



National Aeronautics and
Space Administration

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

SSTD-8070-0135-WELD
Rev. B
OCTOBER 2024

COMPLIANCE IS MANDATORY

JOHN C. STENNIS SPACE CENTER ASME AND AWS PROCEDURES FOR SMAW AND FCAW OF STRUCTURAL STEELS (P-NO. 1, GROUP 1 OR 2)

Approved in DDMS by:

Craig Chandler 10-30-2024
NASA SSC Center Operations Directorate
Facilities Engineering Services Date

Concurrence by:

Gina Ladner 10-30-2024
NASA SSC Center Operations
Directorate Facilities Services Date

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Date

Son Le 10-21-2024
NASA SSC Safety & Mission Assurance Date

Issued by

ISSUED CEF 10-30-2024
Central Engineering Files Date

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Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
Page 2 of 24		
Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services		
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)		

Document History Log

Change/ Revision	Change Date	Originator/ Phone	Description
Basic	07/05/2014	Doug Dike Ext. 8-2803	Initial release.
A	07/01/2019	Doug Dike Ext. 8-2803	<p>Modified title to read: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2. “ASTM A572, High Strength, Low Alloy Columbium-Vanadium” was deleted.</p> <p>Deleted specific references to A572 throughout document.</p> <p>Updated cover sheet approval/concurrence requirements per SSTD-8070-0005-CONFIG.</p> <p>Updated references and references.</p> <p>5.0-a: Amended to read, “These ASME and AWS (structural steel) procedures shall be used for welding steels by the SMAW and FCAW processes.”</p> <p>5.0-b: Added “and in accordance with ASME Section IX and AWS D1.1 requirements.”</p> <p>Minor administrative changes.</p> <p>Updated WPS forms.</p>
B	10/21/2024	Benny McGrath 8-2969	<p>Five-year review. Updated directorate titles on cover sheet and throughout document. Updated references and acronyms.</p> <p>Sections 8.1 and 8.2: Minimum preheat/interpass temperature (°F) changed from “320°F” to “330°F” for both SMAW - E6010 and SMAW E-7018.</p> <p>Section 8.2: In Base Metals section, both Type and Welded To identified as “ASTM A572 Gr. 50” with P-no. “1”.</p> <p>Section 8.3: Preheat temp. changed from “350°F” to 330°F”.</p>

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Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
Page 3 of 24		
Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services		
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)		

TABLE OF CONTENTS

1.0	PURPOSE.....	4
2.0	APPLICABILITY.....	4
3.0	REFERENCES.....	4
4.0	RESPONSIBILITIES	4
5.0	REQUIREMENTS AND PROCEDURES	4
6.0	RECORDS AND FORMS.....	5
7.0	ACRONYMS AND ABBREVIATIONS.....	5
8.0	ATTACHMENTS	6
8.1:	Weld Procedure Specification (ASME WPS)-SMAW.....	7
8.2:	Weld Procedure Specification (AWS WPS)-SMAW	10
8.3:	Weld Procedure Qualification Record (PQR)-SMAW	13
8.4:	Certificate of Analysis	15
8.5:	Weld Procedure Specification (ASME WPS)-FCAW.....	16
8.6:	Weld Procedure Specification (AWS WPS)-FCAW	19
8.7:	Weld Procedure Qualification Record (PQR)-FCAW	22
8.8:	Certificate of Analysis	24

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Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
Page 4 of 24		
Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services		
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)		

1.0 PURPOSE

This John C. Stennis Space Center (SSC) standard (SSTD) outlines the qualified Shielded Metal Arc Welding (SMAW) and Flux-Cored Arc Welding (FCAW) procedures for use in welding carbon steels.

2.0 APPLICABILITY

This SSTD applies to all contractor and subcontractor personnel involved with the welding of steels in accordance with American Society of Mechanical Engineers (ASME) and American Welding Society (AWS) requirements.

3.0 REFERENCES

All references are assumed to be the latest version unless otherwise indicated.

ASME Boiler and Pressure Vessel Codes, Section IX, *Welding and Brazing Qualifications*

AWS D1.1, *Structural Welding Code - Steel*

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, *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. These ASME and AWS (structural steel) procedures shall be used for welding steels by the SMAW and FCAW processes.
- 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 NASA SSC Center Operations Directorate Facilities

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Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
Page 5 of 24		
Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services		
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)		

Engineering Services, the NASA SSC Engineering and Test Directorate (E&TD), the NASA SSC Safety and Mission Assurance (S&MA) Office, and in accordance with ASME Section IX and AWS D1.1 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.
- e. Inspection methods for welds shall be in accordance with SSTD-8070-0013-WELD.

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 National Aeronautics and Space Administration (NASA) SSC Forms Management Officer. Quality Records are identified in the SSC Master Records Index.
- d. The original, signed WPSs, PQRs and WPQs (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).

7.0 ACRONYMS AND ABBREVIATIONS

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CEF	Central Engineering Files
E&TD	Engineering & Test Directorate
FCAW	Flux-Cored Arc Welding
NASA	National Aeronautics and Space Administration
PQR	Procedure Qualification Record
S&MA	Safety & Mission Assurance
SMAW	Shielded Metal Arc Welding
SPR	Stennis Procedural Requirement

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Stennis Standard	SSTD-8070-0135-WELD	B
	<i>Number</i>	<i>Rev.</i>
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
Page 6 of 24		
Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services		
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)		

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

8.0 ATTACHMENTS

WPS/PQR/Certificates of Analysis*

SMAW

- | | |
|------------------------------|-------------------------------------|
| 8.1: WPS - ASME | NASA-A572-SMAW |
| 8.2: WPS - AWS | NASA-A572-SMAW |
| 8.3: PQR | NASA-A572-SMAW-PQR |
| 8.4: Certificate of Analysis | Report No. 6990.90 (April 24, 2013) |

FCAW

- | | |
|------------------------------|-------------------------------------|
| 8.5: WPS – ASME | NASA-A572-FCAW |
| 8.6: WPS – AWS | NASA-A572-FCAW |
| 8.7: PQR | NASA-A572-FCAW-PQR |
| 8.8: Certificate of Analysis | Report No. 6987.90 (April 24, 2013) |

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Stennis Standard	SSTD-8070-0135-WELD	B
	<i>Number</i>	<i>Rev.</i>
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
Page 7 of 24		

8.1: Weld Procedure Specification (ASME WPS)-SMAW

Welding Procedure Specification Record Number		Date	Revision Number	
NASA-A572-SMAW		September 30, 2024	1	
Qualified To ASME Boiler and Pressure Vessel Code		Company Name Syncom Space Services (S3)		
Supporting PQR(s) NASA-A572-SMAW-PQR		Reference Docs. SSTD-8070-0135-WELD		
Scope Welding ASTM A572 Structural Steels		Joint Single V Groove, Single Bevel Groove		
BASE METALS (QW-403)		THICKNESS RANGE QUALIFIED		
Type	ASTM A572 Gr. 50	P-no.	1	Grp-no. 1or2
Welded To	ASTM A572 Gr. 50	P-no.	1	Grp-no. 1or2
Backing	None	P-no.		Grp-no.
Retainers				
Notes	See Note A.			
		Complete Pen.	As-welded Min. 0.1875"	Max. 8.00"
		Complete Pen.		
		Impact Tested		
		Impact Tested		
		Fillet Welds	No limit	
		DIAMETER RANGE QUALIFIED		
		Nominal Pipe Size	As-welded Min. ALL	Max.
			With PWHT Min.	Max.
FILLER METALS (QW-404)		THICKNESS RANGE QUALIFIED		
Process	SFA	Classification	F-no.	A-no.
SMAW	5.1	E6010	3	1
SMAW	5.1	E7018	4	1
Cons. Insert		N/A		
Flux				
WELDING PROCEDURE				
Welding Process		SMAW - E6010		SMAW - E7018
Type		Manual		Manual
Minimum preheat/interpass temperature (°F)		330°F (See Note C.)		330°F (See Note C.)
Maximum interpass temperature (°F)		800°F		600°F
Tungsten Size		N/A		N/A
Tungsten Type		N/A		N/A
Filler Metal Size (in.)		3/32" - 1/8"		3/32" - 3/16"
Layer Number		Root and Hot Pass		Fill
Position of Groove		1G		1G
Weld Progression		N/A		N/A
Current/Polarity		DCEP		DCEP
Amperes		50 - 150		85 - 250
Volts		20 - 30		20 - 35
Travel Speed (in./min)		3 - 14 ipm		4 - 14 ipm
Maximum Heat Input (kJ/in)				
DC Pulsing Current				
Shielding:	Gas Type	N/A		N/A
	Flow Rate (cfh)			
Trailing:	Gas Type	N/A		N/A
	Flow Rate (cfh)			
Backing:	Gas Type	N/A		N/A
	Flow Rate (cfh)			
String or Weave		String or Weave		String or Weave
Orifice/Gas Cup Size		N/A		N/A
Multi/Single Pass per Side		Multiple		Multiple
Weld Deposit Chemistry				
Notes				

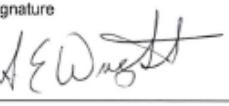
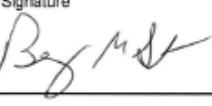
SSC-937 (02/2018)

Page 1 of 3

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Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
	Page 8 of 24	

Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)

	National Aeronautics and Space Administration John C. Stennis Space Center Stennis Space Center, MS 39529-6000		
ASME - WELDING PROCEDURE SPECIFICATIONS (WPS)			
Welding Procedure Specification Record Number NASA-A572-SMAW		Date September 30, 2024	Revision Number 1
Qualified To ASME Boiler and Pressure Vessel Code		Company Name Syncom Space Services (S3)	
BASE METALS (QW-403)			
Peening	Not allowed.		
Surface Preparation	See Note D.		
Initial/Interpass Cleaning	See Note D.		
Back Gouging Method	N/A		
NOTES			
A. Groove Thickness Range: 0.1875" - 8.00" Maximum Pass Thickness: ≤1/2"			
B. Filler Metal Product Form: Low Hydrogen			
C. Preheat maintenance 330°F - 460°F.			
D. Remove all contamination and water from surface. Remove all slag on weld and adjacent base metal using steel brushes.			
Signature 1		Signature 2	
Engineer Name Skip Wright	Signature 	Quality Name Richard Ladner	Signature 
Date 10-07-24		Date 10-7-24	
Signature 3		Signature 4	
Customer Reviewer Name Benjamin McGrath	Signature 	Customer Name	Signature
Date 10-07-24		Date	

SSC-937 (02/2018)

Page 2 of 3

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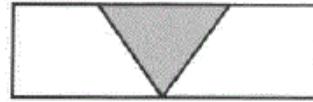
Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)



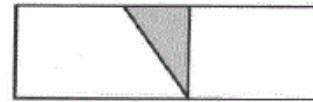
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Stennis Space Center, MS 39529-6000

ASME - WELDING PROCEDURE SPECIFICATIONS (WPS)

Welding Procedure Specification Record Number NASA-A572-SMAW	Date September 30, 2024	Revision Number 1
Qualified To ASME Boiler and Pressure Vessel Code	Company Name Syncom Space Services (S3)	

Weld Joint Designs**Attachment #1****Single-V Groove**

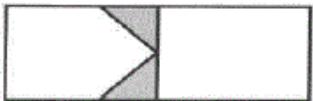
Groove Angle: 50 to 75 deg
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Single-Bevel Groove

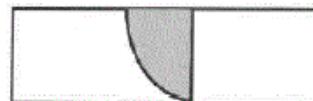
Groove Angle: 37.5 to 45 deg
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Double-V Groove

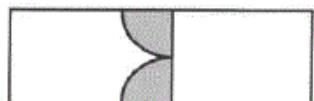
Groove Angle: 50 to 75 deg
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Double-Bevel Groove

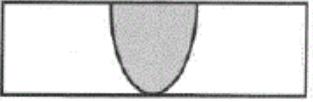
Groove Angle: 37.5 to 45 deg
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Single-J Groove

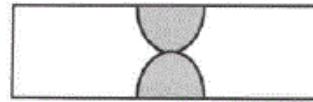
Groove Angle: 37.5 to 45 deg
Groove Radius: 3/8 in.
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Double-J Groove

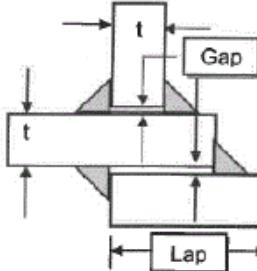
Groove Angle: 37.5 to 45 deg
Groove Radius: 3/8 in.
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

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.

Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
	Page 10 of 24	

Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)

8.2: Weld Procedure Specification (AWS WPS)-SMAW

 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 NASA-A572-SMAW-AWS		Date September 30, 2024	Revision Number A		
Qualified To AWS D1.1		Company Name Syncrom Space Services (S3)			
Supporting PQR(s) NASA-A572-SMAW-PQR		Reference Docs. SSTD-8070-0135-WELD			
Scope Welding P-1 to P-1 Group 1 or 2		Joint Single V Groove, Single Bevel Groove			
BASE METALS					
Type	ASTM A572 Gr. 50	P-no.	1	Grp-no.	1 or 2
Welded To	ASTM A572 Gr. 50	P-no.	1	Grp-no.	1 or 2
Backing	None	P-no.		Grp-no.	
Retainers	N/A				
Notes	See Note A.				
THICKNESS RANGE QUALIFIED					
		As-welded	Min.	Max.	With PWHT
Complete Pen.		<u>≥0.125"</u>			Min. N/A Max. N/A
Impact Tested					
Impact Tested					
Fillet Welds		ALL			Min. N/A Max. N/A
DIAMETER RANGE QUALIFIED					
		As-welded	Min.	Max.	With PWHT
Nominal Pipe Size		<u>≥24"</u>			Min. N/A Max. N/A
FILLER METALS					
Process	SFA	Classification	F-no.	A-no.	Chemical Analysis or Trade Name
SMAW	5.1	E6010	3	1	Note B.
SMAW	5.1	E7018	4	1	Note B.
Cons. Insert		N/A			
Flux		N/A			
WELDING PROCEDURE					
Welding Process	SMAW - E6010		SMAW - E7018		
Type	Manual		Manual		
Minimum preheat/interpass temperature (°F)	330°F (See Note C.)		330°F (See Note C.)		
Maximum interpass temperature (°F)	600°F		600°F		
Tungsten Size	N/A		N/A		
Tungsten Type	N/A		N/A		
Filler Metal Size (in.)	3/32" - 1/8"		3/32" - 3/16"		
Layer Number	Root and Hot Pass		Fill		
Position of Groove	(See Note E.)		(See Note E.)		
Weld Progression	N/A		N/A		
Current/Polarity	DCEP		DCEP		
Amperes	50 - 150		85 - 250		
Volts	20 - 30		20 - 35		
Travel Speed (in./min)	3 - 14 ipm		4 - 14 ipm		
Maximum Heat Input (kJ/in)					
DC Pulsing Current					
Shielding: Gas Type	N/A		N/A		
Flow Rate (cfh)					
Trailing: Gas Type	N/A		N/A		
Flow Rate (cfh)					
Backing: Gas Type	N/A		N/A		
Flow Rate (cfh)					
String or Weave	String or Weave		String or Weave		
Orifice/Gas Cup Size	N/A		N/A		
Multi/Single Pass per Side	Multiple		Multiple		
Weld Deposit Chemistry					
Notes					

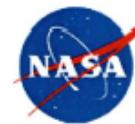
SSC-937A (05/2019)

Page 1 of 3

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Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
		Page 11 of 24

Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
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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 NASA-A572-SMAW-AWS	Date September 30, 2024	Revision Number A
Qualified To AWS D1.1	Company Name Syncon Space Services (S3)	

BASE METALS

Peening	Not allowed.
Surface Preparation	See Note D.
Initial/Interpass Cleaning	See Note D.
Back Gouging Method	None

POSTWELD HEAT TREATMENT

Temperature	None
Time and Temperature	None
Other	None

NOTES

- A. Groove Thickness Range: $\geq 0.125"$
Maximum Pass Thickness: $\leq 1/2"$
 - B. Filler Metal Product Form: Low Hydrogen
 - C. Preheat Maintenance: $330^{\circ}\text{F} - 460^{\circ}\text{F}$.
 - D. Remove all contamination and water from surface. Remove all slag on weld and adjacent base metal using steel brushes.
 - E. Welded in the flat position 1G or 1F (Fillet) weld only.
- _____

Signature 1

Engineer Name
Skip Wright

Date
10-07-24

Signature

Signature 2

Quality Name
Richard Ladner

Date
10-7-24

Signature

Signature 3

Customer Reviewer Name
Benjamin McGrath

Date
10-07-24

Signature

Signature 4

Customer Name

Date

Signature

Page 2 of 3

SSC-937A (05/2019)

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Space Administration
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Stennis Space Center, MS 39529-6000

AWS - AMERICAN WELDING SOCIETY (WPS)

Welding Procedure Specification Record Number
NASA-A572-SMAW-AWS

Date
September 30, 2024

Revision Number
A

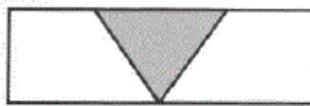
Qualified To
AWS D1.1

Company Name
Syncom Space Services (S3)

Weld Joint Designs

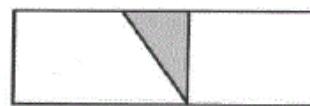
Attachment #1

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



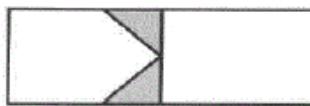
Groove Angle: 37.5 to 45 deg
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Double-V Groove



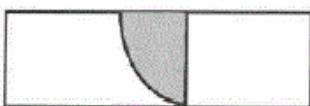
Groove Angle: 50 to 75 deg
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Double-Bevel Groove



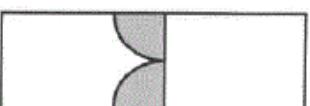
Groove Angle: 37.5 to 45 deg
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Single-J Groove



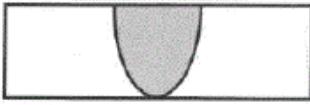
Groove Angle: 37.5 to 45 deg
Groove Radius: 3/8 in.
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Double-J Groove



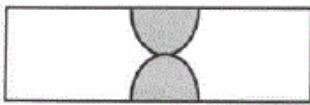
Groove Angle: 37.5 to 45 deg
Groove Radius: 3/8 in.
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Single-U Groove



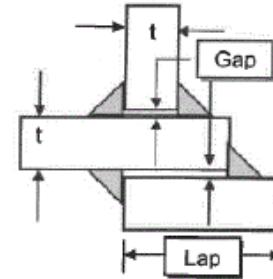
Groove Angle: 50 to 75 deg
Groove Radius: 3/8 in.
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

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.

Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
	Page 13 of 24	

Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)

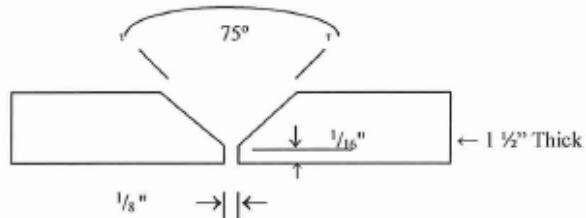
8.3: Weld Procedure Qualification Record (PQR)-SMAW



PROCEDURE QUALIFICATION RECORD (PQR)
(See QW-200.2, Section IX, ASME Boiler and Pressure Vessel Code)
Record Actual Conditions Used to Weld Test Coupon.

Company Name Jacobs Technology
Procedure Qualification Record No. NASA-A572-SMAW-PQR Date 4/24/13
WPS No. NASA-A572-SMAW
Welding Process(es) SMAW
Types (Manual, Automatic, Semi-Auto.) Manual

JOINTS (QW-402)



Groove Design of Test Coupon

(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.)

BASE METALS (QW-403)

Material Spec. ASTM A572

Type or Grade 50

P-No. _____ to P-No. _____

Thickness of Test Coupon 1.500"

Diameter of Test Coupon N/A

Other _____

POSTWELD HEAT TREATMENT (QW-407)

Temperature N/A

Time N/A

Other _____

Percent Composition

Shielding	Gas(es)	(Mixture)	Flow Rate
Shielding	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Trailing	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Backing	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>

ELECTRICAL CHARACTERISTICS (QW-409)

Current DC

Polarity EP

Amps. E6010 (80) E7018(85-126) Volts E6010 (25) E7018(24-26)

Tungsten Electrode Size N/A

Other _____

FILLER METALS (QW-404)

SFA Specification 5.1 5.1

AWS Classification E6010 E7018

Filler Metal F-No. 3 4

Weld Metal Analysis A-No. 1 1

Size of Filler Metal 1/8" 1/8"

Other _____

Deposited Weld Metal 0.250" 1.250"

POSITION (QW-405)

Position of Groove 1G

Weld Progression (Uphill, Downhill) N/A

Other _____

TECHNIQUE (QW-410)

Travel Speed 4-14 IPM

String or Weave Bead String

Oscillation 1 1/2 times the rod diameter

Multipass or Single Pass (per side) Multi-pass

Single or Multiple Electrodes Single

Other _____

PREHEAT (QW-406)

Preheat Temp. 330°F Min.

Interpass Temp. 330°F - 460°F

Other _____

Travis G. Moore Travis G. Moore
CWI 99041251
QC1 EXP. 4/1/2028

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Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
	Page 14 of 24	

Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)

QW-483 (Back)

PQR No. NASA-A572-SMAW-PQR

Tensile Test (QW-150)

Specimen No.	Width	Thickness	Area	Ultimate Total Load lb	Ultimate Unit Stress psi	Type of Failure & Location
6990.90 -T1	0.751"	1.474"	1.1070"	93,747	84,686	Weld
6990.90 -T2	0.744"	1.467"	1.0914"	93,797	85,942	Weld

Guided-Bend Tests (QW-160)

Type and Figure No.			Result	
6990.90 -S1 Side Bend QW-462.2			Acceptable	
6990.90 -S2 Side Bend QW-462.2			Acceptable	
6990.90 -S3 Side Bend QW-462.2			Acceptable	
6990.90 -S4 Side Bend QW-462.2			Acceptable	

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	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Fillet-Weld Test (QW-180)

Result – Satisfactory: Yes N/A No N/A Penetration into Parent Metal: Yes N/A No N/A
 Macro – Results N/A

Other Tests

Type of Test N/A
 Deposit Analysis N/A
 Other N/A

Welder's Name Robert Jones Soc.Sec. No. _____ Stamp No. 52
 Tests conducted by: Inspection Specialists, Inc. - MTL Div. Laboratory Test No. 6990.90
 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.

Manufacturer Jacobs Technology

Date April 24, 2013 By _____


 Travis G. Moore
 CWI 99041251
 QC1 EXP. 4/1/2026

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Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
		Page 15 of 24

Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)

8.4: Certificate of Analysis

 INSPECTION SPECIALISTS, INC. <small>MECHANICAL TESTING LABORATORY DIVISION</small>						
CERTIFICATE OF ANALYSIS						
Client: <u>Jacobs Technology</u>	Job No: <u>6990.90</u>					
Client Representative: <u>Benny McGrath</u>	Purchase Order: _____					
Test Specification: <u>ASME Section IX</u>						
Sample Identification: <u>One (1) – 1.500" Plate Procedure Qualification WPS #NASA-A572-SMAW</u>						
Welder: Robert Jones						
<p>The above referenced sample was prepared and tested in accordance with the welding procedure qualification requirements of ASME Section IX. Two (2) tensile test specimens and four (4) guided bend test specimens were prepared and tested. The results of these tests are reported herein.</p>						
TENSILE TEST						
SPECIMEN ID	WIDTH INCHES	THICKNESS INCHES	AREA SQ. IN.	ULTIMATE LOAD POUNDS	TENSILE STRENGTH PSI	NATURE OF FRACTURE
6990.90 -T1	0.751"	1.474"	1.1070"	93,747	84,686	Weld
6990.90 -T2	0.744"	1.467"	1.0914"	93,797	85,942	Weld
GUIDED BEND TEST						
SPECIMEN ID	TYPE TEST		TEST RESULT			
6990.90 -S1	Side Bend		Acceptable			
6990.90 -S2	Side Bend		Acceptable			
6990.90 -S3	Side Bend		Acceptable			
6990.90 -S4	Side Bend		Acceptable			
<p>The tests expressed herein meet or exceed the requirements of ASME Section IX.</p>						
		CERTIFIED BY:  Travis G. Moore, Lab Manager				
		Date: <u>April 24, 2013</u>	Certificate No: <u>1</u> of <u>1</u>			
<small>ALL TEST SPECIMENS, SAMPLES, DROPS, ETC. WILL BE DISCARDED THIRTY (30) DAYS AFTER TESTING UNLESS OTHERWISE INSTRUCTED IN WRITING.</small>						

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Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
	Page 16 of 24	

Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)

8.5: Weld Procedure Specification (ASME WPS)-FCAW

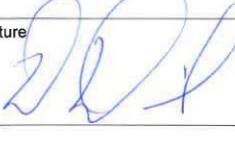
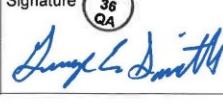
 National Aeronautics and Space Administration John C. Stennis Space Center Stennis Space Center, MS 39529-6000		ASME - WELDING PROCEDURE SPECIFICATIONS (WPS)			
Welding Procedure Specification Record Number NASA-A572-FCAW-ASME		Date June 1, 2019	Revision Number A		
Qualified To ASME Boiler and Pressure Vessel Code		Company Name Syncrom Space Services (S3)			
Supporting PQR(s) NASA-A572-FCAW-PQR		Reference Docs. SSTD-8070-0135-WELD			
Scope Welding P-1 to P-1 Group 1 or 2		Joint Single V Groove, Single Bevel Groove			
BASE METALS					
Type	P-no. <u>1</u>	Grp-no. <u>1 or 2</u>	THICKNESS RANGE QUALIFIED		
Welded To	P-no. <u>1</u>	Grp-no. <u>1 or 2</u>	As-welded Min. <u>0.1875"</u>	Max. <u>8.00"</u>	With PWHT Min. <u>N/A</u>
Backing	None		Impact Tested		Max. <u>N/A</u>
Retainers			Impact Tested		
Notes	Note A.				
Fillet Welds	<u>ALL</u>		N/A	N/A	
DIAMETER RANGE QUALIFIED					
Nominal Pipe Size	As-welded Min. <u>ALL</u>			Max. <u>N/A</u>	With PWHT Min. <u>N/A</u>
					Max. <u>N/A</u>
FILLER METALS					
Process	SFA	Classification	F-no.	A-no.	Chemical Analysis or Trade Name
SMAW	<u>5.1</u>	E6010	<u>3</u>	<u>1</u>	Note B.
FCAW	<u>5.36</u>	E71T-1	<u>6</u>	<u>1</u>	Note B.
Cons. Insert		N/A			
Flux		N/A			
WELDING PROCEDURE					
Welding Process	SMAW A5.1		FCAW A5.36		
Type	Manual / Semi-Automatic		Manual / Semi-Automatic		
Minimum preheat/interpass temperature (°F)	<u>350°F</u>		<u>350°F</u>		
Maximum interpass temperature (°F)	<u>500°F</u>		<u>500°F</u>		
Tungsten Size	N/A		N/A		
Tungsten Type	N/A		N/A		
Filler Metal Size (in.)	<u>3/32" - 3/16"</u>		<u>0.035" - 0.055"</u>		
Layer Number	Root and Hot Pass		Fill		
Position of Groove	All		All		
Weld Progression	N/A		N/A		
Current/Polarity	DCEP		DCEP		
Amperes	<u>50 - 150</u>		<u>180 - 275</u>		
Volts	<u>23 - 32</u>		<u>26 - 30</u>		
Travel Speed (in./min)	<u>3 - 14 ipm</u>		<u>4 - 14 ipm</u>		
Maximum Heat Input (kj/in)					
DC Pulsing Current					
Shielding: Gas Type	N/A		Argon / CO2 - 75% / 25%		
Flow Rate (cfh)			30 - 50 CFH		
Trailing: Gas Type	N/A		N/A		
Flow Rate (cfh)					
Backing: Gas Type	N/A		N/A		
Flow Rate (cfh)					
String or Weave	String or Weave		String or Weave		
Orifice/Gas Cup Size	N/A		1/4" to 1/2" (FCAW CO2)		
Multi/Single Pass per Side	Multiple		Multiple		
Weld Deposit Chemistry					
Notes	See Note C.				

SSC-937 (05/2019)

Page 1 of 3

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Stennis Standard	SSTD-8070-0135-WELD	B
	<i>Number</i>	<i>Rev.</i>
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029

 <p>National Aeronautics and Space Administration John C. Stennis Space Center Stennis Space Center, MS 39529-6000</p>		ASME - WELDING PROCEDURE SPECIFICATIONS (WPS)				
Welding Procedure Specification Record Number NASA-A572-FCAW-ASME		Date June 1, 2019	Revision Number A			
Qualified To ASME Boiler and Pressure Vessel Code		Company Name Syncom Space Services (S3)				
BASE METALS						
Peening	Not allowed.					
Surface Preparation	See Note D.					
Initial/Interpass Cleaning	See Note D.					
Back Gouging Method	None					
POSTWELD HEAT TREATMENT						
Temperature	None					
Time and Temperature	None					
Other	None					
NOTES						
A. Groove Thickness Range: 0.1875" - 8.00"						
Maximum Pass Thickness: $\leq 1/2"$						
B. Filler Metal Product Form: Low Hydrogen						
C. Technique: Contact Tube to Work Distance: 3/4" Max and single electrodes.						
D. Remove all contamination and water from surface. Remove all slag on weld and adjacent base metal.						
Signature 1 Engineer Name Doug Dike Date June 1, 2019				Signature 	Signature 2 Quality Name George Smith Date June 1, 2019	Signature 
Signature 3 Customer Reviewer Name Benjamin McGrath Date June 1, 2019		Signature 	Signature 4 Customer Name <hr/> Date <hr/>	Signature		
SSC-937 (05/2019)					Page 2 of 3	

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Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)

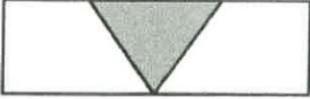
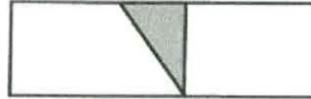
 National Aeronautics and Space Administration
John C. Stennis Space Center
Stennis Space Center, MS 39529-6000

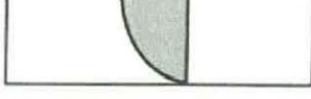
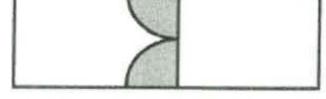
ASME - WELDING PROCEDURE SPECIFICATIONS (WPS)

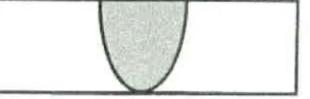
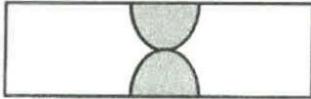
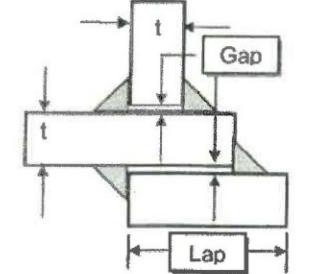
Welding Procedure Specification Record Number NASA-A572-FCAW-ASME	Date June 1, 2019	Revision Number A
Qualified To ASME Boiler and Pressure Vessel Code	Company Name Syncrom Space Services (S3)	

Weld Joint Designs

Attachment #1

Single-V Groove	Single-Bevel Groove	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.	Groove Angle: 37.5 to 45 deg Root Opening: 1/16 to 3/16 in. Root Face: 0 to 1/16 in. Misalignment: 1/16-in. max.	Groove Angle: 50 to 75 deg Root Opening: 1/16 to 3/16 in. Root Face: 0 to 1/16 in. Misalignment: 1/16-in. max.

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

Single-U Groove	Double-U Groove	Fillet Weld T or Lap
		 Gap: 1/16-in. max. / Lap: 5 x t or 1 in. min.
Groove Angle: 50 to 75 deg Groove Radius: 3/8 in. Root Opening: 1/16 to 3/16 in. Root Face: 0 to 1/16 in. Misalignment: 1/16-in. max.	Groove Angle: 50 to 75 deg Groove Radius: 3/8 in. Root Opening: 1/16 to 3/16 in. Root Face: 0 to 1/16 in. Misalignment: 1/16-in. max.	

Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
	Page 19 of 24	

Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)

8.6: Weld Procedure Specification (AWS WPS)-FCAW

 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 NASA-A572-FCAW-AWS		Date June 1, 2019	Revision Number A		
Qualified To AWS D1.1		Company Name Syncom Space Services (S3)			
Supporting PQR(s) NASA-A572-FCAW-PQR		Reference Docs. SSTD-8070-0135-WELD			
Scope Welding P-1 to P-1 Group 1 or 2		Joint Single V Groove, Single Bevel Groove			
BASE METALS					
Type	P-no.	Grp-no.	THICKNESS RANGE QUALIFIED		
Welded To	P-no.	Grp-no.	As-welded Min. $\geq 0.125"$	Max.	With PWHT Min. N/A Max. N/A
Backing	None.	P-no.	Complete Pen.	$\geq 0.125"$	
Retainers	N/A		Impact Tested		
Notes	See Note A.				
DIAMETER RANGE QUALIFIED					
Nominal Pipe Size	As-welded Min. $\geq 24"$			Max.	With PWHT Min. N/A Max. N/A
	Impact Tested				
	Fillet Welds	ALL		N/A	N/A
FILLER METALS					
Process	SFA	Classification	F-no.	A-no.	Chemical Analysis or Trade Name
SMAW	5.1	E6010	3	1	Note B.
FCAW	5.36	E71T-1	6	1	Note B.
Cons. Insert		N/A			
Flux		N/A			
WELDING PROCEDURE					
Welding Process	SMAW A5.1		FCAW A5.36		
Type	Manual / Semi-Automatic		Manual / Semi-Automatic		
Minimum preheat/interpass temperature (°F)	350°F		350°F		
Maximum interpass temperature (°F)	500°F		500°F		
Tungsten Size	N/A		N/A		
Tungsten Type	N/A		N/A		
Filler Metal Size (in.)	3/32" - 3/16"		0.035" - 0.055"		
Layer Number	Root and Hot Pass		Fill		
Position of Groove	(See Note E.)		(See Note E.)		
Weld Progression	N/A		N/A		
Current/Polarity	DCEP		DCEP		
Amperes	50 - 150		180 - 275		
Volts	23 - 32		26 - 30		
Travel Speed (in./min)	3 - 14 ipm		4 - 14 ipm		
Maximum Heat Input (kj/in)					
DC Pulsing Current					
Shielding: Gas Type	N/A		Argon / CO2 - 75% - 25%		
Flow Rate (cfh)			30 - 50 CFH		
Trailing: Gas Type	N/A		N/A		
Flow Rate (cfh)					
Backing: Gas Type	N/A		N/A		
Flow Rate (cfh)					
String or Weave	String or Weave		String or Weave		
Orifice/Gas Cup Size	N/A		1/4" to 1/2" (FCAW CO2)		
Multi/Single Pass per Side	Multiple		Multiple		
Weld Deposit Chemistry					
Notes	See Note C.				

SSC-937A (05/2019)

Page 1 of 3

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Stennis Standard	SSTD-8070-0135-WELD	B
	<i>Number</i>	<i>Rev.</i>
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
Page 20 of 24		

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Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)



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

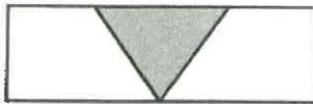
AWS - AMERICAN WELDING SOCIETY (WPS)

Welding Procedure Specification Record Number NASA-A572-FCAW-AWS	Date June 1, 2019	Revision Number A
Qualified To AWS D1.1	Company Name Syncom Space Services (S3)	

Weld Joint Designs

Attachment #1

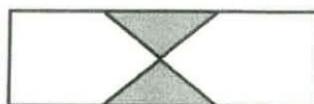
Single-V Groove



Single-Bevel Groove



Double-V Groove

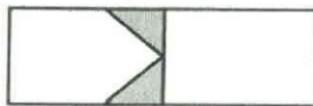


Groove Angle: 50 to 75 deg
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

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

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

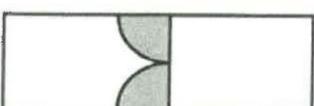
Double-Bevel Groove



Single-J Groove



Double-J Groove

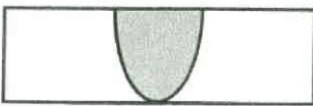


Groove Angle: 37.5 to 45 deg
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

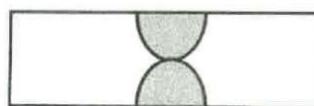
Groove Angle: 37.5 to 45 deg
Groove Radius: 3/8 in.
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

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

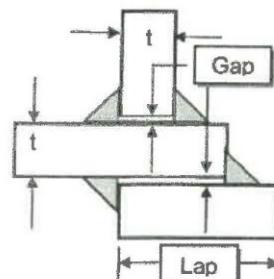
Single-U Groove



Double-U Groove



Fillet Weld T or Lap



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

Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)

8.7: Weld Procedure Qualification Record (PQR)-FCAW

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

Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
	Review Date:	October 21, 2029
	Page 23 of 24	

Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)

QW-483 (Back)						
PQR No. <u>NASA-A572-FCAW-PQR</u>						
Tensile Test (QW-150)						
Specimen No.	Width	Thickness	Area	Ultimate Total Load lb	Ultimate Unit Stress psi	Type of Failure & Location
6987.90 -T1	0.754"	1.495"	1.1272"	98,632	87,502	Weld
6987.90 -T2	0.750"	1.490"	1.1175"	96,368	86,235	Weld

Guided-Bend Tests (QW-160)						
Type and Figure No.			Result			
6987.90 -S1	Side Bend	QW-462.2	Acceptable			
6987.90 -S2	Side Bend	QW-462.2	Acceptable			
6987.90 -S3	Side Bend	QW-462.2	Acceptable			
6987.90 -S4	Side Bend	QW-462.2	Acceptable			

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	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Fillet-Weld Test (QW-180)						
Result – Satisfactory: Yes <u>N/A</u>	No <u>N/A</u>	Penetration into Parent Metal: Yes <u>N/A</u>	No <u>N/A</u>			
Macro – Results <u>N/A</u>						

Other Tests						
Type of Test <u>N/A</u>						
Deposit Analysis <u>N/A</u>						
Other <u>N/A</u>						

Welder's Name <u>Jackie Ladner</u>	Soc.Sec. No. <u></u>	Stamp No. <u>44</u>
Tests conducted by: <u>Inspection Specialists, Inc. - MTL Div.</u>	Laboratory Test No. <u>6987.90</u>	
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.		
Date <u>April 24, 2013</u>	Manufacturer <u>Jacobs Technology</u>	
		By <u>Benjamin A McGrath 4-28-13</u>
 Travis G Moore CWI 99041251 QC1 EXP. 4/1/2017		 Benjamin A McGrath CWI 05070911 QC1 EXP. 7/1/2014

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Stennis Standard	SSTD-8070-0135-WELD	B
	Number	Rev.
	Effective Date:	October 21, 2024
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		Page 24 of 24

Responsible Office: NASA SSC Center Operations Directorate Facilities Engineering Services
SUBJECT: ASME and AWS Procedures for SMAW and FCAW of Structural Steels (P-No. 1, Group 1 or 2)

8.8: Certificate of Analysis

 INSPECTION SPECIALISTS, INC. <small>MECHANICAL TESTING LABORATORY DIVISION</small>																					
<h3>CERTIFICATE OF ANALYSIS</h3>																					
Client: <u>Jacobs Technology</u> Job No: <u>6987.90</u> Client Representative: <u>Benny McGrath</u> Purchase Order: _____ Test Specification: <u>ASME Section IX</u> Sample Identification: <u>One (1) – 1.500" Plate Procedure Qualification WPS # NASA-A572-FCAW</u> <u>Welder: Jackie Ladner</u>																					
<p>The above referenced sample was prepared and tested in accordance with the welding procedure qualification requirements of ASME Section IX. Two (2) tensile test specimens and four (4) guided bend test specimens were prepared and tested. The results of these tests are reported herein.</p>																					
TENSILE TEST																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">SPECIMEN ID</th> <th style="text-align: left;">WIDTH INCHES</th> <th style="text-align: left;">THICKNESS INCHES</th> <th style="text-align: left;">AREA SQ. IN.</th> <th style="text-align: left;">ULTIMATE LOAD POUNDS</th> <th style="text-align: left;">TENSILE STRENGTH PSI</th> <th style="text-align: left;">NATURE OF FRACTURE</th> </tr> </thead> <tbody> <tr> <td>6987.90 -T1</td> <td>0.754"</td> <td>1.495"</td> <td>1.1272"</td> <td>98,632</td> <td>87,502</td> <td>Weld</td> </tr> <tr> <td>6987.90 -T2</td> <td>0.750"</td> <td>1.490"</td> <td>1.1175"</td> <td>96,368</td> <td>86,235</td> <td>Weld</td> </tr> </tbody> </table>	SPECIMEN ID	WIDTH INCHES	THICKNESS INCHES	AREA SQ. IN.	ULTIMATE LOAD POUNDS	TENSILE STRENGTH PSI	NATURE OF FRACTURE	6987.90 -T1	0.754"	1.495"	1.1272"	98,632	87,502	Weld	6987.90 -T2	0.750"	1.490"	1.1175"	96,368	86,235	Weld
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GUIDED BEND TEST																					
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6987.90 -S4	Side Bend	Acceptable																			
<p>The tests expressed herein meet or exceed the requirements of ASME Section IX.</p>																					
<p>CERTIFIED BY:  Travis G. Moore, Lab Manager</p>																					
Date: <u>April 24, 2013</u> Certificate No: <u>1</u> of <u>1</u> ALL TEST SPECIMENS, SAMPLES, DROPS, ETC. WILL BE DISCARDED THIRTY (30) DAYS AFTER TESTING UNLESS OTHERWISE INSTRUCTED IN WRITING.																					

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