



SSTD-8070-0136-WELD Rev. Basic
August 2014

National Aeronautics and
Space Administration

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

COMPLIANCE IS MANDATORY

John C. Stennis Space Center GAS TUNGSTEN ARC WELDING OF ASTM A333 GRADE 3 MATERIAL

Original signed by

<u>Scott Olive</u> NASA SSC Center Operations Directorate Design & Construction Project Management Division	<u>8-7-14</u> Date
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<u>Richard W. Harris</u> NASA SSC Center Operations Directorate Operations and Maintenance Division	<u>8-12-14</u> Date
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<u>Bartt J. Hebert</u> NASA SSC Engineering & Test Directorate	<u>8-7-14</u> Date
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<u>Son Le</u> NASA SSC Safety & Mission Assurance	<u>8-6-14</u> Date
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Issued by

<u>Issued CEF</u> Central Engineering Files	<u>8-13-14</u> Date
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SUBJECT: Gas Tungsten Arc Welding of ASTM A333 Grade 3 Material		

Document History Log

Status/Change/ Revision	Change Date	Originator/Phone	Description
Basic	08.12.2014	Doug Dike x8-2803	Initial release.

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1.0 PURPOSE

This John C. Stennis Space Center (SSC) standard (SSTD) provides for a qualified American Society of Mechanical Engineers (ASME) weld procedure for Gas Tungsten Arc Welding (GTAW) of ASTM A333, Grade 3 steel, using argon shielding gas.

2.0 APPLICABILITY

- a. This SSTD is valid for welding of ASTM A333, Grade 3 steel pipe or plate that will be used in, but not be limited to, nitrogen, helium, air, oxygen and hydrogen service.
- b. This SSTD applies to all contractor and subcontractor personnel involved with the GTAW welding of stainless steel pipe.

3.0 REFERENCES AND APPLICABLE DOCUMENTS

Applicable documents shall be the latest version unless otherwise specified.

ASME Boiler and Pressure Vessel Code, Section II, *Materials*

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

ASTM A333, *Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service*

SPR 1440.1, *SSC 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*

4.0 RESPONSIBILITIES

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. All procedures shall be performed in compliance with applicable requirements in John C. Stennis Space Center Procedural Requirement (SPR) 8715.1. If ever there is a conflict between this SSTD and the SPR, the SPR takes precedence.
- 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

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prior to use by the National Aeronautics and Space Administration (NASA) SSC Center Operations Directorate Project Management Division (PMD), the NASA SSC Engineering and Test Directorate (E&TD), and the NASA SSC Safety and Mission Assurance (S&MA) Office.

- c. The attached NASA-A333 Gr 3-Procedure Qualification Record (PQR) is the PQR for the original WPSs in this SSTD. When performing new qualifications, a new, approved PQR 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.
- f. Qualification tests shall be performed on test coupons welded with argon, helium or nitrogen as the backing gas.

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. The original, signed WPS and PQR (copies of which are provided in Attachment A of this SSTD) and the accompanying Certificate of Analysis validation test document shall be maintained in Central Engineering Files (CEF) together with the original, signed hardcopy of this SSTD.

7.0 ACRONYMS AND ABBREVIATIONS

ASME	American Society of Mechanical Engineers
CEF	Central Engineering Files
E&TD	Engineering and Test Directorate
GTAW	Gas Tungsten Arc Welding
NASA	National Aeronautics and Space Administration
PMD	Project Management Division
PQR	Procedure Qualification Record
PQRD	Procedure Qualification Record Data
S&MA	Safety and Mission Assurance
SPR	John C. Stennis Space Center Procedural Requirement
SSC	John C. Stennis Space Center
SSTD	John C. Stennis Space Center Standard
WPS	Weld Procedure Specifications

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ATTACHMENT A
A1: WPS NASA-A333 Gr 3-WPS

INSPECTION SPECIALISTS, INC.
MECHANICAL TESTING LABORATORY DIVISION

WELDING PROCEDURE SPECIFICATION (WPS)
(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name Jacobs Technology By: Inspection Specialists, Inc.-MTL Div.
Welding Procedure Specification No. NASA-A333 Gr3-WPS Date 4/22/14 Supporting PQR No.(s) NASA-A333 Gr3-PQR
Revision No. -0- Date _____
Welding Process(es) GTAW Type(s) Manual
(Automatic, Manual, Machine, or Semi-Auto.)

JOINTS (QW-402)

Joint Design See Detail Drawing
Backing (Yes) _____ (No) X
Backing Material (Type) _____
(Refer to both backing and retainers.)

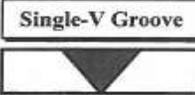
Metal Non-fusing Metal
 Nonmetallic Other

Sketches, Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified

(At the option of the Mfr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

Details

Single-V Groove



Groove Angle: 70° ± 10°
Root Opening: 1/8" ± 1/16"
Root Face: 1/8" ± 1/16"
Misalignment: 1/8-in. max.
Thickness: 1/2" Minimum

***BASE METALS (QW-403)**

P-No. 9B Group No. 1 to P-No. 9B Group No. 1
OR
Specification type and grade ASTM A333 Gr.3
to Specification type and grade ASTM A333 Gr.3
OR
Chem. Analysis and Mech. Prop. _____
to Chem. Analysis and Mech. Prop. _____
Thickness Range:
Base Metal: Groove .1875" - 1.348" Fillet Unlimited
Pipe Dia. Range: Groove All Diameters Fillet Unlimited
Other Maximum Pass Thickness ≤ 3/2"

*FILLER METALS (QW-404)	
Spec. No. (SFA)	<u>A5.28</u>
AWS No. (Class)	<u>ER80S-Ni2</u>
F-No.	<u>6</u>
A-No.	<u>10</u>
Size of Filler Metals	<u>3/32" - 3/16"</u>
Filler Metal Product Form	<u>Solid</u>
Weld Metal	
Thickness Range:	
Groove	<u>0.1875" - 1.348"</u>
Fillet	<u>Unlimited</u>
Electrode-Flux (Class)	<u>N/A</u>
Flux Trade Name	<u>N/A</u>
Consumable Insert	<u>N/A</u>
Other	_____



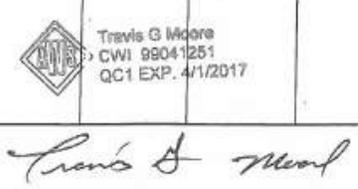
Trevia G. Moore
CWI 96741251
QC1 EXP. 4/17/2017

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

Trevia G. Moore

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QW-482 (Back)
WPS No. NASA-A333 Gr3-WPS² Rev. 0

POSITIONS (QW-405) Position(s) of Groove <u>6G</u> Welding Progression: Up <u>N/A</u> Down <u>N/A</u> Position(s) of Fillet <u>All</u>		POSTWELD HEAT TREATMENT (QW-407) Temperature Range <u>N/A</u> Time Range <u>N/A</u>																	
PREHEAT (QW-406) Preheat Temp. Min. <u>50°F</u> Inter-pass Temp. Max. <u>500°F</u> Preheat Maintenance <u>As Needed</u> (Continuous or special heating where applicable should be recorded)		GAS (QW-408) <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Gas(es)</th> <th>Percent Composition (Mixture)</th> <th>Flow Rate</th> </tr> </thead> <tbody> <tr> <td>Shielding</td> <td>Argon</td> <td>99.9%</td> <td>15-25 CFH</td> </tr> <tr> <td>Trailing</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Backing</td> <td>See Note # 1</td> <td>99.9%</td> <td>15-20 CFH</td> </tr> </tbody> </table>			Gas(es)	Percent Composition (Mixture)	Flow Rate	Shielding	Argon	99.9%	15-25 CFH	Trailing	N/A	N/A	N/A	Backing	See Note # 1	99.9%	15-20 CFH
	Gas(es)	Percent Composition (Mixture)	Flow Rate																
Shielding	Argon	99.9%	15-25 CFH																
Trailing	N/A	N/A	N/A																
Backing	See Note # 1	99.9%	15-20 CFH																
ELECTRICAL CHARACTERISTICS (QW-409) Current AC or DC <u>See Below</u> Polarity <u>See Below</u> Amps (Range) <u>See Below</u> Volts (Range) <u>See Below</u> (Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown below.) Tungsten Electrode Size and Type <u>3/32" - 1/8" 2% Thoriated - Grind electrode to cone shape with a 1/16" flat end</u> (Pure Tungsten, 2% Thoriated, etc.) Mode of Metal Transfer for GMAW <u>N/A</u> (Spray arc, short circuiting arc, etc.) Electrode Wire feed speed range <u>N/A</u>																			
TECHNIQUE (QW-410) String or Weave Bead <u>String or Weave</u> Orifice or Gas Cup Size <u>1/4" - 5/8"</u> Initial and Inter-pass Cleaning (Brushing, Grinding, etc.) <u>Remove all Contamination and water from surface. Clean weld and adjacent base metal using steel brushes.</u> Method of Back Gouging <u>N/A</u> Oscillation <u>N/A</u> Contact Tube to Work Distance <u>N/A</u> Multiple or Single Pass (per side) <u>Multiple</u> Multiple or Single Electrodes <u>Single</u> Travel Speed (Range) <u>3-5 IPM</u> Peening <u>Not Allowed</u> Other _____ Note # 1 <u>Backing gas can be either Argon or Helium. Nitrogen may be used as a backing gas but requires Engineering approval.</u>																			
		Filler Metal		Current															
Weld Layer(s)	Process	Class	Dia.	Type Polar.	Amp. Range	Volt Range	Travel Speed Range	Other (c.g., Remarks, Comments, Hot Wire Addition, Technique, Torch Angle, Etc.)											
All	GTAW	SFA5.28 ER80S-Ni2	3/32" - 1/8"	DCEN	80-200	9-13	3-7 IPM	Hold Electrode 60° to work											
																			

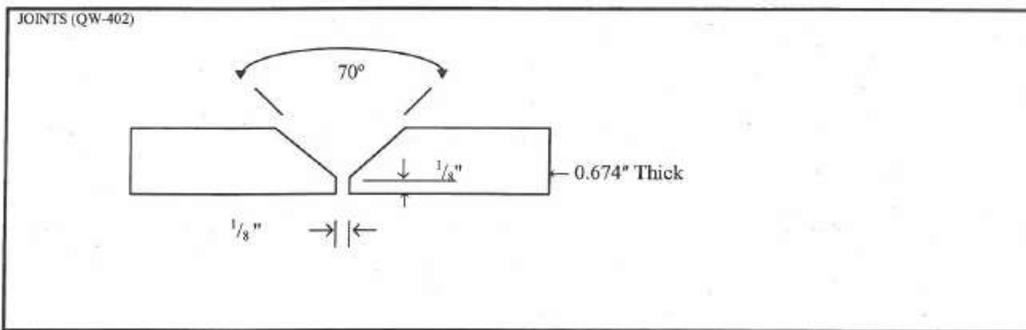
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A2: PQR NASA-A333 Gr 3-PQR



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-A333 Gr3-PQR Date 4/22/14
 WPS No. NASA-A333 Gr3-WPS
 Welding Process(es) GTAW
 Types (Manual, Automatic, Semi-Auto.) Manual



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 A333
 Type or Grade 3
 P-No. 9B to P-No. 9B
 Thickness of Test Coupon 0.674"
 Diameter of Test Coupon 4.5"
 Other _____

POSTWELD HEAT TREATMENT (QW-407)
 Temperature N/A
 Time N/A
 Other _____

FILLER METALS (QW-404)
 SFA Specification 5.28
 AWS Classification ER80S-Ni2
 Filler Metal F-No. 6
 Weld Metal Analysis A-No. 10
 Size of Filler Metal 3/32" - 1/8"
 Other _____
 Deposited Weld Metal 0.674"

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding	Argon	99.9%	20 CFH
Trailing	N/A	N/A	N/A
Backing	Argon	99.9%	20 CFH

ELECTRICAL CHARACTERISTICS (QW-409)
 Current DC
 Polarity EN
 Amps. 126-194 Volts 9-13
 Tungsten Electrode Size 1/8"
 Other _____

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

TECHNIQUE (QW-410)
 Travel Speed 4-7 IPM
 String or Weave Bead String
 Oscillation N/A
 Multi-pass or Single Pass (per side) Multi-pass
 Single or Multiple Electrodes Single
 Other _____

PREHEAT (QW-406)
 Preheat Temp. 50°F Min.
 Inter-pass Temp. 50°F - 300°F
 Other _____

Travis G Moore Travis G Moore
 CVI 89041251
 QC1 EXP. 4/1/2017

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QW-483 (Back)

PQR No. NASA-A333 Gr3-PQR

Tensile Test (QW-150)

Specimen No.	Width	Thickness	Area	Ultimate Total Load lb	Ultimate Unit Stress psi	Type of Failure & Location
7423.90-T1	0.753"	0.657"	0.4947"	38,094	77,004	Weld
7423.90-T2	0.750"	0.661"	0.4958"	39,420	79,508	Weld

Guided-Bend Tests (QW-160)

Type and Figure No.	Result
7423.90-S1 Side Bend QW-462.2	Acceptable
7423.90-S2 Side Bend QW-462.2	Acceptable
7423.90-S3 Side Bend QW-462.2	Acceptable
7423.90-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 Daniel P. Lambert Soc. Sec. No. _____ Stamp No. JT35W

Tests conducted by: Inspection Specialists, Inc. - MTL Div. Laboratory Test No. 7423.90

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 22, 2014

By Benj McNeil 4-22-14

Travis G Moore



Travis G Moore
 CWI 99041251
 QC1 EXP. 4/1/2017



Benjamin A McGrath
 CWI 08070911
 QC1 EXP. 7/1/2014

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A3: Certificate of Analysis



MECHANICAL TESTING LABORATORY DIVISION

CERTIFICATE OF ANALYSIS

Client: Jacobs Technology Job No: 7324.90

Client Representative: Benny McGrath Purchase Order: _____

Test Specification: ASME Section IX

Sample Identification: One (1) - 4.5" x 0.684" Procedure Qualification WPS # NASA-A333 Gr3-WPS
Welder: Daniel Lambert

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.

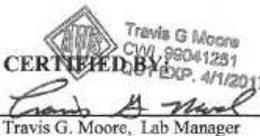
TENSILE TEST

SPECIMEN ID	WIDTH INCHES	THICKNESS INCHES	AREA SQ. IN.	ULTIMATE LOAD POUNDS	TENSILE STRENGTH PSI	NATURE OF FRACTURE
7423.90 -T1	0.753"	0.657"	0.4947"	38,094	77,004	Weld
7423.90 -T2	0.750"	0.661"	0.4958"	39,420	79,508	Weld

GUIDED BEND TEST

SPECIMEN ID	TYPE TEST	TEST RESULT
7423.90 -S1	Side Bend	Acceptable
7423.90 -S2	Side Bend	Acceptable
7423.90 -S3	Side Bend	Acceptable
7423.90 -S4	Side Bend	Acceptable

The tests expressed herein meet or exceed the requirements of ASME Section IX.



CERTIFIED BY
Travis G. Moore, Lab Manager

Date: April 22, 2014 Certificate No: 1 of 1

ALL TEST SPECIMENS, SAMPLES, DROPS, ETC. WILL BE DISCARDED THIRTY (30) DAYS AFTER TESTING UNLESS OTHERWISE INSTRUCTED IN WRITING