

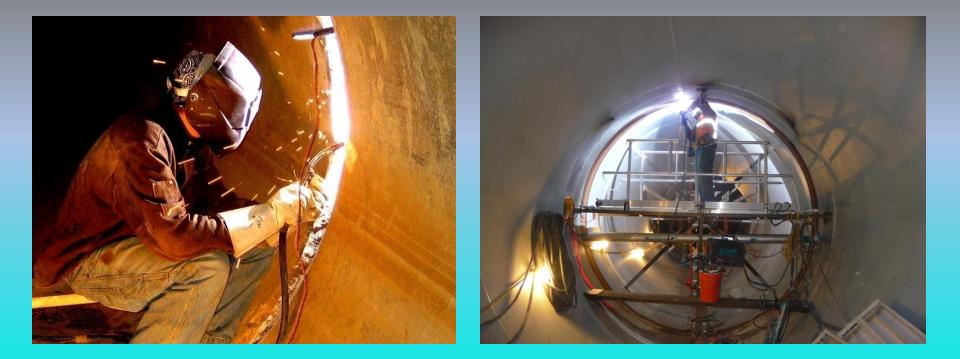
Second Edition



ASCE Manuals and Reports on Engineering Practice No. 79 ASCE

ASCE MOP 79, Chapter 11 – Welding, Overview Nash Williams-National Welding Corp.





"Welding of steel penstocks is critical to the success of hydroelectric projects."





- Welding requirements previously spread throughout 6 chapters
 - Committee task was to compile into a single welding Chapter
 - Consolidated by removing redundancies and conflicts
 - Welding design still based on ASME Section VIII, Division 1



Variety of Penstock configurations Overview





Welding Procedures and Practices Utilize both ASME Sect. VIII or AWS D1.1



NATIONAL WELDING CORPORATION PROCEDURE QUALIFICATION RECORD (POR) Revision 0

| 6/21/2005 SEMI-AUTOMATIC 6G Uphill |
|--|
| 6G |
| |
| |
| Uphill |
| |
| NA |
| |
| |
| (Root Only), FCAW Spray |
| ilobular 🔽 |
| DCEN PULSED |
| |
| |
| Weave |
| Single |
| Multiple Electrode |
| Sector Street and Street Stree |
| ongitudinal NA ateral NA |
| ngle NA |
| .750" |
| No |
| Mechanical-Power Brush |
| 60X29.1X262/11.5=39.8 KJ/in |
| |
| |
| NA |
| no. |
| |
| |
| 50 Deg. F 500 Deg. F |
| SUU Deg. P |
| |
| |
| VOLTS TRAVEL SPEEL |
| VOLTS TRAVEL SPEED |
| 19 6.6 IPM |
| 29.1 11.5 IPM |
| IP 2 |

| Specimen No. | /idth Thickne: 0.77 0.445 775 0.445 | ss Area | TENSILE TEST | | |
|--------------------------------|---|----------------------|------------------------|-----------------------|--------------------------|
| Specimen No. | 0.77 0.445 | ss Area | Ultimate Tensile Load. | Ultimate Unit Stress. | Character of Failure and |
| 2 0. Specimen No. 3 4 | | Width Thickness Area | | PSI | Location |
| Specimen No. 3 4 | .775 0.445 | | 27,200 | 79,370 | BASE METAL |
| 3 4 | | 0.3449 | 27,700 | 80,313 | BASE METAL |
| 3 4 | | | | | |
| 3 4 | | | | | |
| 3 4 | Type of Bend | Result | UIDED BEND TEST | Remarks | |
| 4 | SIDE BEND | PASSEE | | Remarks | N |
| | | | | | |
| 5 SIDE BEND | | PASSED | | | |
| 6 SIDE BEND | | PASSED | | | |
| | | | 1 | | |
| VISUAL INSPECTION | | | | -ULTRASONIC EXAMINA | |
| Appearance | | ACTORY | | ort No. Q457-05 | Result PASSED |
| Undercut | | DNE | UT Rep | ort No. NA | Result NA |
| Piping Porosity | | ONE | | | Increases for the second |
| Convexity | | DNE | ALL WELD MET | AL TENSION TEST | |
| lest Date | | /2005 | | | |
| Witnessed By | NASH W | /ILLIAMS | Tensile Strengt | | |
| | | | Yield Point/Stre | | |
| FILLET WELD TEST RES | | | Elongation in 2 | | |
| | multiple pass Maxim | ium size of single p | | | |
| Macroetch | | 9 B | | NA Stamp N | Io. NA |
| 1 3 | s | 13 | Laboratory Test | NO. N/ | |
| THER TESTS | | | | | |
| | | | | | |
| | | | | | |
| Welders Name | Troy Wittusen | | | | |

Welding Procedures comprised of 3 key documents

- Procedure Qualification Record (PQR)
- Welding Procedure Specification (WPS)
- Welder Performance Qualification (WPQ)



| OMPANY NAME NAT | IONAL WELDING COP | JRE SPECIFICATION (WPS) | AUTHORIZED I | BY Nash Wil | liams |
|--|---|---|--|---------------|----------------|
| VELDING PROCEDURE SPECIFICATION M | | X07 (Butt w/Backup) | DATE | 198301 191 | 6/21/2005 |
| UPPORTING POR NO. | NWC-C | 207 | DATE | | 6/21/2005 |
| VELDING PROCESS(ES) | FCAW | | TYPE SEMI-A | AUTOMATIC | |
| | | () () | | | _ |
| JINTS (QW-402) | | | | | |
| Joint Design | V-Groove | | | | |
| Backing Yes 🗸 | | 8 | | | |
| | ASTM A 139 Grade C | | | | |
| Metal 🔽 Nonfusin | ig Metal | Nonmetalic 🗌 OI | ther 🗌 | T= .250" - 1 | .00" |
| | N 4 | 45 DEG 📥 | 1 | | |
| | | +10 DEG/-0 DEG | / | | |
| Ĺ | <u>`</u> | _ | | | |
| | | / | | | |
| 4 | | Т Т | = .250" - 1.00" | 4 | |
| ſ | | \setminus / | | 1 | |
| | | | | | |
| | 10 | TI | | L. | |
| | | 4 .25" (+.25" | '/-1/16") ROOT OP | ENING | |
| | | | | | |
| | | | | | |
| | | | | | |
| ASE MELAIS ID 9-4031 | | | | | |
| ASE METALS (QW-403) * | | | | | |
| | lorll | to P-No. | Gr | oup No. Ior | IC |
| -No Group No | l or II | to P-No | Gr | oup No. I or | 11 |
| or | l or II | | | roup No. I or | 11 |
| No Group No r pecification Type and Grade | l or ll | ASTM A 139 | Grade C | oup No. Ior | to |
| -No Group No r pecification Type and Grade | l or II | | Grade C | oup No. Ior | 17 |
| No Group No r pecification Type and Grade pecification Type and Grade | | ASTM A 139 | Grade C Grade C | oup No. Ior | to or |
| No Group No r pecification Type and Grade pecification Type and Grade hemich a Analysis and Mechanical Prop | perties | ASTM A 139 | Grade C Grade C NA | oup No. I or | to |
| -No Group No | perties | ASTM A 139 | Grade C Grade C | oup No. I or | to or |
| No. Group No. r pedification Type and Grade pedification Type and Grade hemicha Analysis and Mechanical Prop hemicha Analysis and Mechanical Prop | perties | ASTM A 139 | Grade C Grade C NA | oup No. Lor | to or |
| No. Group No. r r r r r r r r r r r r r | berties | ASTM A 139 ASTM A 139 | Grade C Grade C NA NA | | to or to |
| No Group No r pecification Type and Grade editation Type and Grade hemicha Analysis and Mechanical Prop hemicha Analysis and Mechanical Prop hickness Range: Base Metal: | perties perties | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| No Group No pedification Type and Grade pedification Type and Grade perification Type and Grade perification Type and Grade perification of the set of the se | berties | ASTM A 139 ASTM A 139 | Grade C Grade C NA NA | | to or to |
| No Group No pedification Type and Grade pedification Type and Grade perification Type and Grade perification Type and Grade perification of the set of the se | perties perties | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| No Group No r pedification Type and Grade exercitation Type and Grade exercita a Analysis and Mechanical Prop hernica a Analysis and Mechanical Prop hernica Prop Base Metal: Pase Metal: Pase Metal: Pase Diameter Range: her | perties perties | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| No Group No r pedification Type and Grade excitation Type and Grade excitation Type and Grade hemich a Analysis and Mechanical Prop hemich a Analysis and Mechanical Prop hemicha A | Serties Groove Groove | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| No Group No r pedifustion Type and Grade deritation Type and Grade deritation Type and Grade mendia Analysis and Mechanical Prop hickness Range: Bate Metal: Mich Met ALS (10W-403) pedifation No. (SFA) | SFA 5.20 | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| No Group No r peofication Type and Grade eeffcation Type and Grade hemich a Analysis and Mechanical Prop hemics Analysis and Mechanical Prop hemics Range: Hem ILLEH METALS (UW-403) Peoficiation No. (SFA) WS No. (Class) | verties Groove Groove SFA 5:20 E71-71 | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| Croup No predifation Type and Grade predifation Type and Grade hemich an analysis and Mechanical Prop hemich analysis hemi | SFA 5.20 6 | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| No. Group No | SFA 5.20 E71-11 6 1 | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| No. Group No. Group No. See Control of Section 1999 And Grade Sectionation Type and Grade Sectionation Program of Control of Analysis and Mechanical Program Section 1990 (Section 1990) (| SFA 5.20 6 | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| No. Group No | SFA 5.20 E71-11 6 1 | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| No Group No peofication Type and Grade exercitation Type and Grade exercitation Type and Grade exercitation Type and Mechanical Frop hemicha Ana Juyis and Mechanical Frop Pipe Diameter Range: Date Metalioner State State State State State Hemical State State State State State State State Metalioner State State State State State No No No No No State State St | SFA 5.20 E71-11 6 1 | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| No Group No r peofication Type and Grade peofication Type and Grade perioda Analysis and Mechanical Prop hickness Range: pope Dameter Range: ther Pope Dameter Range: ther ILLER METALS (UW-403) peofication No. (SFA) WS No. (Class) No | SFA 520 E71-11 5 1 .052* | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| No Group No r Group No pecification Type and Grade exertification Type and Grade exertification Type and Grade Base Metal: Pipe Diameter Range: Pipe Diameter Range: Hittir METALS(UW-404) pecification No. (SFA) No No No No No Veld Metal Thicknes Range Grovye | SFA 5:20 E71-11 6 1 1 362 * | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| No Group No r Group No peofiliation Type and Grade exclination Type and Grade femicha Analysis and Mechanical Prop hickness Range: Base Metal Miller METALS(100-403) peofiliameter Range: There of Tiler Metals Yeld Metal Thickness Range Groove Filet | SFA 520 E71 11 5 1 | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| Croup No r Group No peoffication Type and Grade peoffication Type and Grade themicha Analysis and Mechanical Prop Base Metal: Pipe Diameter Range: Pipe Diameter Range: ULLER METALS (UW-404) peoffication No. (SFA) WS No. (Class) Veld Metals Thickness Range Inline se Range Inlin | SFA 5:20 E71-11 5 1 .05 2* | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |
| ND, Group No, pedifaction Type and Grade bencharan Type and Grade bencharan Analysis and Mechanical Prop hernicha Analysis and Mechanical Prop hernicha Analysis and Mechanical Prop hernicharan Mech | SFA 520 E71 11 5 1 | ASTM A 139 ASTM A 139 .250" - 1.00" | Grade C Grade C NA NA Fillet | .250"-1.00 | to or to |

| POSITIONS (QW | /-409} | | | | | | | | |
|---|--|--|-----------|----------|--|---------------|--|-------|-------|
| Positions of Groove Welding Progression | | | ALL | | Temperature Range | | NA | | |
| | s of Fillet | | ALL | Птека | inge | | | NA. | _ |
| PREHEAT (QW- | 409} | | | GAS QV | | | | | |
| | rature Minimum | | 50 DEG F | | Percent Gas(es) | | nt Composition s) Mixture Flow Rate | | |
| | rature Minimum erature Maximum | - | 500 DEG F | Shieldin | | s(es) /CO2 | 75/25 | | 8 CFH |
| Preheat Mainte | | _ | 50 DEG F | Trailing | | | 13/23 | 304 | ourn |
| rieneat manite | endince | - | 500201 | Backing | | | | | |
| ELECTRICAL CH | ARACHTERSITICS (C | 2W-409) | | 1 | 10 W | | | | |
| Current (AC or I | | DC | | Polarity | | | | EP | |
| Amps Range FC | AW | 236-28 | 8 | Volts Ra | ange FCAW | - | 27.1-31.1 | | |
| | | | | | | | | | |
| | Tungsten Electrode | e Size and T | vpe | NA | | | | | |
| | Mode of Metal Tra | insfer | Mas. | NA NA | | | | | |
| | Mode of Metal Tra Electrode Wire Fee | insfer | Mas. | | | | FCAW | 450-5 | 550 |
| TECHNIQUE (Q Stringer or Wea Orifice or Gas C Initial and inter Method of Bad Oscillation Contact Tube to | Mode of Metal Tra Electrode Wire Feo W-410) ave Bead up Size pass cleaning k Gouging o Work Distance gle Pass (Per Side) gle Electrodes | insfer | Mas. | NA | WEAVE 5/8" E BRUSH O NA NA MULTIPI SINGLE 9.7-13.31 NA NA | R GRIND | FCAW | 450- | 550 |
| TECHNIQUE (Q) Stringer or Wea Orifice or Gas C Initial and inter Method of Baci Oscillation Contact Tube to Multiple or Sing Multiple or Sing Multiple or Sing Multiple or Sing Travel Speed Ra Peening | Mode of Metal Tra Electrode Wire Feo W-410) ave Bead up Size pass cleaning k Gouging o Work Distance gle Pass (Per Side) gle Electrodes | Insfer In | ange | WIR | 5/8" E BRUSH O NA NA .75" MULTIPI SINGLE 9.7-13.3 I NA NA | R GRIND | FCAW | 450-5 | |
| TECHNIQUE (Q) Stringer or Wea Orifice or Gas C) Initial and inter Method of Bacl Oscillation Contact Tube to Multiple or Sing Multiple or Sing Multiple or Sing Travel Speed Ra Peening | Mode of Metal Tra Electrode Wire Feo W-410) ave Bead up Size pass cleaning k Gouging o Work Distance gle Pass (Per Side) gle Electrodes | Insfer In | Mas. | NA | 5/8" E BRUSH O NA NA .75" MULTIPI SINGLE 9.7-13.3 I NA NA | R GRIND | TAGE | 450-3 | |

Welding Procedure Specification

Provides parameter ranges



NATIONAL WELDING CORPORATION

WELDER OR WELDING OPERATOR QUALIFICATION RECORD (WQR)

| TEST WITNE | AME HARDY BROWN EST WITNESSED BY BRYAN HANS | | | | IDENTIFICATION NO. | | 123456789 | |
|--|--|--|--|--|---|----------|---|--|
| | SSED BY | | BRYAN HA | NSEN CWI | | DATE | 5/13/2010 | |
| | | | | | Listen and the second | | | |
| | | | | RECORD | ACTUAL VALUES | | | |
| | VAF | RIABLES | | LISED IN C | DUALIIFICATION | QUAL | IFICATION RANGE | |
| | | | | | MI-AUTOMATIC | FEATU | SEMI-AUTOMATIC | |
| PROCESS/TY | | | | FLAW/SE | DCEP | FCAW, | DCEP | |
| CURRENT/PI | | | | | JP AND 4G | A | GROOVE & FILLET | |
| | ELD PROGRESS | | | 36 0 | | ALLU | | |
| BACKING (YE | | | | | NO TO | - | NO | |
| | PECIFICATION | | | A516 | GRADE 70 | A | 516 GRADE 70 | |
| BASE METAL | ASE METAL: | | | | 10000 | | | |
| | THICKNESS: PLATE | | | | .375" | | .125"-750" | |
| | | PIPE/TUBE | | | NA | | .125"-750" | |
| | DIAMETER: | PIPE/TUBE | | | NA | 2 | 4" AND OVER | |
| FILLER META | AL: | | | | | | | |
| | SPECIFIICATIO | ON NUMBER | | | A 5.20 | | 4 5.20, A5.29 | |
| | CLASSIFICATI | ON | | | E71T1 | 1 1 | 71T1, E81T1 | |
| | F-NUMBER | | | | 6 | | 6 | |
| GAS/FLUX TI | (PE | | | 75% AR | SON, 25% CO2 | 75%. | ARGON, 25% CO2 | |
| OTHER | | | | | | | | |
| FILLET TEST RESULTS: APPEARANCE | | | | | | | | |
| ILLET TEST | RESULTS: | APPEARAN | | NA | FILLET SIZE | | NA | |
| RACTURE T | RESULTS: EST ROOT PENET | APPEARAN | CE | NA NA | MACROETCH | | NA | |
| RACTURE T | RESULTS: EST ROOT PENET | APPEARAN | CE | NA NA | | <u>N</u> | | |
| RACTURE T | RESULTS: EST ROOT PENET | APPEARAN | CE | NA NA | MACROETCH | <u></u> | NA | |
| FILLET TEST FRACTURE T DESCRIBE TH | RESULTS: EST ROOT PENET IE LOCATION, NA | APPEARAN RATION ATURE AND SI | CE | NA NA | MACROETCH | <u></u> | NA | |
| FILLET TEST I FRACTURE T DESCRIBE TH | RESULTS: EST ROOT PENET IE LOCATION, NA | APPEARAN RATION ATURE AND SI | CE | NA NA CK OR TEARING C | MACROETCH OF THE SPECIMEN | _ | NA | |
| FILLET TEST FRACTURE T DESCRIBE TH | RESULTS: EST ROOT PENET IE LOCATION, NA | APPEARAN RATION ATURE AND SI | CE | NA NA | MACROETCH | ТУРЕ | NA | |
| FILLET TEST I FRACTURE T DESCRIBE TH GUIDED BEN | RESULTS: EST ROOT PENET IE LOCATION, NA | APPEARAN RATION ATURE AND SI | CE | NA NA CK OR TEARING C | MACROETCH OF THE SPECIMEN | _ | NA | |
| FILLET TEST FRACTURE T DESCRIBE TH GUIDED BEN TYPE NA | RESULTS: EST ROOT PENET IE LOCATION, NA D TEST RESULTS RESULTS | APPEARAN TRATION ATURE AND SI | CE | NA NA CK OR TEARING C | MACROETCH OF THE SPECIMEN | _ | NA | |
| AUDICE TEST | RESULTS: EST ROOT PENET IE LOCATION, NA D TEST RESULTS RESULTS HIC TEST RESULT | APPEARAN TRATION ATURE AND SI | CE | NA NA K OR TEARING O | MACROETCH OF THE SPECIMEN | TYPE | NA A RESULTS | |
| FILLET TEST I FRACTURE T DESCRIBE TH GUIDED BEN TYPE NA RADIOGRAPI FIL | RESULTS: EST ROOT PENET IE LOCATION, NA D TEST RESULTS RESULTS HIC TEST RESULT LM ID NUMBER | APPEARAN IRATION ATURE AND SI TYPE S: | CE | NA NA K OR TEARING O | MACROETCH OF THE SPECIMEN | _ | NA A RESULTS | |
| FILLET TEST I FRACTURE T DESCRIBE TH GUIDED BEN TYPE NA RADIOGRAPI FIL | RESULTS: EST ROOT PENET IE LOCATION, NA D TEST RESULTS RESULTS HIC TEST RESULT | APPEARAN IRATION ATURE AND SI TYPE S: | CE | NA NA K OR TEARING O | MACROETCH OF THE SPECIMEN | TYPE | NA A RESULTS | |
| FILLET TEST I FRACTURE T DESCRIBE TH GUIDED BEN TYPE NA RADIOGRAPI FIL | RESULTS: EST ROOT PENET IE LOCATION, NA D TEST RESULTS RESULTS HIC TEST RESULT LM ID NUMBER | APPEARAN IRATION ATURE AND SI TYPE S: | CE | NA NA K OR TEARING O | MACROETCH OF THE SPECIMEN | TYPE | NA A RESULTS | |
| ADDOGRAPI COLOGRAPI COLOGRAPI COLOGRAPI COLOGRAPI COLOGRAPI COLOGRAPI | RESULTS: EST ROOT PENET IE LOCATION, NA D TEST RESULTS. RESULTS HIC TEST RESULT MID NUMBER 10 3G, Q318-10- | APPEARAN RATION ITURE AND SI TYPE S: 4G | RESULTS RESULTS RESULTS RESULTS | NA NA ICK OR TEARING O TYPE | MACROETCH | TYPE | NA A RESULTS | |
| RACTURE T RACTURE T DESCRIBE TH GUIDED BEN TYPE NA BADIOGRAPI FII 0319 | RESULTS: EST ROOT PENET IE LOCATION, NA D TEST RESULTS RESULTS HIC TEST RESULT IM ID NUMBER 10 3G, Q318-10. QUALIT | APPEARAN RATION ATURE AND SI TYPE S: 4G | CE | NA NA IX OR TEARING O TYPE JUTS TABLE SER 1026- | MACROETCH F THE SPECIMEN RESULTS | TYPE | | |
| FILLET TEST I FRACTURE T DESCRIBE TH GUIDED BEN NA BADIOGRAPH FII 0319 FII 0319 | RESULTS: EST ROOT PENET IE LOCATION, NA IE LOCATION, NA IE LOCATION, NA IE LOCATION, NA RESULTS IN ID NUMBER 10 3G, Q318-10 QUALIT | APPEARAN RATION ATURE AND SI TYPE S: 4G TJ. Suite | RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS | NA NA IX OR TEARING O ITYPE JLTS TABLE SER 1026- | MACROETCH FTHE SPECIMEN RESULTS WQDATE | REMA | NA RESULTS RKS 4/16/2010 | |
| FILLET TEST I RACTURE T DESCRIBE TH SUIDED BEN NA RADIOGRAPI FII Q319- TESTED BY TECHNICIAN We, the und | RESULTS: EST ROOT PENET IE LOCATION, NA ID TEST RESULTS IN ID NUMBER 10 3G, 0318-10- QUALIT ersigned, certify | APPEARAN RATION ATURE AND SI TYPE S: 4G TJ. Suite the statemen | RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS | NA NA IX OR TEARING O TYPE ILTS TABLE ARE 1026- are correct and | MACROETCH FTHE SPECIMEN RESULTS WQ DATE The test welds wi | REMAI | NA RESULTS 4/16/2010 dy welded and | |
| FILLET TEST I FRACTURE T DESCRIBE TH SUIDED BEN TYPE NA RADIOGRAPI FII 0319- TESTED BY TESTED BY TE | RESULTS: EST ROOT PENET EL LOCATION, NA DI TEST RESULTS: RESULTS HIC TEST RESULT MI DI NUMBER 10 3G, 0318-10 QUALIT QUALIT ersigned, certify ordance with the | APPEARAN IRATION ITURE AND SI TYPE S: 4G TJ. Suite the statemen requiremen | RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS | NA NA IX OR TEARING O TYPE ILTS TABLE ARE 1026- are correct and | MACROETCH FTHE SPECIMEN RESULTS WQ DATE The test welds wi | REMAI | NA RESULTS RKS 4/16/2010 | |
| FILLET TEST I FRACTURE T DESCRIBE TH SUIDED BEN TYPE NA RADIOGRAPI FII 0319- TESTED BY TESTED BY TE | RESULTS: EST ROOT PENET IE LOCATION, NA ID TEST RESULTS IN ID NUMBER 10 3G, 0318-10- QUALIT ersigned, certify | APPEARAN IRATION ITURE AND SI TYPE S: 4G TJ. Suite the statemen requiremen | RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS | NA NA K OR TEARING O TYPE JLTS TABLE LER 1026- are correct and Part C of the ANS | MACROETCH FTHE SPECIMEN RESULTS WQDATE The test welds we i/AWS D1.5 Code | REMAI | NA RESULTS 4/16/2010 dy welded and | |
| FILLET TEST I FRACTURE T DESCRIBE TH SUIDED BEN TYPE NA RADIOGRAPI FII Q319- TESTED BY TESTED BY TESTED BY TESTED BY TESTED BY We, the und ested in acc Welding Cod | RESULTS: EST ROOT PENET EL LOCATION, NA DI TEST RESULTS: RESULTS HIC TEST RESULT MI DI NUMBER 10 3G, 0318-10 QUALIT QUALIT ersigned, certify ordance with the | APPEARAN IRATION ITURE AND SI TYPE S: 4G TJ. Suite the statemene requiremeni tion IX. | RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS | NA NA K OR TEARING O TYPE JLTS TABLE LER 1026- are correct and Part C of the ANS | MACROETCH FTHE SPECIMEN RESULTS WQ DATE The test welds wi | REMAI | NA RESULTS RKS 4/16/2010 d, welded and r) Structural Steel | |

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NATIONAL WELDING CORP.

Welders Continuity Log

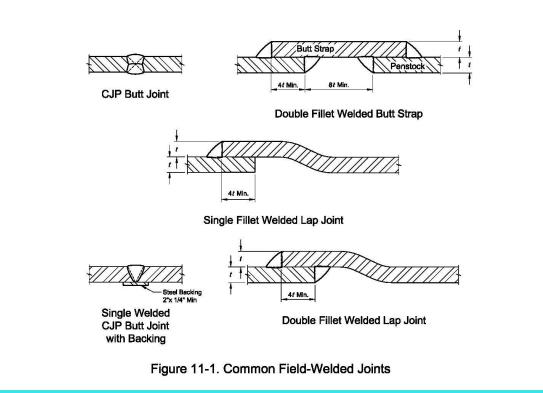
| Welder Name | Hardy Brow | n Stamp | Number. | HB |
|--------------------------------------|------------|----------------------------|---------------------------------------|-----------------|
| Foreman: | No | Identif | ication No. | 123456789 |
| Welder Active | Yes | Acti | ve Date | 5/16/2010 |
| PROCESS | ORIGINAL | MOST RECENT DATE WELDED | PROJECT | EXPIRATION DATE |
| FCAW-Semi-Auto | 5/16/2010 | 10/25/2010 | Palo Verde Nuclear Phoenix, AZ | 4/25/2011 |
| FCAW-Semi-Auto | 5/16/2010 | 6/15/2011 | Blue Ridge Penstock B Ridge, GA | lue 12/15/2011 |
| | | | · · · · · · · · · · · · · · · · · · · | |
| tes: Hardy tional Welding Corpora | | tinuously for National W | elding since hiring on Date | 5/16/2010 |

7025 S. Commerce Park Dr., Midvale, UT 84047 * PH (801) 255-5959 * FAX (801) 255-5919

Welder Performance Qualification

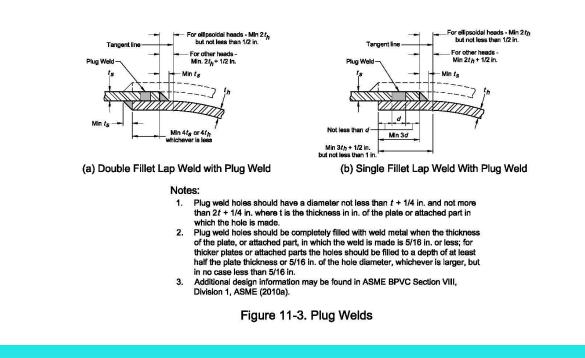
Documents a welders ability to deposit sound welds





Longitudinal joints are generally full penetration butt joints (CJP) Circumferential joints can be a butt weld or fillet weld (designer discretion)





Plug Welds have been added to this manual

Less common joint type but often found beneficial to designers intending to increase joint strength





Flux Cored Arc Welding Gas Metal Arc Welding



Welding Processes

Shielded Metal Arc Welding

Stick-Manual

- FCAW (Flux Cored Arc Welding)
- GMAW (Gas Metal Arc Welding)
- SMAW (Shielded Metal Arc Welding)
 - SAW (Submerged Arc Welding)

Submerged Arc Welding

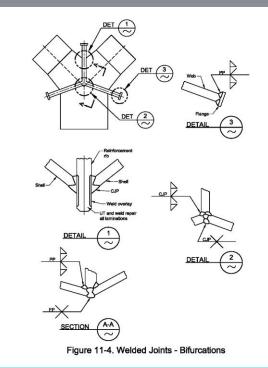


Assembly and Thermal Affects









Bifurcations and Joint Designs





Importance of Inspection

See Chapter 14

Question & Answer

CARSON

NIIGAZ

