SSTD-8070-0037-WELD
Rev. A
SEPTEMBER 2019

National Aeronautics and
Space Administration

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

COMPLIANCE IS MANDATORY

John C. Stennis Space Center
ASME Procedure for Welding Nitronic 40 Stainless Steel Alloy

Original signed by

C. Brennan Sanders	9-24-19
NASA SSC Center Operations Facilities Engineering Test Complex Support	Date
Gina Ladner	10-8-19
NASA SSC Center Operations Directorate Facilities Services	Date
Bartt J. Hebert	9-6-19
NASA SSC Engineering & Test Directorate	Date
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NASA SSC Safety & Mission Assurance	Date

Issued by

ISSUED CEF	10-8-19
Central Engineering Files	Date

Document History Log

Change/ Revision	**Change Date**	**Originator/ Phone**	**Description**
Basic	08.12.14	Doug Dike, Ext. 8-2803	Initial release, superseding SSC STD 34-045. Updated references in 3.0 and 5.0.
A	09.04.19	Doug Dike, Ext. 8-2803	Five-year update. Minor administrative changes. Updated directorate titles on cover sheet as necessary. Updated references and acronyms. Section 5.0-b: Added, "and in accordance with ASME Boiler and Pressure Vessel Codes, Section IX, requirements." Section 8.0: Updated WPS, consolidating data from WPSs for: • Nitronic 40/GTAW • Nitronic 40/GTAW/I625 • Nitronic 40/GTAW/I625/2 Updated WPS to Form SSC-937.

Table of Contents

1.0 PURPOSE

This John C. Stennis Space Center (SSC) standard (SSTD) outlines the qualified Gas Tungsten Arc Welding (GTAW) procedure for use in welding Nitronic 40 at SSC.

2.0 APPLICABILITY

This SSTD applies to all contractor and subcontractor personnel involved with the welding of Nitronic 40 at SSC.

3.0 REFERENCES and APPLICABLE DOCUMENTS

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

AMS 5561, *Steel, Corrosion and Heat-Resistant, Welded and Drawn or Seamless and Drawn Tubing, 9.0Mn – 20Cr – 6.5Ni – 0.28N, High-Pressure Hydraulic*
AMS 5562, *Steel, Corrosion and Heat Resistant, Seamless Tubing, 9.0Mn – 20Cr – 6.5Ni – 0.28N, Solution Heat Treated*
AMS 5595, *Steel, Corrosion Resistant, Sheet, Strip, and Plate, 9.0Mn – 20Cr – 6.5Ni – 0.28N Solution Heat Treated*
AMS 5656, *Steel, Corrosion Resistant, Bars, Wire, Forgings, Extrusions, and Rings, 9.0Mn – 20Cr – 6.5Ni – 0.27N, Solution Heat Treated*
ASME Boiler and Pressure Vessel Code, Section II, *Materials*
ASME Boiler and Pressure Vessel Code, Section IX, *Welding, Brazing and Fusing Qualifications*
ASTM A182, *Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service*
ASTM A240, *Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*
ASTM A269, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service*
ASTM A276, *Standard Specification for Stainless Steel Bars and Shapes*
ASTM A312, *Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes*
ASTM A314, *Standard Specification for Stainless Steel Billets and Bars for Forging*
ASTM A336, *Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts*
ASTM A473, *Standard Specification for Stainless Steel Forgings*
ASTM A479, *Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels*
ASTM A580, *Standard Specification for Stainless Steel Wire*

ASTM A666, *Standard Specification for Annealed or Cold Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar*
ASTM A813, *Standard Specification for Single- or Double-Welded Austenitic Stainless Steel Pipe*
ASTM A814, *Standard Specification for Cold-Worked Welded Austenitic Stainless Steel Pipe*
ASTM A943, *Standard Specification for Spray-Formed Seamless Austenitic Stainless Steel Pipes*
ASTM A965, *Standard Specification for Steel Forgings, Austenitic, for Pressure and High Temperature Parts*
ASTM A988, *Standard Specification for Hot Isostatically-Pressed Stainless Steel Flanges, Fittings, Valves, and Parts for High Temperature Service*
AWS Welding Handbook, *American Welding Society Welding Handbook*
SPR 1440.1, *SSC Records Management Program Requirements*
SPR 8715.1, *Safety and Health Program Requirements*
SSTD-8070-0005-CONFIG, *SSC Preparation, Review, Approval, and Release of SSC Standards*
SSTD-8070-0013-WELD, *Classes of Welding Inspection*
SSTD-8070-0014-WELD, *Standard for Qualifying Welders and Weld Procedures*

4.0 RESPONSIBILITIES

a. Users of this SSTD shall comply with its requirements, ensure use of the correct version of this SSTD and the documents it references, and inform the appropriate organization of needed changes in accordance with SSTD-8070-0005-CONFIG.

b. Responsibilities for the use and control of this SSTD and for the review and approval of revisions or cancellation of this SSTD shall be as specified in SSTD-8070-0005-CONFIG and the applicable documents referenced therein.

5.0 REQUIREMENTS AND PROCEDURES

a. This procedure shall be used for welding any Nitronic 40 stainless steel alloy (UNS S21900, S21903, and S21904) to one or more of the following:

1. AMS 5561, 5562, 5595, 5656
2. ASME SA-182, SA-240, SA-312, SA-479, SA-666, SA-813, SA-814, and SA-965
3. ASTM A182, A240, A269, A276, A312, A314, A336, A473, A479, A580, A666, A813, A814, A943, A965, and A988.

b. Items denoted as essential variables in the attached weld procedure specifications (WPS) shall not be altered when using the WPS. An alternate WPS may be used only if approved prior to use by the National Aeronautics and Space Administration (NASA)

SSC Center Operations Directorate Project Management Division (PMD), the NASA SSC Engineering and Test Directorate (E&TD), NASA SSC Safety and Mission Assurance (S&MA) Office, and in accordance with ASME Boiler and Pressure Vessel Codes, Section IX, requirements.

c. The attached Procedure Qualification Records (PQRs) – No. 34-Nitronic 40/GTAW, No. 34-Nitronic 40/GTAW/I625, and No. 34-Nitronic 40/GTAW/I625/2 – are PQRs for the original qualification of WPSs in this standard. When performing new qualifications, a new PQR should be filled out showing all pertinent data and results of the weld procedure qualification.

d. The minimum service temperature for weldments produced under a WPS shall not be lower than the minimum test temperature of toughness tests (per QW-170) shown on the PQR or PQRs corresponding to the respective WPS.

e. X-ray prints, test results and reports, and dye penetrant test reports must be traceable to individual welds.

f. Welders shall be qualified in accordance with SSTD-8070-0014-WELD.

g. Inspection methods for welds shall be in accordance with SSTD-8070-0013-WELD.

g. All procedures shall be performed in compliance with applicable requirements in SPR 8715.1. If there is a conflict between this standard and the SPR, the SPR shall supersede this standard.

6.0 RECORDS AND FORMS

a. Records required by the procedures of this SSTD shall be maintained in accordance with SPR 1440.1 and as specified in this SSTD.

b. All records and forms are the latest version unless otherwise indicated.

c. Forms may be obtained from the SSC Electronic Forms repository or from the NASA SSC Forms Management Officer. Quality Records are identified in the SSC Master Records Index.

d. The original, signed WPSs, PQRs and Welder Performance Qualification (WPQ) forms (copies of which are provided in Attachments A-I of this SSTD) shall be maintained shall be maintained in Central Engineering Files (CEF).

7.0 ACRONYMS AND ABBREVIATIONS

AMS	Alpha Magnetic Spectrometer
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
GTAW	Gas Tungsten Arc Welding
MIL	Military
NASA	National Aeronautics and Space Administration
PMD	Project Management Division
PQR	Procedure Qualification Record
S&MA	Safety & Mission Assurance
SSC	John C. Stennis Space Center
SSTD	John C. Stennis Space Center Standard
SPR	Stennis Procedural Requirements
WPQ	Welder Performance Qualification
WPS	Weld Procedure Specifications

8.0 ATTACHMENTS

Attachment A: WPS for Nitronic 40/GTAW, Nitronic 40/GTAW/I625; and Nitronic 40/GTAW/I625/2

Attachment B: PQR Nitronic 40/GTAW

Attachment C: WPQ Tests Nitronic 40/GTAW

Attachment D: PQR Nitronic 40/GTAW/I625

Attachment E: Suggested Format for Manufacturing Record of Welder of WPQ Nitronic 40/GTAW/I625

Attachment F: PQR Nitronic 40/GTAW/I625/2

Attachment G: Suggested Format for Manufacturing Record of Welder of WPQ Nitronic 40/GTAW/I625/2

ATTACHMENT A: WELDING PROCEDURE SPECIFICATIONS (WPS)

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	Date	Revision Number
34-045 / GTAW	August 19, 2019	C

Qualified To	Company Name
ASME Boiler and Pressure Vessel Code Sec IX	Syncom Space Services (S3)
Supporting PQR(s)	**Reference Docs.**
34-045/GTAW, 34-045/GTAW/I625, 34-045/GTAW/I625/2	SSTD-8070-0037-WELD
Scope	**Joint**
Welding Nitronic 40 to Stainless steel	Single J Groove, Single V Groove

BASE METALS

		P-no.	Grp-no.
Type	Austenitic SS	8	3
Welded To	Austenitic SS	8	3
Backing	None		
Retainers			
Notes	Spec type. See Note A.		

THICKNESS RANGE QUALIFIED

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Complete Pen.	.188"	2.92"	N/A	N/A
Complete Pen. Impact Tested	.625"	2.92"		
Impact Tested				
Fillet Welds	All		N/A	N/A

DIAMETER RANGE QUALIFIED

	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
Nominal Pipe Size	All		N/A	N/A

FILLER METALS

Process	SFA	Classification	F-no.	A-no.	Chemical Analysis or Trade Name	As-welded Min.	As-welded Max.	With PWHT Min.	With PWHT Max.
GTAW	5.9	See Note B.	6			.188"	2.92"	N/A	N/A
GTAW	5.9	See Note B.	6			.188"	2.92"	N/A	N/A
Cons. Insert		N/A							
Flux		N/A							

WELDING PROCEDURE

Welding Process	GTAW		
Type	Manual		
Minimum preheat/interpass temperature (°F)	60°F		
Maximum interpass temperature (°F)	325°F		
Tungsten Size	(5/64" - 1/8")		
Tungsten Type	Thoriated EWTH-2		
Filler Metal Size (in.)	(3/32" - 1/8")		
Layer Number	Root, Fill & Cap Passes (Note C.)		
Position of Groove	All		
Weld Progression	Up / Down		
Current/Polarity	DCEN (-)		
Amperes	60 - 180		
Volts	12 - 26		
Travel Speed (in./min)	5 - 10 ipm		
Maximum Heat Input (kj/in)			
DC Pulsing Current			
Shielding: Gas Type	Argon ≥99.9% (See Note D.)		
Flow Rate (cfh)	20 - 35 CFH		
Trailing: Gas Type	N/A		
Flow Rate (cfh)			
Backing: Gas Type	Argon ≥99.9% (See Note E.)		
Flow Rate (cfh)	20 - 35 CFH		
String or Weave	String or weave (See Note F.)		
Orifice/Gas Cup Size	4 to 8		
Multi/Single Pass per Side	Multiple		
Weld Deposit Chemistry			
Notes			

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

ASME - WELDING PROCEDURE SPECIFICATIONS (WPS)

Welding Procedure Specification Record Number	Date	Revision Number
34-045 / GTAW	August 19, 2019	C
Qualified To	**Company Name**	
ASME Boiler and Pressure Vessel Code Sec IX	Syncom Space Services (S3)	

BASE METALS

Peening	Not allowed.
Surface Preparation	See Notes G and H.
Initial/Interpass Cleaning	See Notes G and H.
Back Gouging Method	Thermal or Mechanical, if required. Grind 1.6 mm (1/16"), if thermal.

POSTWELD HEAT TREATMENT

Temperature	None
Time and Temperature	None
Other	None

NOTES

A. UNS S21904, S21903, S21900 to UNS S21904, S21903, S21900. No pass greater than 12.7 mm (1/2") thick.

B. SFA 5.9, ASTM A580, TP XM-11, or ER 219. AWS No. (Class) ER 219 or TP XM-11.

C. Tack welds to be removed during welding the root pass.

D. High flow of shielding gas flow over molten puddle is required to eliminate nitrogen absorption from atmosphere.

E. Minimum 10 minutes of back purge prior to welding.

F. String or Weave bead no more than three (3) times weld wire diameter.

G. Wipe with cleaner or 1, 1, 1 Trichloroethane-moistened, clean, lint-free rag then brush with virgin SS brush 2" both sides of weld joint.

H. Rework or repair Grind, followed by brushing with SS brush. For grinding, use aluminum oxide grinding wheel not previously used on Carbon Steel.

Signature 1		**Signature 2**	
Engineer Name: Doug Dike	Signature:	Quality Name: George Smith	Signature: George E. Smith
Date: 8/20/19		Date: 8-16-2019	
Signature 3		**Signature 4**	
Customer Reviewer Name: Benjamin McGrath	Signature: Benjamin A. McGrath	Customer Name	Signature
Date: 8-16-19		Date	

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

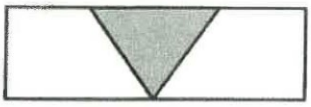
ASME - WELDING PROCEDURE SPECIFICATIONS (WPS)

Welding Procedure Specification Record Number	Date	Revision Number
34-045 / GTAW	August 19, 2019	C
Qualified To	**Company Name**	
ASME Boiler and Pressure Vessel Code Sec IX	Syncom Space Services (S3)	

Weld Joint Designs

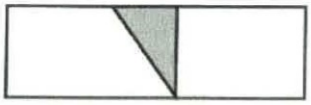
Attachment #1

Single-V Groove



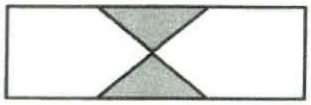
Groove Angle: 50 to 75 deg
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

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.

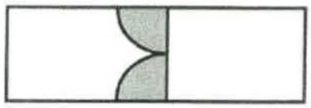
Double-Bevel Groove

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

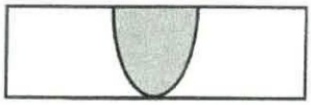
Groove Angle: 37.5 to 45 deg
Groove Radius: 3/8 in.
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Double-J Groove



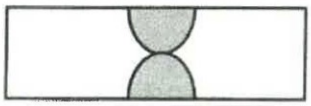
Groove Angle: 37.5 to 45 deg
Groove Radius: 3/8 in.
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

Single-U Groove



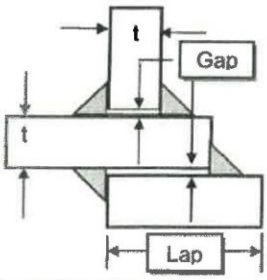
Groove Angle: 50 to 75 deg
Groove Radius: 3/8 in.
Root Opening: 1/16 to 3/16 in.
Root Face: 0 to 1/16 in.
Misalignment: 1/16-in. max.

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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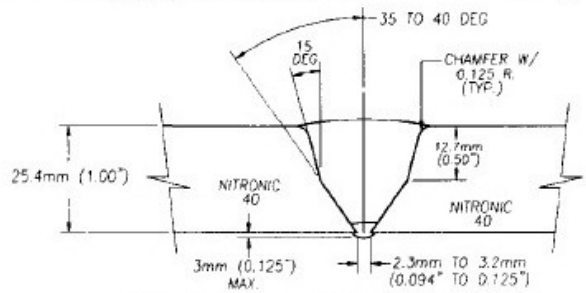
ATTACHMENT B: PQR NITRONIC 40/GTAW

QW-483 SUGGESTED FORMAT FOR WELDING PROCEDURE QUALIFICATION RECORD (PQR)
(See QW-201.2, Section IX, ASME Boiler and Pressure Vessel Code)

Record Actual Conditions Used to Weld Test Coupon

Company Name: Johnson Controls World Services Inc.
Procedure Qualification Record No: 34-Nitronic40 / GTAW Rev. A Date: 5/22/99
WPS No.: 34-045/GTAW Rev. A
Welding Process(es): GTAW
Types (Manual, Automatic, Semi-Auto): Manual

JOINTS (QW-402)



BASE METALS (QW-403)
Material Spec.: UNS 21904 to UNS 21904
Type or Grade: Nitronic 40 to Nitronic 40 (XM-11 to XM-11)
P-No.: 8 to P-No.: 8
Thickness of Test Coupon: 0.951" to 1.070"
Diameter of Test Coupon: 100mm nominal (104mm or 4.500" O.D.)
Other:

POSTWELD HEAT TREATMENT (QW-407)
Temperature: NOT APPLICABLE
Time:
Other:

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding and Backing	ARGON	99.99%	0.566m³/h (20 to 35 CFH)
Trailing	N/A		

FILLER METALS (QW-404)
SFA Specification: 5.9 or ASTM A580
AWS Classification: ER 219 Filler or Type XM-11 wire
Metal F-No.: 6 Weld Metal
Analysis A-No.: Size of Filler
Metal: 2.3mm (3/32") & 3.1mm (1/8") Other:
Deposited Weld Metal:

ELECTRICAL CHARACTERISTICS (QW-409)
Current: DC
Polarity: DCEN (-)
Amps.: 60 - 120 volts: 12 - 20
Tungsten Electrode Size: 2.4mm (3/32")
Other:

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

TECHNIQUE (QW-410)
Travel Speed: 127 - 203mm/min (5 - 8 i.p.m.)
String or Weave Bead: String Bead (3 times weld wire diameter)
Oscillation: Not Applicable
Multipass or Single Pass (per side): Multiple
Single or Multiple Electrodes: Single
Other:

PREHEAT (QW-406)
Preheat Temp.: 60° F Mininum
Interpass Temp.: 325° F Maximum
Other:

QW-483 (Back)

Tensile Test (QW-150)

Specimen No.	Width in.	Thickness in.	Area sq. in.	Ultimate Total Load lb.	Ultimate Unit Stress psi	Character of Failure & Location
T 1	0.491	0.978	0.480	50,400	104,536	Base
T 2	0.496	0.996	0.494	51,900	103,382	Base

Guided Bend Tests (QW-160)

Type and Figure No.	Result
SIDE BEND QW 462.2 1	Satisfactory
SIDE BEND QW 462.2 2	Satisfactory
SIDE BEND QW 462.2 3	Satisfactory
SIDE BEND QW 462.2 4	Satisfactory

Toughness Tests (QW-170)

Specimen No.	Notch Location	Notch Type	Test Temp.	Impact Values	Lateral % Shear	Exp. Mils	Drop Break	Weight No Break
08I02.1 - weld 1	Weld	Charpy V	-100°F	32 ft-lbs	5	21		
08I02.1 - weld 2	Weld	Charpy V	-100°F	30	5	22		
08I02.1 - weld 3	Weld	Charpy V	-100°F	32	5	19		
08I02.1 - Haz. 1	HAZ	Charpy V	-100°F	145	5	27		
08I01.1 - Haz. 2	HAZ	Charpy V	-100°F	33	25	85		
08I02.1 - Haz. 3	HAZ	Charpy V	-100°F	30	5	20		
08I02.1 - Base 1	Base	Charpy V	-100°F	152	30	86		
08I02.1 - Base 2	Base	Charpy V	-100°F	160	40	89		
08I02.1 - Base 3	Base	Charpy V	-100°F	166	40	84		

FILLET WELD TEST (QW-180)

Result - Satisfactory_____ Penetration into Parent Metal
Yes, No Yes, No

Type and Character of Failure_____ Macro-Results
Welder's Name Keith Bryant Clock No. 2307 Stamp No. 4
Tests conducted by: INSPECTION SPECIALISTS, INC. Laboratory Test No. P.O. SP139740 Sample WPP-01
per: ASME Section IX and ASTM A 370

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Signed Johnson Controls World Services Inc.
(Manufacturer)
By_____

Date 5/22/99

ATTACHMENT C: WPQ NITRONIC 40/GTAW

QW-484 SUGGESTED FORMAT FOR MANUFACTURING RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)
(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder Name Keith Bryant Check No. 2307 Stamp No. 4

Using WPS No. 34-045/GTAW Rev. A Date 5/22/99

the above welder is qualified for the following ranges.

Variable	Record Actual Values Used in Qualification	Qualification Range
Process	GTAW	GTAW
Process Type	GTAW	GTAW
Backing (metal,weldmetal,flux,etc. (QW-402)	N/A	N/A
Material Spec. (QW-403)	UNS 21904 to UNS 21094	P-No.8 Group 3 to P-No.8 Group 3
Thickness		
Groove	0.951" to 1.070"	0.188" to 2.00"
Fillet	N/A	0.188" to 2.00"
Diameter	4.5" O.D.	
Groove		2.875" O.D. and larger
Fillet	N/A	2.875" O.D. and larger
Filler Metal (QW-404)		
Spec. No.	AWS (SFA) 5.9	SFA 5.9 or ASTM A580
Class	ER219	ER219 or TP XM-11
F-No.	6	6
Deposited Weld Metal Thickness Groove X Fillet	0.951" to 1.070"	12.7mm (0.50") min.
Position (QW-405)	6G	6G
Weld Progression	Upward	Upward
Gas Type (QW-408)	99.99% Argon	99.99% Argon
Backing Gas (QW-408) 99.99% Argon	99% Argon	99% Argon
Electrical Characteristics (QW-409)		
Current	85 amps root; 90-115 amps remaining	60 - 120 Amps
Polarity	DCEN	DCEN

Guided Bend Test Results QW-462.2(a), WQ-462.3(a), WQ-462.3(b)

Type and Fig No.	Result
Side Bend; Specimen 08I02.1-S1	Satisfactory
Side Bend; Specimen 08I02.1-S2	Satisfactory
Side Bend; Specimen 08I02.1-S3	Satisfactory
Side Bend; Specimen 08I02.1-S4	Satisfactory

Radiographic Test Results (QW-304 & QW-305)
For alternative qualification of groove welds by radiography

Radiographic Results Accept

Fillet Weld Test Results [See QW-462.4(a), QW-462.4(b)]

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen)_____

Length and Percent of Defects_____ inches _____ %

Macro Test--Fusion

Appearance--Fillet Size (leg) _____ in. X _____ in. Convexity _____ in. or Concavity_____ in.

Test Conducted By Inspection Specialists, Inc. Laboratory--Test No. P.O. SP139740 Specimen WPP-01

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.

Organization Johnson Controls

Date 5/22/99 By [signature]

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)
NOTE: Any essential variables in addition to those above shall be recorded.

(12/86) This form (E00008) may be obtained from the Order Dept., ASME, 345 E. 47 St., New York, N.Y. 10017

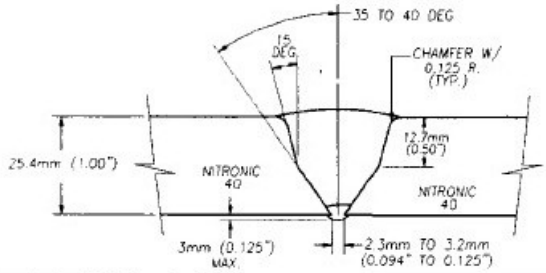
ATTACHMENT D: PQR NITRONIC 40/GTAW/I625

QW-483 SUGGESTED FORMAT FOR WELDING PROCEDURE QUALIFICATION RECORD (PQR)
(See QW-201.2, Section IX, ASME Boiler and Pressure Vessel Code)

Record Actual Conditions Used to Weld Test Coupon

Company Name Johnson Controls World Services Inc.
Procedure Qualification Record No 34-Nitronic 40/GTAW/I625 Rev. A Date 5/22/99
WPS No. 34-045/GTAW/I625
Welding Process(es) GTAW
Types (Manual, Automatic, Semi-Auto) Manual

JOINTS (QW-402)



BASE METALS (QW-403)
Material Spec. UNS 21904 to UNS 21904
Type or Grade Nitronic 40 to Nitronic 40 (XM-11 to XM-11)
P-No. 8 to P-No. 8
Thickness of Test Coupon 0.951" to 1.070"
Diameter of Test Coupon 100mm nominal (104mm or 4.500"O.D.)
Other

POSTWELD HEAT TREATMENT (QW-407)
Temperature NOT APPLICABLE
Time
Other

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding and Backing	ARGON	99.99%	0.566m³/h (20 to 35 CFH)
Trailing	N/A		

FILLER METALS (QW-404)
SFA Specification 5.14
AWS Classification ERNiCrMo-3
Metal F-No. 43 Weld Metal
Analysis A-No. Size of Filler
Metal 2.4mm (3/32") - 4.0mm (5/32") Other
Deposited Weld Metal

ELECTRICAL CHARACTERISTICS (QW-409)
Current DC
Polarity DCEN (-)
Amps. 60 - 140 volts 12 - 20
Tungsten Electrode Size 2.4mm (3/32")
Other

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

TECHNIQUE (QW-410)
Travel Speed 127 - 203mm/min (5 - 8 i.p.m.)
String or Weave Bead String Bead (3 times weld wire diameter)
Oscillation Not Applicable
Multipass or Single Pass (per side) Multiple
Single or Multiple Electrodes Single
Other

PREHEAT (QW-406)
Preheat Temp. 60° F Minimum
Interpass Temp. 325° F Maximum
Other

QW-483 (Back)

Tensile Test (QW-150)

Specimen No.	Width in.	Thickness in.	Area sq. in.	Ultimate Total Load lb.	Ultimate Unit Stress psi	Character of Failure & Location
T 1	0.491	1.017	0.499	54,700	109,619	Base
T 2	0.495	1.024	0.506	52,500	103,754	Weld

Guided Bend Tests (QW-160)

Type and Figure No.	Result
SIDE BEND QW 462.2 1	Satisfactory
SIDE BEND QW 462.2 2	Satisfactory
SIDE BEND QW 462.2 3	Satisfactory
SIDE BEND QW 462.2 4	Satisfactory

Toughness Tests (QW-170)

Specimen No.	Notch Location	Notch Type	Test Temp.	Impact Values	Lateral % Shear	Exp. Mils	Drop Break	Weight No Break
08I02.3 - weld 1	Weld	Charpy V	-100°F	40 ft-lbs	85	14		
08I02.3 - weld 2	Weld	Charpy V	-100°F	85	85	16		
08I02.3 - weld 3	Weld	Charpy V	-100°F	39	85	13		
08I02.3 - HAZ 1	HAZ	Charpy V	-100°F	74	40	16		
08I02.3 - HAZ 2	HAZ	Charpy V	-100°F	44	85	15		
08I02.3 - HAZ 3	HAZ	Charpy V	-100°F	50	85	20		

FILLET WELD TEST (QW-180)

Result - Satisfactory_____ Penetration into Parent Metal_____
Yes, No Yes, No

Type and Character of Failure_____ Macro-Results

Welder's Name Keith Bryant Clock No. 2307 Stamp No. 4

Tests conducted by: Inspection Specialists, Inc. Laboratory Test No. P.O. R1-149804 Sample WPP#3

per: ASME Section IX and ASTM A 370

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Signed Johnson Controls World Services Inc.
(Manufacturer)

Date 5/22/99 By [signature]

ATTACHMENT E: SUGGESTED FORMAT FOR MANUFACTURING RECORD OF WELDER OF WPQ NITRONIC 40/GTAW/I625

QW-484 SUGGESTED FORMAT FOR MANUFACTURING RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)
(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder Name Keith Bryant Check No. 2307 Stamp No. 4

Using WPS No. 34-045/GTAW/I625 Rev. A Date 5/22/99

the above welder is qualified for the following ranges.

Variable	Record Actual Values Used in Qualification	Qualification Range
Process	GTAW	GTAW
Process Type	GTAW	GTAW
Backing (metal,weldmetal,flux,etc. (QW-402)	N/A	N/A
Material Spec. (QW-403)	UNS 21904 to UNS 21904	P-No.8 Group No. 3 to P-No.8 Group No. 3
Thickness		
Groove	0.951" to 1.070"	0.188" to 2.00"
Fillet	N/A	0.188" to 2.00"
Diameter		
Groove	4.5" O.D.	2.875" O.D. and larger
Fillet	N/A	2.875" O.D. and larger
Filler Metal (QW-404) Spec. No.	AWS (SFA) 5.14	SFA 5.14
Class	ERNiCrMo-3	ERNiCrMo-3
F-No.	43	43
Deposited Weld Metal Thickness Groove X Fillet	0.951" to 1.070"	12.7 mm (0.50") min.
Position (QW-405)	6G	6G
Weld Progression	Upward	Upward
Gas Type (QW-408)	99.99% Argon	99.99% Argon
Backing Gas (QW-408) 99.99% Argon	99% Argon	99% Argon
Electrical Characteristics (QW-409) Current	120 amps root; 130-140 amps remaining	60 - 140 Amps
Polarity	DCEN	DCEN

Guided Bend Test Results QW-462.2(a), WQ-462.3(a), WQ-462.3(b)

Type and Fig No.	Result
Side Bend; Specimen 08I02.3-S1	Satisfactory
Side Bend; Specimen 08I02.3-S2	Satisfactory
Side Bend; Specimen 08I02.3-S3	Satisfactory
Side Bend; Specimen 08I02.3-S4	Satisfactory

Radiographic Test Results (QW-304 & QW-305)
For alternative qualification of groove welds by radiography

Radiographic Results Accept

Fillet Weld Test Results [See QW-462.4(a), QW-462.4(b)]

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen)

Length and Percent of Defects _____ inches _____ %

Macro Test--Fusion

Appearance--Fillet Size (leg) _____ in. X _____ in. Convexity _____ in. or Concavity _____ in.

Test Conducted By Inspection Specialists, Inc. Laboratory--Test No. P.O. R1-149804 Sample WPP#3

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.

Organization Johnson Controls

Date 5/22/99 By

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

NOTE: Any essential variables in addition to those above shall be recorded.

(12/86) This form (E00008) may be obtained from the Order Dept., ASME, 345 E. 47 St., New York, N.Y. 10017

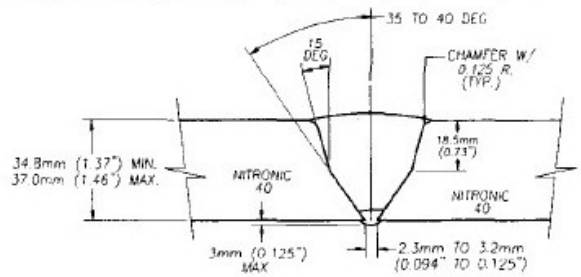
ATTACHMENT F: PQR NITRONIC 40/GTAW/I625/2

QW-483 SUGGESTED FORMAT FOR WELDING PROCEDURE QUALIFICATION RECORD (PQR)
(See QW-201.2, Section IX, ASME Boiler and Pressure Vessel Code)

Record Actual Conditions Used to Weld Test Coupon

Company Name: Johnson Controls World Services Inc.
Procedure Qualification Record No: 34-Nitronic 40/GTAW/I625/2 Date: 5/22/99
WPS No.: 34-045/GTAW/I6252
Welding Process(es): GTAW
Types (Manual, Automatic, Semi-Auto): Manual

JOINTS (QW-402)



BASE METALS (QW-403)
Material Spec.: UNS 21904 to UNS 21904
Type or Grade: Nitronic 40 to Nitronic 40 (XM-11 to XM-11)
P-No.: 8 to P-No.: 8
Thickness of Test Coupon: 34.8mm (1.37") minimum to 37.0mm (1.46") maximum
Diameter of Test Coupon: 323.9mm (12.75") O.D.
Other:

POSTWELD HEAT TREATMENT (QW-407)
Temperature: NOT APPLICABLE
Time:
Other:

GAS (QW-408)

	Gas(es)	Percent Composition (Mixture)	Flow Rate
Shielding and Backing	ARGON	99.99%	0.566m³/h (20 to 35 CFH)
Trailing	N/A		

FILLER METALS (QW-404)
SFA Specification: 5.14
AWS Classification: ERNiCrMo-3
Metal F-No.: 43 Weld Metal
Analysis A-No.: Size of Filler
Metal: 2.4mm (3/32") - 4.0mm (5/32") Other:
Deposited Weld Metal:

ELECTRICAL CHARACTERISTICS (QW-409)
Current: DC
Polarity: DCEN (-)
Amps.: 60 - 140 volts: 12 - 20
Tungsten Electrode Size: 2.4mm (3/32")
Other:

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

TECHNIQUE (QW-410)
Travel Speed: 127 - 203mm/min (5 - 8 i.p.m.)
String or Weave Bead: String Bead (3 times weld wire diameter)
Oscillation: Not Applicable
Multipass or Single Pass (per side): Multiple
Single or Multiple Electrodes: Single
Other:

PREHEAT (QW-406)
Preheat Temp.: 60° F Minimum
Interpass Temp.: 325° F Maximum
Other:

QW-483 (Back)

Tensile Test (QW-150)

Specimen No.	Diameter in.	Area sq. in.	Ultimate Total Load lb.	Ultimate Unit Stress psi	Character of Failure & Location
T 1C (Cap)	0.500	0.1963	16,125	82,100	Base
T 1R (Root)	0.354	0.0984	8,847	89,912	Base
T2C (Cap)	0.490	0.1886	16,423	87,100	Base
T2R (Root)	0.503	0.1987	17,546	88,300	Base

Guided Bend Tests (QW-160)

Type and Figure No.	Result
SIDE BEND QW 462.2 1	Satisfactory
SIDE BEND QW 462.2 2	Satisfactory
SIDE BEND QW 462.2 3	Satisfactory
SIDE BEND QW 462.2 4	Satisfactory

Toughness Tests (QW-170)

Specimen No.	Notch Location	Notch Type	Test Temp.	Impact Values	Lateral Exp. % Shear	Lateral Exp. Mils	Drop Weight Break	Drop Weight No Break
08I02.3 - weld 1 Cap	Weld	Charpy V	-320°F	79 ft-lbs	50	74		
08I02.3 - weld 2 Cap	Weld	Charpy V	-320°F	78 ft-lbs	50	64		
08I02.3 - weld 3 Cap	Weld	Charpy V	-320°F	68 ft-lbs	40	62		
08I02.3 - weld 1 Root	Weld	Charpy V	-320°F	36 ft-lbs	50	31		
08I02.3 - weld 2 Root	Weld	Charpy V	-320°F	40 ft-lbs	50	36		
08I02.3 - weld 3 Root	Weld	Charpy V	-320°F	43 ft-lbs	40	40		
08I02.3 - HAZ 1 Pipe	HAZ	Charpy V	-320°F	33 ft-lbs	10	18		
08I02.3 - HAZ 2 Pipe	HAZ	Charpy V	-320°F	42 ft-lbs	10	21		
08I02.3 - HAZ 3 Pipe	HAZ	Charpy V	-320°F	42 ft-lbs	10	30		
08I02.3 - HAZ 1 Flange	HAZ	Charpy V	-320°F	30 ft-lbs	40	21		
08I02.3 - HAZ 2 Flange	HAZ	Charpy V	-320°F	30 ft-lbs	30	21		
08I02.3 - HAZ 3 Flange	HAZ	Charpy V	-320°F	40 ft-lbs	40	25		

FILLET WELD TEST (QW-180)

Result - Satisfactory_____ Penetration into Parent Metal_____
Yes, No Yes, No

Type and Character of Failure_____ Macro-Results

Welder's Name Mark Corr Clock No. 2394 Stamp No. 34

Tests conducted by: Materials Technology, Inc. Laboratory Test No. 90522; P.O. No. L-R200125065

per: ASME Section IX and ASTM A 370

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Signed Johnson Controls World Services Inc.
(Manufacturer)

Date 5/22/99 By_____

QW-483 (Back)

Tensile Test (QW-150)

Specimen No.	Diameter in.	Area sq. in.	Ultimate Total Load lb.	Ultimate Unit Stress psi	Character of Failure & Location

Guided Bend Tests (QW-160)

Type and Figure No.	Result
SIDE BEND QW 462.2 1	Test Not Performed
SIDE BEND QW 462.2 2	Test Not Performed
SIDE BEND QW 462.2 3	Test Not Performed
SIDE BEND QW 462.2 4	Test Not Performed

Toughness Tests (QW-170)

Specimen No.	Notch Location	Notch Type	Test Temp.	Impact Values	Lateral Exp. % Shear	Lateral Exp. Mils	Drop Weight Break	Drop Weight No Break
08I02.3 - HAZ 1	HAZ	Charpy V	-320°F	44.5 ft-lbs	N/A	25		
08I02.3 - HAZ 2	HAZ	Charpy V	-320°F	40.0 ft-lbs	N/A	25		
08I02.3 - HAZ 3	HAZ	Charpy V	-320°F	40.0 ft-lbs	N/A	21		

FILLET WELD TEST (QW-180)

Result - Satisfactory_____ Penetration into Parent Metal_____
Yes, No Yes, No

Type and Character of Failure_____ Macro-Results

Welder's Name Mark Corr Clock No. 2394 Stamp No. 34

Tests conducted by: Scientific Testing Laboratories Laboratory Test No. 90522; Project No. 16252

per: ASME Section IX and ASTM E 23

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Signed Johnson Controls World Services Inc.
(Manufacturer)

Date 5/22/99 By [signature]

ATTACHMENT G: SUGGESTED FORMAT FOR MANUFACTURING RECORD OF WELDER OF WPQ NITRONIC 40/GTAW/I625/2

QW-484 SUGGESTED FORMAT FOR MANUFACTURING RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS (WPQ)
(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

Welder Name Mark Corr Check No. 2394 Stamp No. 34

Using WPS No. 34-045/GTAW/I625/2 Rev. Basic Date 5/22/99

the above welder is qualified for the following ranges.

Variable	Record Actual Values Used in Qualification	Qualification Range
Process	GTAW	GTAW
Process Type	GTAW	GTAW
Backing (metal,weldmetal,flux,etc. (QW-402)	N/A	N/A
Material Spec. (QW-403)	UNS 21904 to UNS 21904	UNS 21904 to UNS 21904
Thickness		
Groove	1.371" to 1.460"	0.625" to 2.920"
Fillet	N/A	0.625" to 2.920"
Diameter		
Groove	12.75" O.D.	2.875" and larger
Fillet	N/A	2.875" and larger
Filler Metal (QW-404) Spec. No.	AWS (SFA) 5.14	SFA 5.14
Class	ERNiCrMo-3	ERNiCrMo-3
F-No.	43	43
Deposited Weld Metal Thickness Groove X Fillet	1.371" to 1.460"	0.625" to 2.920"
Position (QW-405)	6G	6G
Weld Progression	Upward	Upward
Gas Type (QW-408)	99.99% Argon	99.99% Argon
Backing Gas (QW-408) 99.99% Argon	99% Argon	99% Argon
Electrical Characteristics (QW-409) Current	60-140 amps	60 - 140 Amps
Polarity	DCEN (-)	DCEN (-)

Guided Bend Test Results QW-462.2(a), WQ-462.3(a), WQ-462.3(b)

Type and Fig No.	Result
Side Bend; Specimen 08I02.3-S1	Satisfactory
Side Bend; Specimen 08I02.3-S2	Satisfactory
Side Bend; Specimen 08I02.3-S3	Satisfactory
Side Bend; Specimen 08I02.3-S4	Satisfactory

Radiographic Test Results (QW-304 & QW-305)
For alternative qualification of groove welds by radiography

Radiographic Results Accept

Fillet Weld Test Results [See QW-462.4(a), QW-462.4(b)]

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen)

Length and Percent of Defects inches %

Macro Test--Fusion

Appearance--Fillet Size (leg) in. X in. Convexity in. or Concavity in.

Test Conducted By Inspection Specialists, Inc. Laboratory–Test No. P.O. R1-149804 Sample WPP#3

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.

Organization Johnson Controls

Date 5/22/99 By

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

NOTE: Any essential variables in addition to those above shall be recorded.

(12/86) This form (E00008) may be obtained from the Order Dept., ASME, 345 E. 47 St., New York, N.Y. 10017