Project Manual

for

Southern Utah University
Steam Distribution System Anchor Replacement
DFCM Project No.: 09117730
1 of 2

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DFCM Project No.: 09117730
Steam Distribution System Anchor Replacement

Division of Facilities Construction and Management
Southern Utah University
Cedar City, Utah

Resp. Charge	Section	Title	Page
SPECIFICATIONS GROUP			
GENERAL REQUIREMENTS SUBGROUP – See Drawing GG2			
FACILITY SERVICES SUBGROUP			
DIVISION 03	CONCRETE		
	03 00 10	Concrete Work	1 thru 8
DIVISION 05	METALS		
	05 50 00	Metal Fabrications	1 thru 4
DIVISION 20	FACILITY SERVICES		
	20 05 00	Common Work Results for Facility Services	1 thru 4
		Pipe Class Specifications	
		ACS1 – ASME Class 150 Seamless Carbon Steel	
	20 05 13	Welding Requirements for Facility Services Systems	1 thru 7
	20 05 16	Expansion Compensation for Facility Services Piping	1 thru 3
	20 05 29	Supports and Anchors for Facility Services Piping and Equipment	1 thru 3
	20 07 00	Facility Services Systems Insulation	1 thru 4
DRAWING LIST			1 thru 1
DRAWINGS			Bound Herein

Drawing No.	Title	Rev. No.
GG1	Title Sheet & Sheet Index	0
GG2	General Notes	0
MP1	Mechanical Plan – Demolition and Remodel	0
MP2	Mechanical Plan – Demolition and Remodel	0
MD1	Mechanical Details	0
SG1	Structural General Notes	0
SG2	Structural General Notes	0

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cast-in-place concrete including formwork, reinforcing steel and miscellaneous materials.

1.02 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 117 and 301.

B. Maintain copy of ACI117, 301 and SP-15 in field office at all times.

C. OWNER will retain services of qualified independent testing laboratory.
Responsibility of testing laboratory will include:
1. Obtaining, making samples, and performing laboratory and field-testing specified.
2. Provide reports to ENGINEER giving information on materials and testing performed.
3. Reports shall indicate whether or not materials meet specifications.

D. Perform Work in accordance with ACI 117 and 301.

E. Tests:
1. Establish proposed concrete design mix proportions on basis of either field experience and/or trial mixtures in accordance with ACI 318, Chapter 5, except specific requirements shall conform to requirement of these specifications. Determine and submit supporting data, standard deviation, trial batch tests, required average strength, proportions, air content, and slump range for each mix.
2. Concrete strength tests:
   a. Comply with ASTM C39 for testing and ASTM C31 or C192 for preparation of cylinders.
   b. Field tests: Sample in accordance with ASTM C172; make and test 4 cylinders from each sample, 5 cylinders for walls and elevated slabs, on basis of not less than:
      1) One sample from each day's placement for each class of concrete.
      2) One sample from the first 20 cu yd of each day’s placement.
      3) One sample from each 50 cu yd.
      4) For a given class of concrete, if frequency of testing specified above would provide less than 4 samples, sample at least 4 randomly selected batches or each batch if 4 batches or fewer are required.
   c. 4 of the 5 test cylinders for walls and elevated slabs, and 3 of the 4 test cylinders for other work, shall be laboratory cured, with one cylinder cured under field conditions. Test the field cylinder at 3 or 4 days to determine if the concrete has attained at least 2/3 of the specified 28-day strength and it is safe to strip the forms. Test one laboratory cured cylinder at 7 days and other two at 28 days for average strength. The final cylinder shall be held in reserve to be tested as directed by ENGINEER.
   d. If tests indicate deficient strength as defined by ACI 318, immediately adjust mix to increase average of subsequent test results and, when directed, perform drilled core testing, ASTM C42. Testing and remedial work shall be at no additional cost to OWNER.
3. Slump tests:
   a. Test each batch as delivered; comply with ASTM C172 and C143.
   b. If slump exceeds Specifications, promptly remove batch from Work and dispose of off-site at location selected by CONTRACTOR. Do not add water in excess of specified water-cement ratio to batch to achieve desired slump.
4. Air content tests:
   a. Sample on basis specified above for field strength tests.
   b. Obtain samples from concrete after it has been placed and consolidated.
   c. Determine air content by pressure method; comply with ASTM C231.
   d. If air content does not meet Specifications, remove deficient concrete from Work.
5. Aggregate Tests:
   a. Comply with ASTM C33 for grading, deleterious substances, and soundness.
   b. Gradation: Each 200 tons.

c. Deleterious substances and soundness: Each change in source from which aggregate is taken.
d. Change in strata will be considered a change in source.

1.03 SUBMITTALS

A. Proposed concrete design mixes. Submit standard deviation, required average strength, proportions, and slump of each mix. See article “Concrete Design and Use”. Submit minimum of 7 days prior to commencing concrete placement.

B. Tests, or certificates of compliance with standards specified in this Section at least 14 days prior to commencing concrete placement for:
1. Cement: From each car from which cement will be used.
2. Fly ash: From each separate shipment from which fly ash is being used.
3. Aggregates: For each size aggregate from each source of aggregate, for grading, deleterious substances and soundness.

C. Shop Drawings on reinforcing steel.

D. List of admixtures, joint fillers, sealants, curing compounds, and other manufactured materials proposed identifying manufacturer and type. Provide data on specific items when requested by ENGINEER.

E. Testing laboratory reports required at least 14 days prior to commencing concrete placement for each class of concrete and each size aggregate:
1. Proposed concrete design mix.
2. Tests on concrete cylinders from trial batch of proposed mix.

F. Testing laboratory reports for tests on concrete cylinders taken in field.

1.04 STORAGE OF MATERIALS

A. Cement: Keep clean, dry, and free from weather damage.

B. Aggregates: Stockpile each gradation separately on clean, noncontaminating surface.

PART 2 PRODUCTS

2.01 CEMENT

A. Portland cement: ASTM C150, Type I.

B. High-early-strength portland cement: ASTM C150, Type III. May be used instead of Type I cement at CONTRACTOR's option, unless specified otherwise, to achieve 28-day strength at 7 days.

C. Use only 1 brand of each type of cement.

2.02 AGGREGATE

A. Regular aggregate: Strong, durable, well-graded minerals conforming to ASTM C33 requirements for grading, deleterious substances, and soundness.

B. Aggregates not conforming exactly to above specifications may be used provided:
1. Special tests or actual service establish that such aggregates will produce concrete of quality specified.

C. Coarse aggregate nominal size:
   1. 1-1/2" to No. 4: Use for all concrete unless specified otherwise.
   2. 3/4" to No. 4: Use for slabs and thin sections and areas where clear spacing between reinforcing bars is less than 3".

2.03 WATER

A. Clean, fresh, free from injurious amounts of oil, alkali, acid, salts, organic materials, or other substances that may be deleterious to concrete or steel.

2.04 ADMIXTURES

A. Water-reducing and set-controlling admixture, ASTM C494, type as required. Use for all concrete. High range, water-reducing admixtures permitted for walls.

2.05 FORMS

A. Acceptable materials:
   1. Douglas fir, exterior type, concrete form plywood, 5/8" thick minimum, conforming to DOC PS 1, Grade B-B, Class I or II.
   2. Removable metal and plywood forms equal to symons.
   3. Fiber tube forms: Cylindrical reinforced fiberglass.

B. Form ties: Type leaving no metal within 1/4" of surface after removal of forms for surfaces receiving waterproofing.

C. Form coating:
   1. Wood forms: Nonstaining mineral oil or commercially produced form-release agent that will not bond with, stain, or adversely affect concrete surfaces and curing, and will not impair bond or adhesion of subsequent treatment of concrete surfaces, "Nox-Crete Form Coating," by Nox-Crete Chemicals, or equal.
   2. Metal forms: Treat surfaces as recommended by manufacturer before placing reinforcing.
   3. Fiber tube forms: Treat surfaces as specified for wood forms or as recommended by manufacturer.

2.06 WATERSTOPS

A. Polyvinyl Chloride:
   1. Conform to COE Spec. CRD-C-572.
   2. Manufacturer: Greenstreak, Vinylex Corp., or equal.

2.07 BENTONITE WATERSEALS

A. Type: “Waterstop-RX Cold Joint Water Stop Volclay Waterproofing Systems” by American Colloid Company, or equal.

B. Size: 1” x 3/4".

C. Use: Where specifically shown and around all drain lines that penetrate

2.08 CURING MATERIALS

A. Liquid membrane-forming compound:
   1. ASTM C309, Type 1 with fugitive dye, except Type 2 with white pigment for surfaces exposed to direct rays of sun.
   2. Do not use compounds containing wax, oil, resin, varnish, or other bases that will prevent bonding of finishes such as additional concrete, paint, and similar applied finishes.

3. Use for curing at CONTRACTOR's option except where other products are specified for particular application.

B. Plastic film:
1. Polyethylene plastic film, white, nonstaining, conforming to ASTM D2103.
2. Minimum 4-mil thickness.
3. Use for curing at CONTRACTOR's option except where other products are specified for particular application.

C. Absorptive mat:
1. Cotton fabric, burlap fabric, or burlap-polyethylene material woven or bonded to prevent separation.
2. Material shall be clean and nondetrimental to concrete or finish.
3. Use for curing at CONTRACTOR's option except where other products are specified for particular application.

2.09 NONSHRINK GROUT

A. Acceptable products:
1. “Five Star Grout” by U.S. Grout Corporation.
2. “Masterflow 928 Grout” by Master Builders.
3. “Sealtight 588 Grout” by W. R. Meadows, Inc.

B. Nonmetallic, and free of chloride, gypsum or corrosive-type materials: ASTM C1107, Grade A; formulation suitable for application.

C. Minimum strength: 5000 psi at 28 days.

D. Use for grouting beneath baseplates as shown on drawings.

2.10 CONCRETE DESIGN AND USE

A. Each concrete design mix shall be established in strict accordance with ACI 318 by proportioning on basis of either experience and/or trial mixtures.

B. Strength classifications:

Class	Specified Compressive Strength, f'c	Required Average Compressive Strength, f'cr
A	4,000 psi	5,200 psi
B	2,500 psi	3,500 psi
C	3,500 psi	4,200 psi

C. Required average compressive strengths: Produce concrete of average strengths noted above unless test results substantiate a lower permissible average strength based on standard deviation criteria set forth in ACI 318. Strength listed above is 7-day strength for concrete using high-early-strength cement and 28-day strength for concrete using other type cements.

D. Maximum water-cementitious materials ratio by weight:
1. Class A concrete: 0.48.
2. Class B concrete: 0.55.
3. Class C concrete: 0.48

E. Air entrainment: Concrete used above frost depth shall contain entrained air within following limits. All Class C concrete shall contain air entrainment.

Nominal Maximum Size of Coarse Aggregate, In.	Total Air Content, Percent By Volume
3/4"	4 to 8
1”	3.5 to 6.5
1-1/2"	3 to 6

F. Workability:
1. Proportions of concrete shall produce a mixture, suited to placement methods, which will work readily into corners and angles of forms and around reinforcement and embedded items. Segregation of materials or presence of free water will not be permitted.
2. Slump of concrete: 3” to 5” for Class A concrete; 3” to 6” for Class B concrete. Use minimum practical; vary within limits given to suit placement conditions; in no case is slump to be increased by addition of water in excess of design mix quantity.
3. At CONTRACTOR’s option, tunnel walls may be constructed using flowable concrete containing superplasticizers.

G. Concrete use:
1. Use Class A concrete for all concrete except as specified herein or shown otherwise on Drawings.
2. Use Class B concrete for duct banks, thrust blocks, and fill concrete.
3. Use Class C concrete for sidewalk, curb and gutter.

2.11 READY-MIX CONCRETE

A. Provide concrete from an established, approved ready-mix plant. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC-3.

B. Equipment and methods: Conform to ASTM C94.

2.12 MEASURING

A. Ingredients:
1. Cement: By weight or bag.
2. Aggregate: By weight.
3. Water: By weight or volume.

PART 3 EXECUTION

3.01 PREPARATION

A. Construct forms strong, straight, adequately braced and securely fastened.

B. Remove laitance from previously placed or existing concrete; thoroughly clean surface before placing additional concrete.

C. Apply form coating on formwork in accordance with manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.

3.02 PLACING CONCRETE

A. Clean transporting equipment, reinforcing, and embedded items before placing concrete. Remove water and debris from places to be occupied by concrete.

B. Place no concrete until forms, reinforcing, and embedded items have been verified as adequately supported and accurately placed. Place no concrete over water-covered, muddy, or frozen soil.

C. Where conditions make placement or consolidation difficult or where reinforcement is congested, batches of mortar containing same proportions of cement, sand, and water as used in concrete shall be deposited in forms around congestion immediately prior to concrete placement to avoid segregation induced “honeycomb”.

D. Immediately remove concrete where water, soils, or other deleterious substances are permitted to mix with concrete, form or embedded item movement occurs, or inadequate consolidation is obtained.

E. Hot weather concreting:
   1. Applies to concrete placed when ambient temperature exceeds 90ºF.
   2. Conform to ACI 305R recommendations and requirements.

F. Cold weather concreting:
   1. Applies to concrete placed when ambient temperature is below 40ºF.
   2. Conform to ACI 306R recommendations and requirements.

G. Employ best industry practices to prevent segregation during placing. Do not drop concrete more than 5'. Use tremied or pumped concrete to provide proper placement. Place in layers approximately 18" deep.

H. Place concrete continuously in each section until completed. Permit not more than 30 minutes between depositing adjacent layers of concrete within each section, unless an acceptable set retarder is used in concrete mix.

I. Thoroughly compact, puddle, and vibrate concrete into corners and around reinforcing and embedded items. Use internal vibration where size of section permits.

J. Maintain concrete placing temperature between 50ºF and 90ºF except as specified for hot and cold weather concreting.

K. Place sections of concrete in sequence that eliminates shrinkage effects to greatest extent practicable.

L. Protect concrete from injury due to sun, cold weather, running water, construction operations, and other causes until properly cured.

3.03 REINFORCEMENT PLACEMENT

A. Remove scale, loose flaky rust, dirt, grease, curing compound, and other coatings that would impair bond.

B. Install slab reinforcing bars in correct position by use of preformed bolsters and spacers, except concrete blocks may be used to position bars in concrete placed on grade. Concrete block shall have compressive strength equal to that of surrounding concrete.

C. Space bars properly and tie securely in position before placing concrete. Tack welding to keep reinforcing in place is not permitted.

D. Lap wire fabric not less than 8".

3.04 INSPECTION

A. Verify reinforcement and other items to be cast in concrete are properly placed and secured.

B. Verify opening, recesses, and similar variations to concrete shape are formed and secured.

C. Verify concrete may be placed without resulting in voids and honeycomb areas. Make provisions for release of trapped air.

D. Verify forms are securely braced and tied.

E. Verify elevations and dimensions are accurate.

3.05 EMBEDDED ITEMS

A. Install items required under this contract to be embedded in concrete. Install items required by others for embedding in concrete, if so instructed before placing concrete.

B. Fasten embedded items securely in proper position before placing concrete.

C. Conduit or pipe embedded in slabs or walls:
   1. Locate in center of slab or wall and space not closer than 3 diameters on center; locate to avoid impairing strength of concrete.
   2. Coordinate placing of reinforcing with conduit or pipe location. Do not cut reinforcing to clear conduit or pipe.

D. Aluminum pipe shall not be embedded in concrete. Where aluminum projects into or rests against surface of concrete, coat surfaces of aluminum to prevent direct contact with concrete.

3.06 GROUTING

A. Roughen concrete surfaces by light chipping to remove laitance to approximately 1/4". Do not expose reinforcing steel.

B. Remove materials which might interfere with bond; prepare surfaces in strict conformance to manufacturer's instructions.

C. Mix, place, and cure grout in strict accordance to manufacturer's instructions.

D. Provide formwork as required.

3.07 FINISHING

A. Flatwork:
   1. Tamp concrete to force coarse aggregate down from surface.
   2. Screed with straightedge, eliminate high and low places, bring surface to required finish elevations; slope uniformly to drains.
   3. Dusting of surface with dry cement or sand during finishing operations is not permitted.
   4. Finish surfaces within following tolerances as measured with a 10' straightedge:
      a. Sidewalks: 5/16".
      b. Other slabs: 3/16".
      c. Top surfaces of structures other than slabs: In accordance with ACI 117.
   5. Float finish:
      a. Float surface to true, even plane.
      b. Float second time to uniform finish with wood or cork float; use edger on exposed edges.
      c. Use on top surface of foundations.
   6. Broomed or belted finish:
      a. Float surface to true, even plane.
      b. Steel trowel to smooth, uniform surface.
      c. Broom with fiber brush or drag burlap belt across surface in direction transverse to traffic flow.
      d. Use on all sidewalks, paving, and exterior slabs at door entrances.

B. Formed surfaces:
   1. Remove fins, projections, and loose material.
   2. Clean surfaces of form oil.
   3. Patch honeycomb, aggregate pockets, voids, and holes as follows:
      a. Chip out until sound concrete is exposed to minimum depth of 1".

b. Prepare patching mortar with approximately 2 parts normal portland cement, one part white cement, 9 parts fine aggregate; vary proportions of cement as necessary to match color of adjacent concrete.
c. Saturate surfaces with water and fill cavities with patching mortar.

4. Fill holes left by form ties with patching mortar.
5. Cure patches as specified for concrete.

3.08 FORM REMOVAL

A. Minimum time before removal after placing concrete, unless permitted otherwise:
1. Self-supported beams and slabs: 7 days; prior to that if field cured cylinder test yields 2/3 of the design concrete compressive strength.
2. Time specified above represents cumulative time during which temperature of concrete is maintained above 50ºF and for concrete without set-controlling admixtures.

B. Reduce removal time by half for high-early-strength cement concrete.

C. In any event, do not remove supporting forms and shoring until concrete has acquired sufficient strength to prevent damage to new conrete.

3.09 CURING

A. Cure all concrete; begin curing as soon as possible after placement of concrete.

B. Use liquid membrane-forming compound curing for floor slabs; method of curing optional for other concrete.

C. Plastic film curing:
1. Dampen surface of concrete and lay plastic film with minimum 6" side laps and free of wrinkles; tape side laps.
2. Hold film in place with lumber or use similar provisions to prevent exposure of concrete for 7 days after placing.
3. Immediately repair tears in film.

D. Water curing:
1. Keep concrete continuously wet for 7 days after placing.
2. Use on concrete surfaces not receiving compound or plastic film curing.
3. Clean, nonstaining absorptive mat may be used with water curing.
4. Do not use for curing cold weather concrete.

E. Cure grout and miscellaneous cementitious placements by one of the specified methods.

END OF SECTION

1) W. Turechek
2) B. Baggaley

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural fabrication and erection.

B. Anchor rods.

C. Expansion anchors.

D. Welded studs.

E. Shop painting.

F. Field painting.

1.02 QUALITY ASSURANCE

A. Perform welding in accordance with AWS D1.1 "Structural Welding Code" as applicable.

B. OWNER will retain services of qualified, independent testing company to inspect fastener assemblies, and to perform inspection of welds.

C. Where inspections indicate noncompliance with Contract Documents, repair or replace defective materials at CONTRACTOR's expense.

D. Field Measurements: Take field measurements prior to preparation of Shop Drawings and fabrication of Landscape Arbors.

E. Shop Assembly: Pre-assemble Landscape Arbors in shop to greatest extent possible to minimize field slicing as assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.03 SUBMITTALS

A. Shop Drawings for miscellaneous steel and ladders.

B. List of manufactured materials proposed, identifying manufacturer and type.

C. Certified copies of mill tests.

D. Welder's qualifications.

1.04 INSPECTION OF WELDS

A. Inspection by OWNER's independent testing company: Visual inspection of shop and field welds in accordance with AWS D1.1.

B. Repair welds shown by inspection to have discontinuities which would reduce weld strength in accordance with AWS D1.1. Cost of reworking and inspection shall be borne by CONTRACTOR at no additional cost to OWNER.

PART 2 PRODUCTS

2.01 MATERIALS

A. Structural Steel: ASTM A36.

B. Miscellaneous steel plates and shapes: ASTM A36.

C. Galvanizing: ASTM A123.

D. Standard bolts: ASTM A307.

E. High-strength bolts: ASTM A325, Type 1 only.

2.02 ANCHOR BOLTS

A. Material: ASTM A307 or A36.

B. Provide anchor bolt assemblies for:
1. Structural steel furnished under this Section.
2. Equipment and structures furnished by others, where detailed on Drawings.

C. Provide washers and heavy hexagon heads and nuts on anchor bolts unless specified otherwise.

D. Do not prime paint surfaces which are to be embedded in concrete.

2.03 ANCHOR RODS

A. Type:
1. All-threaded.
2. Stainless steel: ASTM F593 (AISI 304).

B. Anchor rods in concrete with 2-component blend of resin and hardener. Filler material may be mixed with resin and hardener in accordance with manufacturer's directions.

C. Manufacturer:
1. Vertical anchor rods installed in concrete from below: "HVA Adhesive" by Hilti, or equal.
2. Horizontal anchor rods and vertical anchor rods installed in concrete from above: "HY-150 Adhesive System" by Hilti; "Epcon System" by ITW Ramset/Red Head; or equal.

2.04 EXPANSION ANCHORS

A. Wedge-type with expanding cone, stainless steel.

B. Size and locations: As shown or required for equipment installation.

C. Manufacturer: "Wej-It" expansion anchor bolts, by Wej-It Expansion Products, Inc.; "Kwik-Bolt II" or "HSL Heavy-Duty Sleeve Anchors" by Hilti; or equal.

2.05 WELDED STUDS

A. Material: ASTM A108.

B. Type: "Nelson Fluxed Headed Anchor Studs," by Nelson Stud Welding Division, or equal.

C. Automatically end weld in accordance with manufacturer's recommendations.

2.06 SHOP PAINTING

A. Surface preparation: Remove oil, grease, dirt, rust, loose mill scale, and other foreign elements by "Power Tool Cleaning" in accordance with SSPC-SP3.

B. Shop primer: Apply one shop coat of: "90-97 Tnemec-Zinc," by Tnemec Co., or equal; apply in accordance with manufacturer's directions including recommended coverage.

C. Omit shop prime coat from surfaces subject to field welding or to be embedded in concrete.

D. Omit shop prime coat from galvanized surfaces and stainless steel.

E. Leave unpainted steel clean and free from rust.

PART 3 EXECUTION

3.01 ERECTION

A. Anchor ladders and miscellaneous items securely to structural steel framing or concrete.

B. Install expansion anchors in accordance with manufacturer's recommendations.

3.02 ANCHOR RODS

A. Install in strict accordance with manufacturer's directions.

B. Perform work using manufacturer's standard equipment including adhesive cartridges, dispensing guns, mixer tubes and extensions, brush, and air nozzle for compressed air cleaning of holes. CONTRACTOR shall possess equipment at site prior to start of installation and workers shall demonstrate knowledge of procedure for installing anchors prior to installation.

C. Where holes are within 6" of edge of concrete, core drill holes.

D. Inspect existing concrete at anchor rod locations for soundness. Report to ENGINEER evidence of deteriorated or weak concrete detected from drilling operation or from inspection.

3.03 ANCHOR BOLTS

A. Install embedded anchor bolts as shown on Drawings.

B. Coat threaded portion of anchor bolts with oil or grease and wrap with protective tape at time bolts are positioned for new construction. Tape to remain in place until bolts are secured.

3.04 FIELD PAINTING

A. Apply one field coat of primer to cleaned surfaces of bolts, new welds and abrasions to shop coat after erection.

B. Do not paint aluminum, stainless steel, or galvanized steel work.

C. Field finish painting:
   1. Prepare surfaces to be finished in conformance to recommendations of finish manufacturer.
   2. Finish Coat: Apply one coat of “66 Hi-Build Epoxoline”, by Tnemec Co., Inc. or equal. Apply in accordance with manufacturer’s directions including recommended coverage.
   3. Color for use on pipe supports in tunnel: BJ45-Light Gray by Tnemec Co.

3.05 TOUCH-UP OF GALVANIZED FINISH

A. Apply one field coat of cold-applied galvanizing compound to new welds, field drilled holes, and abrasions to galvanized shop coat after erection. Prepare surfaces and apply finish in accordance with manufacturer's directions including recommended coverage.

END OF SECTION

1) W. Turechek
2) B. Baggaley

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe materials.

B. Fittings, unions, flanges, and couplings.

C. Welding fittings.

D. Piping identification.

E. Pipe joining methods.

F. Cleaning and protection.

G. Leakage tests.

H. Piping schedules.

1.02 SUBMITTALS

A. Quality assurance data: Certified records, indicating that procedures used and welding operators employed are in compliance with codes referenced in article "Quality Assurance."

1.03 QUALITY ASSURANCE

A. Regulatory requirements:
   1. Piping construction criteria shall conform to requirements of ANSI B31.1 as applicable. Work shall also comply with applicable state and local codes.
   2. Qualification of welding procedures to be used and welding operators shall be in accordance with ASME Boiler and Pressure Vessel Code, Section IX.

B. Certifications: New materials and equipment shall bear manufacturer's name, model number, or other identification marking.

C. Standard product shall be of latest design with published properties of manufacturer regularly engaged in production of specified material or equipment for minimum 5 years (unless exempted by Engineer).

D. Unless otherwise indicated, equipment of same type in same room shall match color, finish, and design.

E. Standardization: Unless otherwise submitted to and accepted by Engineer, equipment and its devices shall be of same manufacturer; or devices must be approved and warranted by equipment manufacturer.

F. All piping and fittings shall be manufactured in the United States (domestic).

1.04 COORDINATION

A. Make minor modifications in Work required by interferences (structural, work of other trades) following notification to Engineer.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

A. Pipe materials shall be as specified herein and in Mechanical Standards bound at end of Project Manual. No asbestos shall be used. If pipe wall thickness specified is not available, use next heavier wall.

2.02 FITTINGS - GENERAL

A. Material, wall thickness, and pressure class: As specified in article "Pipe Materials," unless otherwise noted.

B. Use long radius fittings, except where space limitations require short radius.

C. Provide dielectric unions at connections between ferrous and nonferrous piping and at connections of nonferrous piping to ferrous equipment.

2.03 UNIONS, FLANGES, AND COUPLINGS

A. Pressure class, material, and facing: As specified in article "Pipe Materials."

B. Pipe size 2" and smaller: Malleable iron unions for threaded ferrous piping; cast bronze or wrought copper unions for copper piping with soldered or brazed joints.

C. Pipe size 2-1/2" and larger: Forged steel welding neck or slip-on flanges for ferrous piping; bronze flanges for copper piping;.

2.04 WELDING FITTINGS

A. Material and wall thickness: As specified in article "Pipe Materials."

B. Use welding tees for socket-welded piping for field-fabricated branch tees in butt-weld end piping.

C. Nozzle-welded branches or "Weldolets" and "Threadolets" only.

D. Mitering of pipe to form elbows, notching straight pipe to form tees, and similar construction will not be acceptable for pressure piping except where specifically permitted in Mechanical Standards.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Equipment shall be installed in accordance with manufacturers' recommendations.

B. Install piping as shown on Drawing and as specified.

C. Provide sufficient unions and flanges to permit removal of equipment.

D. Spacing of piping shall be adequate to permit servicing valves and specialties and replacing sections of pipe.

E. Slope pipe as indicated on drawings.

F. Provide nuts, bolts, gaskets, and washers for complete and proper installation.

G. Provide dirt legs and main drips as indicated on drawings.

3.02 PIPE JOINING METHODS

A. Comply with Mechanical Standards listed under article "Pipe Materials" and with requirements of ANSI B31, unless otherwise indicated.

B. Threaded joints:
1. Clean-cut threads, ream pipe ends, and remove burrs.
2. Apply suitable lubricating, noncorrosive, flexible pipe joint compound to male threads only.

C. Flanged joints:
1. Clean mating surfaces of flanges.
2. Install gasket and tighten bolts evenly.

D. Weld joints:
1. Cut pipe square, and prepare pipe ends for welding as required by ANSI B31.
2. Workmanship shall conform to details and requirements of ANSI B31.

E. Other joints and jointing methods: In accordance with Pipe Material Schedule and Mechanical Standards.

3.03 LEAKAGE TESTS

A. Notify Engineer and Owner of intent to test piping at least 1 week prior to test. Test in presence of Engineer and Owner, unless notified otherwise.

B. Vents and gravity drainage piping: Cap discharge, fill with water, and check for leaks.

C. Other piping: Test hydrostatically, in accordance with ANSI B31.

D. Provide pumps, compressors, meters, gages, piping, fittings, accessories, and labor required to conduct tests.

E. Isolate equipment that may be damaged by test pressure.

F. Refit joints indicating leakage, replace defective pipe, fittings, and accessories.

3.04 CLEANING AND PROTECTION

A. Remove foreign material from pipes before erection.

B. Close ends of partially erected systems.

C. Remove temporary preservative coatings from valves and accessories.

D. Flush or otherwise clean systems after erection.

E. Prior to conducting final performance test Contractor shall verify that strainers are clean.

F. Contractor shall be responsible for malfunctioning of pumps, valves, controls, or other equipment due to presence of foreign material. Contractor shall clean, repair or replace malfunctioning equipment at no cost to Owner.

3.05 EXTERIOR AND BURIED INTERIOR PIPING SCHEDULE

Service	Pipe	Mechanical Standard No.
Steam		
3/4" and larger	ASTM A53 GR B, Type S	ACS1

END OF SECTION

1) C.H. Kim
2) D. Scanlon

Stanley Consultants INC.

PIPE CLASS SPECIFICATION - ACS1

MAWP	TEMP, °F	100	200	300	400	500	600	650	700	750	775
	PRESS, PSIG	285	260	230	200	170	140	125	110	95	87

PIPE	MATERIAL, ASTM	A53 GR B, TYPE S OR A106 GR B	
	NOMINAL PIPE SIZES AND SCHEDULE	3/4" - 2"	XS
		2-1/2" - 24"	STD

JOINT	TYPE	THREADED	SOCKET WELD	BUTT WELD	FLANGED
	USE FOR PIPE SIZES	NONE	3/4" - 2"	2-1/2" - 24"	NONE
FITTINGS	MATERIAL, ASTM		A105	A234 WPB	
	PRESS CL, ASME B16.11		3000		
	MINIMUM WALL THICKNESS			MATCH PIPE	
	WELDING END			ASME B16.25	
	UNIONS		GROUND JOINT	NONE	

FLANGES	MATERIAL, ASTM	A105
	PRESS CL, ASME B16.5	150
	FACING	1/16" RF SERRATED
	GASKETS ASME B16.20	304 SS SPIRAL WOUND FLEXITALLIC FLEXICARB STYLE CG OR EQUAL, UNLESS SPECIFIED OTHERWISE.
	BOLTS & NUTS	A193 GR B7 STUD BOLTS & A194 GR 2H HEAVY HEX NUTS

GENERAL NOTES & COMMENTS:

1. THREADED JOINTS NOT ALLOWED UNLESS SPECIFIED OTHERWISE.
2. THREADED JOINTS ALLOWED FOR INSERTION TYPE TEMPERATURE WELLS. WELLS SHALL BE SEAL WELDED. USE CLASS 2000 A105 FITTINGS.
3. BACKING RINGS NOT PERMITTED.
4. BUTT WELD END PREPARATIONS
   1. NOMINAL PIPE WALL THICKNESSES 0.375" AND LESS: CONFORM TO ASME B16.25, FIGURE 2, DETAIL (A).
5. FURNISH FLAT FACED FLANGES AND USE FULL-FACED GASKETS WHERE REQUIRED FOR CONNECTION TO CAST IRON FLANGES.
6. FLANGES SHALL BE WELD NECK.
7. FITTINGS SHALL BE SEAMLESS.

NO.	REVISION	DATE	DESIGN	CHECK	APVD
0	REVISION 0	9-Dec-04	JSM	JC	MAE

ASME CLASS 150

SEAMLESS CARBON STEEL

NO. **ACS1**

M-1802, M-2000

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Applicable Welding Codes and Standards.

B. Metallic welding requirements.

C. Procedure and performance qualifications.

D. Filler materials.

E. Weld joint preparation.

F. Thermal Treatment

G. Filler metal control.

H. Nondestructive examinations.

I. Weld repairs.

J. Submittals.

1.02 APPLICABLE WELDING CODES AND STANDARDS

A. All welding, welding procedures and qualifications, welder qualifications and fabrication shall be in accordance with the requirements of the applicable fabrication codes invoked by the specification and the additional requirements herein, and the requirements of the Authority Having Jurisdiction (AHJ). The requirements of this section supplement the requirements of the applicable fabrication code.

B. Chilled water, condenser water, cooling water, and compressed air piping shall be designed and installed per ASME B31.9, “Building Services Piping.”

C. Welding of piping within the jurisdictional limits of ASME Boiler and Pressure Vessel Codes (either Section I, Section IV or Section VIII) shall conform to the specific requirements of that code.

D. Reference Specification Section 20 05 00, “Common Work Results for Facility Services Systems”, for specific design conditions of piping services.

1.03 METALLIC WELDING REQUIREMENTS

A. All drawings which show fabrication by welding shall indicate the joints, together with the required weld joint geometry and welding procedure number. Welding and nondestructive examination symbols shall be in accordance with AWS A2.4. Welding terms and definitions shall be in accordance with AWS A3.0.

B. Safety measures for the protection of welders and operators involved in welding and cutting shall be in accordance with AWS Z49.1.

C. Peening shall not be used unless specific written approval is obtained from OWNER and the ENGINEER.

D. All full penetration weld joints, except those with a root pass deposited by the gas tungsten arc welding (GTAW) process, shall have the root of the second side removed to sound metal before welding from

the second side. Full penetration welds or continuous seal welds shall be used on all joints which will be in contact with the flue gas, condensate, or water, require special cleaning or which will be internally coated or lined. Permanent backing rings or bars are not permitted without specific written authorization from the ENGINEER or OWNER. Consumable inserts are not considered backing and may be used with GTAW on pipe welds; it is an essential variable and shall be qualified separately.

E. Inert purging gas shall be used on all GTAW root passes. The gas backing shall be maintained until a minimum of three passes or 0.1875" (5 mm) of weld metal has been deposited. All gases for purging and shielding shall be welding grade and have a dew point of –40ºF (-40°C) or lower.

F. All welding which requires the use of an external gas shielding shall not be done in a draft or wind unless the weld area is protected by a shelter. This shelter shall limit the draft or wind speed to a maximum of 5 miles per hour.

G. Welding shall not be performed on materials that are below 50ºF. Welding shall not be permitted on surfaces that are wet or covered with ice, or when rain or snow is falling on the surfaces to be welded; nor during periods of high winds, unless the welders and the work are properly protected. Temporary heating and/or shelters shall be provided to raise the material temperature and to limit the air velocity.

H. If run-off tabs or temporary attachments are used during production, they shall be removed and the area ground smooth, blended into the surrounding surface, and as a minimum visually examined. Materials used for run-off tabs and temporary attachments shall be of the same nominal chemical composition as the base metal.

I. Tack welds that do not become an integral part of a weld shall be removed, the surface ground smooth, and the area visually inspected in accordance with the fabrication code. Tack welding and welding of temporary attachments shall be performed using qualified welding procedures and qualified welders and welding operators.

J. Arc strikes shall be avoided. All arc strikes shall be removed, blended and the area examined by liquid penetrant or magnetic particle inspection techniques as applicable. Whenever possible, starter pads shall be used to avoid arc strikes on the base metal.

K. Welding may be performed using any of the following processes or combination of these processes:
   1. Shielded Metal Arc Welding (SMAW);
   2. Gas Tungsten Arc Welding (GTAW);
   3. Pulsed, Spray and Globular Transfer Gas Metal Arc Welding (GMAW);
   4. Submerged Arc Welding (SAW).

L. All GTAW will be made with the addition of filler metal.

M. Parts that are to be joined by welding shall be fitted, aligned, and retained in position during the welding operation by the use of bars, jacks, clamps, or other mechanical fixtures. Excluding structural steel, welded temporary attachments shall not be used without specific written approval of OWNER.

1.04 PROCEDURE AND PERFORMANCE QUALIFICATIONS

A. CONTRACTOR, subCONTRACTOR, or fabricator performing welding under jurisdiction of referenced codes shall be responsible for obtaining and qualifying welding procedures.
   1. Structural welding procedures conforming to AWS D1.1 are prequalified as defined in AWS D1.1, Chapter 5 and Appendix E.
   2. Piping and Other Welding: All weld procedures and welders shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code, API 1104, ASME B31.1, ASME B31.3, ASME B31.9, or AWS D1.1, as applicable.

B. CONTRACTOR shall maintain records, and make available to OWNER and ENGINEER when requested, certifying successful completion of procedure qualification tests. ENGINEER reserves the

right to require any welder to retake qualification tests when, in the opinion of the ENGINEER, work of the welder creates reasonable doubt as to the welder's proficiency. ENGINEER reserves the right to witness any required retesting. CONTRACTOR shall conduct such tests at no additional expense to OWNER.

C. CONTRACTOR, subCONTRACTOR, or fabricator performing welding under jurisdiction of referenced codes shall be responsible for testing and qualifying its welding operators in accordance with applicable procedures.

D. Unless welding operators have been previously qualified by CONTRACTOR within last 6 months and have been continuously employed as welders by CONTRACTOR following qualification, requalification tests must be performed.

E. Only qualified welders or welding operators shall be used for production welding, tack welding and fit up. All welding shall be done with qualified procedures.

F. Welders and welding operators shall be pre-qualified at the job site prior to performing production welding.

G. Qualification of field welders shall be performed at the project site.

H. All Welding Procedures and Qualification Records for purchased items subcontracted by the CONTRACTOR shall be reviewed by the CONTRACTOR for content and contract compliance, prior to submittal.

I. Submerged arc welding of production parts shall be performed using the same name brand of flux and the same name brand of AWS/ASME classification of wire as was used for the procedure qualification.

1.05 FILLER MATERIALS

A. Welding filler metals shall meet the requirements of the fabrication code and the applicable ASME Section II, Part C or AWS filler metal specification.

B. Only low hydrogen type electrodes shall be used when the SMAW process is selected for production.

C. Filler material shall be used so that the principal elements in the deposited weld metal shall be of the same nominal composition as the base metal, except as follows:
   1. Submerged arc multi-pass welds in carbon steels will use essentially a neutral flux.
   2. Solid wires for SAW shall contain the principal elements required for the deposited weld metal. Welds deposited by SAW shall not derive any principal element from the flux. Fluxes that the flux manufacturer recommends for single pass applications only shall not be used for multiple pass welds. All welding shall require a minimum of two passes unless specifically approved by the ENGINEER.

1.06 WELD JOINT PREPARATION

A. The method used to prepare the base metal for welding shall leave the weld joint preparation with smooth surfaces.

B. Carbon and low alloy steels may be cut to shape and size by mechanical means, such as machining, shearing, shipping, grinding, air-arc gouging or by thermal cutting. Prior to thermal cutting, the preheat specified by the welding procedure for welding shall be applied to the material. Preheat is not required prior to thermal cutting carbon steel materials. Discoloration which may remain on the oxy-fuel cut surface is not considered to be detrimental oxidation. The cut surface shall be ground back to bright metal.

C. Surfaces to be welded and surfaces up to one inch for ferrous material and two inches for nonferrous materials from the edge of the weld shall be clean and free from oil, rust, scale, slag, grease, paint, and other foreign material which is detrimental to welding. Approved “weld-through primers” (i.e., Carbo Weld 11 and Zinc-lock 352) need not be removed from carbon steel surfaces prior to welding, if they were applied in accordance with the coating manufacturer's instructions.

D. The weld end preparation of the base metals for shop welded joints shall be prepared as required by the welding procedure used.

E. Permanent backing rings are not permitted without specific written authorization from the ENGINEER. If temporary backing rings are used and then removed, the weld area shall be dressed and examined for cracks and other defects using magnetic particle or liquid penetrant examination techniques as applicable.

1.07 THERMAL TREATMENT

A. Preheat and interpass temperatures shall be maintained in accordance with the requirements of the applicable code and the qualified weld procedure. Electric or gas heat sources which provide a uniform application of heat over the weld area shall be used.

B. Postweld heat treatment will be performed in accordance with the requirements of the applicable code, at standard temperatures and holding times required by the fabrication code and specified on the WPS. No low temperature-longer time post weld heat treatments shall be permitted without prior approval from the OWNER.

C. Acceptable postweld heat treatment methods are listed as follows:
   1. Furnace Method
   2. Local Resistance Method
   3. Local Quartz Halogen Lamp Method

D. On pipe diameters 10” nominal O.D. and smaller, a total of two thermocouples are required. These thermocouples shall be designated as "recording" thermocouples. If individually sheathed thermocouples are used, a spare shall be attached adjacent to each recording thermal couple. The two recording thermocouples shall be placed 180 degrees apart and on opposite sides of the welds (one at 12 o'clock and the other at 6 o'clock on the opposite side of the weld). The tips of all thermocouples shall be located a minimum of one inch from the near edge of the weld face.

E. Temperature recording charts shall be used with all recording thermocouples. The CONTRACTOR shall maintain the original strip charts in its files throughout the Warranty Period for review by the OWNER.

1.08 FILLER METAL CONTROL

A. All welding materials shall be stored in a controlled access, clean, dry area that is weather tight and is maintained at a temperature between 40ºF and 140ºF, and above the ambient dew point. The materials shall not be in contact with the floor and shall be stored on wooden pallets or cribbing. The materials shall at all times be identifiable. The CONTRACTOR shall submit a filler metal control procedure to OWNER and ENGINEER for approval no later than six weeks prior to the start of production welding.

B. Storage requirements and atmospheric exposure limits of low hydrogen steel electrodes shall comply with AWS D2.2. If the hermetic seal of the container is damaged during shipment or storage, the covered electrodes may only be baked once. All electrodes removed from a hermetically sealed container shall be immediately placed in a storage oven.

C. Materials that are damaged shall be discarded. All covered electrodes which are oil or water soaked, dirty, have been rained on, or have flux separated from the wire shall be discarded if a bloom of rust

develops which cannot be removed by light sanding. All flux-cored electrodes shall be discarded if they become contaminated with oil or water. Bare and flux-cored wire that becomes dirty can be used if it can be cleaned prior to use and restored to a bright surface. Any filler metal wire that exhibits pitting shall be discarded.

D. Welders shall not be issued more than one type of electrode or filler metal at any one time and shall not have more than one type of electrode or filler metal in their pouches or portable rod heaters except a welder who is assigned to make a weld involving two processes, and who is so qualified, may posses welding materials for each process.

1.09 NONDESTRUCTIVE EXAMINATIONS

A. All nondestructive examination (NDE) methods, acceptance criteria and additional general requirements shall be in accordance with the following subparagraphs.

B. All nondestructive examinations shall be performed by personnel certified in accordance with ASNT recommended practice SNT-TC-IA or CONTRACTOR's own equivalent certification program that has been authorized by OWNER. Personnel certified to Level II or III shall perform interpretation of results.

C. On request, the NDE procedures shall be submitted to OWNER, in which case examination shall not proceed until authorized by OWNER. In addition, all other records pertaining to inspection and certification shall be available for review by OWNER's inspector.

D. For all types of NDE, the evaluation of indications and the acceptance criteria shall be in accordance with the applicable code and the requirements of the AHJ.

E. At a minimum, the CONTRACTOR shall perform the following NDE:
   1. Welding installations per ASME B31.1:
      a. Visually examine all welds.
      b. Perform radiographic examination on a minimum of 2 welds per piping service (steam, condensate, boiler feed water, high temperature hot water, etc.), unless additional examination is required per the design requirements for that piping service (e.g., 100% radiographic examination is required by the ENGINEER).
   2. Welding installations per ASME B31.3:
      a. Visually examine all welds.
      b. Perform radiographic examination on a minimum of 1 weld per piping class or service (high-pressure distribution piping and building service piping would be separate services), unless additional examination is required per the design requirements for that piping service (e.g., 10% radiographic examination is required by the ENGINEER)
   3. Welding installations per ASME B31.9:
      a. Visually examine all welds.
      b. Perform radiographic examination on a minimum of 1 weld per piping service (steam, condensate, boiler feed water, high temperature hot water, etc.).
   4. Welding installations per API 1104:
      a. Visually examine all welds.
      b. Perform radiographic examination on a minimum of 2 welds per piping service high-pressure distribution piping and building service piping would be separate services), unless additional examination is required per the design requirements for that piping service (e.g., 10% radiographic examination is required by the ENGINEER).
   5. For piping welds within ASME Boiler and Pressure Vessel Code jurisdictional limits:
      a. Visually examine all welds.
      b. Perform radiographic examination on all welds, unless otherwise noted by ENGINEER or OWNER.
   6. Perform additional NDE as required by the AHJ, ENGINEER, or OWNER.

F. Visual Examination: Visual examination procedures shall be in accordance with ASME Boiler and Pressure Vessel Code, Section V, Article 9.

G. Magnetic Particle Examination:
   1. Magnetic particle examination procedures shall be in accordance with the requirements and methods specified in ASME Boiler and Pressure Vessel Code, Section V, Article 7.
   2. Magnetic particle examination of welds shall include a band of base metal at least one inch wide on each side of the weld.
   3. If arc burns occur during magnetic particle examination, the arc burns shall be ground out and the area reexamined by the magnetic yoke method.

H. Liquid Penetrant Examination:
   1. Liquid penetrant examination procedures shall be in accordance with the requirements and methods specified in ASME Boiler and Pressure Vessel Code, Section V, Article 6, using solvent removable penetrant.
   2. Penetrant materials shall meet the requirements of ASME Boiler and Pressure Vessel Code, Section V, for sulfur and chloride content regardless of the type of material to be examined.
   3. Liquid penetrant examination of welds shall include a band of base metal at least 1 inch wide on each side of the weld.

I. Ultrasonic Examination: Ultrasonic examination procedures shall be in accordance with the requirements and methods specified in ASME Boiler and Pressure Vessel Code, Section V, Article 5 or ASME B31.3, Paragraph 344.6.2, as applicable.

J. Radiographic Examination: Radiographic examination procedures and techniques shall be in accordance with ASME Boiler and Pressure Vessel Code, Section V, Article 2.

K. Control of Welder/Operator Quality
   1. When progressive examination in accordance with ASME B31.3, Paragraph 341.3.4 is required, then the following additional requirements shall apply:
      a. If any of the items examined in accordance with Paragraph 341.3.4 (c) reveals a defect, then the welder/bonder or welding operator shall be considered unacceptable for any further welding/bonding to that procedure with respect to OWNER work done to this specification without requalification and the agreement of OWNER.
      b. Timing is essential for the control of welder, bonder or operator quality; therefore, the progressive examination required by Paragraph 341.3.4 shall be completed within a day of the first defect, unless otherwise agreed to by OWNER. The examination shall be performed on work performed prior to or in the same time period as rejected or unacceptable performance. For purposes of evaluation, the term "lot welds" shall include a minimum of 15 welds, and may be extended to all welds made by an individual, according to process, weld equipment, or consumables used on agreement of the OWNER.

1.10 WELD REPAIRS

A. Unacceptable discontinuities shall be completely removed by chipping, gouging, grinding or other authorized methods (for the type of material being repaired) to clean, sound metal.

B. Repairs to correct weld defects shall be made using the same procedure used for the original weld, or other previously authorized weld procedure.

C. The repaired areas shall be reexamined using the same NDE and inspection procedures by which the defect was originally detected.

D. Two repair attempts will be allowed on any one defective area. No further attempts to repair shall be carried out without the authorization of OWNER.

1.11 SUBMITTALS

A. Except for procedures exempted by AWS D1.1, Section 5.1, submit 1 copy of each welding procedure to OWNER and ENGINEER with certificate demonstrating successful qualification of welding procedures for each welding process performed in the field: AWS D1.1 – Forms E-1, E-2, E-3; or ASME QW-483.

B. Prior to execution of any field welding, submit to OWNER and ENGINEER 1 copy of welder qualification form for each individual performing field welding: AWS D1.1 – Form E-4; or ASME QW-484.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

1) C. Feuerstein
2) C. Kim

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion joints, pipe alignment guides, pipe supports, and pipe anchors for:
   1. Steam piping systems.

1.02 RELATED SECTIONS

A. Section 20.05.00 – Common Work Results for Facility Systems Services

1.03 QUALITY ASSURANCE

A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section and with the following references as applicable.
   1. Conform to Standards of Expansion Joint Manufacturer's Association.

B. CONTRACTOR shall examine piping layout and notify ENGINEER of additional anchors or expansion joints required to adequately protect system.

1.04 PERFORMANCE REQUIREMENTS

A. Provide structural work and requirement required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

B. Base expansion calculations shall be based on 50ºF installation temperatures. Operational temperature shall be:
   1. Steam: 350ºF.

C. Provide 30% safety factor.

1.05 SUBMITTALS

A. Shop Drawings:
   1. Indicate manufacturer, model, and application.
   2. Submit detailed calculations and procedures applied to making selections as appropriate to lifetime cycles.
   3. Identify materials of construction
   4. Indicate maximum temperature and pressure ratings.
   5. Indicate maximum expansion compensation.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products under provisions of Division 1 and Section 15010.

B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

C. Protect equipment from exposure by leaving factory coverings, pipe and protection, and packaging in place until installation.

PART 2 PRODUCTS

2.01 EXPANSION JOINTS

A. Externally Pressurized Expansion Joints:
   1. Application: Steel Piping 2 inch through 24 inch.
   2. Pressure and temperature rating: 150 psig at 500ºF.
   3. Dual anchor base expansion joint configurations:
      a. 8 inch axial compression and 2 inch extension.
   4. Flanges:
      a. ASME A-36 flat face.
      b. Dimensions per ASME/ANSI B16.5, 150lb.
   5. Pipe/Shell:
      a. ASME A53, Grade B or A106, Grade B standard weight steel pipe.
      b. Weld end preparation per ASME/ANSI B16.9.
   6. Guide Rings:
      a. Steel plate per ASME A-36.
   7. Drain Port & Plug:
      a. 3000 lb. thread-o-let, ASME A105 steel forging.
   8. Bellows:
      a. Three or four ply laminated, ASTM A240 type 321 stainless steel.
   9. Joints:
      a. Flanged.
   10. Manufacturer: Hyspan series 3500.

2.02 PIPE ALIGNMENT GUIDES

A. General:
   1. Low friction graphite pipe guides shall be custom designed for the application and allow for the unrestricted axial movement and expansion of the steam and condensate piping system.

B. Design:
   1. Guide bases shall be designed for welding directly to the support structure.
   2. Guide channels shall be welded directly to the carrier pipe.
   3. Guides shall be capable of up to 8” of axial movement and a maximum ± 1/16” of lateral and 1/8” vertical up movement.

C. Materials:
   1. The guides shall be constructed of carbon steel provided with shop primer.
   2. Guide friction plates shall be low friction graphite, ½” thick, epoxy bonded and mechanically attached on both the upper and lower backing plates of each assembly.

D. Acceptable Manufacturers:
   1. Advanced Thermal Systems, Inc.
   2. Anvil International, Inc.
   3. Or equal.

2.03 PIPE SUPPORTS

A. General:
   1. Low friction graphite pipe supports shall be custom designed for the application and allow for the unrestricted axial movement and expansion of the steam and condensate piping systems

B. Design:
   1. Support bases shall be designed for welding directly to the support structure.
   2. Support channels shall be welded directly to the carrier pipe.
   3. Supports shall be capable of up to 12” of axial movement and a maximum ± 3” of lateral movement.

C. Materials:
   1. The supports shall be constructed of carbon steel provded with shop primer.
   2. Supports friction plates shall be low friction graphite, ½" thick, epoxy bonded and mechanically attached on both the upper and lower backing plates of each assembly.

D. Acceptable Manufacturers:
   1. Advanced Thermal Systems, Inc.
   2. Anvil International, Inc.
   3. Or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install externally pressurized bellows-type expansion joints in accordance with manufacturer's installation instructions, to control axial expansion between anchor points.

B. Rigidly anchor main piping to tunnel structure or piping support rack and provide pipe alignment guides to ensure that axial movement only occurs and buckling is resisted.

END OF SECTION

1) C. Kim
2) D. Scanlon

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe and equipment supports.

B. Supplementary steel

1.02 SUBMITTALS

A. Shop Drawings:
1. Steam and condensate piping supports and guides.

B. Quality assurance data:
1. Pre-engineered standard support certifications as defined in article "Pipe Support Design."

1.03 QUALITY ASSURANCE

A. Pipe hangers and supports, fabrication, and installation practices shall be in accordance with MSS SP-89.

B. Where pre-engineered standard supports are used:
1. Contractor's professional engineer's seal is not required for design of support.
2. Contractor's professional engineer's seal is required for design of attachment of support to structure where details are not included as part of the standard support (e.g., weld requirements, bolts, anchor rods, expansion anchors, etc.)
3. Standard supports (including all components) shall be certified by manufacturer as acceptable for intended use on this project; see article "Pipe Support Design".

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Anvil International (Grinnell).

B. Carpenter & Patterson.

C. Lisega.

D. NPS Industries.

E. Piping Technology.

2.02 SYSTEM DESCRIPTION

A. Designing, furnishing, and installing supports for pipe and equipment furnished and/or installed by Contractor. Supports are defined as hangers, guides, rollers, slide supports, springs, anchors or other devices used to restrain movement and provide support to pipe or equipment. The following definitions establish Contractor design responsibilities in addition to definitions of information and materials in MSS SP90. Design categories of pipe supports are defined as follows:
1. Random supports: Defined as supports in which design of randomly selected representative supports establishes criteria for and selection of pipe support components for a group of similar supports. Supports may be field-fabricated from stock materials.
2. Semi-engineered supports: Defined as supports in which design of supports of similar configuration establishes specific components sizes that can be applied to a group of supports. Loading and movement design criteria shall encompass most stringent conditions of group. Bill of

materials for each support need not be established. Supports may be field fabricated from stock materials.

3. Completely-engineered supports: Defined as supports in which design for each individual support establishes specific component sizes. Details of each support shall be prepared containing all information specified in MSS SP-89, article "Pipe Hanger Assembly Drawings."

B. Designing, furnishing, and installing following related items:
   1. Supplementary support steel framing as required for support of pipe and equipment. Supplementary steel is defined as all steel necessary to support pipe and equipment in addition to existing steel and new steel sized on Drawings.
   2. Localized stiffening of support steel at pipe and equipment support connections.

2.03 PIPE AND EQUIPMENT SUPPORTS

A. Materials and manufacture: MSS SP-58 and ASME B31.1.

B. Supports and accessory items shall have manufacturer's standard shop-applied primer and standard finish coat, unless specified otherwise. Supports located within tunnels, vaults, and concrete trenches shall be galvanized.

C. Provide insulation protection shields of sufficient size and gage to prevent crushing of insulation at supports.

D. Supports for pipe designed to receive anti-sweat insulation shall be sized to allow insulation to be continuous through support. Provide insulation saddles sized to prevent insulation damage at each support.

2.04 SUPPLEMENTARY STEEL

A. Shapes: ASTM A6.

B. Material: ASTM A36 or A572, Grade 50.

C. Supplementary steel that induces torsion in support member not permitted.

D. Furnish supplementary steel with loose clip angles for attachment to structure. Bolt connections to existing columns or other existing steel insofar as practicable. Where connections are common connections, new bolts, washers, and nuts shall be supplied under this contract.

E. Supplementary steel shall conform to requirements of Section 05 50 00 and 09 90 00.

F. Welding: AWS D1.1. Refer to Section 01 43 30.

PART 3 EXECUTION

3.01 PIPING SUPPORTS

A. Fabrication and installation: MSS SP-89.

B. Locate top hanger attachment to allow support assembly to hang plumb in hot position at normal operating temperatures.

3.02 ADJUSTMENTS

A. After hydrostatic testing of pipe, adjust supports to appropriate cold settings.

B. Adjust supports to accommodate movements through entire range of operation. Monitor movements during startup and make final adjustments to assure proper support from cold to maximum temperature excursion.

C. Modify or replace supports or hangers that cannot be properly adjusted for full range of conditions.

END OF SECTION

1) C.H. Kim
2) D. Scanlon

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating and jacketing, including, but not limited to:
   1. Steam and condensate piping systems as necessary.

1.02 SUBMITTALS

A. Product Data: Schedule for insulating materials, including adhesives, fastening methods, and fitting materials, and intended use. Include catalog sheets indicating density, thermal characteristics, jacket, installation instructions.

1.03 QUALITY ASSURANCE

A. Products shall conform to NFPA 90A and 90B with special regard to fire hazard classification requirements of NFPA 255, including vapor barriers and adhesives.

B. Products shall possess a flame spread rating of not over 25 without evidence of continued progressive combustion and a smoke developed rating no higher than 50.

C. Materials shall be asbestos-free.

1.04 JOB CONDITIONS

A. Perform Work at ambient and equipment temperatures as recommended by adhesive manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver material to job site in original nonbroken factory packaging, labeled with manufacturer's density and thickness.

B. Protect insulation during storage and in erected state from damage. Remove and replace all damaged insulation and jacketing.

PART 2 PRODUCTS

2.01 ADHESIVES AND COATINGS

A. Compatible to mechanical surfaces, insulations, and jackets to which they are applied in both wet and dry state.

B. Fire-retardant, moisture-resistant, mildew-resistant and verminproof.

C. Suitable for temperature of systems to which they are applied.

D. Wire mesh reinforcing: 22-gage, 1" galvanized.

E. Glass fabric reinforcing: Childers Chilglass No. 1, or equal.

F. Insulation bonding adhesive to metal surfaces: Foster Products Corp. No. 85-20, or equal.

G. Insulating and finishing cement: P. K. Manufacturing "Quick Cote," Ryder "V-Cement," or equal.

H. Coating and vapor barrier treatment: Foster Products Corp. No. 30-35, or equal.

I. Elastomeric insulation to metal surfaces bonding adhesive: Armstrong 520, Rubatex R-373, or equal.

J. Lap adhesives: Foster Products Corp. No. 85-20, or equal.

K. Lagging adhesives: Foster Products Corp. No. 30-36, or equal.

L. PVC jacket lap and seam adhesive: "Zeston" Perma-weld adhesive by Manville.

2.02 JACKETS

A. Puncture resistance rating based on ASTM D781 test method.

B. Permeance ratings based on ASTM E96, Procedure A.

C. Type P-1 jacket:
1. Material: Heavy-duty, fire-retardant, glass fiber reinforced material with self-sealing lap.
2. Factory applied to insulation.
3. Finish: White vinyl or white kraft suitable for painting.
4. Bench puncture resistance: 50 units minimum.
5. Permeance: 0.02 perms, maximum.
6. Vapor barrier: 0.001" aluminum foil adhered to inner surface of jacket.
7. Manufacturer: Owens-Corning Type ASJ, or equal.

D. Type D-3 jacket:
1. Material: 0.016" thick 303 or 302 aluminum.
2. Jacket cut to size with 2" overlap. Banded 12" oc; seam calked with aluminum color silicon sealant.
3. Manufacturer: Pabsco Metals Corp., or equal.

E. Banding:
1. Over aluminum jacketing with insulation less than 13" diameter: Stainless steel, 1/2" x 0.020"; A. J. Gerrard & Co., No. 305-SS with No. 202-SS seals.
2. Over aluminum jacketing with insulation larger than 13", but less than 6'-0" in diameter: Stainless steel, 3/4" x 0.020"; A. J. Gerrard & Co., No. 311-SS with No. 204-SS seals.
3. Over aluminum jacketing with insulation larger than 6'-0" diameter: Stainless steel, 3/4" x 0.022" Expand-R-Strap"; A. J. Gerrard & Co.
4. Maximum spacing 12" oc.

2.03 INSULATION

A. Insulating materials: Fire-retardant, moisture- and mildew-resistant, and verminproof. Insulation shall be suitable to receive jackets, adhesives, and coatings as indicated.

B. Glass fiber insulation: Inert inorganic material, noncorrosive to mechanical surfaces, preformed into flexible or rigid board as indicated, suitable for temperatures to 450ºF.

C. Insulating cement: P. K. "Super Stick" or Ryder "G.P.," dry density 34 lb/cu ft, thermal conductivity 0.91 Btu-in/hr-sq ftºF at 400ºF, or other asbestos-free equal suitable for same temperature range as adjacent pipe or insulation.

D. Filling and finishing cement: P. K. "Quick Cote" or Ryder "MW," dry density 40 lb/cu ft, thermal conductivity 0.89 Btu-in/hr-sq ft-ºF at 400ºF.

E. Type BS-2 rigid fiberglass insulation:
1. Temperature rating: -20 to 850ºF only for pipe insulation.
2. Density: 3 lb/cu ft.
3. Conductivity: Not more than 0.22 Btu-in/hr-sq ft-ºF at 75ºF.

4. Manufacturer: Owens-Corning Fiberglas 25, or equal.

2.04 REMOVABLE INSULATION BLANKET

A. Application: Use for steam and condensate isolation valves with 2" overlap onto other insulation.

B. Inner and outer jackets and gussets: Teflon-coated fiberglass cloth.

C. Thickness: 2" fiberglass for condensate and 3” for steam.

D. Seams: Factory-sewn.

E. Attachment: Stainless steel "D" rings, Teflon-coated strap, and industrial strength Velcro.

F. Security cable: 1/8" stainless steel, attached with stainless steel grommet or "O" ring, minimum 3' long.

PART 3 EXECUTION

3.01 PREPARATION

A. Do not install covering before piping and equipment has been tested.

B. Verify surface is clean and dry prior to installation. Verify insulation is dry before and during application. Finish with systems at operating conditions.

3.02 INSTALLATION - GENERAL

A. Verify insulation is continuous through*inside walls. Pack around pipes and fireproof self-supporting insulation material, fully seal.

B. Insulate fittings, in-line specialties, and valves. Do not insulate unions, flanges necessary for maintenance of equipment, strainers, flexible connections, and expansion joints. Terminate insulation neatly with plastic material troweled on bevel.

C. Finish insulation neatly at hangers, supports, and other protrusions.

D. Locate insulation or cover seams in least visible locations.

E. Insulating materials shall be installed with necessary joints and terminations, to permit easy access and removal of equipment sections where inspection or frequent service or repair is required, and to allow for expansion.

F. Following systems shall be insulated for complete vapor barrier protection:
1. Cold potable water piping.
2. Chilled water piping, valves, and accessories.

3.03 INSTALLATION - PIPING, VALVE, AND FITTING INSULATION

A. Apply insulation to piping with bonding adhesive, with butt joints and longitudinal seams closed tightly.

B. Laps on factory-applied jackets shall be 1-1/2" minimum width firmly cemented with lap adhesive, or be pressure sealing type lap.

C. Cover joints with factory furnished tape (2" minimum width) to match jacket, firmly cemented with lap adhesive.

D. Install factory-molded insulation for fittings as indicated for valve insulation.

E. Taper terminations of pipe insulation ends.

F. Where thermal pipe shields are used at hanger locations, insulation shall extend to thermal shield. Where vapor barrier is required, Contractor shall be responsible for continuity of vapor barrier at thermal shield.

G. Where thermal pipe shields are not used at hangers for piping with vapor barrier, insulation shall be Type BS-3 to eliminate compression. Type BS-3 insulation shall extend for twice length of metal shield.

H. Insulation at anchors, secured directly to pipe surface, shall extend up anchor for distance of 4 times insulation thickness. Assure vapor seal at termination of vapor barrier.

3.04 INSULATION THICKNESS SCHEDULE

A. Furnish and install insulation and jackets on piping, valves, and piping accessories where required. Thickness shall be in accordance with Mechanical Standard M-1008, or as noted below.

B. Piping insulation application schedule: On steam and condensate where insulation shields are installed use BS-3 insulation.

Service	Insulation	Jacket	Thickness
Steam (360ºF)	BS-2	D-3	

END OF SECTION

1) C. Kim
2) D. Scanlon

MINIMUM NOMINAL INSULATION THICKNESS (INCHES) (NOTE 2)								
FLUID TEMPERATURE RANGES	**39°F & BELOW**	**40°F TO 60°F**	**61°F TO 104°F**	**105°F TO 140°F**	**141°F TO 200°F**	**201°F TO 250°F**	**251°F TO 350°F**	**351°F TO 400°F**
NOMINAL PIPE SIZE								
LESS THAN 1	0.5	0.5	0.5	0.5	1.0	1.5	1.5	2.5
1 - 1.25	1.0	0.5	0.5	0.5	1.0	1.5	2.5	3.0
1.5 - 3	1.0	1.0	1.0	1.0	1.0	2.0	3.0	3.0
4 - 6	1.0	1.0	1.0	1.0	1.5	2.0	3.0	4.0
8 & LARGER	1.5	1.0	1.0	1.0	1.5	2.0	3.0	4.0

NOTES:

1. INSULATION THICKNESSES ARE BASED ON ANSI/ASHRAE/IESNA STANDARD 90.1.
2. ON OUTDOOR EQUIPMENT AND PIPING, THE INSULATING THICKNESS SHOWN ABOVE SHALL BE INCREASED 0.5".
3. INSULATION THICKNESSES SHOWN ARE MINIMUM THICKNESSES AND DO NOT INCLUDE FINISHING OR SEALING COATS.
4. THE MINIMUM INSULATION THICKNESSES ARE BASED ON INSULATION WITHIN THE FOLLOWING CONDUCTIVITY RANGES.

CONDUCTIVITY MEAN RATING TEMPERATURE	100°F	125°F	150°F	200°F	250°F
CONDUCTIVITY (BTU-IN/HR FT-°F)	0.22 - 0.28	0.25 - 0.29	0.27 - 0.30	0.29 - 0.32	0.32 - 0.34

FOR INSULATION WITH CONDUCTIVITY VALUES OUTSIDE THE GIVEN RANGES, THE MINIMUM INSULATION THICKNESS SHALL BE ADJUSTED BASED ON THE FOLLOWING FORMULA.

$$T = r \cdot \left[\left(1 + \frac{t}{r} \right)^{\frac{K}{k}} - 1 \right]$$

WHERE:

T = MINIMUM INSULATION THICKNESS IN INCHES.
r = ACTUAL OUTSIDE PIPE RADIUS IN INCHES
t = MINIMUM THICKNESS FROM ABOVE TABLE.
K= CONDUCTIVITY OF ALTERNATE MATERIAL AT MEAN RATING TEMPERATURE INDICATED FOR THE APPLICABLE FLUID TEMPERATURE IN BTU-IN/HR FT-°F
k = THE UPPER VALUE OF THE CONDUCTIVITY RANGE LISTED IN THE ABOVE TABLE FOR THE APPLICABLE FLUID TEMPERATURE.

REVISIONS	DES	CHK	APP	DATE
3- GENERAL	TJL	JJB	MAE	7/13/2007
2- REV HEADING	JBP	SJS	SJS	10/6/1995
1- REVS & CADD	TRK	SJS	SJS	9/16/1994

Stanley Consultants INC.

MECHANICAL STANDARD

INSULATION

PIPING AND EQUIPMENT

INSULATION THICKNESS

SCALE: NONE

NO. **M-1008**

REV **3**