



National Aeronautics and
Space Administration

John C. Stennis Space Center
Stennis Space Center, MS
39529-6000

SSTD-8070-0035-WELD
Rev. B
NOVEMBER 2023

COMPLIANCE IS MANDATORY

John C. Stennis Space Center ASME Procedure for Welding Monel Alloy (ASME P-No. 42) to Stainless Steel (ASME P-No. 8)

Approved by:

| | |
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| <u>ISSUED CEF</u> | <u>12-7-23</u> |
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Document History Log

| Change/ Revision | Change Date | Originator/ Phone | Description |
|---------------------|----------------|---------------------------|---|
| Basic | 09.20.2013 | Doug Dike, Ext. 8-2803 | Initial release, superseding SSC STD 34-041. CEF Archive Information: Part of Appendix B, Standards and Specifications Plan to Contract NAS13-400. |
| A | 10.03.2018 | Doug Dike, Ext. 8-2803 | Five-year review. Updated cover sheet to include concurrence by Safety & Mission Assurance. Updated references and acronyms. Minor administrative revisions throughout document. Section 6.0: Revised to delete requirement to maintain original, signed hardcopy of this SSTD in CEF upon its electronic approval. Updated WPS attachment to Form SSC-937. |
| B | 11.10.2023 | Benny McGrath 8-2969 | Five-year review. Updated Directorate titles as necessary throughout document. P-42 and P-8 changed to ASME P-No. 42 and ASME P-No. 8, respectively, throughout document. Updated references and acronyms. Section 5.0-c: Added, "and in accordance with ASME Boiler and Pressure Vessel Codes, Section IX, requirements." WPS (Attachment A) updated to the following: Thickness Range Qualified As-Welded, 0.063". Filler Metals (QW-404) Thickness Range Qualified As-Welded Max, 3/16". Welding Procedure: Filler Metal Size (in.), 1/16" – 3/16"; Amperes, 100 – 138; Travel Speed, 3 – 8 i.p.m.; Maximum Heat Input (kj/in), 200 F; and Max. String or Weave Bead, String Bead. |
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1.0 PURPOSE

This John C. Stennis Space Center (SSC) standard (SSTD) outlines the qualified Gas Tungsten Arc Welding (GTAW) procedure for use in welding Monel Alloy to Stainless Steel at SSC.

2.0 APPLICABILITY

This SSTD applies to all contractor and subcontractor personnel involved with the welding of Monel Alloy to Stainless Steel at SSC.

3.0 REFERENCES

All references are assumed to be the latest version unless otherwise indicated.

- ASME Boiler and Pressure Vessel Codes, Section II, *Materials*
- ASME Boiler and Pressure Vessel Codes, Section IX, *Welding, Brazing and Fusing Procedures*
- ASTM A167, *Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip*
- ASTM A182, *Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service*
- ASTM A213, *Standard Specification for Seamless Ferritic and Austenitic Alloy Steel Boiler, Superheater, and Heat Exchanger Tubes*
- ASTM A240, *Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*
- ASTM A249, *Standard Specification for Welded Austenitic Steel Boiler, Superheater, Heat Exchanger, and Condenser Tubes*
- ASTM A269, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service*
- ASTM A270, *Standard Specification for Seamless and Welded Austenitic and Ferritic/Austenitic Stainless Steel Sanitary Tubing*
- ASTM A276, *Standard Specification for Stainless Steel Bars and Shapes*
- ASTM A312, *Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes*
- ASTM A313, *Standard Specification for Stainless Steel Spring Wire*
- ASTM A314, *Standard Specification for Stainless Steel Billets and Bars for Forging*
- ASTM A320, *Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service*
- ASTM A336, *Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts*
- ASTM A358, *Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications*

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ASTM A368, *Standard Specification for Stainless Steel Wire Strand*
 ASTM A376, *Standard Specification for Seamless Austenitic Steel Pipe for High-Temperature Service*
 ASTM A403, *Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings*
 ASTM A409, *Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service*
 ASTM A473, *Standard Specification for Stainless Steel Forgings*
 ASTM A478, *Standard Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire*
 ASTM A479, *Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels*
 ASTM A492, *Standard Specification for Stainless Steel Rope Wire*
 ASTM A493, *Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging*
 ASTM A511, *Standard Specification for Seamless Stainless Steel Mechanical Tubing and Hollow Bar*
 ASTM A554, *Standard Specification for Welded Stainless Steel Mechanical Tubing*
 ASTM A580, *Standard Specification for Stainless Steel Wire*
 ASTM A632, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small Diameter) for General Service*
 ASTM A666, *Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar*
 ASTM A688, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Feedwater Heater Tubes*
 ASTM A774, *Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures*
 ASTM A778, *Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products*
 ASTM A793, *Standard Specification for Rolled Floor Plate, Stainless Steel*
 ASTM A813, *Standard Specification for Single- or Double-Welded Austenitic Stainless Steel Pipe*
 ASTM A814, *Standard Specification for Cold-Worked Welded Austenitic Stainless Steel Pipe*
 ASTM B127, *Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip*
 ASTM B163, *Standard Specification for Seamless Nickel and Nickel Alloy Condenser and Heat-Exchanger Tubes*
 ASTM B164, *Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire*
 ASTM B165, *Standard Specification for Nickel-Copper Alloy (UNS N04400) Seamless Pipe and Tube*
 ASTM B366, *Standard Specification for Factory-Made Wrought Nickel and Nickel Alloy Fittings*

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ASTM B564, *Standard Specification for Nickel Alloy Forgings*
 ASTM B725, *Standard Specification for Welded Nickel (UNS N02200/UNS N02201) and Nickel Copper Alloy (UNS N04400) Pipe*
 ASTM B730, *Standard Specification for Welded Nickel (UNS N02200/UNS N02201) and Nickel Copper Alloy (UNS N04400) Tube*
 ASTM F96, *Standard Specification for Electronic Grade Alloys of Copper and Nickel in Wrought Forms*
 AWS Welding Handbook
 FED QQ-N-281, *Federal Specification: Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections*
 MIL-N-24106, *Nickel Copper Alloy Bars, Rods, and Forgings*
 MIL-S-23195, *Steel Bars and Forgings Corrosion Resistant*
 MIL-S-23196, *Steel Plate, Corrosion Resistant, Austenitic (UNS S30400, S30403, S31600, S34700, and S34800)*
 MIL-T-1368, *Tube and Pipe, Nickel-Copper Alloy, Seamless and Welded*
 MIL-T-23520, *Tube and Pipe, Nickel-Copper Alloy, Seamless, Air Melted*
 SAE J405, *Chemical Compositions of SAE Wrought Stainless Steels*
 SPR 1440.1, *SSC Records Management Program Requirements*
 SPR 8715.1, *Safety and Health Program Requirements*
 SSTD-8070-0005-CONFIG, *SSC Preparation, Review, Approval, and Release of SSC Standards*
 SSTD-8070-0013-WELD, *Classes of Welding Inspection*
 SSTD-8070-0014-WELD, *Qualifying Welders and Weld Procedures*

4.0 RESPONSIBILITIES

- a. Users of this SSTD shall comply with its requirements, ensure use of the correct version of this SSTD and the documents it references, and inform the appropriate organization of needed changes in accordance with SSTD-8070-0005-CONFIG.
- b. Responsibilities for the use and control of this SSTD and for the review and approval of revisions or cancellation of this SSTD shall be as specified in SSTD-8070-0005-CONFIG and the applicable documents referenced therein.

5.0 REQUIREMENTS AND PROCEDURES

- a. This procedure shall be used for welding any UNS N04400 base metal (Monel 400) meeting one or more of the following specifications:

AMS 4544, 4574, 4575, 4675, 4730, 4731

ASME SB127, SB163, SB164, SB165, SB564

ASTM B127, B163, B164, B165, B366, B564, B725, B730

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FED QQ-N-281

MIL-N-24106, MIL-5-1368, MIL-5-23520

- b. The stainless steel to be welded shall meet one or more of the following specifications:
- AISI 340L, 304, 316L, 316, 317L, 317, 321, 347, 348, XM-15, XM-21
- AMS 5501, 5511, 5513, 5560, 5563, 5564, 5565, 5566, 5567, 5639, 5647, 5697, 7228, 7245
- ASME SA-182, SA-213, SA-240, SA-249, SA-312, SA-320, SA-336, SA-351, SA-358, SA-376, SA-403, SA-409, SA-430, SA-451, SA-479, SA-688
- ASTM A167, A182, A213, A240, A249, A269, A270, A271, A276, A312, A313, A314, A320, A336, A358, A368, A376, A403, A409, A430, A473, A478, A479, A492, A493, A511, A554, A580, A632, A666, A688, A793, A813, A814, A851, A774, A778
- SAE J405
- UNS S30400, S30403, S30452, S31600, S31603, S31700, S31703, S32100, S34700, S34800, S38100
- c. Items denoted as essential variables in the attached weld procedure specifications (WPS) shall not be altered when using the WPS. An alternate WPS may be used only if approved prior to use by the National Aeronautics and Space Administration (NASA) SSC Center Operations Directorate Facilities Engineering Test Complex Support, the NASA SSC Engineering and Test Directorate (E&TD), the NASA SSC Safety and Mission Assurance (S&MA) Office, and in accordance with ASME Boiler and Pressure Vessel Codes, Section IX, requirements..
- d. The attached Procedure Qualification Records (PQR), No. 34-041 Monel/Steel/GTAW, is the PQR for the original qualification of this WPS. When performing new qualifications, a new PQR should be filled out showing all pertinent data and results of the weld procedure qualification.
- f. Welders shall be qualified in accordance with SSTD-8070-0014-WELD, *Qualifying Welders and Welding Procedures*.
- g. Inspection methods for welds shall be in accordance with SSTD-8070-0013-WELD, *Classes of Welding Inspection*.

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- h. All procedures shall be performed in compliance with applicable requirements in SPR 8715.1, *SSC Safety and Health Program Requirements*. If ever there is a conflict between this SSTD and the Stennis Procedural Requirement (SPR), the SPR shall superseded this SSTD.

6.0 RECORDS AND FORMS

Records and forms required by the procedures of this SSTD shall be maintained in accordance with SPR 1440.1. All records and forms are assumed to be the latest edition unless otherwise indicated. Forms may be obtained from the SSC Electronic Forms repository or from the NASA SSC Forms Management Officer. Quality Records are identified in the SSC Master Records Index.

The original, signed WPSs and PQRs (copies of which are provided in Attachments A and B of this SSTD) shall be maintained in CEF.


7.0 ACRONYMS AND ABBREVIATIONS

| | |
|------|---|
| AISI | American Iron and Steel Institute |
| AMS | Alpha Magnetic Spectrometer |
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| AWS | American Welding Society |
| E&TD | Engineering & Test Directorate |
| FED | Federal |
| GTAW | Gas Tungsten Arc Welding |
| MIL | Military |
| NASA | National Aeronautics and Space Administration |
| PQR | Procedure Qualification Record |
| S&MA | Safety & Mission Assurance |
| SAE | Society of Automotive Engineers |
| SSC | John C. Stennis Space Center |
| SSTD | John C. Stennis Space Center Standard |
| SPR | Stennis Procedural Requirements |
| UNS | Unified Numbering System |
| WPS | Weld Procedure Specifications |

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ATTACHMENT A: WELDING PROCEDURE SPECIFICATIONS (WPS)

|  National Aeronautics and Space Administration John C. Stennis Space Center Stennis Space Center, MS 39529-6000 | | ASME - WELDING PROCEDURE SPECIFICATIONS (WPS) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|------------|--|----------------------|-------|-----------|--|-----------|--|------|------|------|------|-------------------|-----------|---------------|-------|-------|---------------|-------|-------|-------|-------|---------------|-------|-------|-------|-------|---------------|-------|-------|-------|-------|--------------|------------|---------------|-------|-------|
| Welding Procedure Specification Record Number 34-041 | | Date 10/07/2023 | Revision Number C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Qualified To ASME Boiler and Pressure Vessel Code | | Company Name Syncom Space Services | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Supporting PQR(s) 34-MONEL/SSTEEL/GTAW | | Reference Docs. N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Scope Welding Monel to Stainless Steel | | Joint Single/Double V Groove, Single/Double U Groove, All fillets | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BASE METALS (QW-403) Type <u>Monel</u> P-no. <u>42</u> Grp-no. <u>N/A</u> Welded To <u>SS 304L</u> P-no. <u>8</u> Grp-no. <u>1</u> Backing <u>None</u> P-no. <u> </u> Grp-no. <u> </u> Retainers <u>None</u> Notes <u>N/A</u> | | THICKNESS RANGE QUALIFIED <table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="2">As-welded</th> <th colspan="2">With PWHT</th> </tr> <tr> <th>Min.</th> <th>Max.</th> <th>Min.</th> <th>Max.</th> </tr> </thead> <tbody> <tr> <td>Complete Pen.</td> <td>0.063"</td> <td>0.58"</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Complete Pen.</td> <td>_____</td> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Impact Tested</td> <td>_____</td> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Impact Tested</td> <td>_____</td> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Fillet Welds</td> <td><u>All</u></td> <td><u>No Max</u></td> <td>_____</td> <td>_____</td> </tr> </tbody> </table> | | | As-welded | | With PWHT | | Min. | Max. | Min. | Max. | Complete Pen. | 0.063" | 0.58" | N/A | N/A | Complete Pen. | _____ | _____ | _____ | _____ | Impact Tested | _____ | _____ | _____ | _____ | Impact Tested | _____ | _____ | _____ | _____ | Fillet Welds | <u>All</u> | <u>No Max</u> | _____ | _____ |
| | As-welded | | With PWHT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Min. | Max. | Min. | Max. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Complete Pen. | 0.063" | 0.58" | N/A | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Complete Pen. | _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Impact Tested | _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Impact Tested | _____ | _____ | _____ | _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fillet Welds | <u>All</u> | <u>No Max</u> | _____ | _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FILLER METALS (QW-404) Process <u>SFA</u> Classification <u>ER NiCu-7</u> F-no. <u>42</u> A-no. <u> </u> Chemical Analysis or Trade Name <u>Bare Solid Wire</u> GTAW <u>5.14</u> <u>ER NiCu-7</u> <u>42</u> <u> </u> <u>Bare Solid Wire</u> | | THICKNESS RANGE QUALIFIED <table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="2">As-welded</th> <th colspan="2">With PWHT</th> </tr> <tr> <th>Min.</th> <th>Max.</th> <th>Min.</th> <th>Max.</th> </tr> </thead> <tbody> <tr> <td>Nominal Pipe Size</td> <td><u>1"</u></td> <td><u>No Max</u></td> <td>_____</td> <td>_____</td> </tr> </tbody> </table> | | | As-welded | | With PWHT | | Min. | Max. | Min. | Max. | Nominal Pipe Size | <u>1"</u> | <u>No Max</u> | _____ | _____ | | | | | | | | | | | | | | | | | | | | |
| | As-welded | | With PWHT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Min. | Max. | Min. | Max. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Nominal Pipe Size | <u>1"</u> | <u>No Max</u> | _____ | _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cons. Insert _____ Flux _____ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WELDING PROCEDURE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Welding Process | | GTAW | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Type | | Manual | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Minimum preheat/interpass temperature (°F) | | 60°F | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Maximum interpass temperature (°F) | | 200°F | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Tungsten Size | | 3/32" - 1/8" | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Tungsten Type | | THORIATED EWTH-2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Filler Metal Size (in.) | | 1/16" - 3/16" | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Layer Number | | 1 - 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Position of Groove | | 6G | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Weld Progression | | UPHILL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Current/Polarity | | DC / DCEN (-) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Amperes | | 100 - 138 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Volts | | 15 - 18 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Travel Speed (in./min) | | 3 - 8 i.p.m. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Maximum Heat Input (kJ/in) | | 200 F MAX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DC Pulsing Current | | Not Used | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Shielding: Gas Type | | ARGON 99.99% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Flow Rate (cfh) | | 20 - 45 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Trailing: Gas Type | | NONE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Flow Rate (cfh) | | NONE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Backing: Gas Type | | ARGON 99.99% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Flow Rate (cfh) | | 2 - 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| String or Weave | | Weave Bead | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Orifice/Gas Cup Size | | 4-3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Multi/Single Pass per Side | | MAXIMUM DEPOSIT PER PASS 1/4" | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Weld Deposit Chemistry | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Notes | | See Notes * | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |


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|--|--|
| Stennis Standard | SSTD-8070-0035-WELD B |
| | <i>Number</i> <i>Rev.</i> |
| | Effective Date: November 10, 2023 |
| | Review Date: November 10, 2028 |
| Page 10 of 13 | |
| Responsible Office: NASA SSC Center Operations Directorate | |
| SUBJECT: ASME Procedure for Welding Monel Alloy (ASME P-No. 42) to Stainless Steel (ASME P-No. 8) | |

| | | | |
|---|--|--|----------------------|
|  National Aeronautics and Space Administration John C. Stennis Space Center Stennis Space Center, MS 39529-6000 | | ASME - WELDING PROCEDURE SPECIFICATIONS (WPS) | |
| Welding Procedure Specification Record Number 34-041 | | Date 10/07/2023 | Revision Number C |
| Qualified To ASME Boiler and Pressure Vessel Code | | Company Name Syncom Space Services | |
| BASE METALS (QW-403) Peening <u>Peening not used with this procedure.</u> Surface Preparation _____ Initial/Interpass Cleaning <u>See Notes **.</u> Back Gouging Method <u>Thermal or Mechanical if required. (Grind 1/18" if thermal.)</u> | | | |
| NOTES <u>Two layers of buttering shall be applied to the groove face of the stainless steel. Buttering shall be applied with electrodes of ER-Ni-CU-7 and shall be done in the flat position.</u> <u>Oscillation is not used with this procedure.</u> <u>*Apply two layers of buttering to the groove face of the stainless steel. Repair. Grind followed by brushing with S/S brush. Repair per this procedure or repair as directed by Engineer.</u> <u>**Aluminum oxide grinding wheels only for mechanical grinding. Virgin S/S Brush 2" both sides of weld joint; use only brushes and grinding wheels not previously used on carbon steel when base metal being brushed or ground in stainless or a specialty alloy.</u> | | | |
| Signature 1 Engineer Name Richard "Rick" Grimstead Date <u>10-18-23</u> | | Signature 2 Quality Name Richard Ladner Date <u>10-19-23</u> | |
| Signature 3 Customer Reviewer Name Benjamin McGrath Date <u>10-17-23</u> | | Signature 4 Customer Name Date  | |
| SSC-937 (02/2018) | | Page 2 of 3 | |

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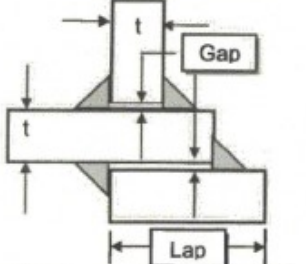
National Aeronautics and
 Space Administration
 John C. Stennis Space Center
 Stennis Space Center, MS 39529-6000

ASME - WELDING PROCEDURE SPECIFICATIONS (WPS)

| | | |
|---|---------------------------------------|----------------------|
| Welding Procedure Specification Record Number 34-041 | Date 10/07/2023 | Revision Number C |
| Qualified To ASME Boiler and Pressure Vessel Code | Company Name Syncom Space Services | |

Weld Joint Designs

Attachment #1

| | | |
|---|---|---|
| Single-V Groove | Single-Bevel Groove | Double-V Groove |
|  |  |  |
| Groove Angle: 50 to 75 deg Root Opening: 1/16 to 3/16 in. Root Face: 0 to 1/16 in. Misalignment: 1/16-in. max. | Groove Angle: 37.5 to 45 deg Root Opening: 1/16 to 3/16 in. Root Face: 0 to 1/16 in. Misalignment: 1/16-in. max. | Groove Angle: 50 to 75 deg Root Opening: 1/16 to 3/16 in. Root Face: 0 to 1/16 in. Misalignment: 1/16-in. max. |
| Double-Bevel Groove | Single-J Groove | Double-J Groove |
|  |  |  |
| Groove Angle: 37.5 to 45 deg Root Opening: 1/16 to 3/16 in. Root Face: 0 to 1/16 in. Misalignment: 1/16-in. max. | Groove Angle: 37.5 to 45 deg Groove Radius: 3/8 in. Root Opening: 1/16 to 3/16 in. Root Face: 0 to 1/16 in. Misalignment: 1/16-in. max. | Groove Angle: 37.5 to 45 deg Groove Radius: 3/8 in. Root Opening: 1/16 to 3/16 in. Root Face: 0 to 1/16 in. Misalignment: 1/16-in. max. |
| Single-U Groove | Double-U Groove | Fillet Weld T or Lap |
|  |  |  |
| Groove Angle: 50 to 75 deg Groove Radius: 3/8 in. Root Opening: 1/16 to 3/16 in. Root Face: 0 to 1/16 in. Misalignment: 1/16-in. max. | Groove Angle: 50 to 75 deg Groove Radius: 3/8 in. Root Opening: 1/16 to 3/16 in. Root Face: 0 to 1/16 in. Misalignment: 1/16-in. max. | Gap: 1/16-in. max. / Lap: 5 x t or 1 in. min. |

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ATTACHMENT B: WELDING PROCEDURE QUALIFICATION RECORD (PQR)

QW-483 SUGGESTED FORMAT FOR WELDING PROCEDURE QUALIFICATION RECORD (PQR)

(See QW-201.2, Section IX, ASME Boiler and Pressure Vessel Code)
Record Actual Conditions Used to Weld Test Coupon

Company Name Johnson Controls World Services Inc.

Welding Procedure Qualification Record No. 34-MONEL/SSTEEL/GTAW Date 07-15-1993

WPS No. 34-041

Welding Process(es) GTAW

Types (Manual, Automatic, Semi-Auto) Manual

JOINTS (QW-402)

BASE METALS (QW-403)

Material Spec. UNS N04400 to S30403

Type or Grade Monel 400 to 304L

P-No. 42 to P-No. 8

Thickness of Test Coupon SCH 40 (.280")

Diameter of Test Coupon 150 mm (6")

POSTWELD HEAT TREATMENT (QW-407)

Temperature NOT APPLICABLE

Time _____

Other _____

FILLER METALS (QW-404)

SFA Specification SFA-5.14

AWS Classification ER NiCu-7 Filler Metal F-No. 42 Weld Metal Analysis A-No. NiCu Size of Filler Metal 2.3mm (3/32") & 3.1mm (1/8") Other _____ Deposited Weld Metal _____

GAS (QW-408)

| | Percent Composition | | |
|-----------|---------------------|-----------|--------------------------------|
| | Gas(es) | (Mixture) | Flow Rate |
| Shielding | ARGON | 99.99% | 0.566m ³ /h (20CFH) |
| Trailing | N/A | | |
| Backing | ARGON | 99.99% | 0.991m ³ /h (35CFH) |

ELECTRICAL CHARACTERISTICS (QW-409)

Current DC

Polarity DCEN (-)

Amps. 100 - 138 volts 15 - 18

Tungsten Electrode Size 2.4mm (3/32")

Other _____

POSITION (QW-405)

Position of Groove 6G

Weld Progression (Uphill, Downhill) UPHILL

Other _____

TECHNIQUE (QW-410)

Travel Speed 75 - 125 mm/min (3 - 5 i.p.m.)

String or Weave Bead String Bead

Oscillation Not Applicable

Multipass or Single Pass (per side) Multiple

PREHEAT (QW-406)

Preheat Temp. 75° F

Interpass Temp. 200° F MAX

Other Applied two layers of buttering to the groove face of the stainless steel. Applied with specified electrodes in the flat position.

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PQR No. 34-Monel/SSSteel/GTAW

QW-483 (Back)

Tensile Test (QW-150)

| Specimen No. | Width in. | Thickness in. | Area in ² | Ultimate Total Load lb | Ultimate Unit Stress psi | Character of Failure & Location |
|--------------|-----------|---------------|----------------------|------------------------|--------------------------|---------------------------------|
| T 1 | (0.497) | (0.277) | 0.1377 | 10,300 | 74,800 | BASE |
| T 2 | (0.505) | (0.283) | 0.1429 | 10,700 | 74,878 | BASE |
| | | | | | | |
| | | | | | | |

Guided Bend Tests (QW-160)

| Type and Figure No. | Result |
|----------------------|--------------|
| SIDE BEND QW 462.2 1 | SATISFACTORY |
| SIDE BEND QW 462.2 2 | SATISFACTORY |
| SIDE BEND QW 462.2 3 | SATISFACTORY |
| SIDE BEND QW 462.2 4 | SATISFACTORY |

Toughness Tests (QW-170)

| Specimen No. | Notch Location | Notch Type | Test Temp. | Impact Values | Lateral Exp. | | Drop Weight | |
|--------------|----------------|------------|------------|---------------|--------------|------|-------------|----------|
| | | | | | % Shear | Mils | Break | No Break |
| N/A | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

FILLET WELD TEST (QW-180)

Result - Satisfactory N/A Penetration into Parent Metal Yes, No

Type and Character of Failure Macro-Results

Welder's Name BILL BUFKIN Clock No. 2735 Stamp No. W - 1

Tests conducted by: MECHANICAL TEST LABORATORY Laboratory Test No. 07F05.1 (.2)

per:

We certify that the statements in this record are correct and that the test welds were prepared, welded and test in accordance with the requirements of Section IX of the ASME Code.

Signed Johnson Controls World Services
(Manufacturer)

Date By

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