TOPCOR BELCO

P.O. BOX 1019

PRAIRIEVILLE, LA. 70769

Welding Procedure Specification (WPS)

WPS No.: **TopCoreBelco-101-FC** Date: **10/27/2005** Rev.: **0** Page: **1 of 6**

By: Date Signed: 10/28/2005

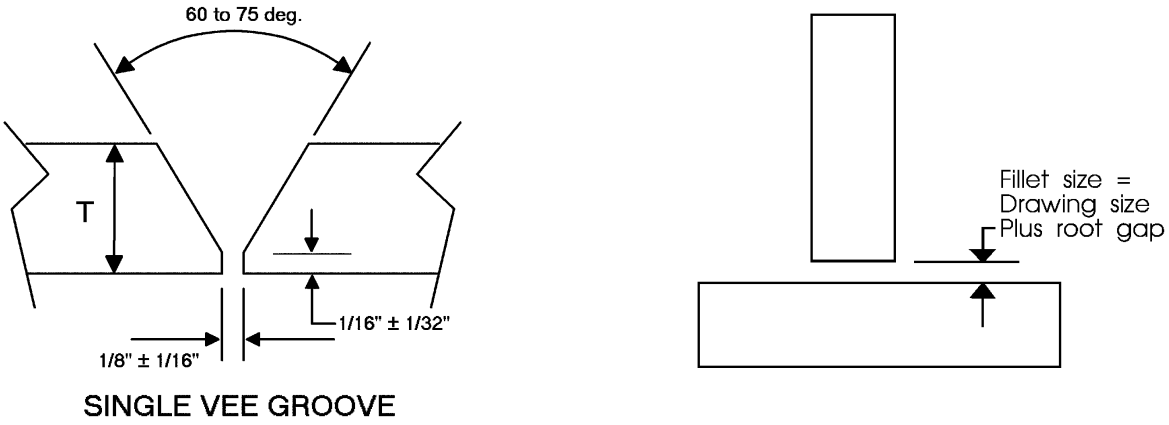
Supporting PQR's: **TopCoreBelco-101-FC/A**

Welding Process(es) / Type(s): **FCAW / Semiautomatic**

Joints (QW-402)

Joint Design: Groove and fillet welds

Backing: With or without backing Backing Material: Weld or Group 1 Base Metal



SINGLE VEE GROOVE

Fillet Welds: All fillet sizes on all base metal thicknesses and all diameters.

Retainers: None

WELD JOINT DESCRIPTIONS SHOWN ARE NOT INCLUSIVE OF ALL THOSE FOUND ON A JOB. WELD JOINT DESIGN REFERENCE IN AN ENGINEERING SPECIFICATION OR A DESIGN DRAWING SHALL TAKE PRECEDENCE OVER WELD JOINTS SHOWN IN THIS WPS.

Base Metals (QW-403)

P-No.: 1 Group No.: 1 & 2 Thickness Range (in.): 0.1875 to 0.7500

to P-No.: 1 Group No.: 1 & 2

Minimum preheat must be maintained during thermal cutting, tacking, and welding operations.
Welds shall be cleaned between each pass. When completed, remove all slag and projections.

Filler Metals (QW-404)

Spec. No. (SFA): 5.20

AWS No. (Class): E71T-1

F No.: 6 A No.: (verify chemistry)

Weld Metal Thickness Range: 0.1875 to 0.7500 in. No Pass Greater Than ½" Allowed

Flux Type: N/A

Flux Trade Name: N/A

Consumable Insert: N/A

Other:

Product Form: Flux cored

Supplemental Filler Metal: NONE

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Positions (QW-405)
Position of Joint: All Positions
Weld Progression: Vertical up

Preheat (QW-406)
Preheat Temp. Min.: 70 °F
Interpass Temp. Max.: 450 °F
Preheat Maintenance: None

Postweld Heat Treatment (QW-407)
Type: No PWHT will be performed
Temperature Range: None °F
Time Range: None

Gas (QW-408)
Gas Composition / Flow Rate
Shielding: 75% Argon, 25% CO2 / 25-60 CFH
Trailing: None
Backing: None

Electrical Characteristics (QW-409)
Current Type / Polarity: DCEP (reverse)
Tungsten Electrode Type and Size: N/A
Mode of Metal Transfer for GMAW: Spray arc
Max. Heat Input (J/in): None

Technique (QW-410)
String or Weave Bead: Stringer and weave bead
Orifice or Gas Cup Size: 3/8" to 5/8"
Initial and Interpass Cleaning: With wire brush clean 1 inch (25 mm) on both sides of weld joint
Method of Back Gouging: When required, grind until all defects are removed.
Oscillation: N/A
Contact Tube to Work Distance: 3/4" > 1"
Single or Multiple Passes (per side): Multipass
Single or Multiple Electrodes: N/A
Peening: None

FCAW SPRAY LIKE TRANSFER

Process Welding Parameters

Weld Layer(s) and/or Pass(es)	Process	Filler Metal Class	Filler Metal Diameter (in.)	Current Type / Polarity	Current Amperage Range	Voltage Range	Travel Speed Range (in/min)	Wire Feed Speed Range
Root	FCAW	E71T-1	0.035	DCEP (reverse)	120-200	19-24	Var.	5
Balance	FCAW	E71T-1	0.045	DCEP (reverse)	150-225	22-26	Var.	5
Root	FCAW	E71T-1	1/16	DCEP (reverse)	175-275	25-28	Var.	5
Balance	FCAW	E71T-1	5/64	DCEP (reverse)	200-400	26-32	Var.	5
Balance	FCAW	E71T-1	3/32	DCEP (reverse)	300-500	26-34	Var.	5

Optional Notes

General Notes

1) One inch each side of the weld area (ID & OD) shall be free of heavy mill scale, heavy rust deposits oils or other deleterious materials.

2) All deep curf gouges on torch bevels shall be blended or where required repaired prior to fit up.

3) Sufficient preheat shall be used to remove moisture and prevent cracking on highly restrained joints. The minimum preheat shall be in accordance with the fabrication code unless superceded by the client specification.

4) Tack welds which are to be incorporated into the final weld shall be:
(a) Subject to the same quality as the final weld.
(b) Cleaning shall be the same as addressed in interpass.
(c) Tacks will be of sufficient size and cross sectional area to retain the appropriate fit up and alignment.
(d) After clean up of the tacks, they shall be visually examined for cracking or other rejectable indications.

5) After completing clean up of the tacks the welder shall visually check for cracking prior to depositing the root pass.

6) Cleaning:
Initial- weld joint edges shall be uniform and free from fins, notches, tears, cracks and other visual defects. The welding surfaces shall also be free from moisture, loose or thick scale, heavy oxides, grease or other foreign deleterious materials. Plasma cut surfaces shall be ground to virgin metal prior to welding. All gouges in the bevel shall be blended or where required repaired prior to fit up.

Interpass- Before welding over previously deposited weld metal all slag and visible porosity shall be removed. Any unacceptable bead profile shall be ground to accommodate a defect free weld. The weld and adjacent base metal shall be brushed clean and visually examined.

Final-All excessive gas residue shall be removed from all completed welds. The weld and the adjacent base metal shall be cleaned by brushing or other suitable means. Tightly adhering weld spatter remaining after the cleaning operation shall be removed by other suitable means as required by contact specifications or as required to perform nondestructive examination or prevent masking of indications.

7) The completed weld shall blend smoothly into the surface plain of the parent metal.

8) Excessive weld reinforcement and excessive weave width shall be avoided. Reinforcement shall not exceed the allowable limits of the fabrication code.

9) The final weld shall be cleaned based on NDE inspection method and contract requirements. The final weld shall be cleared of slag and heavy weld spatter.

10) All rolls of wire shall be tagged as to their type and stored in a dry environment. The wire should be protected from excessive grinding contaminates both on the feeder and when not in use.

11) Other acceptable filler metal with engineering and written authorization by the client are ER70T-1 for flat position welds and horizontal fillet welds.

12) Weld Backing strips are not allowed with out the written approval of the client. Specific client not allowing backing strips. Written approval must be appended to welding procedure or shop traveler.

13) Amperage, voltage and travel are non-essential variable and are projected ranges that should be followed closely.

In Process Repairs:

Significant defects that appear on the surface on any bead of weld deposit shall be removed by chipping, gouging and or grinding and re-welded before depositing the next successive weld layer.

Defect Repair
All repairs both in process and on completed weld which are deemed as significant defects that appear on the surface of a completed weld layer or completed weld shall be repaired in accordance with the attached appendix. The repair welding shall be in accordance with this welding procedure or other special provisions directed by engineering specifications.

Treatment of Second Side of Weld Groove (Back Weld)
The underside of the groove shall be prepared by gouging (Arc or Plasma) and or grinding so as to have a surface free of slag, carburized metal, oxidized surfaces or other possible weld discontinuities that would prevent making a sound weld.
Welder Qualification- Welders using this procedure shall be qualified in accordance with applicable section of ASME Section IX (Latest Edition).

Recommended General Repair Procedure Rules

This section of the document is intended to provide basic guidelines for repair of defects in welds and base metals.

Extensive or unusual repairs will be documented through normal procedures by obtaining a rework router through the Methods Department.

This procedure is to apply to all repairs of weldments.

Procedures:

Defective or unsound welds or base metal shall be corrected by either removal or replacement of the entire area or as follows:

1. Overlap Or Excessive Convexity- Reduce by removal of excess metal.
2. Excess Concavity Of Weld Or Crater, Undersized Welds Or Undercut-Clean and deposit additional weld metal.

3. Excessive Weld Porosity, Slag-Inclusions, Incomplete Fusion Or Penetration- Remove defective portion and re-weld. The cavity created by excavation (groove) shall have approximately a 15° bevel all around and a root radius of 1/8" minimum. Use caution NOT to nick base metal outside of groove.

4. Cracks In Weld Or Base Metal- Remove the crack to sound metal and at least 50% of the crack length, or two (2) inches (whichever is least) beyond each end of the crack and re-weld, observing all provisions of this Procedure. The minimum length of the weld repair groove should not be less than two (2) inches. Minimize removal of base metal during repair cavity excavation. Minimize heat input when excavating repair cavity with Arc-Air process. Excess heat may cause the crack to propagate.

5. Contour of repair welds shall blend smoothly into adjacent welds and base metal.

6. Slugging of welds is not permitted.

7. Improperly fitted parts should be cut apart and refitted at the discretion of supervision.

8. Minor distortion caused by welding may be corrected by mechanical means, as approved by Engineering.

Inspectors
Visual-All visual welding inspectors shall be qualified and certified to the requirements of AWS QC-1-96 Standard for Qualification and Certification of Welding Inspectors or one of the applicable API certifications (example 510, 563, 570).
Production Requirements
Workmanship, welding quality and inspection shall be as required by the fabrication code or Engineering specifications when the code criterion is superseded.

Preheat Requirements Per Codes for P1 Materials

ASME B31.1
1) 175°F (79°C) for material which has both a specified maximum carbon content in excess of 0.30% and a thickness at the joint in excess of 1"(25mm).
2) 50°F (10°C) for all other materials in this P number.

ASME B31.3
1) 175°F (79°C) for material which has both a specified minimum tensile strength greater than 71ksi
2) 175°F (79°C) for material which has a thickness at the joint in excess of 1"(25mm) regardless of tensile strength.
3) 50°F (10°C) for all other materials in this P number less than 1" thick and equal to or less than 71ksi.

ASME Section I & ASME Section VIII

General requirements per Appendix A100 and Appendix R
1) 175°F (79°C) for material which has both a specified maximum carbon content in excess of 0.30% and a thickness at the joint in excess of 1"(25mm).
2) 50°F (10°C) for all other materials in this P number.

Specific Requirements to section I Table PW-39 & section VIII Table UCS-56
1) 200°F (93°C) for fillet welds attaching slip on flanges or socket welds to a pressure part with a size of ½" or less.
2) 200°F (93°C) for fillet welds attaching a non pressure part to a pressure part when the pressure part exceeds 3/4".
3) 200°F (93°C) for seal welds on tubes or handhold and inspection plugs with a throat thickness 3/8" or less when the thickness of either part exceeds 3/4".
4) 200°F (93°C) for tube to tubesheet welds in firetube boilers where the depth of penetration exceeds 3/8".

5) 200°F (93°C) for a combination of groove and fillet welds attaching a non pressure part to a pressure part when the thickness of the weld is less than ½" and the pressure part exceeds 3/4".
6) 50°F (10°C) for all other materials in this P number.

NBIC Appendix B
1) 175°F (79°C) for material which has both a specified maximum carbon content in excess of 0.30% and a thickness at the joint in excess of 1"(25.mm).
2) 50°F (10°C) for all other materials in this P number.

NBIC RD-1030 & 1050 Welding Method as Alternative to PWHT (non impact on original fabrication). Limited to SMAW, GMAW, FCAW and GTAW processes.
1) 300°F (149°C) for 4" each side of the weld or 4 times the material thickness (which ever is greater). Preheat shall be maintained during welding.
2) 450°F (232°C)maximum interpass temperature.
3) For partial penetration repair preheat shall be based on 4" or 4 times the depth of the depth of the groove.

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Procedure Qualification Record (PQR)

PQR No.: **TopCoreBelco-101-FC/A** WPS No.: **TopCoreBelco-101-FC** Date: **10/27/2005** Page: **1 of 3**

Welding Process(es) / Type(s): **FCAW / Semiautomatic**

Joints (QW-402)

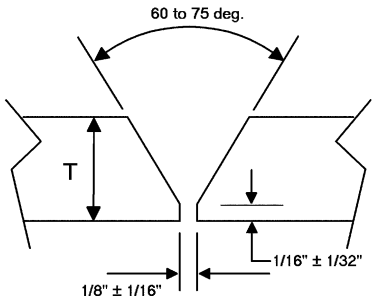
Weld Type: Groove weld

Single-bevel groove

Backing: Back welded

Root Opening: 1/16" in. Root Face: 1/8" in.

Groove Angle: 30 °



SINGLE VEE GROOVE

Gouge and or grinding.

Base Metals (QW-403)

Material Spec., Type or Grade:

SA-516, Grade 70 to SA-516, Grade 70

P-No.: 1 Group No.: 2 to P-No.: 1 Group No.: 2

Thickness of Test Coupon (in.): 0.500

Base metal shall be cleaned back minimum of 1" to shinny metal before welding.

Filler Metals (QW-404)

SFA Specification: 5.20

AWS Classification: E71T-1

Filler Metal F-No: 6

Weld Metal Analysis A-No: (verify chemistry)

Size of Filler Metal (in.): 0.045

Weld Deposit 't' (in.): 0.500

Pass Greater Than ½": No

Filler Metal Product Form: Flux cored

Supplemental Filler Metal: NONE

Positions (QW-405)

Position of Joint: 2G - Horizontal

Weld Progression: N/A

Preheat (QW-406)

Preheat Temp.: 70 °F

Interpass Temp.: 450 °F

Preheat Maintenance: Slow cool under still air

Postweld Heat Treatment (QW-407)

Type: No PWHT performed

Temperature: None °F

Time: None hr

Gas (QW-408)

Gas Composition / Flow Rate

Shielding: 75% Argon, 25% CO2 / 35 CFH

Trailing: None

Backing: None

Electrical Characteristics (QW-409)

Current / Polarity: DCEP (reverse)

Amps: 140

Volts: 24

Tungsten Type / Size: N/A

Transfer Mode: Spray arc

Wire Feed Speed (in/min): 5

Heat Input: N/R

Technique (QW-410)

Travel Speed (in/min): 5

String/Weave Bead: Stringer and weave bead

Oscillation: N/A

Mult./Single Pass (per side): Multipass

Mult./Single Electrode: N/A

Nozzle/Gas Cup Size: 7/8"

Contact Tube to Work Dist.: 3/4" > 1"

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PQR No.: **TopCoreBelco-101-FC/A**

Additional Welding Parameters

Layer(s) and/or Pass(es)	Process	Filler Metal		Current		Voltage Range	Travel Speed Range (in/min)
		AWS Classification	Size (in.)	Type / Polarity	Amperage Range		
2G ROOT	FCAW	E71T-1	0.045	DCEP (reverse)	140	24	5
2G FILL	FCAW	E71T-1	0.045	DCEP (reverse)	150	24	6
2G CAP	FCAW	E71T-1	0.045	DCEP (reverse)	150	24	6.5
2G BW	FCAW	E71T-1	0.045	DCEP (reverse)	150	24	5
3G ROOT	FCAW	E71T-1	0.045	DCEP (reverse)	150	24	4.5
3G FILL	FCAW	E71T-1	0.045	DCEP (reverse)	150	24	5
3G CAP	FCAW	E71T-1	0.045	DCEP (reverse)	150	24	5
3G BW	FCAW	E71T-1	0.045	DCEP (reverse)	150	24	5.5
4G ROOT	FCAW	E71T-1	0.045	DCEP (reverse)	150	24	5
4G FILL	FCAW	E71T-1	0.045	DCEP (reverse)	150	24	7
4G CAP	FCAW	E71T-1	0.045	DCEP (reverse)	150	24	7
4G	FCAW	E71T-1	0.045	DCEP (reverse)	150	24	6.5

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Tensile Test (QW-150)

Specimen No.	Width (in.)	Thickness (in.)	Area (in²)	Ultimate Total Load (lb)	Ultimate Stress (PSI)	Failure Type and Location
2G-15211	0.750	0.492	0.369	26217	71000	Ductile - BM
2G-15211	0.750	0.490	0.368	25705	69900	Ductile - BM
3G-15211	0.750	0.473	0.355	26080	73500	Ductile - BM
3G-15211	0.750	0.465	0.349	25469	73000	Ductile - BM

Guided Bend Test (QW-160)

Figure Number and Type	Result	Figure Number and Type	Result
QW-462.2 Side bend	Acceptable	QW-462.2 Side bend	Acceptable
QW-462.2 Side bend	Acceptable	QW-462.2 Side bend	Acceptable
QW-462.2 Side bend	Acceptable	QW-462.2 Side bend	Acceptable

Macro-Examination Test: none

Visual Examination: Good

Liquid Penetration Test: Acceptable

RT acceptable see report # G7055 2-3-4

Welder's Name: Vaughn Monroe ID: 90518 Stamp: VM

PQR was done and welding of coupon was witnessed by: TOPCOR BELCO

Tests Conducted By: Larry Boyette Test ID.: 3448

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.

Prepared By: _____ 10/27/2005 QA/QC Manager

TOPCORBELCO Date