SSTD-8070-0034-WELD
Rev. A
SEPTEMBER 2019

National Aeronautics and
Space Administration

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

COMPLIANCE IS MANDATORY

JOHN C. STENNIS SPACE CENTER ASME PROCEDURE FOR GTAW WELDING MONEL ALLOY (ASME P-No. 42)

Approved by:

C. Brennan Sanders 9-24-19
NASA SSC Center Operations Date
Facilities Engineering
Test Complex Support

Concurrence by:

Gina Ladner 10-8-19
NASA SSC Center Operations Directorate Date
Facilities Services

Bartt J. Hebert 9-6-19
NASA SSC Engineering & Test Directorate Date

Son Le 9-5-19
NASA SSC Safety & Mission Assurance Date

Issued by

ISSUED CEF 10-8-19
Central Engineering Files Date

Document History Log

Change/ Revision	**Change Date**	**Originator/ Phone**	**Description**
Basic	7/03/2014	Doug Dike Ext. 8-2803	Initial release, superseding SSC-34-040. ***CEF Archive Information:*** Part of Appendix B, Standards and Specifications Plan to Contract NAS13-400.
A	9/4/2019	Doug Dike Ext. 8-2803	Five-year review. Updated cover sheet to reflect approval, concurrence authorizations as necessary. Updated references and acronyms. 5.0-a: Eliminated all but "Monel ASME P-No. 42 to ASME P-No. 42 material". 5.0-b: Added "and in accordance with ASME Boiler and Pressure Vessel Codes, Section IX, requirements." Updated WPS to Form SSC-937. Administrative changes.

Table of Contents

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 (ASME P-No. 42, per ASME Boiler and Pressure Vessel Codes) at SSC.

2.0 APPLICABILITY

This SSTD applies to all contractor and subcontractor personnel involved with the welding of Monel Alloy (ASME P-No. 42).

3.0 REFERENCES AND APPLICABLE DOCUMENTS

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 IV, *Welding, Brazing, and Fusing Qualifications*
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*
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*
MIL-N-24106, *Nickel-Copper Alloy Bars, Rods, and Forgings*
MIL-T-1368, *Military Specification for Tube and Pipe, Nickel-Copper Alloy, Seamless and Welded*
MIL-T-23520, *Tube and Pipe, Nickel-Copper Alloy, Seamless, Air Melted*
QQ-N-281, *Federal Specification: Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections.*
SAE AMS 4544, *Nickel-Copper Alloy, Corrosion Resistant, Sheet, Strip and Plate 67Ni-30Cu, Annealed*
SAE AMS 4574, *Nickel-Copper Alloy, Corrosion Resistant, Tubing, Seamless 671Ni-31Cu Annealed*

SAE AMS 4575, *Nickel-Copper Alloy Tubing, Brazed, Corrosion Resistant, 67Ni-31Cu, Annealed*
SAE AMS 4675, *Nickel-Copper Alloy, Corrosion Resistant, Bars and Forgings 67Ni-30Cu*
SPR 1440.1, *SSC Records Management 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, *Standard for Qualifying Welders and Welding 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 Monel ASME P-No. 42 to ASME P-No. 42 material.

b. 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 Project Management Division, the NASA SSC Engineering and Test Directorate (E&TD), the NASA SSC Safety and Mission Assurance (S&MA) Office, and in accordance with ASME Sec IX requirements.

c. The attached Procedure Qualification Record (PQR) and Welder Performance Qualification (WPQ) are the PQRs and WPQs for the original WPSs in this SSTD. When performing new qualifications, a new, approved PQR and WPQ shall be completed showing all pertinent data and results of the weld procedure qualification.

d. Welders shall be qualified in accordance with SSTD-8070-0014-WELD, *Qualifying Welders and Welding Procedures*.

e. Inspection methods for welds shall be in accordance with SSTD-8070-0013-WELD, *Classes of Welding Inspection*.

6.0 RECORDS AND FORMS

a. Records required by the procedures of this SSTD shall be maintained in accordance with SPR 1440.1 and as specified in this SSTD.

b. All records and forms are the latest version unless otherwise indicated.

c. 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.

d. The original, signed WPS and PQR and Welder Performance Qualification (WPQ) forms (copies of which are provided in Attachments A-I of this SSTD) shall be maintained in Central Engineering Files (CEF).

7.0 ACRONYMS AND ABBREVIATIONS

AMS	Alpha Magnetic Spectrometer
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CEF	Central Engineering Files
E&TD	Engineering & Test Directorate
Fed.	Federal
GTAW	Gas Tungsten Arc Welding
MIL	Military
NASA	National Aeronautics and Space Administration
OMD	Operations and Maintenance Division
PMD	Project Management Division
PQR	Procedure Qualification Record
S&MA	Safety & Mission Assurance
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

Attachment A: Welding Procedure Specifications

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	Date	Revision Number
34-040	July 19, 2019	C

Qualified To: ASME Boiler and Pressure Vessel Code	Company Name: Syncom Space Services (S3)
Supporting PQR(s): 34-Monel/Monel/GTAW	Reference Docs.: SSTD-8070-0034-WELD
Scope: ASME Procedure for GTAW Welding Monel Alloy (P-No. 42)	Joint: Single/Double V Groove, Single/Double U Groove, All Fillets

BASE METALS

		P-no.	Grp-no.
Type	UNS 04400 Monel	42	
Welded To	UNS 04400 Monel	42	
Backing	None		

Retainers: N/A

Notes:

THICKNESS RANGE QUALIFIED

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Complete Pen.	.188"	.560"	N/A	N/A
Complete Pen.				
Impact Tested				
Impact Tested				
Fillet Welds	ALL			

DIAMETER RANGE QUALIFIED

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Nominal Pipe Size	ALL		N/A	N/A

FILLER METALS

Process	SFA	Classification	F-no.	A-no.	Chemical Analysis or Trade Name	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
GTAW	5.14	ER NICu-7	42			.188"	.560"	N/A	N/A
Cons. Insert		N/A							
Flux		N/A							

WELDING PROCEDURE

Welding Process		GTAW		
Type		Manual		
Minimum preheat/interpass temperature (°F)		75°F		
Maximum interpass temperature (°F)		200°F		
Tungsten Size		2.4 mm (3/32") - 3.2 mm (1/8")		
Tungsten Type		Thoriated EWTH-2		
Filler Metal Size (in.)		2.4 mm (3/32") - 3.2 mm (1/8")		
Layer Number		1-8		
Position of Groove		ALL		
Weld Progression		UP		
Current/Polarity		DCEN (-)		
Amperes		60 - 150		
Volts		12 - 25		
Travel Speed (in./min)		2.5 - 6.0 in./min		
Maximum Heat Input (kj/in)		N/A		
DC Pulsing Current		DC		
Shielding:	Gas Type	Argon ≥99.9% (See Note A.)		
	Flow Rate (cfh)	20 - 35		
Trailing:	Gas Type	None		
	Flow Rate (cfh)	None		
Backing:	Gas Type	Argon ≥99.9% (See Note B.)		
	Flow Rate (cfh)	10 - 30		
String or Weave		String Bead		
Orifice/Gas Cup Size		4 - 8		
Multi/Single Pass per Side		Single (See Note C.)		
Weld Deposit Chemistry				
Notes				

SSC-937 (05/2019) Page 1 of 3

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	Date	Revision Number
34-040	July 19, 2019	C
Qualified To	**Company Name**	
ASME Boiler and Pressure Vessel Code	Syncom Space Services (S3)	

BASE METALS

Peening	Not allowed.
Surface Preparation	See Note D, E and F.
Initial/Interpass Cleaning	See Note D, E and F.
Back Gouging Method	See Note G.

POSTWELD HEAT TREATMENT

Temperature	None
Time and Temperature	None
Other	None

NOTES

A. High flow of shielding gas flow over molten puddle is required to eliminate nitrogen absorption from atmosphere.

B. Minimum 10 minutes of back purge prior to welding.

C. No pass greater than 12.7 mm (1/2") thick.

D. 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 is stainless or a special alloy.

E. Wipe with cleaner or 1, 1, 1 Trichloroethane-moistened, clean, lint-free rag then brush with virgin SS brush 2" both sides of weld joint.

F. Rework or repair Grind, followed by brushing with SS brush. For grinding, use aluminum oxide grinding wheel not previously used on Carbon Steel.

G. Thermal or mechanical if required. (Grind 1/16" if thermal.)

Signature 1		**Signature 2**	
Engineer Name: Doug Dike	Signature: [signature]	Quality Name: George Smith	Signature: George E. Smith
Date: 8/20/19		Date: 8-16-2019	
Signature 3		**Signature 4**	
Customer Reviewer Name: Benjamin McGrath	Signature: Benjamin McGrath	Customer Name:	Signature:
Date: 8-16-19		Date:	

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

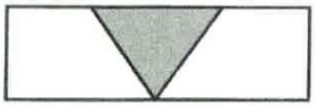
ASME - WELDING PROCEDURE SPECIFICATIONS (WPS)

Welding Procedure Specification Record Number	Date	Revision Number
34-040	July 19, 2019	C
Qualified To	**Company Name**	
ASME Boiler and Pressure Vessel Code	Syncom Space Services (S3)	

Weld Joint Designs

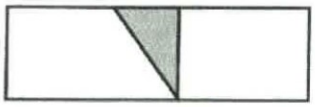
Attachment #1

Single-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.

Single-Bevel 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.

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.

Double-Bevel 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.

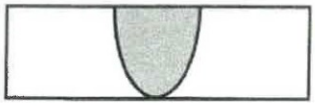
Single-J Groove

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.

Double-J Groove

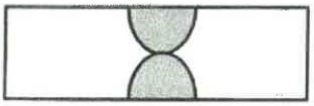
Groove Angle: 37.5 to 45 deg
Groove Radius: 3/8 in.
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Single-U Groove



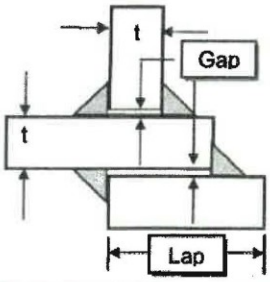
Groove Angle: 50 to 75 deg
Groove Radius: 3/8 in.
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Double-U Groove



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.

Fillet Weld T or Lap



Gap: 1/16-in. max. / Lap: 5 x t or 1 in. min.

SSC-937 (05/2019)

Page 3 of 3

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.

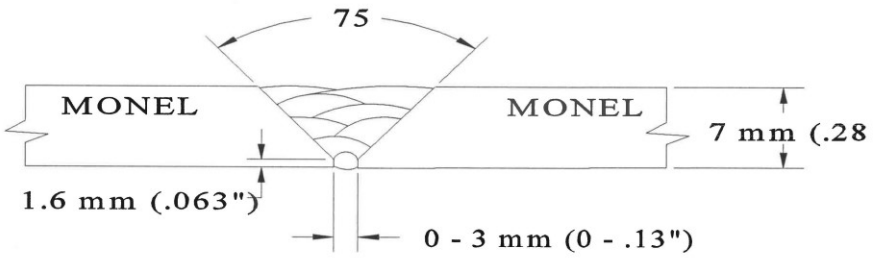
Procedure Qualification Record No: 34-MONEL/MONEL/GTAW Date: 07-15-1993

WPS No.: 34-040

Welding Process(es): GTAW

Types (Manual, Automatic, Semi-Auto): Manual

JOINTS (QW-402)



BASE METALS (QW-403)
Material Spec.: UNS 04400 to UNS 04400
Type or Grade: Monel 400 to MONEL
P-No.: 42 to P-No.: 42
Thickness of Test Coupon: SCH 40 (.280")
Diameter of Test Coupon: 150 mm (6")
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:

POSITION (QW-405)
Position of Groove: 6G
Weld Progression (Uphill, Downhill): UPHILL
Other:

PREHEAT (QW-406)
Preheat Temp.: 75° F
Interpass Temp.: 200° F MAX
Other:

POSTWELD HEAT TREATMENT (QW-407)
Temperature: NOT APPLICABLE
Time:
Other:

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding	ARGON	99.99%	0.566m³/h (20CFH)
Trailing	N/A		
Backing	ARGON	99.99%	0.991m³/h (35CFH)

ELECTRICAL CHARACTERISTICS (QW-409)
Current: DC
Polarity: DCEN (-)
Amps.: 100 - 138 volts: 15 - 18
Tungsten Electrode Size: 2.4mm (3/32")
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
Single or Multiple Electrodes: Single
Other:

PQR No. 34-Monel/Monel/GTAW

QW-483 (Back)

Tensile Test (QW-150)

Specimen No.	Width in.	Thickness in	Area in²	Ultimate Total Load lb	Ultimate Unit Stress psi	Character of Failure & Location
T 1	0.515	0.283	0.1457	11,050	75,841	BASE
T 2	0.516	0.278	0.1434	10,850	75,662	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 Yes, No 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 tested in accordance with the requirements of Section IX of the ASME Code.

Signed Johnson Controls World Services (Manufacturer)

Date _____ By _____