Division 232200
Steam and Condensate Piping and Pumps
DESIGN GUIDE

1 General

1.1 General

A. CWU has a campus steam and condensate return system. See section 230500.

B. At the end of design development, review major pipe routing and branch pipe isolation with the Mechanical Plumbing Manager (MPM).

C. Show isolation valves and branch piping in the construction documents on the floor plans.

D. All installations shall conform to the International Mechanical Code and Uniform Plumbing Code and ASME where indicated.

E. At the end of design development, review major pipe routing and branch pipe isolation with the Mechanical Plumbing Manager (MPM).

F. Show isolation valves and branch piping in the construction documents on the floor plans.

G. Design piping systems for thermal expansion. Provide expansion joints and anchors as required to control movement. Coordinate anchor forces and anchor locations with the structural engineer. For pipe in utility trenches, the precast concrete cannot handle anchor forces and vertical anchors are anchored below the foot of the trench in a concrete block.

H. The engineer shall include details for valves, and other system specialties (strainers, unions etc).

1.2 Redundancy

A. Provide for equipment redundancy as follows:

1. Steam condensate pumps-duplexing

2. Steam pressure reducing valves-provide one sized at 1/3 capacity and one sized at 2/3 capacity.

1.3 Steam Definitions

A. High Pressure Steam

1. Any piping over fifteen (15) pounds per square inch (PSI) of pressure shall be considered high pressure steam piping and shall conform to Section B31.1 of the ASME Piping Code.

1.4 Campus Steam and Condensate Utility

A. Steam is generated at the central steam plant located at the Jongeward Building.

B. High pressure steam and pumped condensate are distributed through the majority of campus in shallow precast concrete utility trenches (Utilidors). Direct buried steam and condensate lines are not allowed.

C. The concrete trench lids are below the ground surface in the range of 12” deep and landscaped or paved over the top.

D. Common practice is to slope pipe in the trench rather than sloping the trench due to economy and simplicity of the precast system.

E. Intermediate valve vaults are provided in the main distribution system for intersection of steam piping or at each branch take off to a facility.

F. Vaults contain sumps and sump pumps for drainage.

G. Steam enters the building at 100 psig) and is reduced to low pressure 15 psig steam through a single stage pressure reducing station. Exception: The campus is in the trail phase of using vertical high pressure steam convertors. When there is no need for intermediate steam pressures, the use of the high-pressure steam convertors has the benefit of eliminating condensate pumps, PRV stations and associated maintenance and additionally reduce mechanical room

space requirements. Ideally these convertors are located near the steam entrance to the building.

H. Steam is converted at the building service to heating hot water at 120 degrees maximum. Heating hot water is piped throughout the building for heating. It is preferred that systems not be treated with glycol. Where specific coils or conditions require glycol for freeze protection, a heat exchanger shall be provided to isolate the non-glycol heating water from the glycol heating water. See 232500 for freeze protection water treatment.

1.5 Quality Assurance-High Pressure Steam

A. All welders performing work on high pressure steam lines (butt welds and socket welds) are to be certified in the appropriate procedure in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code.

B. The welding contractor will provide Central Washington University with a copy of the Welder's Performance Qualification Test Record for each welder working on high pressure piping.

C. Central Washington University will provide each certified welder with a unique stamp. The welder will use this stamp to mark his/her welds upon completion. If more than one welder works on the same weld, the welder performing the root, or root and hot passes will stamp his/her number on the pipe near the weld cap (but outside the heat-affected zone). The welder performing the entire weld, or the fill and cap, will stamp his/her number on the weld cap.

D. The welding contractor shall provide, for Central Washington University's approval, a written Weld Procedure Specification (WPS) sheet describing how the welds are to be made. It will be the responsibility of the contractor to ensure the WPS is followed. Unless otherwise agreed to by the welding contractor and Central Washington University, the Weld Procedure Specification will conform to the American Welding Society's Std. WPS B2.1-1-201-96.

E. All welds will be subject to inspection by Central Washington University. Central Washington University, or an inspection firm hired by them, will be responsible for non-destructive weld testing to ensure compliance with the B31.1 code. Unless otherwise agreed to, this testing will consist of radiograph of selected project welds. Welds for testing will be chosen by Central Washington University or their

assigned inspectors. In the event a defective weld is found, the welding contractor will make the indicated repair at their expense and the weld will be re-tested. After two unsuccessful repairs to the same weld, the weld will be cut out and re-welded. The contractor will reimburse CWU for all costs associated with any re-testing of defective welds.

1. All welding shall be performed on site. Should the contractor elect to fabricate off site, the contractor shall pay for any additional costs associated for welding inspections not on the job site

F. Refer to ***Appendix*** for Weld Quality Control Program for High Pressure Steam Piping

2 Materials

2.1 Low Pressure Steam Pipe

A. Pipe, fittings and joints up to 2”

1. ASTM Grade A53, A or B, seamed or seamless pipe, schedule 40 black steel
2. ASTM A234 forged steel fittings; Class 125; threaded joints
3. Joints: Threaded utilizing an approved non-hardening pipe dope unless noted otherwise

B. Pipe, fittings and joints greater than 2”

1. ASTM Grade A53, A or B, seamed or seamless pipe, schedule 40 black steel
2. ASTM A234 forged steel fittings; Class 150; butt welding type.
3. Joints: Butt welding type, ASME B31.1 and ASME Section 9.

2.2 High Pressure Steam Pipe

A. Pipe, Fittings and joints up to 2”

1. ASTM Grade A53, A or B, seamed or seamless pipe, schedule 80 or XS black steel

2. ASTM A234 forged steel fittings; Class 300; threaded joints unless noted otherwise in appendix details:

    a. Socket welded only where indicated on details this appendix

    b. High pressure trap line assemblies shall be socket welded except where threaded nipples are required to pipe in screwed traps, strainers, check valves, etc. (See Typical High Pressure Drip Installation detail in index).

3. Joints: Threaded, utilizing an approved non-hardening pipe dope, unless noted otherwise (socket welded where indicated on details this appendix)

B. Pipe, fittings and joints greater than 2""

1. ASTM Grade A53, A or B, seamed or seamless pipe, schedule 80 black steel.

2. ASTM A234 forged steel fittings; Class 300; butt welding type.

3. Joints: Butt welding type, ASME B31.1 and ASME Section 9.

C. No gray cast iron, bronze, brass, or stainless-steel pipe fittings shall be used on high pressure steam piping.

2.3 Low Pressure Condensate and Pumped Condensate

A. Pipe, Fittings and Joints up to 2"

1. ASTM Grade A53, A or B, seamed or seamless pipe, schedule 80 or XS black steel

2. ASTM A234 forged steel fittings; Class 125; threaded fittings

3. Joints: Threaded, utilizing an approved non-hardening pipe dope, unless noted otherwise

B. Pipe, Fittings and Joints greater than 2""

1. ASTM Grade A53, A or B, seamed or seamless pipe, schedule 80 black steel

2. ASTM A234 forged steel fittings; Class 150; butt welding type

3. Joints: Butt welding type, ASME B31.1 and ASME Section 9.

2.4 High Pressure Condensate Pipe

A. Pipe, Fittings and Joints up to 2”

1. ASTM Grade A53, A or B, seamed or seamless pipe, schedule 80 black steel unless indicated on appendix details

2. ASTM A234 forged steel fittings; Class 300; threaded fittings unless noted otherwise in appendix details

    a. Note: high pressure condensate trap line assemblies shall be socket welded except where threaded nipples are required to pipe in screwed taps, strainers, check valves, etc. See typical High Pressure Drip Installation Detail in appendix.

3. Joints: Threaded, utilizing an approved non-hardening pipe dope, unless noted otherwise

B. Pipe, Fittings and Joints greater than 2”

1. ASTM Grade A53, A or B, seamed or seamless pipe, schedule 80 black steel

2. ASTM A234 forged steel fittings; Class 300; butt welding type

3. Joints: Butt welding type, ASME B31.1 and ASME Section 9.

2.5 Gaskets

A. Spiral-wound, non-asbestos type. No composite or paper gaskets are allowed.

2.6 Flanges on High Pressure Steam

A. Flanges shall be made up in a craftsman like manner with a minimum of hi-low or gap differential (see ASME B 31.1 and/or B 31.9).

B. Flanges shall be bolted with grade 5 bolts or stronger (or equivalent grade studs)

2.7 Valves

A. General: All valves used in high pressure steam service to be forged or cast steel, bolted bonnet OS&Y (rising stem), back-seatable (repackable under pressure), with hard seat and trim (13 Cr or 4xx stainless steel typical). Valves shall be designed for steam service. No cast iron, stainless steel, brass, or bronze valves shall be used on high pressure steam service, regardless of their rating.

B. Provide gear operators and chains for valves in mechanical rooms installed more than 8 feet above finished floor level.

C. Gate Valves

1. Low pressure steam service and condensate service
    a. Up to and including 2”: bronze body; bronze trim; rising stem; class 150
    b. Over 2": MSS-SP70; cast iron body; bronze trim; OS and Y pattern; class 150.
2. High pressure steam service: forged steel body; OS and Y pattern; class 300.

D. Globe Valves

1. Low pressure steam service and condensate service
    a. Up to and including 2”: bronze body; bronze trim; class 150.
    b. Over 2”: iron body; bronze trim; OS and Y pattern; class 150.
2. High pressure steam service: forged steel body; OS and Y pattern; class 300.

E. Swing Check Valves

1. Low pressure steam service and condensate service
    a. Up to and including 2”: bronze body; bronze trim; class 150.
    b. Over 2”: Iron body, bronze trim, class 150.
2. High pressure steam service
    a. Up to and including 2”: forged steel body; class 300.

F. Lift Check Valves

1. High pressure steam service - drip traps

a. Up to and including 2”: forged steel body, class 300.

G. Control Valves: Provided in 230900.

2.8 Air Vents

A. Construction: Balanced pressure, thermostatic air vent, cast iron body with stainless steel internals. 250 psig maximum operating pressure, ¾ inch size.

2.9 Vacuum Breakers

A. Construction: Brass body, seat, stem and locknut; stainless steel spring; 150 psig maximum operating pressure; 350 °F maximum operating temperature.

2.10 Strainers

A. Up to and including 2”: brass or iron body; Y pattern with stainless steel perforated screen; 250 psig maximum operating pressure

B. Over 2”: iron body; Y pattern with stainless steel perforated screen 174 maximum operating pressure

C. ¾ inch gate valve for blow down.

2.11 Traps

A. Float and thermostatic traps: Use at steam equipment condensate return connections and drip legs for steam 15 psig and lower.

B. Thermodynamic Traps: Use for drip legs at pressures above 15 psig.

2.12 Pressure Reducing Valves

A. Manufacturers

1. Spence (no substitutions) type E pressure reducing valve with type D pressure reducing pilot.

B. Provide with silencer or muffler orifice plate to keep room dba below 85 and within criteria established for surrounding building programs.

2.13 Safety Reliefs

A. Construction: Bronze body; stainless steel valve spring, stem, and trim; direct pressure actuated; capacities ASME certified and labeled.

B. With drip pan ell.

C. Size for full relieving capacity of pressure reducing valve or bypass line.

2.14 Condensate Pumps

A. Manufactured assembly consisting of receiver, dual pumps, pump valves, controller for pump sequencing.

2.15 Condensate Metering

A. See Section 230900.

2.16 Heat Exchangers

A. Steel shell, copper tube with vacuum breaker and ASME safety relief valve.

2.17 Expansion Joints

A. Packed metal expansion joints with abrasion-free internal and external guides, joint shall be designed to allow packing/lubricant to be injected under full line pressure.

B. Factory tested at 1.5 times the design pressure.

C. Provide with drain port located at bottom of housing for steam applications.

2.18 Strainers

A. Provide gate valve on strainer for blow down with a pipe plug doped and run into the gate valve. Plug shall be hand tightened only.

3 Execution

3.1 General

A. Test all system sections during construction prior to being concealed in building construction. Re-test entire system upon completion.

B. Test in the presence of the Owner's representative. Provide copies of test to the Owner's representative and include in the O&M manual.

C. All piping, including branches, stubs, mains, risers, etc., shall be tested with a hydrostatic test. Low and medium pressure systems shall be tested at 125 psig. High pressure steam and steam condensate systems shall be tested at 150 psig or the system pressure, whichever is higher.

D. Due care shall be taken that equipment with a maximum working pressure which is less than the required test pressure is removed from the line during the test. After the test is complete, the equipment shall be reinstalled and a test of the maximum working pressure of the equipment put on the connections to the respective equipment.

3.2 Pipe

A. Slope steam and gravity condensate piping 1 inch per 40 feet (0.25 %) towards the condensate receiver and steam pipe 1 inch per 20 feet towards the steam boiler or steam trap.

3.3 Flanges, Unions and Gaskets

A. All exterior flanges, unions, and valves shall be accessible in manholes or vaults with liftable lids.

B. For pipe 2" and smaller, provide unions downstream of each valve, on each port of control valves, and at each equipment or piping specialty

requiring service. Valves with threaded connections that cannot be rotated shall have unions on both sides of the valve. If equipment or valve has a flanged connection that is acceptable and preferred.

C. For pipe 2 ½" and greater, provide flanged connections on each side of valve, on each port of control valves, and at each equipment or piping specialty requiring service.

D. Unions and flanges for serviceable equipment shall be installed in non--parallel lines to eliminate spreading of pipe assembly during servicing.

E. Install gaskets in accordance with the manufacturer's recommendations as indicated in the manufacturers installation guide including torque specifications and lubrication requirements. Proper bolt lubrication and torque shall be demonstrated to the Owner's Representative prior to pressurizing the steam system.

F. Bolts shall be properly sized and tightened to the appropriate torque. Exposed threads should not protrude more than ½ bolt diameter past nut.

G. Di-electric unions shall be used to separate dissimilar materials. Each di- electric union shall have an isolation valve upstream and downstream for maintenance and replacement.

3.4 Steam Pressure Reducing Station

A. Provide single stage pressure reducing station to reduce high pressure steam to low pressure steam unless intermediate pressures are required for specialty equipment such as autoclaves. Steam station shall consist of 2 valves, one sized for 1/3 of the peak load and one sized for 2/3 of the peak load.

B. Connection type to conform to CWU steam piping standards.

C. Strainers to be installed upstream.

D. Manufacturer's recommendations for up-stream and down-stream distances from fittings shall be followed for regulator location and pilot .

E. See ***Appendix*** for typical installation detail.

3.5 Traps

A. Provide drip legs at intermediate piping locations, at equipment, and at the base of risers to effectively remove condensate during system operation and at start up.

B. Provide steam traps at all drip legs and at each low-pressure condensate connection at steam equipment and upstream of all control valves.

C. Provide isolation valves at trap, strainer upstream of trap and check valve downstream of trap.

D. See ***Appendix*** for typical high pressure trap detail.

E. Provide flash tank on high pressure condensate and high-pressure drip legs before returning to the condensate receiver.

3.6 Valves

A. Provide isolation valves (gate) to isolate each building as indicated below. Each valve shall be as close to the room or equipment that they isolate. In no cases may the valves be located on any other floor or a building but the floor they serve.

1. Each building
2. Branch isolation by floor
3. Mechanical rooms
4. Equipment

B. All valves shall have adequate access for servicing, operation, repairs and/or replacement.

C. It is preferred that valves be installed with the stem in the vertical position. Do not install valves with the stem below the horizontal plane.

D. Gate Valves: Used only for equipment replacement or other, non-scheduled maintenance) shut-off service and to isolate equipment, parts of systems or vertical risers

E. Globe Valves: Used as part of a routine maintenance program or for seasonal changes in system operation, shut-off, throttling and bypass service including manual flow control services

3.7 Air Vents

A. Install at the end of all steam mains and headers to facilitate start-up and heat transfer.

B. Install with gate valve and union between main pipe header and air vent.

3.8 Vacuum Breaker

A. Provide after the steam control valve and after steam isolation valves above the trap inlet to facilitate drainage of condensate.

3.9 Thermometers

A. Provide at outlet of condensate pump.

B. Enlarge pipes as required for installation of thermometer sockets on 24 inches of each side of thermometer. Ensure sockets are extended to allow clearance for insulation. Install where temperature is visible from standing person height.

3.10 Pressure Gauges

A. Provide isolation ball valve, syphon (for steam systems), and snubbers at each gauge. Extend nipples to allow clearance for insulation.

B. Provide at steam building, at inlet and outlet of each stage of steam pressure reducing station, and at discharge of each condensate pump.

4 Appendix

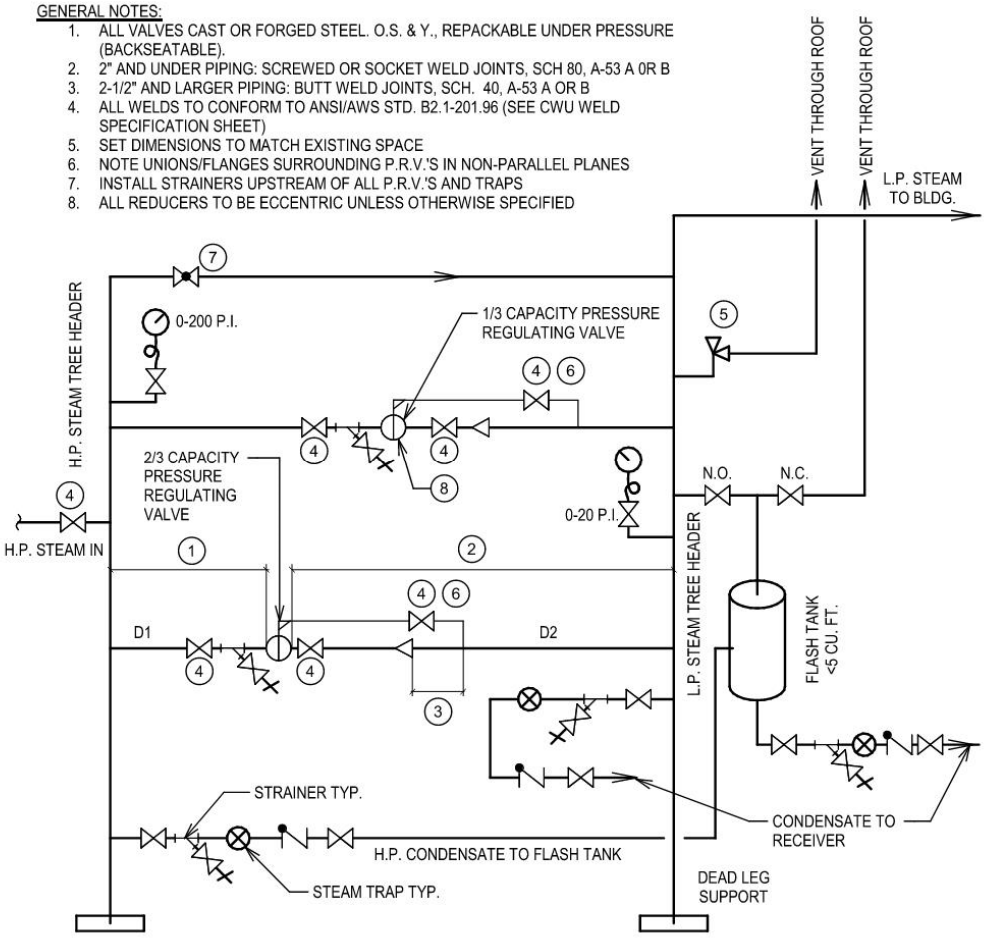
4.1 CWU Steam Pressure Reducing Station

KEY NOTES:

1. 10 PIPE DIAMETERS (D1) STRAIGHT (MIN)
2. 20 PIPE DIAMETERS (D2) STRAIGHT (MIN)
3. 4 PIPE DIAMETERS (D2) STRAIGHT (MIN)
4. GATE VALVE
5. SAFETY RELIEF WITH DRIP PANEL
6. PITCH PILOT LINE AWAY FROM PRV
7. MANUAL BYPASS GLOBE VALVE
8. DO NOT INSULATE THE BOTTOM OF THE PRV OR ANY PART OF THE PILOT PER MANUFACTURERS RECOMMENDATIONS.

GENERAL NOTES:

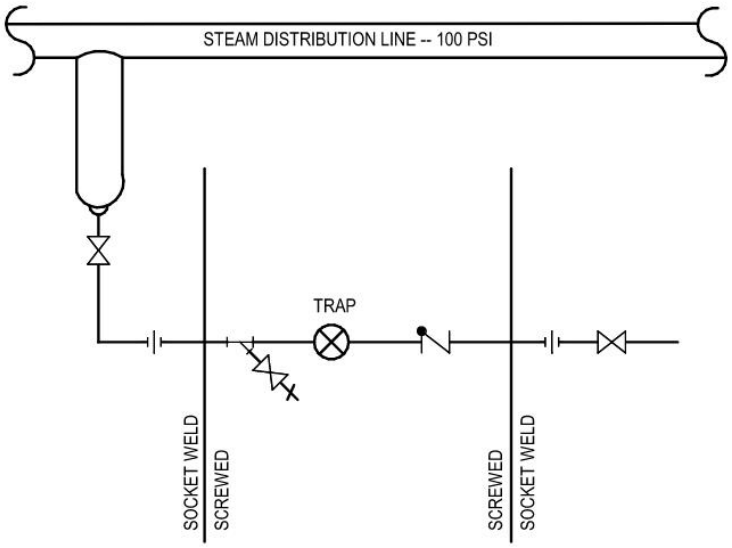
1. ALL VALVES CAST OR FORGED STEEL. O.S. & Y., REPACKABLE UNDER PRESSURE (BACKSEATABLE).
2. 2" AND UNDER PIPING: SCREWED OR SOCKET WELD JOINTS, SCH 80, A-53 A 0R B
3. 2-1/2" AND LARGER PIPING: BUTT WELD JOINTS, SCH. 40, A-53 A OR B
4. ALL WELDS TO CONFORM TO ANSI/AWS STD. B2.1-201.96 (SEE CWU WELD SPECIFICATION SHEET)
5. SET DIMENSIONS TO MATCH EXISTING SPACE
6. NOTE UNIONS/FLANGES SURROUNDING P.R.V.'S IN NON-PARALLEL PLANES
7. INSTALL STRAINERS UPSTREAM OF ALL P.R.V.'S AND TRAPS
8. ALL REDUCERS TO BE ECCENTRIC UNLESS OTHERWISE SPECIFIED



TYPICAL PRESSURE REDUCING STATION

DATE: 9.30.2022

4.2 CWU High Pressure Drip Installation



NOTES:
1. ALL PIPE SCHEDULE 80 ASTM A-53 A OR B
2. ALL VALVES FORGED OR CAST STEEL
3. UNIONS IN NON-PARALLEL PLANES
4. SCREWED STEEL OR MALLEABLE CAST IRON TRAP, STRAINER, AND CHECK VALVE
5. ALL OTHER FITTINGS 1500# SOCKET WELD
6. SEE CWU WELD PROCEDURE SPECIFICATION FOR SOCKET WELDED FITTINGS

TYPICAL HIGH PRESSURE DRIP INSTALLATION

DATE: 9.30.2022

4.3 CWU Weld Procedures-Socket Weld

CENTRAL WASHINGTON UNIVERSITY

WELD PROCEDURE SPECIFICATION

For Welded Piping

WELD PROCEDURE SPECIFICATION : ANSI/AWS STANDARD B2.1-1.201.96 **CWU WPS NO.:** 1-BW
WELDING PROCESS: SMAW (Shielded Metal Arc Welding) **REVISION:** 11/15/99
METHOD OF APPLICATION: MANUAL

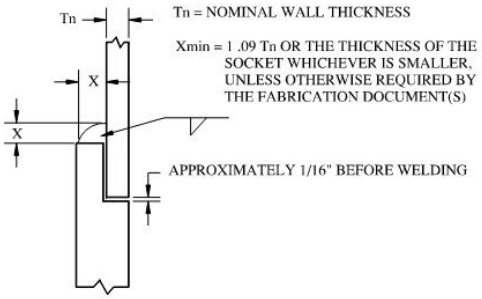
BASE METAL: CARBON STEEL, M-1, P-1, OR S-1, GROUP 1, or 2 TO M-1, P-1, OR S-1 GROUP 1 or 2
THICKNESS RANGE: 1/8 IN. THROUGH 3/4 IN. FOR GROOVE WELDS, 1/8 IN. MINIMUM FOR FILLET WELDS
PIPE DIAMETER: GROOVE WELDS: 1 IN. O.D. MINIMUM, FILLET WELDS: 3/4 IN. MINIMUM

FILLER METAL: CARBON STEEL - ANSI/AWS A5.1 OR ASME SFA 5.1
ROOT PASS: E-6010 **F-** 3 **A-** 1 (NOTE: HOT PASS WITH E-6010 IS OPTIONAL)
WELD OUT: E-7018 **F-** 4 **A-** 1

GENERAL SPECIFICATIONS:

JOINT PREPARATION: TYP. 37 1/2^0 BEVEL WITH 1/16 IN. LAND
BACKING: NOT REQ'D. FOR E-6010, REQ'D. FOR E-7018
BACK GOUGING: MECHANICAL OR THERMAL
BACKING MATERIAL: CARBON STEEL - BASE METAL SPEC.
CLEANING: SOLVENT CLEAN TO REMOVE ALL GREASE, WIRE BRUSH, GRIND.
FIT UP: GROOVE WELDS: 1/16 MINIMUM ROOT GAP AND LAND, SOCKET WELD: APPROX. 1/16 IN. GAP (SEE DRAWING).
POSITIONS: ALL
VERTICAL PROGRESSION: UPHILL ONLY
PREHEAT TEMP: 50^0 F. MINIMUM
INTERPASS TEMP: 50^0 F. MINIMUM, 500^0 F. MAXIMUM
PREHEAT MAINTENANCE: NO SPECIAL REQUIREMENTS
POSTWELD HEAT TREATMENT: NONE

SOCKET-WELD JOINT SKETCH



GROOVE AND FILLET WELDS

	ELECTRODES[1]		CURRENT	
PASS	CLASSIFICATION	DIA. (IN.)	AMPERES	POLARITY
ROOT[2]	E-6010	3/32	40-80	DCEP (REVERSE)
ROOT[2]	E-6010	1/8	75-125	DCEP (REVERSE)
FILL	E-7018	3/32	70-100	DCEP (REVERSE)
FILL	E-7018	1/8	115-165	DCEP (REVERSE)
FILL	E-7018	5/32	150-220	DCEP (REVERSE)
FILL	E-7018	3/16[3]	200-275	DCEP (REVERSE)

1. The care and storage of electrodes shall be as recommended by the electrode manufacturer.
2. An additional pass is optional (hot pass with E-6010)
3. Flat and Horizontal positions by permission only.

TECHNIQUE

CHOICE OF WEAVE OR STRINGER BEAD IS LEFT TO THE WELDER'S DISCRETION.
PEENING OF WELD IS NOT PERMITTED.
ALL PRESSURE RETAINING WELDS SHALL BE A MINIMUM OF TWO PASSES.
MAXIMUM BEAD THICKNESS IS 1/4 IN.
DEFECTS IN WELDS SHALL BE REMOVED BY MECHANICAL OR THERMAL METHODS. THE REPAIR CAVITY MAY DIFFER IN CONTOUR AND DIMENSION FROM A NORMAL JOINT PREPARATION AND MAY PRESENT DIFFERENT RESTRAINT CONDITIONS. REPAIR OF BASE METAL DEFECTS SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE FABRICATION DOCUMENT(S).

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4.4 CWU Weld Procedures-Bevel Weld

CENTRAL WASHINGTON UNIVERSITY

WELD PROCEDURE SPECIFICATION

For Welded Piping

WELD PROCEDURE SPECIFICATION : ANSI/AWS STANDARD B2.1-1.201.96 **CWU WPS NO.:** 1-BW
WELDING PROCESS: SMAW (Shielded Metal Arc Welding) **REVISION:** 11/15/99
METHOD OF APPLICATION: MANUAL

BASE METAL: CARBON STEEL, M-1, P-1, OR S-1, GROUP 1, or 2 TO M-1, P-1, OR S-1 GROUP 1 or 2
THICKNESS RANGE: 1/8 IN. THROUGH 3/4 IN. FOR GROOVE WELDS, 1/8 IN. MINIMUM FOR FILLET WELDS
PIPE DIAMETER: GROOVE WELDS: 1 IN. O.D. MINIMUM, FILLET WELDS: 3/4 IN. MINIMUM

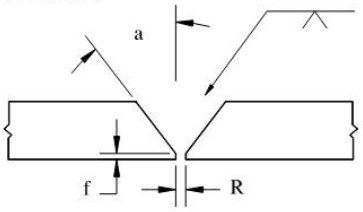
FILLER METAL: CARBON STEEL - ANSI/AWS A5.1 OR ASME SFA 5.1

ROOT PASS: E-6010	**F-** 3	**A-** 1	(NOTE: HOT PASS WITH E-6010 IS OPTIONAL)
WELD OUT: E-7018	**F-** 4	**A-** 1	

GENERAL SPECIFICATIONS:

JOINT PREPARATION: TYP. 37 1/2^0 BEVEL WITH 1/16 IN. LAND
BACKING: NOT REQ'D. FOR E-6010, REQ'D FOR E-7018
BACK GOUGING: MECHANICAL OR THERMAL
BACKING MATERIAL: CARBON STEEL - SEE BASE METAL SPEC
CLEANING: SOLVENT CLEAN TO REMOVE ALL GREASE, WIRE BRUSH, GRIND.
FIT UP: GROOVE WELDS: 1/16 MINIMUM ROOT GAP AND LAND, SOCKET WELD: 1/16 IN. GAP (SEE DRAWING).
POSITIONS: ALL
VERTICAL PROGRESSION: UPHILL ONLY
PREHEAT TEMP: 50^0 F. MINIMUM
INTERPASS TEMP: 50^0 F. MINIMUM, 500^0 F. MAXIMUM
PREHEAT MAINTENANCE: NO SPECIAL REQUIREMENTS
POSTWELD HEAT TREATMENT: NONE

BEVEL SKETCH



a = 30° , + 10° , - 0°
f = 1/16 in., ± 1/32 in.
R = 1/8 in., ± 1/16 in.
I.D. MISMATCH = 1/16 in. MAX.

GROOVE AND FILLET WELDS

	ELECTRODES[1]		CURRENT	
PASS	CLASSIFICATION	DIA. (IN.)	AMPERES	POLARITY
ROOT[2]	E-6010	3/32	40-80	DCEP (REVERSE)
ROOT[2]	E-6010	1/8	75-125	DCEP (REVERSE)
FILL	E-7018	3/32	70-100	DCEP (REVERSE)
FILL	E-7018	1/8	115-165	DCEP (REVERSE)
FILL	E-7018	5/32	150-220	DCEP (REVERSE)
FILL	E-7018	3/16[3]	200-275	DCEP (REVERSE)

1. The care and storage of electrodes shall be as recommended by the electrode manufacturer.
2. An additional pass is optional (hot pass with E-6010)
3. Flat and Horizontal positions by permission only.

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DEFECTS IN WELDS SHALL BE REMOVED BY MECHANICAL OR THERMAL METHODS. THE REPAIR CAVITY MAY DIFFER IN CONTOUR AND DIMENSION FROM A NORMAL JOINT PREPARATION AND MAY PRESENT DIFFERENT RESTRAINT CONDITIONS. REPAIR OF BASE METAL

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DEFECTS SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE FABRICATION DOCUMENT(S).