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Space Administration

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

**SSTD-8070-0034-WELD Rev. Basic
JULY 2014**

COMPLIANCE IS MANDATORY

John C. Stennis Space Center ASME Procedure For GTAW Welding Monel Alloy (P-42)

Original signed by

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Central Engineering Files	Date

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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. <i>CEF Archive Information:</i> Part of Appendix B, Standards and Specifications Plan to Contract NAS13-400.

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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) 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

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 B127, *Standard Specification for Nickel-Copper Alloy (UNS 4400) 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*

MIL-T-1368, *Military Specification for Tube and Pipe, Nickel-Copper Alloy, Seamless and Welded*

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 Standard and the documents it references, and inform the appropriate organization of needed changes in accordance with SSC Standard 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 Standard shall be as specified in SSTD-8070-0005-CONFIG and the applicable documents referenced therein.

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5.0 REQUIREMENTS AND PROCEDURES

- a. This procedure shall be used for welding any Monel 400 (UNS NO4400 base metal) to one or more of the following:
 1. SAE AMS 4544, 4574, 4575, 4675, 4730, 4731
 2. ASME SB127, SB 163, SB164, SB165, SB564
 3. MIL-N-24106, MIL-T-23520, MIL-T-1368
 4. Fed. QQ-N-281
 5. ASTM B127, B163, B164, B165, B366, B564, B725, B730
- 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), and the NASA SSC Safety and Mission Assurance (S&MA) Office.
- 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

Records and forms required by the procedures of this standard 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 National Aeronautics and Space Administration (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 together with the original, signed hardcopy of this SSTD.

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7.0 ACRONYMS AND ABBREVIATIONS

AMS	Alpha Magnetic Spectrometer
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
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
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

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATIONS (WPS) (See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name NASA, JOHN C. STENNIS SPACE CENTER By K.A. Broom
Welding Procedure Specification No. 34-040 Date 08/05/1993 Supporting PQR No.(s) 34-Monel/Monel/GTAW
Revision No. B Date 09/11/2013

Welding Process(es) GTAW Type(s) Manual
(Automatic, Manual, Machine, or Semi Automatic)

JOINTS (QW-402)		Details
Joint Design <u>Single/Double V Groove/Single/Double U Groove/All Filets</u>		Figure 1 shows typical groove detail examples
Root Spacing _____		
Backing: Yes _____ No <u>X</u>		
Backing Material (Type) <u>None</u>		
<small>(Refer to both backing and reamer)</small>		
<input type="checkbox"/> Metal <input type="checkbox"/> Nonfusing Metal <input type="checkbox"/> Nonmetallic <input type="checkbox"/> Other		
Sketches, Production Drawings, Weld Symbols, or Written Description should show the general arrangement of the parts to be welded. Where applicable, the details of weld groove may be specified.		
[At the option of the manufacturer, sketches may be attached to illustrate joint design, weld layers, and bead sequence (e.g., for notch toughness procedures, for multiple process procedures, etc.)]		
*BASE METALS (QW-403)		
P-No. <u>42</u> Group No. _____ to P-No. <u>42</u> Group No. _____		
OR		
Specification and type/grade or UNS Number _____		UNS 04400
to Specification and type/grade or UNS Number _____		UNS 04400
OR		
Chem. Analysis and Mech. Prop. _____		Not Required
to Chem. Analysis and Mech. Prop. _____		Not Required
Thickness Range:		
Base Metal: Groove <u>4.8mm (0.188") to 14.7mm (0.58")</u>		Fillet <u>ALL</u>
Maximum Pass Thickness \leq $\frac{1}{2}$ inch (13 mm) (Yes) <input type="checkbox"/> (No) <input type="checkbox"/>		
Other <u>No pass greater than 12.7mm (1/2") thick; pipe diameter range: Groove-25.4mm (1") and larger; Fillet-All</u>		
*FILLER METALS (QW-404)		
	1	2
Spec. No. (SFA) _____	Root Pass 5.14	Remainder 5.14
AWS No. (Class) _____	ER NiCu-7	ER NiCu-7
F-No. _____	42	42
A-No. _____		
Size of Filler Metals _____	2.0mm (5/64") - 3.2mm (1/8")	2.0mm (5/64") - 3.2mm (1/8")
Filler Metal Product Form _____		
Supplemental Filler Metal _____		
Weld Metal		
Thickness Range:		
Groove	1.6mm (0.062") - 2.4mm (0.094")	2.4mm (0.094") - 14.2mm (0.56")
Fillet		
Electrode-Flux (Class) _____	N/A	N/A
Flux Type _____	N/A	N/A
Flux Trade Name _____	N/A	N/A
Consumable insert _____	N/A	N/A
Other _____		

*Each base metal-filler metal combination should be recorded individually.

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QW-482 (Back)

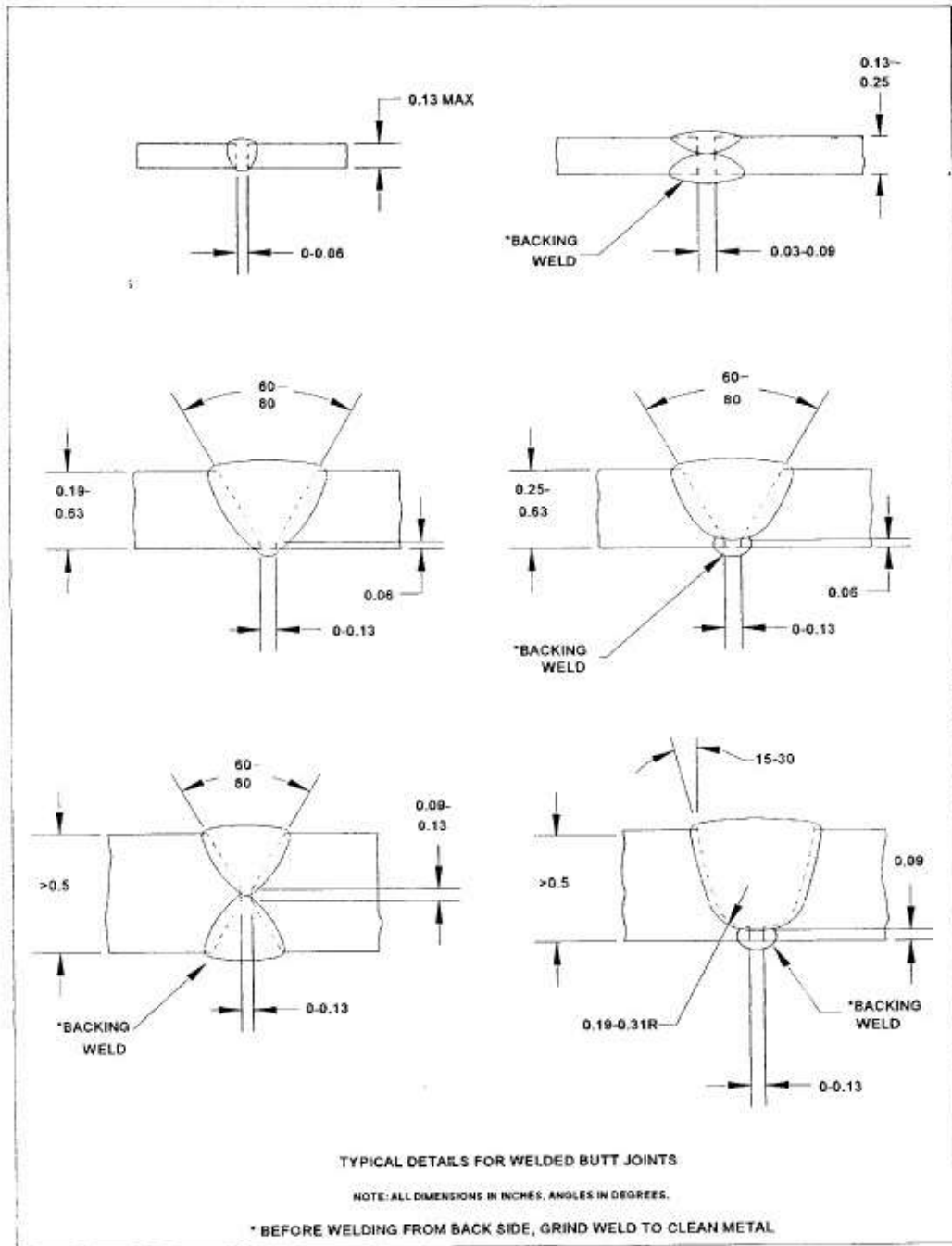
WPS No. 34-040 Rev. BASIC

POSITIONS (QW-405) Position(s) of Groove <u>ALL</u> Welding Progression: Up <u>UP</u> Down _____ Position(s) of Fillet <u>ALL</u> Other _____				POSTWELD HEAT TREATMENT (QW-407) Temperature Range _____ <u>N/A</u> Time Range _____ <u>N/A</u> Other _____																												
PREHEAT (QW-406) Preheat Temperature, Minimum <u>60 F</u> Interpass Temperature, Maximum <u>200 F</u> Preheat Maintenance <u>N/A</u> Other _____ (Continuous or special heating, where applicable, should be recorded)				GAS (QW-408) <table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="3">Percent Composition</th> </tr> <tr> <th>Gases</th> <th>(Mixture)</th> <th>Flow Rate</th> </tr> </thead> <tbody> <tr> <td>Shielding</td> <td>Argon</td> <td>99.99</td> <td>30-35</td> </tr> <tr> <td>Trailing</td> <td>None</td> <td>None</td> <td>None</td> </tr> <tr> <td>Backing</td> <td>Argon</td> <td>99.99</td> <td>10</td> </tr> <tr> <td>Other</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>					Percent Composition			Gases	(Mixture)	Flow Rate	Shielding	Argon	99.99	30-35	Trailing	None	None	None	Backing	Argon	99.99	10	Other					
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Backing	Argon	99.99	10																													
Other																																
ELECTRICAL CHARACTERISTICS (QW-409) _____ _____																																
Weld Pass(es)	Process	Filler Metal		Current Type and Polarity	Amps (Range)	Wire Feed Speed (Range)	Energy or Power (Range)	Volts (Range)	Travel Speed (Range)	Other (e.g., Remarks, Comments, Hot Wire Addition, Technique, Torch Angle, etc.)																						
		Classification	Diameter																													
Root Pass	GTAW	ER NiCu-7	1.6mm-3.2 mm	DCEN (-)	70-130	N/A		13-20	66-127mm/min																							
Fill	GTAW	ER NiCu-7	1.6mm-3.2 mm	DCEN (-)	70-130			13-20	66-127mm/min																							
Cap	GTAW	ER NiCu-7	1.6mm-3.2 mm	DCEN (-)	70-130			13-20	66-127mm/min																							
Amps and volts, or power or energy range, should be recorded for each electrode size, position, and thickness, etc.																																
Pulsing Current _____ DC _____ Heat Input (max.) _____																																
Tungsten Electrode Size and Type _____ 2.4mm (3/32") to 3.2mm (1/8") Thoriated EWTH-2 (Pure Tungsten, Z, Thoriated, etc.)																																
Mode of Metal Transfer for GMAW (FCAW) _____ N/A (Spray Arc, Short Circuiting Arc, etc.)																																
Other _____																																
TECHNIQUE (QW-410) <table border="1"> <tr> <td>String or Weave Bead</td> <td>String Bead</td> </tr> <tr> <td>Orifice, Nozzle, or Gas Cup Size</td> <td>4 to 8</td> </tr> <tr> <td>Initial and Interpass Cleaning (Brushing, Grinding, etc.)</td> <td>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 is stainless or a specialty alloy.</td> </tr> <tr> <td>Method of Back Gouging</td> <td>Thermal or Mechanical if required (Grind 1.6mm (1/16") if thermal)</td> </tr> <tr> <td>Oscillation</td> <td>Oscillation not used with this procedure</td> </tr> <tr> <td>Contact Tube to Work Distance</td> <td>None</td> </tr> <tr> <td>Multiple or Single Pass (Per Side)</td> <td>Single</td> </tr> <tr> <td>Multiple or Single Electrodes</td> <td>Single</td> </tr> <tr> <td>Electrode Spacing</td> <td></td> </tr> <tr> <td>Peening</td> <td>Peening not used with this procedure</td> </tr> <tr> <td>Other</td> <td>Repair - Grind followed by brushing with SS brush Repair per this procedure or repair as directed by Engineer</td> </tr> </table>											String or Weave Bead	String Bead	Orifice, Nozzle, or Gas Cup Size	4 to 8	Initial and Interpass Cleaning (Brushing, Grinding, etc.)	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 is stainless or a specialty alloy.	Method of Back Gouging	Thermal or Mechanical if required (Grind 1.6mm (1/16") if thermal)	Oscillation	Oscillation not used with this procedure	Contact Tube to Work Distance	None	Multiple or Single Pass (Per Side)	Single	Multiple or Single Electrodes	Single	Electrode Spacing		Peening	Peening not used with this procedure	Other	Repair - Grind followed by brushing with SS brush Repair per this procedure or repair as directed by Engineer
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Multiple or Single Pass (Per Side)	Single																															
Multiple or Single Electrodes	Single																															
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Figure 1



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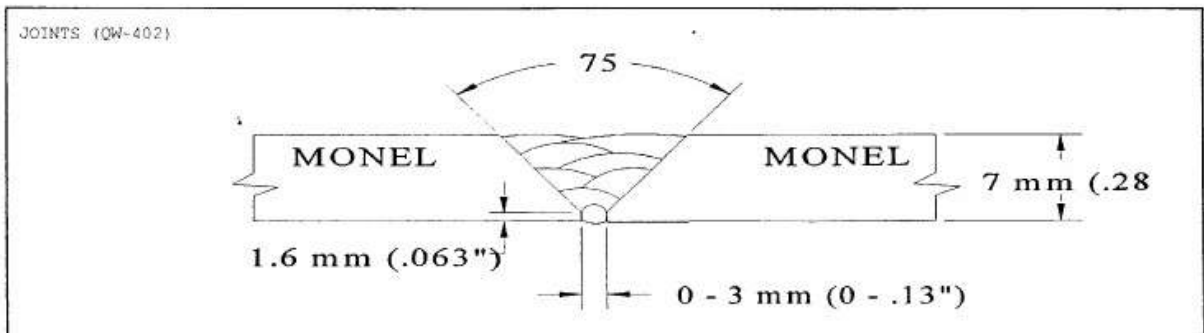
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ATTACHMENT B: WELDING PROCEDURE QUALIFICATION RECORD (PQR)**QW-483 SUGGESTED FORMAT FOR WELDING PROCEDURE QUALIFICATION RECORD (PQR)**

(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.
 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



<p>BASE METALS (QW-403)</p> <p>Material Spec. <u>UNS 04400 to UNS 04400</u></p> <p>Type or Grade <u>Monel 400 to MONEL</u></p> <p><u>42</u> to P-No. <u>42</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>Other:</p>	<p>POSTWELD HEAT TREATMENT (QW-407)</p> <p>Temperature <u>NOT APPLICABLE</u></p> <p>Time</p> <p>Other</p>												
<p>FILLER METALS (QW-404)</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") & 3.1mm (1/8")</u> Other</p> <p>Deposited Weld Metal</p>	<p>GAS (QW-408)</p> <table border="1"> <thead> <tr> <th>Gas(es)</th> <th>Percent Composition (Mixture)</th> <th>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)	Percent Composition (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>
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Backing <u>ARGON</u>	<u>99.99%</u>	<u>0.991m³/h (35CFH)</u>											
<p>POSITION (QW-405)</p> <p>Position of Groove <u>6G</u></p> <p>Weld Progression (Uphill, Downhill) <u>UPHILL</u></p> <p>Other</p>	<p>ELECTRICAL CHARACTERISTICS (QW-409)</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>PREHEAT (QW-406)</p> <p>Preheat Temp. <u>75° F</u></p> <p>Interpass Temp. <u>200° F MAX</u></p> <p>Other</p>	<p>TECHNIQUE (QW-410)</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</p>												

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PQR No. 34-Monel/Monel/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	0.515	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 Penetration into Parent Metal Yes, No
 Type and Character of Failure Yes, No Macro-Results Yes, No
 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 _____

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