



National Aeronautics and  
Space Administration

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

**SSTD-8070-0035-WELD Rev. A**  
**OCTOBER 2018**

# COMPLIANCE IS MANDATORY

## **John C. Stennis Space Center ASME Procedure for Welding Monel Alloy (P-42) to Stainless Steel (P-8)**

### **Approved by:**

<u>Scott Olive in DDMS</u> NASA SSC Center Operations Design & Construction Project Management Division	<u>10-29-18</u> Date
--	-------------------------

### **Concurrence by:**

<u>Mike Killam in DDMS</u> NASA SSC Center Operations Directorate Operations and Maintenance Division	<u>11-05-18</u> Date
---	-------------------------

<u>Bartt J. Hebert in DDMS</u> NASA SSC Engineering & Test Directorate	<u>10-22-18</u> Date
---	-------------------------

<u>Son Le in DDMS</u> NASA SSC Safety & Mission Assurance	<u>10-26-18</u> Date
--	-------------------------

### **Issued by**

<u>ISSUED CEF</u> Central Engineering Files	<u>11-5-18</u> Date
--	------------------------

This is an uncontrolled document when printed. Verify that the document is current before use.

Stennis Standard	SSTD-8070-0035-WELD A
	<i>Number</i> <span style="float: right;"><i>Rev.</i></span>
	Effective Date: October 3, 2018
	Review Date: October 3, 2023
Page 2 of 13	
Responsible Office: NASA SSC Center Operations Directorate	
<b>SUBJECT: ASME Procedure for Welding Monel Alloy (P-42) to Stainless Steel (P-8)</b>	

## 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. <b>CEF Archive Information:</b> 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.

Stennis Standard	SSTD-8070-0035-WELD A
	<i>Number</i> <span style="float: right;"><i>Rev.</i></span>
	Effective Date: October 3, 2018
	Review Date: October 3, 2023
Page 3 of 13	
Responsible Office: NASA SSC Center Operations Directorate	
<b>SUBJECT: ASME Procedure for Welding Monel Alloy (P-42) to Stainless Steel (P-8)</b>	

## Table of Contents

<b>1.0</b>	<b>PURPOSE .....</b>	<b>4</b>
<b>2.0</b>	<b>APPLICABILITY.....</b>	<b>4</b>
<b>3.0</b>	<b>REFERENCES.....</b>	<b>4</b>
<b>4.0</b>	<b>RESPONSIBILITIES .....</b>	<b>6</b>
<b>5.0</b>	<b>REQUIREMENTS AND PROCEDURES .....</b>	<b>6</b>
<b>6.0</b>	<b>RECORDS AND FORMS.....</b>	<b>8</b>
	<b>ATTACHMENT A: WELDING PROCEDURE SPECIFICATIONS (WPS).....</b>	<b>9</b>
	<b>ATTACHMENT B: WELDING PROCEDURE QUALIFICATION RECORD (PQR).....</b>	<b>12</b>

Stennis Standard	SSTD-8070-0035-WELD A
	<i>Number</i> <span style="float: right;"><i>Rev.</i></span>
	Effective Date: October 3, 2018
	Review Date: October 3, 2023
Page 4 of 13	
Responsible Office: NASA SSC Center Operations Directorate	
<b>SUBJECT: ASME Procedure for Welding Monel Alloy (P-42) to Stainless Steel (P-8)</b>	

## 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 and Brazing Qualifications*
- 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*
- ASTM A368, *Standard Specification for Stainless Steel Wire Strand*

Stennis Standard	SSTD-8070-0035-WELD A
	<i>Number</i> <span style="float: right;"><i>Rev.</i></span>
	Effective Date: October 3, 2018
	Review Date: October 3, 2023
Page 5 of 13	
Responsible Office: NASA SSC Center Operations Directorate	
<b>SUBJECT: ASME Procedure for Welding Monel Alloy (P-42) to Stainless Steel (P-8)</b>	

- 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*
- ASTM B564, *Standard Specification for Nickel Alloy Forgings*

Stennis Standard	SSTD-8070-0035-WELD A
	<i>Number</i> <span style="float: right;"><i>Rev.</i></span>
	Effective Date: October 3, 2018
	Review Date: October 3, 2023
Page 6 of 13	
Responsible Office: NASA SSC Center Operations Directorate	
<b>SUBJECT: ASME Procedure for Welding Monel Alloy (P-42) to Stainless Steel (P-8)</b>	

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, Sheet and Strip, Corrosion Resistant*

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

FED QQ-N-281

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

Stennis Standard	SSTD-8070-0035-WELD A
	<i>Number</i> <span style="float: right;"><i>Rev.</i></span>
	Effective Date: October 3, 2018
	Review Date: October 3, 2023
Page 7 of 13	
Responsible Office: NASA SSC Center Operations Directorate	
<b>SUBJECT: ASME Procedure for Welding Monel Alloy (P-42) to Stainless Steel (P-8)</b>	

- 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, S3480, 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 NASA SSC Center Operations Directorate Project Management Division (PMD), the NASA SSC Engineering and Test Directorate (E&TD), and the NASA SSC Safety and Mission Assurance (S&MA) Office.
- d. The attached Procedure Qualification Records (PQR), No. 34-041 Monel/SSSteel/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*.
- 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.

Stennis Standard	SSTD-8070-0035-WELD A
	<i>Number</i> <span style="float: right;"><i>Rev.</i></span>
	Effective Date: October 3, 2018
	Review Date: October 3, 2023
Page 8 of 13	
Responsible Office: NASA SSC Center Operations Directorate	
<b>SUBJECT: ASME Procedure for Welding Monel Alloy (P-42) to Stainless Steel (P-8)</b>	

## 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
E&TD	Engineering & Test Directorate
GTAW	Gas Tungsten Arc Welding
MIL	Military
NASA	National Aeronautics and Space Administration
PMD	Project Management Division
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
WPQ	Welder Performance Qualification
WPS	Weld Procedure Specifications



Stennis Standard	SSTD-8070-0035-WELD A
	<i>Number</i> <span style="float:right"><i>Rev.</i></span>
	Effective Date: October 3, 2018
	Review Date: October 3, 2023
Page 9 of 13	
Responsible Office: NASA SSC Center Operations Directorate	
<b>SUBJECT: ASME Procedure for Welding Monel Alloy (P-42) to Stainless Steel (P-8)</b>	

### 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 09/20/2018	Revision Number B																														
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																															
<b>BASE METALS (QW-403)</b>		<b>THICKNESS RANGE QUALIFIED</b>																															
Type	Monel	P-no.	42	Grp-no.	N/A																												
Welded To	SS 304L	P-no.	8	Grp-no.	1																												
Backing	None	P-no.		Grp-no.																													
Retainers	None																																
Notes	No pass greater than 12.7 mm (1/2") thick.																																
		<table border="1"> <thead> <tr> <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>0.188"</td> <td>0.58"</td> <td>N/A</td> </tr> <tr> <td>Complete Pen.</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Impact Tested</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Impact Tested</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Fillet Welds</td> <td>No Min</td> <td>No Max</td> <td></td> </tr> </tbody> </table>				As-welded		With PWHT		Min.	Max.	Min.	Max.	Complete Pen.	0.188"	0.58"	N/A	Complete Pen.				Impact Tested				Impact Tested				Fillet Welds	No Min	No Max	
As-welded		With PWHT																															
Min.	Max.	Min.	Max.																														
Complete Pen.	0.188"	0.58"	N/A																														
Complete Pen.																																	
Impact Tested																																	
Impact Tested																																	
Fillet Welds	No Min	No Max																															
		<table border="1"> <thead> <tr> <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>1"</td> <td>No Max</td> <td>N/A</td> </tr> </tbody> </table>				As-welded		With PWHT		Min.	Max.	Min.	Max.	Nominal Pipe Size	1"	No Max	N/A																
As-welded		With PWHT																															
Min.	Max.	Min.	Max.																														
Nominal Pipe Size	1"	No Max	N/A																														
<b>FILLER METALS (QW-404)</b>		<b>THICKNESS RANGE QUALIFIED</b>																															
Process	SFA	Classification	F-no.	A-no.	Chemical Analysis or Trade Name																												
GTAW	5.14	ER NiCu-7	42		Bare Solid Wire																												
Cons. Insert																																	
Flux																																	
<b>WELDING PROCEDURE</b>																																	
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.)		5/64" - 1/8"																															
Layer Number		1 - 7																															
Position of Groove		6G																															
Weld Progression		UPHILL																															
Current/Polarity		DC / DCEN (-)																															
Amperes		70 - 140																															
Volts		15 - 18																															
Travel Speed (in./min)		3 - 5 i.p.m.																															
Maximum Heat Input (kJ/in)		20.0																															
DC Pulsing Current		Not Used																															
Shielding: Gas Type		ARGON 99.99%																															
Flow Rate (cch)		20 - 45																															
Trailing: Gas Type		NONE																															
Flow Rate (cch)		NONE																															
Backing: Gas Type		ARGON 99.99%																															
Flow Rate (cch)		2 - 15																															
String or Weave		STRING BEAD																															
Orifice/Gas Cup Size		4-8																															
Multi/Single Pass per Side		EITHER MULTI OR SINGLE		MAXIMUM DEPOSIT PER PASS 1/4"																													
Weld Deposit Chemistry																																	
Notes		See Notes *																															

Stennis Standard	SSTD-8070-0035-WELD A
	<i>Number</i> <span style="float: right;"><i>Rev.</i></span>
	Effective Date: October 3, 2018
	Review Date: October 3, 2023
Page 10 of 13	
Responsible Office: NASA SSC Center Operations Directorate	
<b>SUBJECT: ASME Procedure for Welding Monel Alloy (P-42) to Stainless Steel (P-8)</b>	

	National Aeronautics and Space Administration John C. Stennis Space Center Stennis Space Center, MS 39529-6000	<b>ASME - WELDING PROCEDURE SPECIFICATIONS (WPS)</b>	
Welding Procedure Specification Record Number 34-041	Date 09/20/2018	Revision Number B	
Qualified To ASME Boiler and Pressure Vessel Code	Company Name Syncom Space Services		
<b>BASE METALS (QW-403)</b> 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>			
<b>NOTES</b> 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. _____ Oscillation is not used with this procedure. _____ *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. _____ **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. _____ _____ _____ _____ _____ _____ _____ _____			
<b>Signature 1</b> Engineer Name Doug Dike Date 09/20/18		<b>Signature 2</b> Quality Name Stephen Koch Date 09/20/18	
			
<b>Signature 3</b> Customer Reviewer Name Benjamin McGrath Date 09/20/18		<b>Signature 4</b> Customer Name _____ Date _____	
			

Stennis  
Standard

SSTD-8070-0035-WELD A

Number Rev.



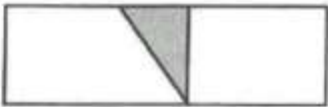



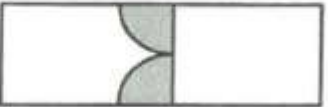


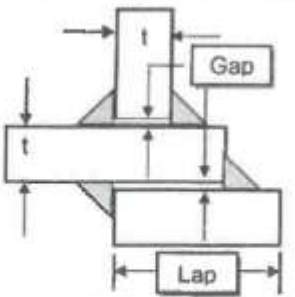
Effective Date: October 3, 2018

Review Date: October 3, 2023

Page 11 of 13

Responsible Office: NASA SSC Center Operations Directorate

**SUBJECT: ASME Procedure for Welding Monel Alloy (P-42) to Stainless Steel (P-8)**

		National Aeronautics and Space Administration John C. Stennis Space Center Stennis Space Center, MS 39529-6000		<b>ASME - WELDING PROCEDURE SPECIFICATIONS (WPS)</b>	
Welding Procedure Specification Record Number 34-041		Date 09/20/2018		Revision Number B	
Qualified To ASME Boiler and Pressure Vessel Code		Company Name Syncom Space Services			
<b>Weld Joint Designs</b>					
<b>Attachment #1</b>					
<b>Single-V Groove</b>		<b>Single-Bevel Groove</b>		<b>Double-V Groove</b>	
					
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.	
<b>Double-Bevel Groove</b>		<b>Single-J Groove</b>		<b>Double-J Groove</b>	
					
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.	
<b>Single-U Groove</b>		<b>Double-U Groove</b>		<b>Fillet Weld T or Lap</b>	
					
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.	

Stennis Standard	SSTD-8070-0035-WELD A
	Number _____ Rev. _____
	Effective Date: October 3, 2018
	Review Date: October 3, 2023
Page 12 of 13	
Responsible Office: NASA SSC Center Operations Directorate	
<b>SUBJECT: ASME Procedure for Welding Monel Alloy (P-42) to Stainless Steel (P-8)</b>	

### 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/SSSTEEL/GTAW Date 07-15-1993

WPS No. 34-041

Welding Process(es) GTAW

Types (Manual, Automatic, Semi-Auto) Manual

JOINTS (QW-402)

<p><b>BASE METALS (QW-403)</b></p> <p>Material Spec. <u>UNS N04400 to S30403</u></p> <p>Type or Grade <u>Monel 400 to 304L</u></p> <p>P-No. <u>42</u> to P-No. <u>8</u></p> <p>Thickness of Test Coupon <u>SCH 40 (.280")</u></p> <p>Diameter of Test Coupon <u>150 mm (6")</u></p>	<p><b>POSTWELD HEAT TREATMENT (QW-407)</b></p> <p>Temperature <u>NOT APPLICABLE</u></p> <p>Time _____</p> <p>Other _____</p>												
<p><b>FILLER METALS (QW-404)</b></p> <p>SFA Specification <u>SFA-5.14</u></p> <p>AWS Classification <u>ER NiCu-7</u> Filler</p> <p>Metal F-No. <u>42</u> Weld Metal</p> <p>Analysis A-No. <u>NiCu</u> Size of Filler</p> <p>Metal <u>2.3mm (3/32") &amp; 3.1mm (1/8")</u> Other _____</p> <p>Deposited Weld Metal _____</p>	<p><b>GAS (QW-408)</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Gas(es)</th> <th style="text-align: left;">(Mixture)</th> <th style="text-align: left;">Flow Rate</th> </tr> </thead> <tbody> <tr> <td>Shielding <u>ARGON</u></td> <td><u>99.99%</u></td> <td><u>0.566m³/h (20CFH)</u></td> </tr> <tr> <td>Trailing <u>N/A</u></td> <td></td> <td></td> </tr> <tr> <td>Backing <u>ARGON</u></td> <td><u>99.99%</u></td> <td><u>0.991m³/h (35CFH)</u></td> </tr> </tbody> </table>	Gas(es)	(Mixture)	Flow Rate	Shielding <u>ARGON</u>	<u>99.99%</u>	<u>0.566m³/h (20CFH)</u>	Trailing <u>N/A</u>			Backing <u>ARGON</u>	<u>99.99%</u>	<u>0.991m³/h (35CFH)</u>
Gas(es)	(Mixture)	Flow Rate											
Shielding <u>ARGON</u>	<u>99.99%</u>	<u>0.566m³/h (20CFH)</u>											
Trailing <u>N/A</u>													
Backing <u>ARGON</u>	<u>99.99%</u>	<u>0.991m³/h (35CFH)</u>											
<p><b>POSITION (QW-405)</b></p> <p>Position of Groove <u>6G</u></p> <p>Weld Progression (Uphill, Downhill) <u>UPHILL</u></p> <p>Other _____</p>	<p><b>ELECTRICAL CHARACTERISTICS (QW-409)</b></p> <p>Current <u>DC</u></p> <p>Polarity <u>DCEN (-)</u></p> <p>Amps. <u>100 - 138</u> volts <u>15 - 18</u></p> <p>Tungsten Electrode Size <u>2.4mm (3/32")</u></p> <p>Other _____</p>												
<p><b>PREHEAT (QW-406)</b></p> <p>Preheat Temp. <u>75° F</u></p> <p>Interpass Temp. <u>200° F MAX</u></p>	<p><b>TECHNIQUE (QW-410)</b></p> <p>Travel Speed <u>75 - 125 mm/min (3 - 5 i.p.m.)</u></p> <p>String or Weave Bead <u>String Bead</u></p> <p>Oscillation <u>Not Applicable</u></p> <p>Multipass or Single Pass (per side) <u>Multiple</u></p> <p>Single or Multiple Electrodes <u>Single</u></p> <p>Other <u>Applied two layers of buttering to the groove face of the stainless steel. Applied with specified electrodes in the flat position.</u></p>												

Stennis  
Standard

SSTD-8070-0035-WELD A

Number \_\_\_\_\_ Rev. \_\_\_\_\_

Effective Date: October 3, 2018

Review Date: October 3, 2023

Page 13 of 13

Responsible Office: NASA SSC Center Operations Directorate

SUBJECT: ASME Procedure for Welding Monel Alloy (P-42) to Stainless Steel (P-8)

PQR No. 34-Monel/SSSteel/GTAW

QW-483 (Back)

Tensile Test (QW-150)

Specimen No.	Width in.	Thickness in.	Area in <sup>2</sup>	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	
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 BUFRIN 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 tested in accordance with the requirements of Section IX of the ASME Code.

Signed Johnson Controls World Services  
(Manufacturer)

Date   By