| Joint Geometry   |           |   |                 |      |                 |            |          |
| Double bevel groove weld   |           |   |                 |      |                 |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 1''$<br>$f = 1/8''$                  |           |   |                 |      |                 |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |                 |            |          |
| Pass No.   | Weld Type | Electrode Size<br>(number)  | Welding Current |      | Travel<br>Speed | Heat Input | Polarity |
|  |           |   | Volts           | Amps |                 |            |          |
| ALL  | GROOVE    | 3/32" (single)  | 30              | 430  | 18 IPM          | 40 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 30°C/s |           |   |                 |      |                 |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:           |            |          |



|   |  |  |                                  |
|---|--|--|----------------------------------|
| <b>Weld Procedure Specification</b>   |  | <b>A709 50W 2.75" - 53A-E - ESW-NG</b>   |                                  |
| <b>Joint Design Used: Square butt - narrow gap</b>  |  |  |                                  |
| <b>Joint Preparation:</b>   |  | <b>Position:</b>   |                                  |
| Plate surfaces inside weld joint as well as 1" (25 mm) on either side of joint to be free of mill scale, rust, or other contaminants. |  | Vertical - up  |                                  |
| <b>Base Metals:</b>   |  | <b>Electrical Characteristics:</b>   |                                  |
| Material Spec.: <u>ASTM A709 (AASHTO M270)</u>  |  | Current: <u>DC</u>   |                                  |
| Type or Grade: <u>50W (345W)</u>  |  | Polarity: <u>Reverse (EP)</u> Wire Feed Speed: <u>250 ipm</u>                              |                                  |
| Thickness: <u>2.75" (70mm)</u>  |  | (REF. T4.7) <u>target 34</u>   |                                  |
|   |  | Voltage: <u>(range 31-36)</u>  |                                  |
| <b>Filler Metals:</b>   |  | <b>Technique:</b>  |                                  |
| AWS Spec./ Class.: <u>A5.25 / EW - TG</u>   |  | Dist. Edge shoe to Elect. Guide: <u>3/8"</u>   |                                  |
| Electrode Manuf.: <u>Arcmatic Integrated Systems</u>  |  | Dist. Shoe to center of guide: <u>1 5/8"</u>   |                                  |
| Trade Name: <u>VertaSlag VMC-105</u>  |  | Elect. Separation (mult. Elect.): <u>1 7/8"</u>  |                                  |
| Electrode Diameter: <u>3/32" (2.4mm)</u>  |  | Starting sump value: <u>44 grams</u>   |                                  |
| Number of Electrodes: <u>2</u>  |  | Initial Flux Feed: <u>104 grams</u>  |                                  |
| Flux: <u>VertaSlag VF-106</u>   |  | In-Weld flux feed rate: <u>9 grams/min.</u>  |                                  |
| Flux Manufacturer: <u>Arcmatic Integrated Systems</u>   |  | Target travel speed: <u>1 1/2 ipm</u>  |                                  |
|   |  | Travel speed range: <u>1 3/8 thru 1 7/8</u>  |                                  |
|   |  | Root Opening: <u>3/4" (+/- 1/8")</u>   |                                  |
|   |  | Oscillation: <u>None</u>   |                                  |
| <b>Consumable Guides:</b>   |  | <b>Retaining Shoes:</b>  |                                  |
| Material Composition: <u>Conforms to Annex I</u>  |  | Material Spec.: <u>Copper</u>  |                                  |
| Guide hole diamtere: <u>1/8"</u>  |  | Water Flow (gal./min.): <u>4 gal./min.</u>   |                                  |
| Guide tube width: <u>2 1/2"</u>   |  | Single sided shoe only plumbed in series. Water transfer to opposite weld side prohibited. |                                  |
| <b>Cooling Shoes Configuration</b>  | <b>Sealing Material</b>                          |  | <b>Weld Joint Detail</b>         |
| <p>Serration pitch depth = 0.06"<br/>Serration wear angle = 90°</p>   | Trade Name: <u>Stop Leak RSL-101</u>             |  |                                  |
|   | Manufacturer: <u>Arcmatic Integrated Systems</u> |  | <p>* 3" MIN. NOT LESS THAN T</p> |
|   | <b>Accessories</b>                               |  |                                  |
|   | Trade Name: <u>Alumna Tape (1/16" or 1/8")</u>   |  |                                  |
| Manufacturer: <u>Arcmatic Integrated Systems</u>  |  |  |                                  |
| Trade Name: <u>Insulator Buttons</u>  |  |  |                                  |
| Manufacturer: <u>Arcmatic Integrated Systems</u>  |  |  |                                  |
| Comments:   |  |  |                                  |
| Approved By:  | Signed:  |  | Date:                            |





| Weld Procedure Specification   |           | A709 50W 2.75" - 53A-S10 - SAW High Heat  |                 |      |                 |            |          |
|--|-----------|---|-----------------|------|-----------------|------------|----------|
| Material Specification:  |           | ASTM A709 Gr. 50W / AASHTO M270 Gr. 50W   |                 |      |                 |            |          |
| Welding Process:   |           | SAW   |                 |      |                 |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |                 |            |          |
| Weld Position:   |           | Flat  |                 |      |                 |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |                 |            |          |
| Filler Metal Classification:   |           | EM12K-H8  |                 |      |                 |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |                 |            |          |
| Trade Name:  |           | "Lincoln L-61"  |                 |      |                 |            |          |
| Flux:  |           | F7A2 "Lincoln 960" (Neutral Flux)   |                 |      |                 |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |                 |            |          |
| Preheat and Interpass Temperature:   |           | Max: 400°F (200°C)<br>Min: 350°F (175°C)  |                 |      |                 |            |          |
| Postheat Treatment:  |           | None  |                 |      |                 |            |          |
| Joint Geometry   |           |   |                 |      |                 |            |          |
| Double bevel groove weld   |           |   |                 |      |                 |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 2.75''$<br>$f = 3/8''$               |           |   |                 |      |                 |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |                 |            |          |
| Pass No.   | Weld Type | Electrode Size<br>(number)  | Welding Current |      | Travel<br>Speed | Heat Input | Polarity |
|  |           |   | Volts           | Amps |                 |            |          |
| ALL  | GROOVE    | 3/32" (single)  | 34              | 620  | 15 IPM          | 80 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 10°C/s |           |   |                 |      |                 |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:           |            |          |



| Weld Procedure Specification   |           | A709 50W 2.75" - 53A-S30 - SAW Low Heat   |                 |      |              |            |          |
|--|-----------|---|-----------------|------|--------------|------------|----------|
| Material Specification:  |           | ASTM A709 Gr. 50W / AASHTO M270 Gr. 50W   |                 |      |              |            |          |
| Welding Process:   |           | SAW   |                 |      |              |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |              |            |          |
| Weld Position:   |           | Flat  |                 |      |              |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |              |            |          |
| Filler Metal Classification:   |           | EM12K-H8  |                 |      |              |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |              |            |          |
| Trade Name:  |           | "Lincoln L-61"  |                 |      |              |            |          |
| Flux:  |           | F7A2 "Lincoln 960" (Neutral Flux)   |                 |      |              |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |              |            |          |
| Preheat and Interpass Temperature:   |           | Max: 300°F (150°C)<br>Min: 175°F (80°C)   |                 |      |              |            |          |
| Postheat Treatment:  |           | None  |                 |      |              |            |          |
| Joint Geometry   |           |   |                 |      |              |            |          |
| Double bevel groove weld   |           |   |                 |      |              |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 2.75''$<br>$f = 1/4''$<br><br>(Reference: AWS D1.5 Figure 2.4) |           |   |                 |      |              |            |          |
| Pass No.   | Weld Type | Electrode Size (number)   | Welding Current |      | Travel Speed | Heat Input | Polarity |
| ALL  | GROOVE    | 3/32" (single)  | Volts           | Amps | 18 IPM       | 40 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 30°C/s                           |           |   |                 |      |              |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:        |            |          |



|   |  |  |  |
|---|--|--|--|
| <b>Weld Procedure Specification</b>   |  | <b>A709 50W 3.00" - 53B-E - ESW-NG</b>   |  |
| <b>Joint Design Used: Square butt - narrow gap</b>  |  |  |  |
| <b>Joint Preparation:</b>   |  | <b>Position:</b>   |  |
| Plate surfaces inside weld joint as well as 1" (25 mm) on either side of joint to be free of mill scale, rust, or other contaminants. |  | Vertical - up  |  |
| <b>Base Metals:</b>   |  | <b>Electrical Characteristics:</b>   |  |
| Material Spec.: <u>ASTM A709 (AASHTO M270)</u>  | Current: <u>AC</u>   | Wire Feed Speed: <u>262 ipm</u>  |  |
| Type or Grade: <u>50W (345W)</u>  | Polarity: <u>N/A</u>   | Actual Voltage: <u>33.6</u>  |  |
| Thickness: <u>3.00" (76 mm)</u>   | (REF. T4.7) <u>target 34</u>   | Voltage: <u>(range 31-36)</u>  |  |
| <b>Filler Metals:</b>   |  | <b>Technique:</b>  |  |
| AWS Spec./ Class.: <u>A5.25 / EW - TG</u>   | Electrode Manuf.: <u>Arcmatic Integrated Systems</u>   | Dist. Edge shoe to Elect. Guide: <u>3/8"</u>   |  |
| Trade Name: <u>VertaSlag VMC-105</u>  | Electrode Diameter: <u>3/32" (2.4mm)</u>   | Dist. Shoe to center of guide: <u>1 5/8"</u>   |  |
| Number of Electrodes: <u>2</u>  | Flux: <u>VertaSlag VF-106</u>  | Elect. Separation (mult. Elect.): <u>1 7/8"</u>  |  |
| Flux Manufacturer: <u>Arcmatic Integrated Systems</u>   |  | Starting sump value: <u>60 grams</u>   |  |
|   |  | Initial Flux Feed: <u>90 grams</u>   |  |
|   |  | In-Weld flux feed rate: <u>7.4 grams/min.</u>  |  |
|   |  | Target travel speed: <u>1 1/2 ipm</u>  |  |
|   |  | Travel speed range: <u>1 3/8 thru 1 7/8</u>  |  |
|   |  | Actual travel speed: <u>1 5/8 ipm</u>  |  |
|   |  | Root Opening: <u>3/4" (+/- 1/16")</u>  |  |
|   |  | Oscillation: <u>None</u>   |  |
| <b>Consumable Guides:</b>   |  | <b>Retaining Shoes:</b>  |  |
| Material Composition: <u>Conforms to Annex I</u>  |  | Material Spec.: <u>Copper</u>  |  |
| Guide hole diamtere: <u>1/8"</u>  |  | Water Flow (gal./min.): <u>8 gal./min.</u>   |  |
| Guide tube width: <u>2 1/2"</u>   |  | Single sided shoe only plumbed in series. Water transfer to opposite weld side prohibited. |  |
| <b>Cooling Shoes Configuration</b>  | <b>Sealing Material</b>  | <b>Weld Joint Detail</b>   |  |
| <p>Serration pitch depth = 0.06"</p> <p>Serration vee angle = 90°</p>   | N/A  | <p>* 3" MIN. NOT LESS THAN T</p>   |  |
|   | <b>Accessories</b>   |  |  |
|   | Trade Name: <u>Alumna Tape (1/16" or 1/8")</u><br>Manufacturer: <u>Arcmatic Integrated Systems</u><br>Trade Name: <u>Insulator Buttons</u><br>Manufacturer: <u>Arcmatic Integrated Systems</u> |  |  |
| <b>Comments:</b>  |  |  |  |
| Approved By:  | Signed:  | Date:  |  |



| Weld Procedure Specification   |           | A709 50W 3.00" - 53B-S10 - SAW High Heat  |                 |      |                 |            |          |
|--|-----------|---|-----------------|------|-----------------|------------|----------|
| Material Specification:  |           | ASTM A709 Gr. 50W / AASHTO M270 Gr. 50W   |                 |      |                 |            |          |
| Welding Process:   |           | SAW   |                 |      |                 |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |                 |            |          |
| Weld Position:   |           | Flat  |                 |      |                 |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |                 |            |          |
| Filler Metal Classification:   |           | EM12K-H8  |                 |      |                 |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |                 |            |          |
| Trade Name:  |           | "Lincoln L-61"  |                 |      |                 |            |          |
| Flux:  |           | F7A2 "Lincoln 960" (Neutral Flux)   |                 |      |                 |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |                 |            |          |
| Preheat and Interpass Temperature:   |           | Max: 440°F (225°C)<br>Min: 350°F (175°C)  |                 |      |                 |            |          |
| Postheat Treatment:  |           | None  |                 |      |                 |            |          |
| Joint Geometry   |           |   |                 |      |                 |            |          |
| Double bevel groove weld   |           |   |                 |      |                 |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 3.00''$<br>$f = 3/8''$               |           |   |                 |      |                 |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |                 |            |          |
| Pass No.   | Weld Type | Electrode Size<br>(number)  | Welding Current |      | Travel<br>Speed | Heat Input | Polarity |
|  |           |   | Volts           | Amps |                 |            |          |
| ALL  | GROOVE    | 3/32" (single)  | 34              | 620  | 15 IPM          | 80 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 10°C/s |           |   |                 |      |                 |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:           |            |          |



| Weld Procedure Specification   |           | A709 50W 3.00" - 53B-S30 - SAW Low Heat   |                 |      |              |            |          |
|--|-----------|---|-----------------|------|--------------|------------|----------|
| Material Specification:  |           | ASTM A709 Gr. 50W / AASHTO M270 Gr. 50W   |                 |      |              |            |          |
| Welding Process:   |           | SAW   |                 |      |              |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |              |            |          |
| Weld Position:   |           | Flat  |                 |      |              |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |              |            |          |
| Filler Metal Classification:   |           | EM12K-H8  |                 |      |              |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |              |            |          |
| Trade Name:  |           | "Lincoln L-61"  |                 |      |              |            |          |
| Flux:  |           | F7A2 "Lincoln 960" (Neutral Flux)   |                 |      |              |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |              |            |          |
| Preheat and Interpass Temperature:   |           | Max: 300°F (150°C)<br>Min: 175°F (80°C)   |                 |      |              |            |          |
| Postheat Treatment:  |           | None  |                 |      |              |            |          |
| Joint Geometry   |           |   |                 |      |              |            |          |
| Double bevel groove weld   |           |   |                 |      |              |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 3.00''$<br>$f = 1/8''$               |           |   |                 |      |              |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |              |            |          |
| Pass No.   | Weld Type | Electrode Size (number)   | Welding Current |      | Travel Speed | Heat Input | Polarity |
|  |           |   | Volts           | Amps |              |            |          |
| ALL  | GROOVE    | 3/32" (single)  | 30              | 430  | 18 IPM       | 40 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 30°C/s |           |   |                 |      |              |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:        |            |          |



| Weld Procedure Specification  |  | A709 HPS 70W 1.00" - 71A-E - ESW-NG  |  |
|---|--|--|--|
| <b>Joint Design Used: Square butt - narrow gap</b>  |  |  |  |
| <b>Joint Preparation:</b>   |  | <b>Position:</b>   |  |
| Plate surfaces inside weld joint as well as 1" (25 mm) on either side of joint to be free of mill scale, rust, or other contaminants. |  | Vertical - up  |  |
| <b>Base Metals:</b>   |  | <b>Electrical Characteristics:</b>   |  |
| Material Spec.: <u>ASTM A709 (AASHTO M270)</u>  |  | Current: <u>DC</u>   |  |
| Type or Grade: <u>HPS 70W</u>   |  | Polarity: <u>Reverse (EP)</u> Wire Feed Speed: <u>134 ipm</u>                              |  |
| Thickness: <u>1" (25mm)</u>   |  | (REF. T4.7) <u>target 34</u>   |  |
|   |  | Voltage: <u>(range 33-37)</u>  |  |
| <b>Filler Metals:</b>   |  | <b>Technique:</b>  |  |
| AWS Spec./ Class.: <u>A5.25 / EW - TG</u>   |  | Dist. Edge shoe to Elect. Guide: <u>5/16"</u>  |  |
| Electrode Manuf.: <u>Arcmatic Integrated Systems</u>  |  | Dist. Shoe to center of guide: <u>5/8"</u>   |  |
| Trade Name: <u>VertaSlag VMC-105</u>  |  | Elect. Separation (mult. Elect.): <u>N/A</u>   |  |
| Electrode Diameter: <u>3/32" (2.4mm)</u>  |  | Starting sump value: <u>17 grams</u>   |  |
| Number of Electrodes: <u>1</u>  |  | Initial Flux Feed: <u>40 grams</u>   |  |
| Flux: <u>VertaSlag VF-106</u>   |  | In-Weld flux feed rate: <u>15 grams/min.</u>   |  |
| Flux Manufacturer: <u>Arcmatic Integrated Systems</u>   |  | Target travel speed: <u>2 1/2 ipm</u>  |  |
|   |  | Travel speed range: <u>2 1/4 thru 3 1/8 ipm</u>  |  |
|   |  | Root Opening: <u>3/4" (+/- 1/8")</u>   |  |
|   |  | Oscillation: <u>None</u>   |  |
| <b>Consumable Guides:</b>   |  | <b>Retaining Shoes:</b>  |  |
| Material Composition: <u>Conforms to Annex I</u>  |  | Material Spec.: <u>Copper</u>  |  |
| Guide hole diamtere: <u>1/8"</u>  |  | Water Flow (gal./min.): <u>4 gal./min.</u>   |  |
| Guide tube width: <u>5/8"</u>   |  | Single sided shoe only plumbed in series. Water transfer to opposite weld side prohibited. |  |
| <b>Cooling Shoes Configuration</b>  | <b>Sealing Material</b>                          | <b>Weld Joint Detail</b>   |  |
|   | Trade Name: <u>Stop Leak RSL-101</u>             |  |  |
|   | Manufacturer: <u>Arcmatic Integrated Systems</u> |  |  |
|   | <b>Accessories</b>                               |  |  |
|   | Trade Name: <u>Alumna Tape (1/16" or 1/8")</u>   |  |  |
| Manufacturer: <u>Arcmatic Integrated Systems</u>  | Trade Name: <u>Insulator Buttons</u>             |  |  |
| Trade Name: <u>Insulator Buttons</u>  | Manufacturer: <u>Arcmatic Integrated Systems</u> |  |  |
| Manufacturer: <u>Arcmatic Integrated Systems</u>  |  |  |  |
| Comments:   |  |  |  |
| Approved By:  | Signed:  | Date:  |  |



| Weld Procedure Specification   |           | A709 HPS 70W 1" - 71A-S10 - SAW High Heat   |                 |      |                 |            |          |
|--|-----------|---|-----------------|------|-----------------|------------|----------|
| Material Specification:  |           | ASTM A709 HPS Gr. 70W / AASHTO M270 HPS Gr. 70W   |                 |      |                 |            |          |
| Welding Process:   |           | SAW   |                 |      |                 |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |                 |            |          |
| Weld Position:   |           | Flat  |                 |      |                 |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |                 |            |          |
| Filler Metal Classification:   |           | ENi5  |                 |      |                 |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |                 |            |          |
| Trade Name:  |           | "Lincoln LA-85"   |                 |      |                 |            |          |
| Flux:  |           | Lincolnweld MIL800 (Neutral Flux)   |                 |      |                 |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |                 |            |          |
| Preheat and Interpass Temperature:   |           | Max: 350°F (175°C)<br>Min: 275°F (135°C)  |                 |      |                 |            |          |
| Postheat Treatment:  |           | None  |                 |      |                 |            |          |
| Joint Geometry   |           |   |                 |      |                 |            |          |
| Double bevel groove weld   |           |   |                 |      |                 |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 1''$<br>$f = 3/8''$                  |           |   |                 |      |                 |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |                 |            |          |
| Pass No.   | Weld Type | Electrode Size<br>(number)  | Welding Current |      | Travel<br>Speed | Heat Input | Polarity |
|  |           |   | Volts           | Amps |                 |            |          |
| ALL  | GROOVE    | 3/32" (single)  | 34              | 620  | 15 IPM          | 80 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 10°C/s |           |   |                 |      |                 |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:           |            |          |



| Weld Procedure Specification   |           | A709 HPS 70W 1" - 71A-S30 - SAW Low Heat  |                 |      |                 |            |          |
|--|-----------|---|-----------------|------|-----------------|------------|----------|
| Material Specification:  |           | ASTM A709 HPS Gr. 70W / AASHTO M270 HPS Gr. 70W   |                 |      |                 |            |          |
| Welding Process:   |           | SAW   |                 |      |                 |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |                 |            |          |
| Weld Position:   |           | Flat  |                 |      |                 |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |                 |            |          |
| Filler Metal Classification:   |           | ENi5  |                 |      |                 |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |                 |            |          |
| Trade Name:  |           | "Lincoln LA-85"   |                 |      |                 |            |          |
| Flux:  |           | Lincolnweld MIL800 (Neutral Flux)   |                 |      |                 |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |                 |            |          |
| Preheat and Interpass Temperature:   |           | Max: 450°F (230°C)<br>Min: 350°F (175°C)  |                 |      |                 |            |          |
| Postheat Treatment:  |           | None  |                 |      |                 |            |          |
| Joint Geometry   |           |   |                 |      |                 |            |          |
| Double bevel groove weld   |           |   |                 |      |                 |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 1''$<br>$f = 1/8''$                  |           |   |                 |      |                 |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |                 |            |          |
| Pass No.   | Weld Type | Electrode Size<br>(number)  | Welding Current |      | Travel<br>Speed | Heat Input | Polarity |
|  |           |   | Volts           | Amps |                 |            |          |
| ALL  | GROOVE    | 3/32" (single)  | 30              | 430  | 18 IPM          | 40 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 30°C/s |           |   |                 |      |                 |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:           |            |          |





|   |  |  |  |
|---|--|--|--|
| <b>Weld Procedure Specification</b>   |  | <b>A709 HPS 70W 0.875" - 71B-E - ESW-NG</b>  |  |
| <b>Joint Design Used: Square butt - narrow gap</b>  |  |  |  |
| <b>Joint Preparation:</b>   |  | <b>Position:</b>   |  |
| Plate surfaces inside weld joint as well as 1" (25 mm) on either side of joint to be free of mill scale, rust, or other contaminants. |  | Vertical - up  |  |
| <b>Base Metals:</b>   |  | <b>Electrical Characteristics:</b>   |  |
| Material Spec.: <u>ASTM A709 (AASHTO M270)</u>  |  | Current: <u>AC</u>   |  |
| Type or Grade: <u>HPS 70W</u>   |  | Polarity: <u>N/A</u> Wire Feed Speed: <u>376 ipm</u>                                       |  |
| Thickness: <u>0.875" (22mm)</u>   |  | (REF. T4.7) <u>target 34</u> Actual Voltage: <u>35.1</u>                                   |  |
|   |  | Voltage: <u>(range 33-37)</u> Actual Amperage: <u>711</u>                                  |  |
| <b>Filler Metals:</b>   |  | <b>Technique:</b>  |  |
| AWS Spec./ Class.: <u>N/A</u>   |  | Dist. Edge shoe to Elect. Guide: <u>5/16"</u>  |  |
| Electrode Manuf.: <u>Select Arc, Inc.</u>   |  | Dist. Shoe to center of guide: <u>5/8"</u>   |  |
| Trade Name: <u>ESW-NGI</u>  |  | Elect. Separation (mult. Elect.): <u>N/A</u>   |  |
| Electrode Diameter: <u>3/32" (2.4mm)</u>  |  | Starting sump value: <u>30 grams</u>   |  |
| Number of Electrodes: <u>1</u>  |  | Initial Flux Feed: <u>37 grams</u>   |  |
| Flux: <u>VertaSlag VF-106</u>   |  | In-Weld flux feed rate: <u>12.6 grams/min.</u>   |  |
| Flux Manufacturer: <u>Arcmatic Integrated Systems</u>   |  | Target travel speed: <u>2 1/2 ipm</u>  |  |
|   |  | Travel speed range: <u>2 1/4 thru 3 1/8 ipm</u>  |  |
|   |  | Actual travel speed: <u>3 ipm</u>  |  |
|   |  | Root Opening: <u>3/4" (+/- 1/16")</u>  |  |
|   |  | Oscillation: <u>None</u>   |  |
| <b>Consumable Guides:</b>   |  | <b>Retaining Shoes:</b>  |  |
| Material Composition: <u>Conforms to Annex I</u>  |  | Material Spec.: <u>Copper</u>  |  |
| Guide hole diamtere: <u>1/8"</u>  |  | Water Flow (gal./min.): <u>8 gal./min.</u>   |  |
| Guide tube width: <u>5/8"</u>   |  | Single sided shoe only plumbed in series. Water transfer to opposite weld side prohibited. |  |
| <b>Cooling Shoes Configuration</b>  | <b>Sealing Material</b>  | <b>Weld Joint Detail</b>   |  |
|   | N/A  |  |  |
|   | <b>Accessories</b>   |  |  |
|   | Trade Name: <u>Alumna Tape (1/16" or 1/8")</u><br>Manufacturer: <u>Arcmatic Integrated Systems</u><br>Trade Name: <u>Insulator Buttons</u><br>Manufacturer: <u>Arcmatic Integrated Systems</u> |  |  |
| Comments:   |  |  |  |
| Approved By:  | Signed:  | Date:  |  |



| Weld Procedure Specification   |           | A709 HPS 70W 0.875" - 71B-S10 - SAW High Heat   |                 |      |              |            |          |
|--|-----------|---|-----------------|------|--------------|------------|----------|
| Material Specification:  |           | ASTM A709 HPS Gr. 70W / AASHTO M270 HPS Gr. 70W   |                 |      |              |            |          |
| Welding Process:   |           | SAW   |                 |      |              |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |              |            |          |
| Weld Position:   |           | Flat  |                 |      |              |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |              |            |          |
| Filler Metal Classification:   |           | ENi5  |                 |      |              |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |              |            |          |
| Trade Name:  |           | "Lincoln LA-85"   |                 |      |              |            |          |
| Flux:  |           | Lincolnweld MIL800 (Neutral Flux)   |                 |      |              |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |              |            |          |
| Preheat and Interpass Temperature:   |           | Max: 260°F (125°C)<br>Min: 170°F (75°C)   |                 |      |              |            |          |
| Postheat Treatment:  |           | None  |                 |      |              |            |          |
| Joint Geometry   |           |   |                 |      |              |            |          |
| Double bevel groove weld   |           |   |                 |      |              |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |              |            |          |
| Pass No.   | Weld Type | Electrode Size (number)   | Welding Current |      | Travel Speed | Heat Input | Polarity |
| ALL  | GROOVE    | 3/32" (single)  | Volts           | Amps | 15 IPM       | 80 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 10°C/s |           |   |                 |      |              |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:        |            |          |



| Weld Procedure Specification   |           | A709 HPS 70W 0.875" - 71B-S30 - SAW Low Heat  |                 |      |              |            |          |
|--|-----------|---|-----------------|------|--------------|------------|----------|
| Material Specification:  |           | ASTM A709 HPS Gr. 70W / AASHTO M270 HPS Gr. 70W   |                 |      |              |            |          |
| Welding Process:   |           | SAW   |                 |      |              |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |              |            |          |
| Weld Position:   |           | Flat  |                 |      |              |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |              |            |          |
| Filler Metal Classification:   |           | ENi5  |                 |      |              |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |              |            |          |
| Trade Name:  |           | "Lincoln LA-85"   |                 |      |              |            |          |
| Flux:  |           | Lincolnweld MIL800 (Neutral Flux)   |                 |      |              |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |              |            |          |
| Preheat and Interpass Temperature:   |           | Max: 365°F (185°C)<br>Min: 275°F (135°C)  |                 |      |              |            |          |
| Postheat Treatment:  |           | None  |                 |      |              |            |          |
| Joint Geometry   |           |   |                 |      |              |            |          |
| Double bevel groove weld   |           |   |                 |      |              |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |              |            |          |
| Pass No.   | Weld Type | Electrode Size (number)   | Welding Current |      | Travel Speed | Heat Input | Polarity |
| ALL  | GROOVE    | 3/32" (single)  | Volts           | Amps | 18 IPM       | 40 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 30°C/s |           |   |                 |      |              |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:        |            |          |



| Weld Procedure Specification  |  | A709 HPS 70W 3.125" - 73A-E - ESW-NG   |  |
|---|--|--|--|
| <b>Joint Design Used: Square butt - narrow gap</b>  |  |  |  |
| <b>Joint Preparation:</b>   |  | <b>Position:</b>   |  |
| Plate surfaces inside weld joint as well as 1" (25 mm) on either side of joint to be free of mill scale, rust, or other contaminants. |  | Vertical - up  |  |
| <b>Base Metals:</b>   |  | <b>Electrical Characteristics:</b>   |  |
| Material Spec.: <u>ASTM A709 (AASHTO M270)</u>  |  | Current: <u>DC</u>   |  |
| Type or Grade: <u>HPS 70W</u>   |  | Polarity: <u>Reverse (EP)</u> Wire Feed Speed: <u>250 ipm</u>                              |  |
| Thickness: <u>3.125" (80mm)</u>   |  | (REF. T4.7) <u>target 34</u>   |  |
|   |  | Voltage: <u>(range 31-36)</u>  |  |
| <b>Filler Metals:</b>   |  | <b>Technique:</b>  |  |
| AWS Spec./ Class.: <u>A5.25 / EW - TG</u>   |  | Dist. Edge shoe to Elect. Guide: <u>3/8"</u>   |  |
| Electrode Manuf.: <u>Arcmatic Integrated Systems</u>  |  | Dist. Shoe to center of guide: <u>1 5/8"</u>   |  |
| Trade Name: <u>VertaSlag VMC-105</u>  |  | Elect. Separation (mult. Elect.): <u>1 7/8"</u>  |  |
| Electrode Diameter: <u>3/32" (2.4mm)</u>  |  | Starting sump value: <u>44 grams</u>   |  |
| Number of Electrodes: <u>2</u>  |  | Initial Flux Feed: <u>104 grams</u>  |  |
| Flux: <u>VertaSlag VF-106</u>   |  | In-Weld flux feed rate: <u>9 grams/min.</u>  |  |
| Flux Manufacturer: <u>Arcmatic Integrated Systems</u>   |  | Target travel speed: <u>1 1/2 ipm</u>  |  |
|   |  | Travel speed range: <u>1 3/8 thru 1 7/8</u>  |  |
|   |  | Root Opening: <u>3/4" (+/- 1/8")</u>   |  |
|   |  | Oscillation: <u>None</u>   |  |
| <b>Consumable Guides:</b>   |  | <b>Retaining Shoes:</b>  |  |
| Material Composition: <u>Conforms to Annex I</u>  |  | Material Spec.: <u>Copper</u>  |  |
| Guide hole diamtere: <u>1/8"</u>  |  | Water Flow (gal./min.): <u>4 gal./min.</u>   |  |
| Guide tube width: <u>2 1/2"</u>   |  | Single sided shoe only plumbed in series. Water transfer to opposite weld side prohibited. |  |
| <b>Cooling Shoes Configuration</b>  | <b>Sealing Material</b>                          | <b>Weld Joint Detail</b>   |  |
| <p>Serration pitch depth = 0.06"</p> <p>Serration vee angle = 90°</p>   | Trade Name: <u>Stop Leak RSL-101</u>             | <p>* 3" MIN. NOT LESS THAN T</p>   |  |
|   | Manufacturer: <u>Arcmatic Integrated Systems</u> |  |  |
|   | <b>Accessories</b>                               |  |  |
|   | Trade Name: <u>Alumna Tape (1/16" or 1/8")</u>   |  |  |
|   | Manufacturer: <u>Arcmatic Integrated Systems</u> |  |  |
|   | Trade Name: <u>Insulator Buttons</u>             |  |  |
|   | Manufacturer: <u>Arcmatic Integrated Systems</u> |  |  |
| Comments:   |  |  |  |
| Approved By:  | Signed:  | Date:  |  |



| Weld Procedure Specification  |           | A709 HPS 70W 3.125" - 73A-S10 - SAW High Heat   |                 |      |              |            |          |
|---|-----------|---|-----------------|------|--------------|------------|----------|
| Material Specification:   |           | ASTM A709 HPS Gr. 70W / AASHTO M270 HPS Gr. 70W   |                 |      |              |            |          |
| Welding Process:  |           | SAW   |                 |      |              |            |          |
| Manual or Machine:  |           | Auto-Machine  |                 |      |              |            |          |
| Weld Position:  |           | Flat  |                 |      |              |            |          |
| Filler Metal Specification:   |           | AWS A5.17   |                 |      |              |            |          |
| Filler Metal Classification:  |           | ENi5  |                 |      |              |            |          |
| Filler Metal Manufacturer:  |           | Lincoln   |                 |      |              |            |          |
| Trade Name:   |           | "Lincoln LA-85"   |                 |      |              |            |          |
| Flux:   |           | Lincolnweld MIL800 (Neutral Flux)   |                 |      |              |            |          |
| Root Treatment:   |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |              |            |          |
| Preheat and Interpass Temperature:  |           | Max: 400°F (200°C)<br>Min: 350°F (175°C)  |                 |      |              |            |          |
| Postheat Treatment:   |           | None  |                 |      |              |            |          |
| Joint Geometry  |           |   |                 |      |              |            |          |
| Double bevel groove weld  |           |   |                 |      |              |            |          |
| $\alpha = 45^\circ$<br>$\beta = 0^\circ$<br>$R = 0''$<br>$T_1 = 3.125''$<br>$f = 3/8''$<br><br>(Reference: AWS D1.5 Figure 2.4) |           |   |                 |      |              |            |          |
| Pass No.  | Weld Type | Electrode Size (number)   | Welding Current |      | Travel Speed | Heat Input | Polarity |
| ALL   | GROOVE    | 3/32" (single)  | Volts           | Amps | 15 IPM       | 80 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 10°C/s                            |           |   |                 |      |              |            |          |
| Approved By:  |           | Signed:   |                 |      | Date:        |            |          |



| Weld Procedure Specification   |           | A709 HPS 70W 3.125" - 73A-S30 - SAW Low Heat  |                 |      |              |            |          |
|--|-----------|---|-----------------|------|--------------|------------|----------|
| Material Specification:  |           | ASTM A709 HPS Gr. 70W / AASHTO M270 HPS Gr. 70W   |                 |      |              |            |          |
| Welding Process:   |           | SAW   |                 |      |              |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |              |            |          |
| Weld Position:   |           | Flat  |                 |      |              |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |              |            |          |
| Filler Metal Classification:   |           | ENi5  |                 |      |              |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |              |            |          |
| Trade Name:  |           | "Lincoln LA-85"   |                 |      |              |            |          |
| Flux:  |           | Lincolnweld MIL800 (Neutral Flux)   |                 |      |              |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |              |            |          |
| Preheat and Interpass Temperature:   |           | Max: 300°F (150°C)<br>Min: 175°F (80°C)   |                 |      |              |            |          |
| Postheat Treatment:  |           | None  |                 |      |              |            |          |
| Joint Geometry   |           |   |                 |      |              |            |          |
| Double bevel groove weld   |           |   |                 |      |              |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |              |            |          |
| Pass No.   | Weld Type | Electrode Size (number)   | Welding Current |      | Travel Speed | Heat Input | Polarity |
| ALL  | GROOVE    | 3/32" (single)  | Volts           | Amps | 18 IPM       | 40 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 30°C/s |           |   |                 |      |              |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:        |            |          |



|   |  |  |  |
|---|--|--|--|
| <b>Weld Procedure Specification</b>   |  | <b>A709 HPS 70W 3.00" - 73B-E - ESW-NG</b>   |  |
| <b>Joint Design Used: Square butt - narrow gap</b>  |  |  |  |
| <b>Joint Preparation:</b>   |  | <b>Position:</b>   |  |
| Plate surfaces inside weld joint as well as 1" (25 mm) on either side of joint to be free of mill scale, rust, or other contaminants. |  | Vertical - up  |  |
| <b>Base Metals:</b>   |  | <b>Electrical Characteristics:</b>   |  |
| Material Spec.: <u>ASTM A709 (AASHTO M270)</u>  |  | Current: <u>AC</u>   |  |
| Type or Grade: <u>HPS 70W</u>   |  | Polarity: <u>N/A</u> Wire Feed Speed: <u>270 ipm</u>                                       |  |
| Thickness: <u>3.00" (76mm)</u>  |  | (REF. T4.7) <u>target 34</u> Actual Voltage: <u>32</u>                                     |  |
|   |  | Voltage: <u>(range 31-36)</u> Actual Amperage: <u>1300</u>                                 |  |
| <b>Filler Metals:</b>   |  | <b>Technique:</b>  |  |
| AWS Spec./ Class.: <u>N/A</u>   |  | Dist. Edge shoe to Elect. Guide: <u>3/8"</u>   |  |
| Electrode Manuf.: <u>Select Arc, Inc.</u>   |  | Dist. Shoe to center of guide: <u>1 5/8"</u>   |  |
| Trade Name: <u>ESW-NGI</u>  |  | Elect. Separation (mult. Elect.): <u>1 7/8"</u>  |  |
| Electrode Diameter: <u>3/32" (2.4mm)</u>  |  | Starting sump value: <u>60 grams</u>   |  |
| Number of Electrodes: <u>2</u>  |  | Initial Flux Feed: <u>90 grams</u>   |  |
| Flux: <u>VertaSlag VF-106</u>   |  | In-Weld flux feed rate: <u>7.4 grams/min.</u>  |  |
| Flux Manufacturer: <u>Arcmatic Integrated Systems</u>   |  | Target travel speed: <u>1 1/2 ipm</u>  |  |
|   |  | Travel speed range: <u>1 3/8 thru 1 7/8</u>  |  |
|   |  | Actual travel speed: <u>1 3/4 ipm</u>  |  |
|   |  | Root Opening: <u>3/4" (+/- 1/16")</u>  |  |
|   |  | Oscillation: <u>None</u>   |  |
| <b>Consumable Guides:</b>   |  | <b>Retaining Shoes:</b>  |  |
| Material Composition: <u>Conforms to Annex I</u>  |  | Material Spec.: <u>Copper</u>  |  |
| Guide hole diameters: <u>1/8"</u>   |  | Water Flow (gal./min.): <u>8 gal./min.</u>   |  |
| Guide tube width: <u>2 1/2"</u>   |  | Single sided shoe only plumbed in series. Water transfer to opposite weld side prohibited. |  |
| <b>Cooling Shoes Configuration</b>  | <b>Sealing Material</b>  | <b>Weld Joint Detail</b>   |  |
| <p>Sealant patch depth = 0.06"</p> <p>Sealant vee angle = 90°</p>   | N/A  | <p>* 3" MIN. NOT LESS THAN T</p>   |  |
|   | <b>Accessories</b>   |  |  |
|   | Trade Name: <u>Alumna Tape (1/16" or 1/8")</u><br>Manufacturer: <u>Arcmatic Integrated Systems</u><br>Trade Name: <u>Insulator Buttons</u><br>Manufacturer: <u>Arcmatic Integrated Systems</u> |  |  |
| Comments:   |  |  |  |
| Approved By:  | Signed:  | Date:  |  |



| Weld Procedure Specification   |           | A709 HPS 70W 3.00" - 73B-S10 - SAW High Heat  |                 |      |              |            |          |
|--|-----------|---|-----------------|------|--------------|------------|----------|
| Material Specification:  |           | ASTM A709 HPS Gr. 70W / AASHTO M270 HPS Gr. 70W   |                 |      |              |            |          |
| Welding Process:   |           | SAW   |                 |      |              |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |              |            |          |
| Weld Position:   |           | Flat  |                 |      |              |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |              |            |          |
| Filler Metal Classification:   |           | ENi5  |                 |      |              |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |              |            |          |
| Trade Name:  |           | "Lincoln LA-85"   |                 |      |              |            |          |
| Flux:  |           | Lincolnweld MIL800 (Neutral Flux)   |                 |      |              |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |              |            |          |
| Preheat and Interpass Temperature:   |           | Max: 440°F (225°C)<br>Min: 350°F (175°C)  |                 |      |              |            |          |
| Postheat Treatment:  |           | None  |                 |      |              |            |          |
| Joint Geometry   |           |   |                 |      |              |            |          |
| Double bevel groove weld   |           |   |                 |      |              |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |              |            |          |
| Pass No.   | Weld Type | Electrode Size (number)   | Welding Current |      | Travel Speed | Heat Input | Polarity |
|  |           |   | Volts           | Amps |              |            |          |
| ALL  | GROOVE    | 3/32" (single)  | 34              | 620  | 15 IPM       | 80 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 10°C/s |           |   |                 |      |              |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:        |            |          |





| Weld Procedure Specification   |           | A709 HPS 70W 3.00" - 73B-S30 - SAW Low Heat   |                 |      |              |            |          |
|--|-----------|---|-----------------|------|--------------|------------|----------|
| Material Specification:  |           | ASTM A709 HPS Gr. 70W / AASHTO M270 HPS Gr. 70W   |                 |      |              |            |          |
| Welding Process:   |           | SAW   |                 |      |              |            |          |
| Manual or Machine:   |           | Auto-Machine  |                 |      |              |            |          |
| Weld Position:   |           | Flat  |                 |      |              |            |          |
| Filler Metal Specification:  |           | AWS A5.17   |                 |      |              |            |          |
| Filler Metal Classification:   |           | ENi5  |                 |      |              |            |          |
| Filler Metal Manufacturer:   |           | Lincoln   |                 |      |              |            |          |
| Trade Name:  |           | "Lincoln LA-85"   |                 |      |              |            |          |
| Flux:  |           | Lincolnweld MIL800 (Neutral Flux)   |                 |      |              |            |          |
| Root Treatment:  |           | Back gouge by grinding (no air arc gouging) to sound metal before welding second side to reduce excess heat input |                 |      |              |            |          |
| Preheat and Interpass Temperature:   |           | Max: 300°F (150°C)<br>Min: 175°F (80°C)   |                 |      |              |            |          |
| Postheat Treatment:  |           | None  |                 |      |              |            |          |
| Joint Geometry   |           |   |                 |      |              |            |          |
| Double bevel groove weld   |           |   |                 |      |              |            |          |
| (Reference: AWS D1.5 Figure 2.4)   |           |   |                 |      |              |            |          |
| Pass No.   | Weld Type | Electrode Size (number)   | Welding Current |      | Travel Speed | Heat Input | Polarity |
|  |           |   | Volts           | Amps |              |            |          |
| ALL  | GROOVE    | 3/32" (single)  | 30              | 430  | 18 IPM       | 40 kJ/in.  | DCEP     |
| Comments: The preheat and interpass temperature range is designed to target a cooling rate of 30°C/s |           |   |                 |      |              |            |          |
| Approved By:   |           | Signed:   |                 |      | Date:        |            |          |