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 NASA SSC Center Operations Facilities Engineering Test Complex Support	<u>9-24-19</u> Date
Concurrence by:	
Gina Ladner NASA SSC Center Operations Directorate Facilities Services	<u>10-8-19</u> Date
Bartt J. Hebert NASA SSC Engineering & Test Directorate	<u>9-6-19</u> Date
Son Le NASA SSC Safety & Mission Assurance Issued by	<u>9-5-19</u> Date
ISSUED CEF Central Engineering Files	<u>10-8-19</u> Date

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SUBJECT: ASME Procedure For Welding Monel Alloy (ASME P-No. 42)

# **Document History Log**

Change/	Change	Originator/	Description
Revision Basic	<b>Date</b> 7/03/2014	Phone Doug Dike Ext. 8-2803	Initial release, superseding SSC-34-040. <i>CEF</i> <i>Archive Information:</i> 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.

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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 (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

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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.
- 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.*

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#### 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	
<b>ASME</b> American Society of Mechanical Engineers	
<b>ASTM</b> American Society for Testing and Materials	
<b>CEF</b> Central Engineering Files	
<b>E&amp;TD</b> Engineering & Test Directorate	
Fed. Federal	
GTAW Gas Tungsten Arc Welding	
MIL Military	
NASA National Aeronautics and Space Administra	tion
<b>OMD</b> 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	

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### **Attachment A: Welding Procedure Specifications**

National Aeronaut Space Administrat John C. Stennis S Stennis Space Ce	tion	ASME - WELDING	B PROCED	OURE SPEC	IFICATIONS	6 (WPS)
Welding Procedure Specification Record Nur 34-040	mber	Date July 19, 2019		Revision C	Number	
Qualified To ASME Boiler and Pressure Vessel Cod	e	Company Name Syncom Space Ser	rvices (S3)			
Supporting PQR(s) 34-Monel/Monel/GTAW		Reference Docs. SSTD-8070-0034-	WELD			
Scope ASME Procedure for GTAW Welding	Monel Allov (P-No. 42)	Joint Single/Double V (		gle/Double U	Groove, All	Fillets
BASE METALS	(* 1.61.12)		THICKNESS	RANGE QUA	LIELED	
	P-no. <u>42</u> Grp-no P-no. <u>42</u> Grp-no	Complete Pen.	As-we Min. .188"	.560"	With P Min. N/A	WHT Max. N/A
Backing <u>None</u> F Retainers N/A	D-no Grp-no	Complete Pen. Impact Tested Impact Tested				
Notes		Fillet Welds	ALL			
		Nominal Pipe Size	As-we	RANGE QUAL elded Max.	IFIED With P' Min. N/A	WHT Max. N/A
FILLER METALS		. ·		RANGE QUA	LIFIED	
Process SFA Classificat GTAW 5.14 ER NICu-		ysis or Trade Name	As-we Min. .188"	Max. .560"	With P Min. N/A	MHT Max. N/A
Flux N/A WELDING PROCEDURE			7	········		
Welding Process	GTAW					
Type	Manual					
Minimum preheat/interpass temperature (°F) Maximum interpass temperature (°F)	75°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) Trailing: Gas Type	20 - 35 None					
Trailing: Gas Type 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	1					
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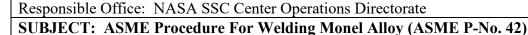
А

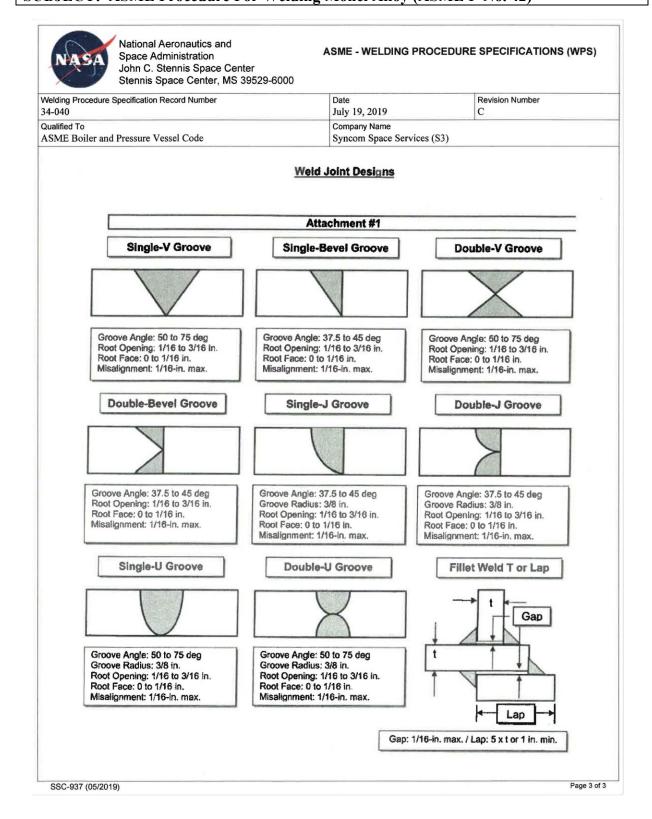
NASA Space John C	al Aeronautics and Administration 2. Stennis Space Center s Space Center, MS 39529-600		DCEDURE SPECIFICATIONS (WPS)
Welding Procedure Specificati 34-040	on Record Number	Date July 19, 2019	Revision Number C
Qualified To ASME Boiler and Pressure	Vasal Cada	Company Name Syncom Space Services	
TSIME BOILE and Tressure		Syncom Space Services	(33)
BASE METALS	Not allowed.		
Peening Surface Preparation	See Note D, E and F.		
nitial/Interpass Cleaning	See Note D, E and F.		
Back Gouging Method	See Note G.		
POSTWELD HEAT TREATM			
Temperature	None		
Time and Temperature	None		
Other	None		
<ul><li>A. High flow of shieldin</li><li>B. Minimum 10 minute</li><li>C. No pass greater than</li></ul>	s of back purge prior to welding. 12.7 mm (1/2") thick.	required to eliminate nitrogen absorp	
<ul><li>B. Minimum 10 minute</li><li>C. No pass greater than</li></ul>	s of back purge prior to welding. 12.7 mm (1/2") thick.		ption from atmosphere. sides of weld joint. Use only brushes and
<ul> <li>A. High flow of shieldin</li> <li>B. Minimum 10 minute</li> <li>C. No pass greater than</li> <li>D. Aluminum Oxide grin</li> <li>grinding wheels not p</li> </ul>	s of back purge prior to welding. 12.7 mm (1/2") thick. nding wheels only for mechanical previously used on carbon steel wh	grinding. Virgin S/S brush 2" both s hen base metal being brushed is stair	sides of weld joint. Use only brushes and aless or a special alloy.
<ul> <li>A. High flow of shieldin</li> <li>B. Minimum 10 minute</li> <li>C. No pass greater than</li> <li>D. Aluminum Oxide grin</li> <li>grinding wheels not p</li> <li>E. Wipe with cleaner or</li> </ul>	s of back purge prior to welding. 12.7 mm (1/2") thick. nding wheels only for mechanical previously used on carbon steel wh	grinding. Virgin S/S brush 2" both s hen base metal being brushed is stair	sides of weld joint. Use only brushes and
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<ul> <li>A. High flow of shieldin</li> <li>B. Minimum 10 minute</li> <li>C. No pass greater than</li> <li>D. Aluminum Oxide gringrinding wheels not p</li> <li>E. Wipe with cleaner or</li> <li>joint.</li> <li>F. Rework or repair Gringon Carbon Steel.</li> <li>G. Thermal or mechanic</li> </ul>	s of back purge prior to welding. 12.7 mm (1/2") thick. nding wheels only for mechanical previously used on carbon steel wh 1, 1, 1 Trichloroethane-moistened nd, followed by brushing with SS l	grinding. Virgin S/S brush 2" both s hen base metal being brushed is stain l, clean, lint-free rag then brush with brush. For grinding, use aluminum mal.) Signature 2 Quality Name George Smith	sides of weld joint. Use only brushes and aless or a special alloy. virgin SS brush 2" both sides of weld oxide grinding wheel not previously used
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SUBJECT: ASME Procedure For Welding Monel Alloy (ASME P-No. 42)

## Attachment B: Welding Procedure Qualification Record (PQR)

Best W821.2. Section X, SME Boler and Passer Vene Coupon         Company Name       Johnson Controls World Services Inc.         Proceedure Qualification Record No       34-900         Nes No.       34-040         Balding Process(es)       GTAW         Ypes (Manual, Automatic, Semi-Auto)       Manual         JOINTS (QN-402)       75         MONEL       7 mm (.2         1.6 mm (.063")       0 - 3 mm (013")         BASE METALS (QN-402)       75         MONEL       7 mm (.2         1.6 mm (.063")       0 - 3 mm (013")         BASE METALS (QN-402)       1.6 mm (.0663")         Monel       POSTMELD HEAT TREATMENT (QN-407)         Temperature       Not APPLICOBLE         Theorem Coread Monel 400 to MNEL       1.2         Monel       9.998       0.5668th /.2         Thickness of Fast Coupon       201 m (6')         Other:       GAS (QN-408)         FILLER HETALS (CM-60)       SFA-5.14         ANS Classification       EFA-5.14         ANS Classification <th>QW-483 SUGGESTED FORMAT FOR WELDING</th> <th>PROCEDURE QUALIFICATION RECORD (PQR)</th>	QW-483 SUGGESTED FORMAT FOR WELDING	PROCEDURE QUALIFICATION RECORD (PQR)
Proceedure Qualification Record No34-MENEL/MENEL/GTAM       Date07-15-1993         NPS No34-040       GTAM         Wight Process(es)GTAM       GTAM         Ypes (Manual, Automatic, Semi-Auto)Manual       MONELT         JOINTS (QM-402)       75         MONEL       MONELT         1.6 mm (.063")       75         Mone (.063")       0 - 3 mm (013")         EASE METALS (QM-402)       POSTMELD HEAT TREATMENT (QM-407)         Theorem Grade Menel 400 to MNREL       42         Thickness of Test Coupon150 mm (6")       90 SPECID HEAT TREATMENT (QM-407)         Theorem Grade Menel 400 to MNREL       100 mm (6")         Other:       GAS (QM-404)         FILER METALS (QM-404)       STA-5.14         PANO		
NFE No	Company Name Johnson Controls World Services	Inc.
Balding Process(es)       GTAW         Ypes (Manual, Automatic, Semi-Auto)       Manual         JOINTS (Q4-402)       75         MONEL       70 mm (.2         1.6 mm (.063 ")       0 - 3 mm (013")         BASE METALS (Q4-402)       0 - 3 mm (013")         BASE METALS (Q4-402)       0 - 3 mm (013")         BASE METALS (Q4-403)       Monel         Material Spec.       UNS 04400 to UNS 04400         PHO.       42         Thickness of Test Coupon       150 mm (6")         Other:       For Test Coupon         FILLER METALS (Q4-404)       SFA-5.14         SFA Specification       EN NiCu-7         SFA Specification       EN NiCu-7         Malysis A-No.       A2         Metal 2.3mm (3/32") 4 3.1mm (1/8")       Other         Deposition of Groove       66         Weld Metal       Traysis A-10.         Deposition of Groove       66         Weld Progression (Uphill, Downhill)       UPHILL         Other       TECKNIQUE (Q8-410)         Testing To Wave Bead, String Bead       String Bead         Other       Metal Prosees (of Phile)         Thickness of Single Pass (per side)       Multiples         Destinon of Groove	Procedure Qualification Record No34-MONEL/MONEL/GTAW	Date 07-15-1993
Balding Process(es)       GTAW         Ypes (Manual, Automatic, Semi-Auto)       Manual         JOINTS (Q4-402)       75         MONEL       70 mm (.2         1.6 mm (.063 ")       0 - 3 mm (013")         BASE METALS (Q4-402)       0 - 3 mm (013")         BASE METALS (Q4-402)       0 - 3 mm (013")         BASE METALS (Q4-403)       Monel         Material Spec.       UNS 04400 to UNS 04400         PHO.       42         Thickness of Test Coupon       150 mm (6")         Other:       For Test Coupon         FILLER METALS (Q4-404)       SFA-5.14         SFA Specification       EN NiCu-7         SFA Specification       EN NiCu-7         Malysis A-No.       A2         Metal 2.3mm (3/32") 4 3.1mm (1/8")       Other         Deposition of Groove       66         Weld Metal       Traysis A-10.         Deposition of Groove       66         Weld Progression (Uphill, Downhill)       UPHILL         Other       TECKNIQUE (Q8-410)         Testing To Wave Bead, String Bead       String Bead         Other       Metal Prosees (of Phile)         Thickness of Single Pass (per side)       Multiples         Destinon of Groove	IPS No 34-040	
JOINTS (QN-402)       75         MONEL       MONEL         I.6 mm (.063")       0 - 3 mm (013")         BASE METALS (QN-403)       POSTWELD HEAT TREATMENT (QN-407)         Meterial Spc.       UNS 04400 to UNS 04400         Type or Grade Monel 400 to MONEL       POSTWELD HEAT TREATMENT (QN-407)         Temperature       NOT APPLICABLE         Tinkness of Test Coupon       SCH 40 (.280")         Dlameter of Test Coupon       SCH 40 (.280")         Diaseter of Test Coupon       SCH 40 (.280")         FILLER METALS (QN-404)       SFA-5.14         FILLER METALS (QN-404)       SFA-5.14         RAS Classification       EF NICu-7         Metal P-No.       42         Metal P-No.       42         Total Radium (3/32")       6 3.11mm (1/8")         Other       Deposited Weid Metal         Metal P-No.       42         TechNIQUE (QM-401)       Travel Speed 75 - 125 mm/min (3 - 5 1.p.m.)         String or Wave Bead       String Dead         Position of Groova       6G         Mother       Travel Speed 75 - 125 mm/min (3 - 5 1.p.m.)         String or Wave Bead       String Dead         Other       Multiple         Destition of Groova       6G		
75         MONEL         1.6 mm (.063")         0 - 3 mm (013")         BASE METALS (QM-403)         Material Spec.         Tisk 04400 to UNS 04400         Type or Grade         Monel 400 to MONEL         PNO.         42         Thickness of Test Coupon         SCH 40 (.200")         Diameter of Test Coupon         Sch 40 (.200")         Diameter of Test Coupon         Sch 40 (.200")         Other:         FILLER METALS (QM-404)         SFA Specification         SFA Specification         EXP No.         Metal P-No.         42         Weld Metal         Analysis A-No.         Metal P-No.         42         Metal P-No.	Ypes (Manual, Automatic, Semi-Auto)Manual	
MONEL       MONEL       7 mm (.2         1.6 mm (.063")       0 - 3 mm (013")       0 - 3 mm (013")         BASE METALS (QM-403)       Material Spec.       UNS 04400 to UNS 04400       Temperature       NOT APPLICABLE         Type or Grade       Monel 400 to MONEL       42       Time       Other       Other       GAS (QM-408)         FILLER METALS (QM-404)       SFA-5.14       Percent Composition       Gas(es)       Mixture)       Flow Rate         Shielding ARGON       99.99%       0.566m²/h (22       Trailing N/A       Backing ARGON 99.99%       0.951m²/h (33         FILLER METALS (QM-404)       SFA-5.14       ELECTRICAL CHARACTERISTICS (QM-409)       Current DC         Metal 2.3mm (3/32") 4 .3.1mm (1/8")       Other       Deposited Weld Metal       Trailing N/A         Metal 2.3mm (3/32") 4 .3.1mm (1/8")       Other       Other       Trailing to CS (QM-409)         Other	JOINTS (QW-402)	
I.6 mm (.063")       -       0 - 3 mm (013")         BASE METALS (QM-403) Material Spec.       UNS 04400 to UNS 04400 Type or Grade Monel 400 to MONEL       Time         P-No.       42       Time       Other         Diameter of Test Coupon       SCH 0 (.260")       Other       Other         GAS (QM-408)       Fercent Composition       Gas (s)       (Mixture)       Flow Rate         Shielding ARGON       99.998       0.566m²/h (22         FILLER METALS (QM-404)       SFA-5.14       Backing ARGON       99.998       0.991m²/h (32         FILLER METALS (QM-404)       SFA-5.14       ELECTRICAL CHARACTERISTICS (QM-409)         Gurant       DCEN (-)       Amalysis A-No.       Ale	75	5
I.6 mm (.063")       -       0 - 3 mm (013")         BASE METALS (QM-403) Material Spec.       UNS 04400 to UNS 04400 Type or Grade Monel 400 to MONEL       Time         P-No.       42       Time       Other         Diameter of Test Coupon       SCH 0 (.260")       Other       Other         GAS (QM-408)       Fercent Composition       Gas (s)       (Mixture)       Flow Rate         Shielding ARGON       99.998       0.566m²/h (22         FILLER METALS (QM-404)       SFA-5.14       Backing ARGON       99.998       0.991m²/h (32         FILLER METALS (QM-404)       SFA-5.14       ELECTRICAL CHARACTERISTICS (QM-409)         Gurant       DCEN (-)       Amalysis A-No.       Ale		
I.6 mm (.063")       -       0 - 3 mm (013")         BASE METALS (QM-403) Material Spec.       UNS 04400 to UNS 04400 Type or Grade Monel 400 to MONEL       Time         P-No.       42       Time       Other         Diameter of Test Coupon       SCH 0 (.260")       Other       Other         GAS (QM-408)       Fercent Composition       Gas (s)       (Mixture)       Flow Rate         Shielding ARGON       99.998       0.566m²/h (22         FILLER METALS (QM-404)       SFA-5.14       Backing ARGON       99.998       0.991m²/h (32         FILLER METALS (QM-404)       SFA-5.14       ELECTRICAL CHARACTERISTICS (QM-409)         Gurant       DCEN (-)       Amalysis A-No.       Ale	MONEL	MONEL 7 mm (28
BASE METALS (QM-403)     PO - 3 mm (013")       Material Spec.     UNS 04400 to UNS 04400       Type or Grade Monel 400 to MONEL     Temperature NOT APPLICABLE       P-No. 42     to P-No. 42       Thickness of Test Coupon SCH 40 (.260")     Time -       Diameter of Test Coupon 150 mm (6")     GAS (QM-408)       Other:     GAS (QM-404)       FILLER METALS (QM-404)     SFA-5.14       SFA Specification SFA-5.14     Size of Filler       Metal F-No. 42     Weld Metal       ANS Classification ER NiCu-7 Filler     ELECTRICAL CHARACTERISTICS (QM-409)       Current DC     Polarity DCEN (-)       Polarity Decor (-)     Amp other       Deposited Weld Metal     Travel Speed 75 - 125 mm/min (3 - 5 1.p.m.)       STAPON (QM-405)     TeCHNIQUE (QM-410)       PostTrion (QM-405)     TeCHNIQUE (QM-410)       PostTrion (QM-405)     TeCHNIQUE (QM-410)       Present Scient (Dphill, Downhill) UPHILL     String or Neade Size (single Pass (per side) Multiple       Multipass or Single Pass (per side) Multiple     Multipass or Single Pass (per side) Multiple		
BASE METALS (QM-403)     PO - 3 mm (013")       Material Spec.     UNS 04400 to UNS 04400       Type or Grade Monel 400 to MONEL     Temperature       P-No.     42       Thickness of Test Coupon     SCH 40 (.280")       Diameter of Test Coupon     SCH 40 (.280")       Other:     GAS (QM-408)       FILLER METALS (QM-404)     SFA-5.14       SFA Specification     SFA-5.14       ANS Classification     ER NiCu-7       Metal F-No.     42       Weld Metal     Deposited Weld Metal       Deposited Weld Metal     Deposited Weld Metal       Deposited Weld Metal     Trailing N/A       Deposited Weld Metal     Dus other       Cher     Gas (es)       POSITION (QM-405)     TecHNIQUE (QM-410)       Position of Groove     6G       Weld Progression (Uphill, Downhill)     UPHILL       Other     TecHNIQUE (QM-410)       Travel Speed 75 - 125 mm/min (3 - 5 1.p.m.)       String or Neader String Dead       Ocienter     String or Neader String Dead       Other     Not Applicable       Mutipass or Single Pass (per side) Multiple	1.6 mm (063")	
BASE METALS (QM-403)       POSTWELD HEAT TREATMENT (QM-407)         Material Spec.       UNS 04400 to UNS 04400         Type or Grade_Monel 400 to MONEL       Time		= 0.3 mm (0.13")
Material Spec.       UNS 04400 to UNS 04400         Type or Grade       Monel 400 to MONEL         The P-No.       42         Thickness of Test Coupon       SCH 40 (.280")         Dlameter of Test Coupon       150 mm (6")         Other:       GAS (QW-408)         FILLER METALS (QW-404)       Fercent Composition         SFA Specification       SFA-5.14         Matal r-No.       42         Metal r-No.       42         Weld Metal       Size of Filler         Metal 2.3mm (3/32") & 3.1mm (1/8")       Other         Deposited Weld Metal       Tungsten Electrode Size 2.4mm (3/32")         Other       Other         POSITION (QW-405)       Travel Speed 75 - 125 mm/min (3 - 5 i.p.m.)         String or Weave Bead       String Bead         Ocher       Oscillation         Metal Progression (Uphill, Downhill)       UPHILL         PREHEAT (QW-406)       Single or Multiple Electrodes		0 - 3 mm (013 )
Material Spec.       UNS 04400 to UNS 04400         Type or Grade_Monel 400 to MONEL       TemperatureNOT_APPLICABLE         Type or Grade_Monel 400 to MONEL       Time	BASE METALS (QW-403)	POSTWELD HEAT TREATMENT (OW-407)
P-No.       42       to P-No.       42         Thickness of Test Coupon       SCH 40 (.280")       0ther         Diameter of Test Coupon       150 mm (6")       GAS (QW-408)         Other:       GAS (QW-408)         FILLER METALS (QW-404)       SFA-5.14       Gas(es)         SFA Specification       SFA-5.14       Trailing N/A         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)       TecHNIQUE (QW-410)       Travel Speed 75 - 125 mm/min (3 - 5 i.p.m.)         String or Weave Bead       String Bead       Oscillation         POSITION (QW-406)       Single or Multiple Electrodes       Single	Material Spec. UNS 04400 to UNS 04400	Temperature NOT APPLICABLE
Thickness of Test Coupon       SCH 40 (.280")         Dlameter of Test Coupon       150 mm (6")         Other:       GAS (QW-408)         FILLER METALS (QW-404)       FFA-5.14         SFA Specification       SFA-5.14         AWS Classification       ER NiCu-7         Metal F-No.       42         Metal 2.3mm (3/32") & 3.1mm (1/8")       Other         Deposited Weld Metal       Tungsten Electrode Size       2.4mm (3/32")         Other       Other       Other         POSITION (QW-405)       Fichnicut GG       Travel Speed 75 - 125 mm/min (3 - 5 i.p.m.)         String or Weave Bead       String Bead       Oscillation         Metal Progression (Uphill, Downhill)       UPHILL       String or Weave Bead       String Bead         PREHEAT (QW-406)       Single or Multiple Electrodes       Single		
Diameter of Test Coupon150 mm (6")         Other:       GAS (QW-408)         Percent Composition		Other
Other:       GAS (QW-408)         Percent Composition		
Percent Composition         Gas (es)       (Mixture)         FILLER METALS (QW-404)         SFA Specification       SFA-5.14         AWS Classification       ER NiCu-7         Filler       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 (QW-405)         POSITION (QW-405)         Present Composition         PREHEAT (QW-406)		
	ouner:	
Shielding ARGON       99.99%       0.566m³/h (20)         FILLER METALS (QW-404)       SFA-5.14       Trailing N/A		
FILLER METALS (QW-404)         SFA Specification       SFA-5.14         AWS Classification       ER NiCu-7         Metal F-No.       42         Metal 2.3mm (3/32") & 3.1mm (1/8")       Other		
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	FILLER METALS (OW-404)	
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		Backing ARGON 99.99% $0.991m^3/h$ (35CF)
Analysis A-No.       NiCu       Size of Filler         Metal_2.3mm (3/32") & 3.1mm (1/8")       Other       Amps.       100 - 138       volts       15 - 18	· · · · · · · · · · · · · · · · · · ·	
Analysis A-No.       NiCu       Size of Filler         Metal_2.3mm (3/32") & 3.1mm (1/8")       Other       Amps.       100 - 138       volts       15 - 18	AWS Classification ER NiCu-7 Filler	FLECTRICAL CHARACTERISTICS (OW-409)
Analysis A-No.       NiCu       Size of Filler         Metal_2.3mm (3/32") & 3.1mm (1/8")       Other       Amps.       100 - 138       volts       15 - 18	Metal F-No. 42 Weld Metal	Current DC
Deposited Weld Metal Tungsten Electrode Size 2.4mm (3/32") Other Other POSITION (QW-405) Position of Groove 6G Position of Groove 6G Position of Groove 6G Dublic Communication (3 - 5 i.p.m.) String or Weave Bead String Bead Oscillation Not Applicable Multipass or Single Pass (per side) Multiple PREHEAT (QW-406) Single or Multiple Electrodes Single	Analysis A-No. NiCu Size of Filler	
Other		
POSITION (QW-405)       TECHNIQUE (QW-410)         Position of Groove 6G       Travel Speed 75 - 125 mm/min (3 - 5 i.p.m.)         Veld Progression (Uphill, Downhill) UPHILL       String or Weave Bead String Bead         Other	Deposited Weld Metal	Tungsten Electrode Size 2.4mm (3/32")
POSITION (QW-405)       TECHNIQUE (QW-410)         Position of Groove 6G       Travel Speed 75 - 125 mm/min (3 - 5 i.p.m.)         Veld Progression (Uphill, Downhill) UPHILL       String or Weave Bead String Bead         Other		Other
Position of Groove       6G         Weld Progression (Uphill, Downhill)       UPHILL         Other       String or Weave Bead         String or Weave Bead       String Bead         Oscillation       Not Applicable         Multipass or Single Pass (per side)       Multiple         PREHEAT (QW-406)       Single or Multiple Electrodes		
Position of Groove6G       Travel Speed 75 - 125 mm/min (3 - 5 i.p.m.)         Weld Progression (Uphill, Downhill)_UPHILL       String or Weave BeadString Bead         Other       OscillationNot Applicable         Multipass or Single Pass (per side)_Multiple         PREHEAT (QW-406)       Single or Multiple ElectrodesSingle	POSITION (QW-405)	TECHNIQUE (QW-410)
Other       Oscillation       Not Applicable         Multipass or Single Pass (per side)       Multiple         PREHEAT (QW-406)       Single or Multiple Electrodes		
Multipass or Single Pass (per side)       Multiple         PREHEAT (QW-406)       Single or Multiple Electrodes       Single		
PREHEAT (QW-406) Single or Multiple Electrodes Single	Other	
		multipass or Single Pass (per side) <u>Multiple</u>
	DREHEAT (OW-406)	- Single on Multiple Flootender Single
Preheat Temp. 75° F Other	PREHEAT (QW-406) Preheat Temp. 75° F	
Interpass Temp. 200° F MAX		
0ther	Other	

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# Responsible Office: NASA SSC Center Operations Directorate SUBJECT: ASME Procedure For Welding Monel Alloy (ASME P-No. 42)

#### PQR No. 34-Monel/Monel/GTAW QW-483 (Back) Tensile Test (QW-150) Ultimate Total Load lb Ultimate Unit Stress psi Character of Failure & Location Specime Thickness in Width Area in² n No. in. 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 2 QW 462.2 SATISFACTORY SIDE BEND QW 462.2 3 SATISFACTORY SIDE BEND QW 462.2 4 SATISFACTORY Toughness Tests (QW-170) Specimen Notch Notch Test Impact Lateral Exp. Drop Weight No. Location Values % Shear Type Mils Temp. 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\_