



SSTD-8070-0123-WELD  
Rev. D  
JULY 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 FLUX CORED ARC WELDING (FCAW) OF STRUCTURAL CARBON STEEL

### Approved by:

Approved in DDMS by Scott Olive  
NASA SSC Center Operations  
Design & Construction Project  
Management Division

7-11-2019  
Date

### Concurrence by:

Approved in DDMS by Gina Ladner  
NASA SSC Center Operations Directorate  
Operations and Maintenance Division

7-17-2019  
Date

Approved in DDMS by Bartt Hebert  
NASA SSC Engineering & Test Directorate

7-15-2019  
Date

Approved in DDMS by Son Le  
NASA SSC Safety & Mission Assurance

7-15-2019  
Date

### Issued by

ISSUED CEF  
Central Engineering Files

7-17-2019  
Date

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## Document History Log

Revision	Date	Originator/ Phone	Description
Basic	10/16/03	D. Dike Ext. 8-2803	Initial Release
A	10/30/03	W. St. Cyr Ext. 8-1134	<p><u>Administrative Changes:</u>  Title, and throughout, change ‘core’ to ‘cored’ per AWS terminology; change page headers ‘of page’ from 14 to 16; on all Form E-1: change WPS Id. # (front) &amp; PQR number (back); change all SA516/GR70 to AWS D1.1, Table 3.1, Group I&amp;II; add Root Face Dimension ‘zero’; and change the following: Pipe Diameter N/A to <math>\geq 24</math>”, Base Metal thickness Groove 1.00” to <math>\geq 1/8</math>” (add Fillet <math>\geq 1/8</math>”), Filler Metal AWS Class E71T-1 to AWS D1.1, Table 3.1, Grp I &amp; II materials;  6.1-b add ref to Appendix A for qualifications of welder;  6.1-c add “acceptance criteria” and change STD 34-004 to AWS D1.1.</p> <p><u>Other changes:</u>  1.0 delete ASTM MA516, add AWS D1.1 Table 3.1, and change P1 Carbon Steel to Group 1 and Group II materials;  3.0 delete ASTM A516, ASME Boiler Code, and SSC Standard 34-004, and add AWS A5.29;  6.2 delete ASTM A516, add AWS D1.1 Table 3.1 Grp I&amp;II;  6.3 add ‘Procedure’ to title, change para ref from 4.0 to 4.1.1; 6.5 add AWS A5.29, and change D1.1 refs from Paragraphs to Table 3.1 Groups I and II;  6.6 delete ref to para C5.3.1.3;  6.7 add Flat 1-G position;  6.14 change Appendix A to “approved SSC engineering” and add ref to AWS D1.1;  6.15 add ‘Post Weld’ to title, and change text to “none.”  6.16 add ref to AWS D1.1 and change “approved” to “appropriate”.</p>

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B		W. St. Cyr Ext. 8-1134	Updated references throughout document. Updated format in accordance with SPR 1400.1 requirements. Moved requirement in Document Control (Section 4.0) to Responsibilities (Section 5.0), added responsible organization for this task, and renumbered the sections that followed. Added section for acronyms and abbreviations. Removed references to FOSC Safety data requirement document and AWS Welding Handbook. Revised Section 5.10 for clarity. Edited requirements in Sections 5.13.a and 5.13.b.
C	11/3/14	Doug Dike Ext. 8-2803	Five-year revision. Updated references and acronyms. Section 2.0: Added AWS A5.36 and noted AWS A5.20 and AWS A5.29 are superseded by AWS A5.36. Sections 7.1, 7.3 and 7.5: Replaced A 5.20 or A5.29 to A 5.36 in "Filler Material" section; changed Rev. A to Rev B, and resigned.
D	7/01/19	Doug Dike Ext 8-2803	Updated cover sheet approval/concurrence requirements per SSTD-8070-0005-CONFIG. Updated references and acronyms. Minor administrative changes. References to FOS changed to SACOM throughout document. Section 4.1-c: Added SSTD-8070-0013-WELD Class IV. Section 4.3: Changed paragraph 4.1 to section 4. Section 4.5: Expanded to include AWS A5.20 and A5.29 as well as A5.36. Changed Table 3.1 to 3.2. Section 4.6: Changed paragraph 5.3.1.3 to section 5. Section 4.9: Changed paragraph 3.13 to section 5. Section 4.10: Changed section 5.10 to section 5. Section 4.12: Changed paragraph 5.12 to section 5. Added SSTD-8070-0013-WELD Class IV. Section 4.12-b: Added "Maintain purge gas uniformity by eliminating disruptive drafts during FCAW operations." Section 4.13-a: Changed "should merge smoothly" to "shall be full, smooth, and well profiled". Section 4.13-b: Added note. Section 4.14: Deleted original Section 4.14 as it was redundant content from Section 4.1. Within the new Section 4.14, added SSTD-8070-0013-WELD Class IV section 10.0. Updated WPS forms (SSC937A). Deleted 7.8, Weld No. PQR 2G2, as the details of this Radiographic Request/Report were included in the Section 7.7 report.

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## 1.0 SCOPE

This John C. Stennis Space Center (SSC) standard (SSTD) provides a qualified American Welding Society (AWS) D1.1 weld procedure for Flux Cored Arc Welding (FCAW) of AWS D1.1 Table 3.1 Group I and Group II carbon steel for structural use at SSC.

## 2.0 REFERENCES

Referenced documents shall be the latest version unless otherwise specified.

AWS D1.1, *Structural Welding Code - Steel*  
 AWS A5.20, *Specification for Carbon Steel Electrodes for Flux Cored Arc Welding*  
 AWS A5.29, *Specification for Low-Alloy Steel Electrodes for Flux Cored Arc Welding*  
 AWS A5.36, *Specification for Carbon and Low-Alloy Steel Flux Cored Electrodes for Flux Cored Arc Welding and Metal Cored Electrodes for Gas Metal Arc Welding*  
 SPR 1440.1, *Records Management Program Requirements*  
 SPR 8715.1, *SSC Safety and Health Program Requirements*  
 SSTD-8070-0005-CONFIG, *Preparation, Review, Approval and Release of SSC Standards*  
 SSTD-8070-0013-WELD, *Classes Of Welding Inspection*  
 SSTD-8070-0014-WELD, *Qualifying Welders and Welding Procedures*

## 3.0 RESPONSIBILITIES

- a. Responsibilities for the qualification of welders and the performance of the welding procedures are defined in Section 5.0.
- b. SSC Center Operations Directorate, Operations and Maintenance Division (OMD) shall maintain this SSTD in accordance with the control, review, approval, and release requirements of SSTD-8070-0005-CONFIG and the documents referenced therein.

## 4.0 REQUIREMENTS AND PROCEDURES

### 4.1 General

- a. All procedures shall be performed in compliance with applicable requirements in SSC Procedural Requirement (SPR) 8715.1. If ever there is a conflict between this SSTD and SPR 8715.1, the SPR shall take precedence.
- b. Welders shall be qualified in accordance with SSTD-8070-0014-WELD (e.g., Radiographic Reports in Appendix A are for qualification of welder).

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- c. Inspection methods and acceptance criteria shall be in accordance with SSTD-8070-0013-WELD Class IV and AWS D1.1.

#### **4.2 Specification Compliances**

The carbon steel base metal to be welded shall meet the American Society for Testing and Materials (ASTM) specification(s) for one or more Group I or Group II materials listed in Table 3.1 of AWS D1.1.

#### **4.3 Procedure Qualification**

Qualification of procedures shall be in accordance with Section 4 of AWS D1.1.

#### **4.4 Base Metal**

The carbon steel base metal to be welded shall meet the ASTM specification(s) for one or more Group I or Group II materials listed in Table 3.1 of AWS D1.1.

#### **4.5 Electrodes**

Electrodes shall conform to the requirements of AWS A5.20, A5.29 and A5.36, and in accordance with Table 3.2 of AWS D1.1.

#### **4.6 Shielding Gas**

- a. Shielding gas shall be Argon/CO<sub>2</sub> with a 75%/25% composition.
- b. Shielding gas shall meet the requirements in accordance with section 5 of AWS D1.1.

#### **4.7 Positions**

Flat - 1G  
Horizontal - 2G  
Vertical - 3G  
Overhead - 4G

#### **4.8 Root Purge**

None required.

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#### 4.9 Base Metal Preparation

Base metal preparation shall be per the requirements in accordance with section 5 of AWS D1.1.

#### 4.10 Backing

Backing, if used, shall meet the requirements of AWS D1.1, Section 5.

#### 4.11 Electrical Characteristics

Refer to joining procedure for the selected process in attached sketches to this SSTD.

#### 4.12 Welding Environment

- a. The welding environment shall meet the requirements in accordance with section 5 of AWS D1.1 and SSTD-8070-0013-WELD Class IV section 10.0.
- b. Maintain purge gas uniformity by eliminating disruptive drafts during FCAW operations.

#### 4.13 Appearance of Weld

- a. The deposited weld metal shall be full, smooth, and well profiled into the parent metal, have a uniform throat section, and be free of overlaps or undercuts. Spot repair visual defects by grinding and re-welding, if necessary.
- b. Confine arc strikes to the weld area only. Arc strikes outside of the area of permanent welds should be avoided on any base metal. Cracks or blemishes caused by arc strikes shall be ground to a smooth contour and checked to ensure soundness.

**Note:** Exercise care to examine each pass to ensure the welds shall be free from flux, salt bath residue, weld spatter and other contaminants. This should be done with a grinder or wire wheel. Consult the Certified Weld inspector during the welding process.

#### 4.14 Repair Welding

Weld defects beyond limits prescribed in AWS D1.1 and SSTD-8070-0013-WELD Class IV section 10.0. shall be removed by appropriate methods (such as air arc gouging, scarfing, or grinding), after which the defective area shall be re-welded using the same procedure used to weld the original weld.

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## 5.0 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 National Aeronautics and Space Administration (NASA) SSC Forms Management Officer. Quality Records are identified in the SSC Master Records Index.
- d. The original, signed Welding Procedure Specification (WPS), Procedure Qualification Record(PQR) PQR and Welder Qualification Report (WQR) (copies of which are provided in the attachments of this SSTD) and the accompanying Certificate(s) of Analysis validation test documents shall be maintained in Central Engineering Files (CEF).

## 6.0 ACRONYMS AND ABBREVIATIONS

<b>ASTM</b>	American Society for Testing and Materials
<b>AWS</b>	American Welding Society
<b>CEF</b>	Central Engineering Files
<b>CO<sub>2</sub></b>	Carbon Dioxide
<b>FCAW</b>	Flux Cored Arc Welding
<b>NASA</b>	National Aeronautics and Space Administration
<b>OMD</b>	Operations and Maintenance Division
<b>PQR</b>	Procedure Qualification Record
<b>QA</b>	Quality Assurance
<b>SACOM</b>	Synergy Achieving Consolidated Operations and Maintenance
<b>SPR</b>	John C. Stennis Space Center Procedural Requirement
<b>SSC</b>	John C. Stennis Space Center
<b>SSTD</b>	John C. Stennis Space Center Standard
<b>WPS</b>	Welding Procedure Specification



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## 7.0 ATTACHMENTS

### WPS/PQR for Weld Positions 2G, 3G, 4G (\*1)

Horizontal Position 2G WPS SSTD-8070-0123-WELD (2G)  
Horizontal Position 2G PQR SWR PT0A7Q1BTR-2  
Vertical Position 3G WPS SSTD-8070-0123-WELD (3G)  
Vertical Position 3G PQR SWR PT0A7Q1BTR-3  
Overhead Position 4G WPS SSTD-8070-0123-WELD (4G)  
Overhead Position 4G PQR SWR PT0A7Q1BTR-4

### Radiographic Request/Report (\*2)

Weld nos. PQR 2G, 3G, 4G  
Weld no. PQR 2G2

### Certificates of Analysis (\*1)

Report no. 676-2 Position 2G (November 25, 2002)  
Report no. 662-2B Position 3G (November 20, 2002)  
Report no. 662-2C Position 4G (November 20, 2002)


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\*1 – Originals in CEF.

\*2 – Originals in SACOM QA files. (Records for qualifications of welders.)

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## 7.1 Horizontal Position 2G, WPS SSTD-8070-0123-WELD (2G)

 National Aeronautics and Space Administration John C. Stennis Space Center Stennis Space Center, MS 39529-6000		AWS - AMERICAN WELDING SOCIETY (WPS)																																																																																					
Welding Procedure Specification Record Number SSTD-8070-0123-WELD (2G)		Date June 1, 2019	Revision Number C																																																																																				
Qualified To AWS D1.1		Company Name Syncom Space Services (S3)																																																																																					
Supporting PQR(s) SWR PTO A7Q1BR-2		Reference Docs. SSTD-8070-0123-WELD																																																																																					
Scope FCAW Structural Carbon Steel		Joint Single																																																																																					
<b>BASE METALS</b> Type See Note A. P-no. Grp-no. I + II Welded To See Note A. P-no. Grp-no. I + II Backing See Note A. P-no. Grp-no. I + II Retainers Notes See Note B.		<b>THICKNESS RANGE QUALIFIED</b> <table border="1"> <thead> <tr> <th></th> <th>As-welded Min.</th> <th>Max.</th> <th>With PWHT Min.</th> <th>Max.</th> </tr> </thead> <tbody> <tr> <td>Complete Pen.</td> <td>≥ 1/8"</td> <td></td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Complete Pen.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Impact Tested</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Impact Tested</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Fillet Welds</td> <td>ALL</td> <td></td> <td>N/A</td> <td>N/A</td> </tr> </tbody> </table> <b>DIAMETER RANGE QUALIFIED</b> <table border="1"> <thead> <tr> <th></th> <th>As-welded Min.</th> <th>Max.</th> <th>With PWHT Min.</th> <th>Max.</th> </tr> </thead> <tbody> <tr> <td>Nominal Pipe Size</td> <td>≥ 24"</td> <td></td> <td>N/A</td> <td>N/A</td> </tr> </tbody> </table>			As-welded Min.	Max.	With PWHT Min.	Max.	Complete Pen.	≥ 1/8"		N/A	N/A	Complete Pen.					Impact Tested					Impact Tested					Fillet Welds	ALL		N/A	N/A		As-welded Min.	Max.	With PWHT Min.	Max.	Nominal Pipe Size	≥ 24"		N/A	N/A																																												
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<b>FILLER METALS</b> Process SFA Classification F-no. A-no. Chemical Analysis or Trade Name FCAW E71T-1 See Note C. Cons. Insert N/A Flux N/A		<b>THICKNESS RANGE QUALIFIED</b> <table border="1"> <thead> <tr> <th></th> <th>As-welded Min.</th> <th>Max.</th> <th>With PWHT Min.</th> <th>Max.</th> </tr> </thead> <tbody> <tr> <td></td> <td>≥ 1/8"</td> <td></td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>			As-welded Min.	Max.	With PWHT Min.	Max.		≥ 1/8"		N/A	N/A																																																																										
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<b>WELDING PROCEDURE</b> <table border="1"> <thead> <tr> <th></th> <th>FCAW</th> <th>FCAW</th> </tr> </thead> <tbody> <tr> <td>Welding Process</td> <td>Semi-Automatic</td> <td>Semi-Automatic</td> </tr> <tr> <td>Type</td> <td>75°F (Ambient)</td> <td>75°F (Ambient)</td> </tr> <tr> <td>Minimum preheat/interpass temperature (°F)</td> <td>400°F</td> <td>400°F</td> </tr> <tr> <td>Maximum interpass temperature (°F)</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Tungsten Size</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Tungsten Type</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Filler Metal Size (in.)</td> <td>.045" - 0.063"</td> <td>.045" - 0.063"</td> </tr> <tr> <td>Layer Number</td> <td>Root Pass through Pass 3</td> <td>Pass 4 - 35</td> </tr> <tr> <td>Position of Groove</td> <td>1G or 2G</td> <td>1G or 2G</td> </tr> <tr> <td>Weld Progression</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Current/Polarity</td> <td>DCEP</td> <td>DCEP</td> </tr> <tr> <td>Amperes</td> <td></td> <td></td> </tr> <tr> <td>Volts</td> <td>24.5</td> <td>27</td> </tr> <tr> <td>Travel Speed (in./min)</td> <td>6 - 10 ipm</td> <td>6 - 12 ipm</td> </tr> <tr> <td>Maximum Heat Input (kJ/in)</td> <td></td> <td></td> </tr> <tr> <td>DC Pulsing Current</td> <td></td> <td></td> </tr> <tr> <td>Shielding: Gas Type</td> <td>Argon / CO2 - 75% / 25%</td> <td>Argon / CO2 - 75% / 25G</td> </tr> <tr> <td>FlowRate (cfh)</td> <td>10 - 30 CFH</td> <td>10 - 30 CFH</td> </tr> <tr> <td>Trailing: Gas Type</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>FlowRate (cfh)</td> <td></td> <td></td> </tr> <tr> <td>Backing: Gas Type</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>FlowRate (cfh)</td> <td></td> <td></td> </tr> <tr> <td>String or Weave</td> <td>String or Weave</td> <td>String or Weave</td> </tr> <tr> <td>Orifice/Gas Cup Size</td> <td>1/2"</td> <td>1/2"</td> </tr> <tr> <td>Multi/Single Pass per Side</td> <td>Multi-pass</td> <td>Multi-pass</td> </tr> <tr> <td>Weld Deposit Chemistry</td> <td></td> <td></td> </tr> <tr> <td colspan="3">Notes Contact Tube to Work Distance 1/2" - 1"</td> </tr> </tbody> </table>					FCAW	FCAW	Welding Process	Semi-Automatic	Semi-Automatic	Type	75°F (Ambient)	75°F (Ambient)	Minimum preheat/interpass temperature (°F)	400°F	400°F	Maximum interpass temperature (°F)	N/A	N/A	Tungsten Size	N/A	N/A	Tungsten Type	N/A	N/A	Filler Metal Size (in.)	.045" - 0.063"	.045" - 0.063"	Layer Number	Root Pass through Pass 3	Pass 4 - 35	Position of Groove	1G or 2G	1G or 2G	Weld Progression	N/A	N/A	Current/Polarity	DCEP	DCEP	Amperes			Volts	24.5	27	Travel Speed (in./min)	6 - 10 ipm	6 - 12 ipm	Maximum Heat Input (kJ/in)			DC Pulsing Current			Shielding: Gas Type	Argon / CO2 - 75% / 25%	Argon / CO2 - 75% / 25G	FlowRate (cfh)	10 - 30 CFH	10 - 30 CFH	Trailing: Gas Type	N/A	N/A	FlowRate (cfh)			Backing: Gas Type	N/A	N/A	FlowRate (cfh)			String or Weave	String or Weave	String or Weave	Orifice/Gas Cup Size	1/2"	1/2"	Multi/Single Pass per Side	Multi-pass	Multi-pass	Weld Deposit Chemistry			Notes Contact Tube to Work Distance 1/2" - 1"		
	FCAW	FCAW																																																																																					
Welding Process	Semi-Automatic	Semi-Automatic																																																																																					
Type	75°F (Ambient)	75°F (Ambient)																																																																																					
Minimum preheat/interpass temperature (°F)	400°F	400°F																																																																																					
Maximum interpass temperature (°F)	N/A	N/A																																																																																					
Tungsten Size	N/A	N/A																																																																																					
Tungsten Type	N/A	N/A																																																																																					
Filler Metal Size (in.)	.045" - 0.063"	.045" - 0.063"																																																																																					
Layer Number	Root Pass through Pass 3	Pass 4 - 35																																																																																					
Position of Groove	1G or 2G	1G or 2G																																																																																					
Weld Progression	N/A	N/A																																																																																					
Current/Polarity	DCEP	DCEP																																																																																					
Amperes																																																																																							
Volts	24.5	27																																																																																					
Travel Speed (in./min)	6 - 10 ipm	6 - 12 ipm																																																																																					
Maximum Heat Input (kJ/in)																																																																																							
DC Pulsing Current																																																																																							
Shielding: Gas Type	Argon / CO2 - 75% / 25%	Argon / CO2 - 75% / 25G																																																																																					
FlowRate (cfh)	10 - 30 CFH	10 - 30 CFH																																																																																					
Trailing: Gas Type	N/A	N/A																																																																																					
FlowRate (cfh)																																																																																							
Backing: Gas Type	N/A	N/A																																																																																					
FlowRate (cfh)																																																																																							
String or Weave	String or Weave	String or Weave																																																																																					
Orifice/Gas Cup Size	1/2"	1/2"																																																																																					
Multi/Single Pass per Side	Multi-pass	Multi-pass																																																																																					
Weld Deposit Chemistry																																																																																							
Notes Contact Tube to Work Distance 1/2" - 1"																																																																																							



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

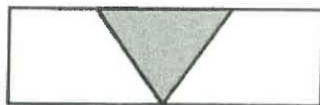
**AWS - AMERICAN WELDING SOCIETY (WPS)**

Welding Procedure Specification Record Number SSTD-8070-0123-WELD (2G)	Date June 1, 2019	Revision Number C
Qualified To AWS D1.1	Company Name Syncom Space Services (S3)	

### Weld Joint Designs

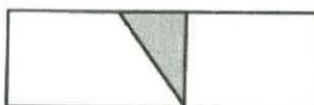
#### **Attachment #1**

##### **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**



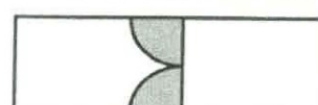
Groove Angle: 37.5 to 45 deg  
Root Opening: 1/16 to 3/16 in.  
Root Face: 0 to 1/16 in.  
Misalignment: 1/16-in. max.

##### **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**



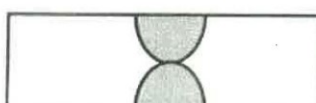
Groove Angle: 37.5 to 45 deg  
Groove Radius: 3/8 in.  
Root Opening: 1/16 to 3/16 in.  
Root Face: 0 to 1/16 in.  
Misalignment: 1/16-in. max.

##### **Single-U Groove**



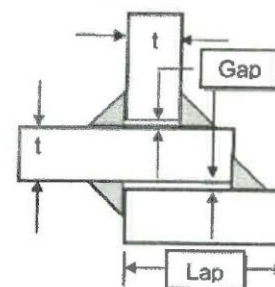
Groove Angle: 50 to 75 deg  
Groove Radius: 3/8 in.  
Root Opening: 1/16 to 3/16 in.  
Root Face: 0 to 1/16 in.  
Misalignment: 1/16-in. max.

##### **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.



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## 7.2 Horizontal Position 2G, PQR SWR PT0A7Q1BTR-2

WELDING PROCEDURE SPECIFICATION (WPS) Yes ☒  
 PREQUALIFIED \_\_\_\_\_ QUALIFIED BY TESTING ☒  
 or PROCEDURE QUALIFICATION RECORDS (PQR) Yes ☒

Company Name <u>Mississippi Space Services</u>	Identification # <u>SSTD-8070-0123-WELD (2G)</u>
Welding Process(es) <u>FCAW</u>	Revision <u>A</u> Date <u>10/29/2003</u> By <u>W. St. Cyr</u>
Supporting PQR No. (s) <u>SWR PTOA7Q1BTR-2</u>	Authorized by <u>[Signature]</u> Date: <u>10/30/03</u>
	Type - Manual <input type="checkbox"/> Semi-Automatic <input checked="" type="checkbox"/> Machine <input type="checkbox"/> Automatic <input type="checkbox"/>
JOINT DESIGN USED	
Type:	POSITION
Single <input checked="" type="checkbox"/> Double Weld <input type="checkbox"/>	Position of Groove: <u>Horizontal 2G</u> Fillet: <u>2G</u>
Backing: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Vertical Progression: Up <input type="checkbox"/> Down <input type="checkbox"/>
Backing Material: <u>AWS D1.1 Table 3.1, Groups I &amp; II</u>	ELECTRICAL CHARACTERISTICS
Root Opening <u>5/32"</u> Root Face Dimension <u>Zero</u>	Transfer Mode (GMAW) _____ Short-Circuiting <input type="checkbox"/>
Groove Angle: <u>37-1/2°</u> Radius (J-U) <u>N/A</u>	Globular <input checked="" type="checkbox"/> Spray <input type="checkbox"/>
Back Gouging: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Method _____	Current: AC <input type="checkbox"/> DCEP <input checked="" type="checkbox"/> DCEN <input type="checkbox"/> Pulsed <input type="checkbox"/>
BASE METALS	Other _____
Material Spec. <u>AWS D1.1</u>	Tungsten Electrode (GTAW) _____
Type or Grade <u>AWS D1.1 Table 3.1, Groups I &amp; II</u>	Size: <u>N/A</u>
Thickness: Groove <u>≥1/8"</u> Fillet <u>≥1/8"</u>	Type: <u>N/A</u>
Diameter (Pipe) <u>≥24"</u>	
FILLER METALS	TECHNIQUE
AWS Specification <u>A5.20 or A5.29</u>	Stringer or Weave Bead: <u>Stringer and Weave</u>
AWS Classification <u>See AWS D1.1 Table 3.1 for Group I and Group II materials.</u>	Multi-pass or Single Pass (per side) <u>Multipass</u>
SHIELDING	Number of Electrodes <u>1</u>
Flux _____ Gas <u>Argon/CO<sub>2</sub></u>	Electrode Spacing _____ Longitudinal _____ N/A
Composition <u>75%/25%</u>	Lateral _____ N/A
Electrode-Flux (Class) <u>N/A</u> Flow Rate <u>30 CFH</u>	Angle _____ N/A
Gas Cup Size <u>1/2"</u>	Contact Tube to Work Distance <u>1/2" - 1"</u>
PREHEAT	Peening <u>None</u>
Preheat Temp., Min <u>75°F (Ambient)</u>	Interpass Cleaning: <u>Chipping Hammer, Wire Brush, Grinding</u>
Interpass Temp., Min <u>75°F</u> Max <u>400°F</u>	POSTWELD HEAT TREATMENT
	Temp. <u>N/A</u>
	Time <u>N/A</u>

WELDING PROCEDURE								
Pass or Weld Layer(s)	Process	Filler Metals		Current		Volts	Travel Speed	Joint Details
		Class	Diam.	Type & Polarity	Amps or Wire Feed Speed			
ROOT THRU PASS 3	FCAW	E71T-1	1/16"	DCEP	157 in/min	24.5	8 ipm	
4-35	FCAW	E71T-1	1/16"	DCEP	155 in/min	27	10 ipm	

Form E-1 (Front)

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Procedure Qualification Record (PQR) # SWR PTOA7Q1BTR-2

Test Results

TENSILE TEST					2G Position	
Specimen No.	Width	Thickness	Area	Ultimate tensile load, lb.	Ultimate unit stress, psi	Character of failure and location
T-1	0.754"	0.933"	0.703"	56,600	80,512	BASE
T-2	0.757"	0.929"	0.703"	56,800	80,797	BASE

GUIDED BEND TEST

Specimen No.	Type of bend	Result	Remarks
SB-1	Side Bend	Satisfactory	
SB-2	Side Bend	Satisfactory	
SB-3	Side Bend	Satisfactory	
SB-4	Side Bend	Satisfactory	

VISUAL INSPECTION

Appearance Acceptable  
 Undercut None  
 Piping porosity None  
 Convexity None  
 Test date 11-21-02  
 Witnessed by Monty Wiggins

Radiographic-ultrasonic examination

RT report no.: PTOA7Q1BTR Result Accept  
 UT report no.: N/A Result N/A

FILLET WELD TEST RESULTS

Minimum size multiple pass Maximum size single pass  
 Macroetch Macroetch  
 1. N/A 3. N/A 1. N/A 3. N/A  
 2. N/A 2. N/A

Other Tests

All-weld-metal tension test

Tensile strength, psi 80 512 and 80 797  
 Yield point/strength, psi N/A  
 Elongation in 2 in., % N/A

Laboratory test no. 676-2

Welder's name Mark Corr

Clock no. N/A Stamp no. MSS 34

Tests conducted by Tech Weld

Laboratory

Test Number 676-2

Per Tech Weld

We, the undersigned, 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 4 of ANSI/AWS D.1.1, (2002) Structural Welding Code – Steel. (year)

Signed Mississippi Space Services

Manufacturer or Contractor

By [Signature]

Title Quality Assurance Engineer

Date October 16, 2003

### 7.3 Vertical Position 3G, WPS SSTD-8070-0123-WELD (3G)

SSC-937A (05/2019)





Stennis  
Standard

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

**AWS - AMERICAN WELDING SOCIETY (WPS)**

Welding Procedure Specification Record Number  
SSTD-8070-0123-WELD (3G)

Date  
June 1, 2019

Revision Number  
C

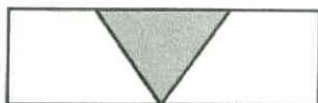
Qualified To  
AWS D1.1

Company Name  
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**



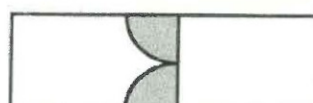
Groove Angle: 37.5 to 45 deg  
Root Opening: 1/16 to 3/16 in.  
Root Face: 0 to 1/16 in.  
Misalignment: 1/16-in. max.

##### **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**



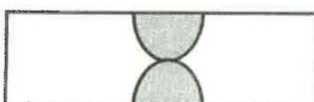
Groove Angle: 37.5 to 45 deg  
Groove Radius: 3/8 in.  
Root Opening: 1/16 to 3/16 in.  
Root Face: 0 to 1/16 in.  
Misalignment: 1/16-in. max.

##### **Single-U Groove**



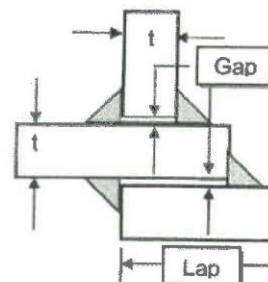
Groove Angle: 50 to 75 deg  
Groove Radius: 3/8 in.  
Root Opening: 1/16 to 3/16 in.  
Root Face: 0 to 1/16 in.  
Misalignment: 1/16-in. max.

##### **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.

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#### 7.4 Vertical Position 3G, PQR SWR PT0A7Q1BTR-3

WELDING PROCEDURE SPECIFICATION (WPS) Yes ☒  
 PREQUALIFIED \_\_\_\_\_ QUALIFIED BY TESTING ☒  
 or PROCEDURE QUALIFICATION RECORDS (PQR) Yes ☒

Company Name <u>Mississippi Space Services</u> Welding Process(es) <u>FCAW</u> Supporting PQR No. (s) <u>SWR PTOA7Q1BTR-3</u>  <b>JOINT DESIGN USED</b> Type: Single <input checked="" type="checkbox"/> Double Weld <input type="checkbox"/> Backing: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Backing Material: <u>AWS D1.1 Table 3.1 Groups I &amp; II</u> Root Opening <u>5/32"</u> Root Face Dimension <u>Zero</u> Groove Angle: <u>37-1/2°</u> Radius (J-U) <u>N/A</u> Back Gouging: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Method _____  <b>BASE METALS</b> Material Spec. <u>AWS D1.1</u> Type or Grade <u>AWS D1.1 Table 3.1 Groups I &amp; II</u> Thickness: Groove <u>≥1/8"</u> Fillet <u>≥1/8"</u> Diameter (Pipe) <u>≥24"</u>  <b>FILLER METALS</b> AWS Specification <u>A5.20 or A5.29</u> AWS Classification <u>See AWS D1.1 Table 3.1 for</u> <u>Group I and Group II materials.</u>  <b>SHIELDING</b> Flux _____ Gas <u>Argon/CO<sub>2</sub></u> Composition <u>75%/25%</u> Electrode-Flux (Class) <u>N/A</u> Flow Rate <u>30 CFH</u> Gas Cup Size <u>1/2"</u>  <b>PREHEAT</b> Preheat Temp., Min <u>75°F (Ambient)</u> Interpass Temp., Min <u>75°F</u> Max <u>400°F</u>	Identification # <u>SSTD-8070-0123-WELD (3G)</u> Revision <u>A</u> Date <u>10/29/2003</u> By <u>W. St. Cyr</u> Authorized by <u>[Signature]</u> Date: <u>10/30/03</u> Type – Manual <input type="checkbox"/> Semi-Automatic <input checked="" type="checkbox"/> Machine <input type="checkbox"/> Automatic <input type="checkbox"/>  <b>POSITION</b> Position of Groove: <u>Vertical 3G</u> Fillet: <u>3G</u> Vertical Progression: <u>Up</u> <input checked="" type="checkbox"/> <u>Down</u> <input type="checkbox"/>  <b>ELECTRICAL CHARACTERISTICS</b> Transfer Mode (GMAW) _____ Short-Circuiting <input type="checkbox"/> Globular <input checked="" type="checkbox"/> Spray <input type="checkbox"/> Current: AC <input type="checkbox"/> DCEP <input checked="" type="checkbox"/> DCEN <input type="checkbox"/> Pulsed <input type="checkbox"/> Other _____ Tungsten Electrode (GTAW) Size: <u>N/A</u> Type: <u>N/A</u>  <b>TECHNIQUE</b> Stringer or Weave Bead: <u>Stringer and Weave</u> Multi-pass or Single Pass (per side) _____ Multipass Number of Electrodes <u>1</u> Electrode Spacing _____ Longitudinal <u>N/A</u> Lateral <u>N/A</u> Angle <u>N/A</u> Contact Tube to Work Distance <u>1/2" – 1"</u> Peening <u>None</u> Interpass Cleaning: <u>Chipping Hammer, Wire Brush, Grinding</u>  <b>POSTWELD HEAT TREATMENT</b> Temp. <u>N/A</u> Time <u>N/A</u>
--	--

#### WELDING PROCEDURE

Pass or Weld Layer(s)	Process	Filler Metals		Current		Volts	Travel Speed	Joint Details
		Class	Diam.	Type & Polarity	Amps or Wire Feed Speed			
ROOT	FCAW	E71T-1	1/16"	DCEP	196 in/min	28	8 ipm	
2 & 3	FCAW	E71T-1	1/16"	DCEP	196 in/min	28	8 ipm	
4-10	FCAW	E71T-1	1/16"	DCEP	196 in/min	28	10 ipm	
11-18	FCAW	E71T-1	1/16"	DCEP	164 in/min	25	8 ipm	

Form E-1 (Front)

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**Procedure Qualification Record (PQR) # SWR PTOA7Q1BTR-3**

**Test Results**

TENSILE TEST				3G Position		
Specimen No.	Width	Thickness	Area	Ultimate tensile load, lb.	Ultimate unit stress, psi	Character of failure and location
T-1	0.752"	0.979"	0.736"	59,600	80,978	BASE
T-2	0.753"	0.988"	0.744"	59,600	80,108	BASE

GUIDED BEND TEST			
Specimen No.	Type of bend	Result	Remarks
SB-1	Side Bend	Satisfactory	
SB-2	Side Bend	Satisfactory	
SB-3	Side Bend	Satisfactory	
SB-4	Side Bend	Satisfactory	

**VISUAL INSPECTION**

Appearance Acceptable

Undercut None

Piping porosity None

Convexity None

Test date 11-14-02

Witnessed by Monty Wiggins

Radiographic-ultrasonic examination

RT report no.: PTOA7Q1BTR Result Accept

UT report no.: N/A Result N/A

**FILLET WELD TEST RESULTS**

Minimum size multiple pass	Maximum size single pass
Macroetch	Macroetch
1. <u>N/A</u> 3. <u>N/A</u>	1. <u>N/A</u> 3. <u>N/A</u>
2. <u>N/A</u>	2. <u>N/A</u>

Other Tests

All-weld-metal tension test

Tensile strength, psi 80 978 and 80 108

Yield point/strength, psi N/A

Elongation in 2 in., % N/A

Laboratory test no. 662-2B

Welder's name Mark Corr Clock no. N/A Stamp no. MSS 34

Tests conducted by Tech Weld Laboratory

Test Number 662-2B

Per Tech Weld

We, the undersigned, 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 4 of ANSI/AWS D.1.1, (2002) Structural Welding Code – Steel.  
(year)

Signed Mississippi Space Services  
Manufacturer or Contractor

By [Signature]

Title Quality Assurance Engineer


Date October 16, 2003

Form E-1 (Back)



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## 7.5 Overhead Position 4G, WPS SSTD-8070-0123-WELD (4G)

 National Aeronautics and Space Administration John C. Stennis Space Center Stennis Space Center, MS 39529-6000		AWS - AMERICAN WELDING SOCIETY (WPS)																																																																																																																	
Welding Procedure Specification Record Number SSTD-8070-0123-WELD (4G)		Date June 1, 2019	Revision Number C																																																																																																																
Qualified To AWS D1.1		Company Name Syncom Space Services (S3)																																																																																																																	
Supporting PQR(s) SWR PTOA7Q1BTR-4		Reference Docs. SSTD-8070-0123-WELD																																																																																																																	
Scope FCAW Structural Carbon Steel		Joint Single																																																																																																																	
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SSC-937A (05/2019)

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Stennis  
Standard

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Responsible Office: NASA SSC Center Operations, Operations and Maintenance Division

**SUBJECT: Flux Cored Arc Welding (FCAW) of Structural Carbon Steel**



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

**AWS - AMERICAN WELDING SOCIETY (WPS)**

Welding Procedure Specification Record Number  
SSTD-8070-0123-WELD (4G)

Date  
June 1, 2019

Revision Number  
C

Qualified To  
AWS D1.1

Company Name  
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



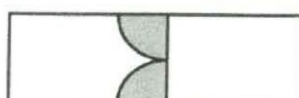
Groove Angle: 37.5 to 45 deg  
Root Opening: 1/16 to 3/16 in.  
Root Face: 0 to 1/16 in.  
Misalignment: 1/16-in. max.

##### 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



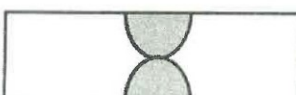
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Groove Radius: 3/8 in.  
Root Opening: 1/16 to 3/16 in.  
Root Face: 0 to 1/16 in.  
Misalignment: 1/16-in. max.

##### Single-U Groove



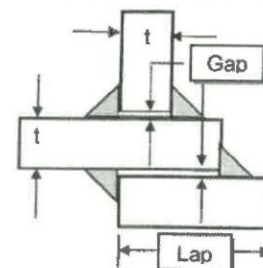
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Root Opening: 1/16 to 3/16 in.  
Root Face: 0 to 1/16 in.  
Misalignment: 1/16-in. max.

##### 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.



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## 7.6 Overhead Position 4G, PQR SWR PT0A7Q1BTR-4

WELDING PROCEDURE SPECIFICATION (WPS) Yes ☒  
 PREQUALIFIED QUALIFIED BY TESTING ☒  
 or PROCEDURE QUALIFICATION RECORDS (PQR) Yes ☒

Company Name Mississippi Space Services  
 Welding Process(es) FCAW  
 Supporting PQR No. (s) SWR PTOA7Q1BTR-4

Identification # SSTD-8070-0123-WELD (4G)  
 Revision A Date 10/29/2003 By W. St. Cyr  
 Authorized by [Signature] Date: 10/30/03  
 Type - Manual ☐ Semi-Automatic ☒  
 Machine ☐ Automatic ☐

### JOINT DESIGN USED

Type:  
 Single ☒ Double Weld ☐  
 Backing: Yes ☒ No ☐  
 Backing Material: AWS D1.1 Table 3.1, Groups I & II  
 Root Opening 5/32" Root Face Dimension Zero  
 Groove Angle: 37-1/2° Radius (J-U) N/A  
 Back Gouging: Yes ☐ No ☒ Method

### BASE METALS

Material Spec. AWS D1.1  
 Type or Grade AWS D1.1 Table 3.1, Groups I & II  
 Thickness: Groove ≥1/8" Fillet ≥1/8"  
 Diameter (Pipe) ≥24"

### FILLER METALS

AWS Specification A5.20 or A5.29  
 AWS Classification See AWS D1.1 Table 3.1 for  
Group I and Group II materials.

### SHIELDING

Flux  Gas Argon/CO<sub>2</sub>  
 Composition 75%/25%  
 Electrode-Flux (Class) N/A Flow Rate 30 CFH  
 Gas Cup Size 1/2"

### PREHEAT

Preheat Temp., Min 75°F (Ambient)  
 Interpass Temp., Min 75°F Max 400°F

### POSITION

Position of Groove: Overhead 4G Fillet: 4G  
 Vertical Progression: Up ☐ Down ☐

### ELECTRICAL CHARACTERISTICS

Transfer Mode (GMAW)  Short-Circuiting ☐  
 Globular ☒ Spray ☐  
 Current: AC ☐ DCEP ☒ DCEN ☐ Pulsed ☐  
 Other   
 Tungsten Electrode (GTAW)  
 Size: N/A  
 Type: N/A

### TECHNIQUE

Stringer or Weave Bead: Stringer and Weave  
 Multi-pass or Single Pass (per side) Multipass  
 Number of Electrodes 1  
 Electrode Spacing Longitudinal N/A  
Lateral N/A  
Angle N/A  
 Contact Tube to Work Distance 1/2" - 1"  
 Peening None  
 Interpass Cleaning: Chipping Hammer Wire Brush Grinding

### POSTWELD HEAT TREATMENT

Temp. N/A  
 Time N/A

### WELDING PROCEDURE

Pass or Weld Layer(s)	Process	Filler Metals		Current		Volts	Travel Speed	Joint Details
		Class	Diam.	Type & Polarity	Amps or Wire Feed Speed			
ROOT	FCAW	E71T-1	1/16"	DCEP	192 in/min	26	8 ipm	
2 & 3	FCAW	E71T-1	1/16"	DCEP	192 in/min	26	8 ipm	
4-21	FCAW	E71T-1	1/16"	DCEP	192 in/min	26	8 ipm	
22-26	FCAW	E71T-1	1/16"	DCEP	192 in/min	25	8 ipm	

Form E-1 (Front)

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**Procedure Qualification Record (PQR) # SWR PTOA7Q1BTR-4**

**Test Results**

TENSILE TEST					4G Position	
Specimen No.	Width	Thickness	Area	Ultimate tensile load, lb.	Ultimate unit stress, psi	Character of failure and location
T-1	0.752"	0.976"	0.734"	59,300	80,790	BASE
T-2	0.757"	0.964"	0.730"	59,600	81,644	BASE

GUIDED BEND TEST			
Specimen No.	Type of bend	Result	Remarks
SB-1	Side Bend	Satisfactory	
SB-2	Side Bend	Satisfactory	
SB-3	Side Bend	Satisfactory	
SB-4	Side Bend	Satisfactory	

<b>VISUAL INSPECTION</b>		<b>Radiographic-ultrasonic examination</b>	
Appearance <u>Acceptable</u>	Undercut <u>None</u>	RT report no.: <u>PTOA7Q1BTR</u>	Result <u>Accept</u>
Piping porosity <u>None</u>	Convexity <u>None</u>	UT report no.: <u>N/A</u>	Result <u>N/A</u>
Test date <u>11-14-02</u>	Witnessed by <u>Monty Wiggins</u>	<b>FILLET WELD TEST RESULTS</b>	
		Minimum size multiple pass	Maximum size single pass
		Macroetch	Macroetch
		1. <u>N/A</u> 3. <u>N/A</u>	1. <u>N/A</u> 3. <u>N/A</u>
		2. <u>N/A</u>	2. <u>N/A</u>

<b>Other Tests</b>	<b>All-weld-metal tension test</b>
	Tensile strength, psi <u>80,790 and 81,644</u>
	Yield point/strength, psi <u>N/A</u>
	Elongation in 2 in., % <u>N/A</u>
	Laboratory test no. <u>662-2C</u>
Welder's name <u>Mark Corr</u>	Clock no. <u>N/A</u> Stamp no. <u>MSS 34</u>
Tests conducted by <u>Tech Weld</u>	Laboratory
	Test Number <u>662-2C</u>
	Per <u>Tech Weld</u>

We, the undersigned, 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 4 of ANSI/AWS D.1.1, (2002) Structural Welding Code – Steel. (year)

Signed Mississippi Space Services  
Manufacturer or Contractor

By [Signature]  
Title Quality Assurance Engineer

Date October 16, 2003

Form E-1 (Back)





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**7.8 Report no. 676-2, Position 2G (November 25, 2002)**



P.O. Box 1900 PASCAGOULA, MS 39568-1900

OFFICE: 228-762-2890 FAX: 228-769-5219

**CERTIFICATE OF ANALYSIS**

Report No. **676-2**  
Page **1 of 1**  
Date **11/25/02**  
Lab No. **676-1102-1**

Material	SA 516 Gr. 70	Thickness	1.00"	Dia.	----	Ht/ID No.	----
Material	SA 516 Gr. 70	Thickness	1.00"	Dia.	----	Ht/ID No.	----
Process	FCAW	Filler Metal	E71T-1			Position	2G
WPS	----			Welder	----	ID	----
From	Mississippi Space Service			PO	39699	Other	----
Test For	Guided Bend & Tension Test					Test Date	11/25/02
Machine Model & Serial No.	Tinus-Olsen Universal Tester #31193					Date	7/31/02
Calibration Certified By	Mobile Calibration Service						
Specification Followed	ASTM E-74 and E-4						

THIS CERTIFICATE MAY NOT BE ALTERED, DELETED FROM, PUBLISHED AND/OR USED EXCEPT IN FULL

**GUIDED BEND TEST**

Type	Figure No.	Results
Side Bend SB-1	4.13	180° Satisfactory
Side Bend SB-2	4.13	180° Satisfactory
Side Bend SB-3	4.13	180° Satisfactory
Side Bend SB-4	4.13	180° Satisfactory

**TENSION TEST**

Spec. No.	Width (in.)	Thickness (in.)	Area (in <sup>2</sup> )	Load at Fracture (lbs.)	Tensile Strength (psi)	Failure Location
T-1	0.754	0.933	0.703	56,600	80,512	Base
T-2	0.757	0.929	0.703	56,800	80,797	Base

We certify that the statements in this record are correct and that the test samples were prepared and testing accordance with the requirements of Techweld PMT Procedure No. 1, ASTM E-8 and AWS D1.1, 2002 Edition.

Test materials will be discarded after 90 days unless prior written notification is received.

Certified By

*John C. Taylor*



Date **11-25-02**

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**7.9 Report no. 662-2B, Position 3G (November 20, 2002)**



P.O. Box 1900 PASCAGOULA, MS 39568-1900

OFFICE: 228-762-2890 FAX: 228-769-5219

**CERTIFICATE OF ANALYSIS**

Report No. 662-2B  
Page 1 of 1  
Date 11/20/02  
Lab No. 662-1102-2

Material	SA 516 Gr. 70	Thickness	1.00"	Dia.	----	Ht/ID No.	----
Material	SA 516 Gr. 70	Thickness	1.00"	Dia.	----	Ht/ID No.	----
Process	FCAW	Filler Metal	E71T-1			Position	3G
WPS	----			Welder	----	ID	----
From	Mississippi Space Service			PO	39279	Other	----
Test For	Guided Bend & Tension Test					Test Date	11/20/02
Machine Model & Serial No.	Tinus-Olsen Universal Tester #31193					Date	7/31/02
Calibration Certified By	Mobile Calibration Service						
Specification Followed	ASTM E-74 and E-4						

THIS CERTIFICATE MAY NOT BE ALTERED, DELETED FROM, PUBLISHED AND/OR USED EXCEPT IN FULL

**GUIDED BEND TEST**

Type	Figure No.	Results
Side Bend SB-1	QW 462.2	180° Satisfactory
Side Bend SB-2	QW 462.2	180° Satisfactory
Side Bend SB-3	QW 462.2	180° Satisfactory
Side Bend SB-4	QW 462.2	180° Satisfactory

**TENSION TEST**

Spec. No.	Width (in.)	Thickness (in.)	Area (in <sup>2</sup> )	Load at Fracture (lbs.)	Tensile Strength (psi)	Failure Location
T-1	0.752	0.979	0.736	59,600	80,978	Base
T-2	0.753	0.988	0.744	59,600	80,108	Base

We certify that the statements in this record are correct and that the test samples were prepared and testing accordance with the requirements of Techweld PMT Procedure No. 1, ASTM E-8 and AWS D1.1, 2002 Edition.

Test materials will be discarded after thirty (30) days unless prior written notification is received.

Certified By

*John C. Taylor*

JOHN C. TAYLOR  
11/20/02  
Techweld, Inc.

Date 11-20-02

Stennis Standard	SSTD-8070-0123-WELD	D
	Number	Rev.
	Effective Date: July 1, 2019	
	Review Date: July 1, 2024	
Page 28 of 28		
Responsible Office: NASA SSC Center Operations, Operations and Maintenance Division		
<b>SUBJECT: Flux Cored Arc Welding (FCAW) of Structural Carbon Steel</b>		

**7.10 Report no. 662-2C, Position 4G (November 20, 2002)**



P.O. Box 1900 PASCAGOULA, MS 39568-1900

OFFICE: 228-762-2890 FAX: 228-769-5219

**CERTIFICATE OF ANALYSIS**

Report No. 662-2C  
Page 1 of 1  
Date 11/20/02  
Lab No. 662-1102-3

Material	SA 516 Gr. 70	Thickness	1.00"	Dia.	----	Ht/ID No.	----
Material	SA 516 Gr. 70	Thickness	1.00"	Dia.	----	Ht/ID No.	----
Process	FCAW	Filler Metal	E71T-1			Position	4G
WPS	----			Welder	----	ID	----
From	Mississippi Space Service			PO	39279	Other	----
Test For	Guided Bend & Tension Test					Test Date	11/20/02
Machine Model & Serial No.	Tinus-Olsen Universal Tester #31193					Date	7/31/02
Calibration Certified By	Mobile Calibration Service						
Specification Followed	ASTM E-74 and E-4						

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**GUIDED BEND TEST**

Type	Figure No.	Results
Side Bend SB-1	QW 462.2	180° Satisfactory
Side Bend SB-2	QW 462.2	180° Satisfactory
Side Bend SB-3	QW 462.2	180° Satisfactory
Side Bend SB-4	QW 462.2	180° Satisfactory

**TENSION TEST**

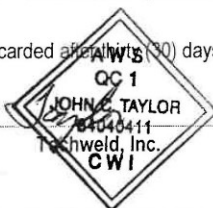
Spec. No.	Width (in.)	Thickness (in.)	Area (in <sup>2</sup> )	Load at Fracture (lbs.)	Tensile Strength (psi)	Failure Location
T-1	0.752	0.976	0.734	59,300	80,790	Base
T-2	0.757	0.964	0.730	59,600	81,644	Base

We certify that the statements in this record are correct and that the test samples were prepared and testing accordance with the requirements of Techweld PMT Procedure No. 1, ASTM E-8 and AWS D1.1, 2002 Edition.

Test materials will be discarded after thirty (30) days unless prior written notification is received.

Certified By

*John C. Taylor*



Date 11-20-02