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ASSIGNMENT PAGE

RESOURCE CONSERVATION AND RECOVERY ACT
HAZARDOUS WASTE MANAGEMENT PERMIT
DOCUMENT

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APPENDIX D

SPECIFICATIONS FOR C-733 INTERIM HAZARDOUS MATERIALS STORAGE SHELTER

(SEE ATTACHMENT II, APPENDIX C FOR REFERENCED DRAWINGS)

SPECIFICATION
FOR
C-733 INTERIM HAZARDOUS MATERIALS STORAGE SHELTER (WBS-5)

OF

PROJECT NO. 80-UE-2 CONTROL OF WATER POLLUTION
GASEOUS DIFFUSION PLANTS

LOCATED AT THE
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH, KENTUCKY

UNITED STATES DEPARTMENT OF ENERGY
INVITATION NUMBER 8072
SUBCONTRACT SPECIFICATION NUMBER 15757

PREPARED BY

RUST INTERNATIONAL CORPORATION
BIRMINGHAM, ALABAMA

CERTIFIED FOR CONSTRUCTION

Submitted by Rust International Corporation

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3.130 - EARTHWORK - GENERAL SECTION

1. GENERAL:

This specification covers clearing, stripping, excavation, trench excavation, fill, backfill, and grading.

This specification is composed of a general section supplemented by sections which provide detail specifications for earthwork for structures, grounds and utilities. Only those specification sections applicable to the work are included.

2. DEFINITIONS:

Earth excavation consists of the removal of material to the lines, elevations and dimensions shown on the drawings and specified herein and disposition of all materials encountered in the grading and excavation work, except that classified as rock.

Unauthorized excavation consists of excavation not required by the specifications or drawings or not authorized in writing by the Contractor.

Fill consists af earth or other material as specified, used to bring sad existing grade to a specified grade.

Backfill consists of earth, crushed stone or other material as specified, used *to* replace material excavated during construction.

Subgrade is the compacted fill or backfill of embankments or the undisturbed soil of cut sections which supports the base course aad wearing surface.

Undercutting consists of removal of soft or undersirable materials encountered in :he undisturbed subgrade below grades specified for excavation.

Spot Subgrade Reinforcement consists or' placing approved fill or backfill in areas where authorized undercutting had been performed.

3. MATERIALS:

Materials suitable for use as fill and backfill shall be as follows:

Earth shall be soil of such gradation and moisture content that it will compact to specified density and remain stable under the final conditions of use. Earth shall be free of boulders and organic matter and may be earth excavation or borrow.

Sand shall be natural sand or crushed stone passing a No. 10 sieve.

Crushed stone shall be an aggregate mixture conforming to AASHTO Standard Specification M-147, latest revision, gradation C.

4. PROTECTION OF EXISTING FACILITIES:

Existing utility lines and structures in the work area and existing roadway surfaces, seeded areas and other features adjacent to the work area shall be protected by the Subcontractor during prosecution of the work. Damages occuring shall be repaired by the Subcontractor at his expense.

5. DISPOSAL AREA

The disposal area will be designated on drawing C5E15757A.

6. CLEARING:

The area within the limits of the work shall be cleared of all trees, bushes, stumps and other organic matter and obstructions.

7. STRIPPING:

The area within the limits of the work shall be stripped of topsoil or sod. Topsoil or sod suitable for reuse shall be stored in stockpiles at nearby locations *to* be designated by the Contractor. Topsoil or sod not suitable for reuse shall be disposed of in an area designated by the Contractor.

a. EXCAVATION:

Excavation shall be carried through whatever material is encountered to depths shown on the drawings. Excavated material not required or not suitable for fill or backfill shall be removed from the site to an approved disposal uca. Unauthorized excavation shall be back filled at the Subcontractor's expense with compacted earth, sand, crushed stone or concrete, as directed by the Contractor.

The Subcontractor shall maintain excavations free from water aaa disposed of the excess water by methods approved by the Contractor. Spring or seepage water encountered in the excavation shall be reported to the Contractor.

When additional material is required for fill, backfill, or topsoil, it shall be provided by the Subcontractor.

Existing concrete slabs or foundations and asphaltic concrete road surfacing shall be removed prior to placing fill, backfill, or topsoil. Material moved shall be disposed of in designated disposal area.

Newly graded areas shall be maintained by the Subcontractor until final acceptance by the Contractor. Areas showing settlement or washes shall be restored to specified grades by the Subcontractor at no additional cost *to* the Contractor prior *to* final acceptance.

3.131 - EARTHWORK FOR YARDS AND GROUNDS

1. METHODS AND WORKMANSHIP:

Preparation of Cuts: Soft and yielding material that will not compact shall be removed and disposed of in an area designated by the Contractor. Removal of soft materials extending below the specified grades shall be classified as "Undercutting". The area extending below grade shall be replaced with compacted earth backfill and shall be classified as "Spot Subgrade Reinforcement".

Preparation for Fill: Areas upon which fill is to be placed having greater than 3 to 1 slope shall be stepped before placement of fill materials. Surfaces other than rock upon which fill is to be placed, including earth, gravel and soft shale, shall be scarified to a depth of 6 inches so that fill material will bond with existing surfaces.

Fill: Materials for fill shall be free from clods of earth, boulders, broken rock or concrete exceeding 3 inches in Largest dimension, or organic or vegetable matter, rubbish and other unsuitable material.

Fill material shall be spread in layers that will not exceed 6 inches in thickness after compaction. If the moisture content of excavated material or borrow material is higher than optimum, the Subcontractor shall take whatever measures are necessary to reduce moisture content to a point within the optimum range. This may be achieved by making shallow cuts from successive layers and allowing time for drying prior to compaction; or by the use of harrowing, disking and natural evaporation. If moisture content of the fill material is below optimum, water shall be added by sprinkling. No fill material shall be placed when weather conditions, conditions of subgrade or condition of the fill material precludes obtaining the specified compaction. Frozen material shall not be used for fill and fill material shall not be placed on or against frozen surfaces.

Compaction shall be obtained by the use of sheepsfoot tamping rollers, pneumatic tired rollers or vibratory rollers operated at low speed, Compaction at locations not accessible to mechanical equipment shall be obtained by the use of hand maneuvered power tamping tools.

Crushed stone shall be spread in layers that will not exceed 3 inches after compaction. The proper amount of moisture shall be present in crushed stone to obtain the maximum compaction using three-wheel, tandem or vibrating rollers. Compaction at locations not accessible to mechanical equipment shall be by use of hand maneuvered power compacting tools.

Fill shall be compacted to a minimum of 90% of maximum density at optimum moisture content which shall be determined in accordance with the provisions of ASTM D-1557, Modified Proctor, unless otherwise noted on the drawings.

The required compaction shall be verified by in-place density tests using any one of the following provisions for "Methods of Testing, AASHTO T-191, T-204, T-205, T-215, T-233, or T-238". Maximum density determinations and in-place density tests will be performed by the Contractor.

Backfill: Backfill shall be spread and compacted in the same manner as fill.

Grading: The top of the subgrade shall be a uniformly smooth grade surface without high or low points and shall not be more than 0.10 feet above or below specified grades. Thinlayers of added material shall be bound tight *to* the material in place by scarifying and recompacting.

Cut and fill slopes shall. be not steeper than 1.0 vertical on 3.0 horizontal unless otherwise specified and shall be finished to a smooth compact surface, or scarified if topsoil is to be added.

Placement of Topsoil: Newly graded areas not specified for other surface treatments shall be finished with a uniform layer of topsoil *4* inches thick unless otherwise specified. Topsoil shall be from stockpiled material or approved borrow and shall be bonded to subsoil by rolling with a light roller or by tamping. The surface shall be hand raked.

Seeding and Mulching: Newly topsoiled areas shall receive an application of agricultural grade limestone, applied at the race *of* not less than 75 lb. per 1000 square feet and commercial grade 6-12-12 fertilizer applied at the rate of not less than 20 lb. per 1000 square feet.

Seeding shall be with 100% Kentucky 31 fescue seed applied at the rate of not less than 3 lbs. per 1000 square feet. Seeding shall be performed only when soil is in a tillable and workable condition. Soil shall be loosened and pulverized to a depth of not less than *4* inches. Work fertilizer into the soil for a depth of approximately 3 inches. Out of season planting shall be permitted only with written approval of the Contractor.

Immediately following seeding, seeded areas shall be compacted by an approved roller, followed by a uniform application of mulch applied at a rate of 100 pounds per 1000 square feet. Mulch shall be straw or other approved fiberous material.

3.132 - EARTHWORK FOR STRUCTURES

1. METHODS AND WORKMANSHIP:

Excavation: Excavation tor foundations shall be carried to elevations specified. If satisfactory load-bearing soil is not reached at drpth specified, excavation shall be carried deeper as directed in writing by the Contractor. When freezing temperatures arc expcctrd, no excavation shall be made to the full drpth specified unless either the foundation can be poured immadiately after excavation has been completed or bottom of the excavation is adequately protected from frost.

The limits of excavation shall be that required to provide a minimum of a 2 foot working space around the structure, except where authorized by the Contractor. to deposit concrete directly against excavated surfaces. In areas where the excavated walls arc unstable walls shall be shored or sloped in accordance with OSHA Safety Regulations, latest edition.

Excavation in the vicinity of existing buildings and structures shall not be carried below the existing foundations until underpinning and shoring have been installed. Existing structures, piping *or* foundations which *are* to be incorporated into the final work shall be protected or replaced by the Subcontractor.

Excavation below elevations or beyond other required limits as specified or as approved in writing by the Cootractor shall be restored at the Subcontractor's expense as follows: if under slabs, the excavation shall be restored in accordance with the procedure specified for backfill; if under footings, the footing shall be increased in depth. Backfill under concrete footings shall not be permitted, unless otherwise specified.

Fill: The entire area of the original ground to be occupied by fill shall be scarified and rolled thoroughly with a sheepsfoot or tamping roller prior to placing new fill.

Earth fill shall be spread in Layers that will not exceed 6 inches in thickness after compaction. Water shall be added or excess =isture shall ba removed if required to obtain desired compaction. Compaction shall be obtained by use of sheepsfoot tamping rollers or pneumatic tired rollers where possible, or by use of hand-maneuvered power tamping tools.

Crushed stone or sand fill shall be spread in Layers that will not exceed 3 inches after compaction. The proper amount of moisture shall be present in the fill *to* obtain maximum compaction using three-wheel or tandem rollers where possible, or by use of hand-maneuvered power compacting tools-

Fill, unless otherwise specified on the drawings shall be compacted to a minimum of 90% of maximum density at optimum moisture content, as determined in accordance with the provisions of ASTM D-1557, Modified Proctor. The required compaction shall be verified by in-place density tests using any one of the following provisions for "Methods of Testing, AASHTO T-191, T-205, T-214, T-233 or T-238." Maximum density determinations and in-place density tests will be performed by the Contractor.

Backfill: After the completion of construction below grade, forms shall be removed and the excavation shall be cleaned of all waste material and debris. The excavation shall be backfilled as soon as, in the opinion of the Contractor, work can be done without injury to the structure. When backfill is placed on each side of piers, walls and free-standing structures, it shall be deposited and compacted evenly on all sides at the same time. Proper provisions shall be made to prevent wedging action against walls or structures. If directed by the Contractor, slopes bounding or within areas to be backfilled shall be stepped as necessary *to* prevent wedging action.

Backfill shall be spread and compacted in the *same* manner as fill.

Grading: *The* Subcontractor shall control grading in the vicinity of excavations to prevent water from running into excavated areas.

All areas shall be finished to a smooch compact surface at specified grades. Areas to *receive* topsoil shall be scarified immediately prior to placement of topsoil.

Placement of Topsoil.: Placement of topsoil shall be as specified in 3.131 - EARTHWORK FOB YARDS AND GROUNDS.

Seeding and Mulching: Seeding and mulching shall be as specified in 3.i31 - EARTHWORK FOR YARDS AND GROUNDS.

3.133 - EARTHWORK FOR UTILITIES

1. METHODS AND WORKMANSHIP:

Trench Excavation: Trenches shall be a width necessary for proper installation of pipe, duct run or other utility to be accommodated. Clearance between pipe and the trench wall, except where indicated otherwise on the drawings or specifications, shall be 6 inches for trenches less than 2 frat deep and 12 inches for trenches more than 2 feet deep. Trench walls shall be maintaned at the width specified from trench bottom to top of the pipe. The bottom of trench shall be accurately graded to provide uniform bearing and support for the utility either on undisturbed soil or properly compacted backfill throughout its entire length except where it is necessary to excavate for bell or coupling holes and for proper sealing of pipe joints. Bell and coupling holes shall be excavated after the trench bottom has been fine graded. Soft, spongy, or otherwise unstable material encountered at the elevation of the pipe, which will not provide a firm foundation for the pipe, shall be removed and replaced ar directed in writing by.the Contractor with suitable selected materials and compacted. Removal of this undesirable material shall be considered "Undercutting" and replacement with suitable material shall be considered "Spot Subgrade Reinforcement."

Shoring: Trench and structure excavations shall be in accordance with the Special Conditions.

Backfilling: Backfill of utility trenches shall be done promptly after all required tests on the utilities have been approved by the Contractor.

Backfill material shall be earth, unless otherwise specified in this specification or on the drawings. Selected fine graded earth shall. be used to backfill around the pipe and to a depth of 12 inches above the pipe. Earth shill be deposited in 6-inch thick layers and shall be carefully rammed or tamped until the utility has a cover of not less thin 1 foot. The remainder of the backfill shall be placed in horizontal layers 12 inches in depth and compacted by hand-maneuvered power tamping tool:! to a density equal to that of the surrounding earth. In areas where paving, top soiling or sodding is to be dona, stop the fill or backfill the required distance below finish grade *to* permit installation of these items. Backfill not under structures or roadways shall be brought *to* a suitable elevation above grade to provide for anticipated settlement.

Fill and backfill, unless otherwise specified on the drawings, shall be compacted to a minimum of 90% of maximum dry density at optimum moisture content as determined in accordance with the provisions of ASTM D-1557. To insure that the required compaction has been obtained, in-place density tests shall be in accordance with any one

of the following provisions for "Methods of Testing, AASHTO T-191, T-204, T-205, T-214, T-233 or T-238." Maximum density determinations and in-place density tests will be performed by the Contractor.

Repair of Surfaces: Where pavements have been cut for utility line trenches, the asphaltic concrete surfacing shall be cut back 12 inches from each side of the trench wall. The utility trench shall be backfilled for its entire depth with stabilized aggregate base to an elevation 1-1/2 inches below the finished paved surface, and 1-1/2 inches of hot asphaltic concrete wearing course shall be installed by the Subcontractor.

Topsoil shall be placed 4 inches thick over backfill in grassed areas and shall be seeded. Placement of topsoil and seeding shall be as specified in 3.131, EARTHWORK FOR YARDS *AND* GROUNDS.

3.610 PERIMETER FENCE AND GATES

1. GENERAL

This specification covers furnishing, fabricating, and erecting of chain link fence with gates.

2. CODES AND STANDARDS

Codes and standards which are called for or referred to herein are hereby made a part of these specifications to the extent indicted by the reference thereto.

A. American Society for Testing and Materials (ASTM) Standards

A 53-79	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A 90-09	Tests for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
A 123-78	Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
A 143-74	Recommended Practice for Safeguarding Against Embrittlement of Hot Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
A 153-78	Specification for Zinc Coating (Hot-Drip) on Iron and Steel Hardware
A 392—74	Specification for Zinc-Coating Steel Chain-Link Fence Fabric
A 570-79	Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
B 6-77	Specification for Zinc Metal (Slab Zinc)
C 150-80	Specification for Portland Cement
E 8-79a	Tension Testing of Metallic Materials
F 552-78	Definition of Terms Relating to Chain Link Fencing

B. Chain Link Fence Manufacturer's Institute

Product Manual, 2.13(d) CHL, 1981

3. WORKMANSHIP

All work on this project shall be in accordance vith the Chain Link Fence Manufacturer's Institute Product Manual 2.13(d) CHL, 1981.

4. SHOP DRAWINGS

Shop drawings shall be submitted for approval in accordance with SPECIAL CONDITIONS paragraph: SUBCONTRACTOR'S SUBMITTALS.

The Subcontractor shall submit completed and checked shop drawings for approval. The approval of shop drawings will be for materials and fabrication of the fence, including gates and associated accessories, and shall not relieve the Subcontractor of the responsibility for errors, omissions, or the accuracy of his own dimensions.

5. MATERIALS

A. General

1) Zinc (galvanized) coatings on products fabricated from rolled, pressed, or forged steel shapes, plates, bars, or strips shall be Lo accordance vith ASTM A 123.

2) Zinc (galvanized) coatings on steel or iron fittings shall be in accordance with ASTM A 153.

B. Chain Link Fabric

Chain link fabric shall be constructed of zinc-coated steel wire 7' high, with both top and bottom selvages twisted and shall be woven from No, 9 gauge wire in a 2" diamond shaped mesh. Tension strength of wire shall not be less than 80,000 lbs per square inch, and shall be in accordance vith ASTM E 8. Zinc coated fabric shall be galvanized after weaving per ASTM A 392, Class 2 coating, co give a minimum of 20 ounces of zinc per square foot of wire surface, evenly distributed over the entire fabric. Certification of compliance tags shall be attached to and supplied vith each roll of fabric delivered to the work area for use on this subcontract.

C. Tension Wire

Tension wire shall be zinc-coated 7-gauge spring coil steel wire. Tensile strength of coated wire shall be not less than 80,000 lbs *per* square inch. Zinc coating shall have a minimum of 0.80 ounces of zinc per square foot of surface area.

D. Line Posts

Line posts shall be 2.25" x 1.7" galvanized steel H column, 3.26 lbs per foot, or 2.375" O.D. galvanized steel pipe, weight 3.65 lbs per foot.

E. Terminal Posts

All end, corner, and pull posts shall be 2.875" (2-7/8) O.D., galvanized Schedule 40 pipe, 5.79 lb per foot.

F. Gate Ports

Gate posts shall be 2.875" (2-7/8") O.D., galvanized Schedule 40 pipe, 5.79 lbs per foot.

G. Post Bracing Assembly

Brace rail shall be 1.66" O.D., galvanized Schedule 40 pipe, with minimum bending strength of. 202 lbs. Brace assembly shall include a 3/8" diameter galvanized steel truss rod and adjustable take-up. All corner, end, and end panels of sloping runs shall be braced. Pull posts shall be braced into two directions. Corner posts shall be braced in the direction of each line of fence. Brace rails shall be securely fastened to all posts with socket type brace sad connections and brace bands. Connections shall be watertight.

He Truss Rods

Truss rods shall be 3/8" diameter, galvanized steel rod.

I. Tension Bars

Tension *bats* shall be one piece of galvanized steel with lengths equal to full height of the fabric and with a minimum cross section of 1/4" x 3/4". Provide one tension bar for each gate and end post and two for tach comer and pull *post.* The tension bars shall be passed through the end loops of the fabric.

J. Tension Bar Bands

Tension bar bands shall be heavy-pressed, galvanized steel, spaced not over 14" *o.c.* to secure tension bars to and corner, pull, and gate posts.

K. Base Plates shall be 5"x5"x3/8" galvanized steel with four 5/8" diameter holes.

L. Fabric Ties

For tying fabric to H-Section line posts, use 6-gauge steel wire clips space 24" o.c., for other posts use 9-gauge steel wire clips spaced 24" o.c. For securing fabric to tension wire, use 9-gauge hog rings spaced 24" o.c. Bend ends of wire ties to minimize hazard to persons or clothing.

M. Post Tops

Galvanized pressed steel, or galvanized malleable iron, designed as a watertight closure cap shall be used for all tubular posts.

N. Miscellanous Fittings All miscellanous fittings shall be galvanized steel or galvanized malleable iron.

P. Gates

1) Gate frames and brace members shall be the size shown on the design drawing and shall be galvanized Schedule 40 pipe. Gates shall be designed with adequate vertical members and cross bracing to provide frame rigidity with sag or twist and to ensure proper gate operation. The end members of gate frames shall be equipped with a post cap. Clearance between frames and posts shall be 2" maximum; clearance between frames shall be 3" maximum.

2) Fabric shall be the same as specified for fence. Install fabric with stretcher bars at vertical edges and tie wires at top and bottom edger. Attach stretcher ban to gate frame with bar bands at not more than 15" o.c. Wire ties at top and bottom shall not be more than 12" o.c. Attach hardware with rivets or by other means which will provide security against removal or breakage.

3) Provide the following hardware and accessories for each swing gate, finish to be heavy galvanized:

a) Hinges shall be pressed steel or malleable iron, nonlift-off type, offset to permit 180' gate opening. Provide one pair of hinges per leaf.

b) Double swing gates shall have a forked latching device with an integral padlock eye designed to permit operation from either side of the gate. Each double swing gate latching assembly shall also have a center plunger rod, rod guides, and a center stop set into concrete.

c) Provide a keeper set into concrete for each swinging gate which automatically engages the gate leaf and holds it in the open position until manually released.

6. ERECTION

A. Posts

Space posts as shown on the drawings and weld to base plates. Base plates shall be secured to concrete curb with 1/2" diameter anchor bolts. Gate posts shall be secured to steel columns with "U-shaped" galvanized steel clamps with 1/4" bolts. All exposed surfaces resulting from field cuts, welding and other erection activities shall receive one (1) coat of "Zinkote" paint as manufactured by the Amercon Corporation or "Galvanox" as manufactured by the Subox Company.

B. Brace Assemblies

Install bracer so posts are plumb when diagonal rod is under proper tension.

C. Tension Wire

Install tension wire approximately 3" above bottom and below top line of fabric before installing and stretching fabric. Tension wire shall be pulled taut and secured at ends to posts in a satisfactory manner, such that the wire remains in tension after being secured.

D. Fabric

Fabric shall be erected with standard chain link stretching equipment, pulled taut and attached to posts, rails, and tension wires. Bottom of fabric shall be a maximum of 2" above the concrete slab. Fabric shall be installed on the fence side as shown on the design drawings and anchored so the fabric remains in tension after the pulling force is released.

E. Stretcher Bars

Stretcher bars shall be threaded through fabric and secured to posts with metal bands spaced not over 14" o.c.

F. Gates

Gates shall be installed plumb, level, and secure for full opening without interference. Ground-set items shall be set in concrete for anchorage in accordance with the design drawings or shop approved drawings. Hardware shall be adjusted and greased for smooth operation.

7. FINISHING AND CLEANUP

The finished fence shall be true to line, taut, and solid at all points. All surplus excavated material and ocher debris resulting from construction shall be disposed of and the fence line left in an orderly appearance.

SECTION 4

ARCHITECTURAL

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4.310 - CONCRETE FOR STRUCTURAL USE

1. GENERAL:

This section of the specifications relates to the furnishing and installation of all poured-in-place concrete and related vork as shown on the drawings and as specified.

2. CODES AND STANDARDS:

Codes and standards which are called for or referred to herein ate hereby made a part of this specification to the extent indicated by the reference thereto. In the event of discrepancies between this specification and the coder and standards, this specification shall govern.

A. American Concrete Institute (ACI) Standards:

ACI 211.1-77	Recommended Practice for Selecting Proportions for Normal Weight Concrete
ACI 302-69	Recommended Practice for Concrete Floor and Slab Construction
ACI 304-75	Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
ACI 305-77	Recommended Practice for Hot Weather Concreting
ACI 306-78	Recommended Practice for Cold Weather Concreting
ACI 315-74	Manual of Standard Practice for Detailing Reinforcing Concrete Structures
ACI 318-77	Building Code Requirements for Reinforced Concrete
ACI 347-78	Recommended Practice for Concrete Formwork

B. American Society for Testing and Materials (ASTM) Standards:

ASTM A185-79	Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement

ASTM A306-64	Standard Specification for Carbon Steel-Bars Subject to Mechanical Property Requirements
ASTM A615-78	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C-31-69	Standard Method of Making and Curing Compressive and Flexural Strength Test Specimens in the Field
ASTM C-33-78	Standard Specification for Concrete Aggregates
ASTM C-39-72	Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens
ASTM C-94-78	Standard Specification for Ready-Mixed Concrete
ASTM C-143-78	Standard Method of Test for Slump of Portland Cement Concrete
ASTM C-150-78	Standard Specification for Portland Cement
ASTM C-231-78	Tentative Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C-260-77	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C-309-74	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C-494-79	Admixtures
ASTM D-2103-67	Standard Specification for Polyethylene Film and Sheeting

C. Federal Specifications (FS)

SS-S-164	Sealing Compound; Hot Poured Type, for Joints in Concrete
SS-S-00195	Sealing Compound, Two-Component, Elastomeric, Polymer Type, Cold Applied, Concrete Paving Joints
CCC-C-467	Cloth, Burlap, Jute, (or Kenaf)

U.S. Department of Commerce, National Bureau of Standards (NBS) Product Standards

PS-1	Softwood Plywood, Construction and Industrial

American Association or' State Highway Officials (WHO) Standard:

M 73 Cotton Mats for Curing Concrete

Kentucky Department of Highways (KDH):

"Standard Specifications for Road and Bridge Construction"

3. MATERIALS:

A. General. Except as otherwise specified herein, all materials shall conform to ACI 318 and ACI 211.1.

B. Aggregates. Aggregates shall conform to ASTM C 33 and have the following physical properties:

1) Coarse aggregate shall be gravel or crushed stone, well graded from fine to coarse within the prescribed limits. Maximum nominal coarse aggregate shall be 1 inch; except for slabs on grade and mass or foundation concrete, the sizes shall be 1-1/2 inch.

2) Fine aggregate shall be sand, clean and sharp.

C. Reinforcement.

1) Reinforcing bars shall conform to ASTM A 615 Grade *60* unless otherwise indicated on drawings.

2) Plain smooth rods or dowels shall conform to ASTM A 306, with minimum yield of 40,000 psi.

3) Provide metal accessories, including all spacers, chairs, ties, and other devices necessary for properly placing, spacing, and supporting reinforcement in place.

4) Wire mesh shall be welded wire fabric conforming to ASTM A185.

D. Premolded Expansion Joint. Premolded expansion joint filler strips shall conform to ASTM D1751 or D1752, or shall be a resin-impregnated fiberboard conforming to the physical requirements or' ASTM D 1752, 1/2 inch thick unless otherwise indicated.

E. Joint Sealer. Joint sealer shall be the hot-pourtd elastic type conforming to ASTM D1190 or FS SS-S-164, or the cold-application type conforming to ASTM D1850 or FS SS-S-00195.

F. Cover Materials for Curing.

1) Burlap cloth shall conform to the requirements of FS CCC-C 467.

2) Cotton mats shall conform to the requirements of AASHO 3-73.

3) Liquid membrane-forming compounds shall conform to the requirements of ASTM C-309.

G. Vapor Barrier. Vapor barrier shall be 6 mil polyethylene conforming to ASTM D2103.

H. Water Stop. Water stop shall be 24 oz copper.

4. ADMIXTURES:

A, The use of admixtures in the concrete shall be restricted to the specific applications outlined hereafter.

B. All concrete shall be air-entrained. Air content by volume shall be 5% to 7% as determined in conformance with ASTM C-231. Air entraining agents shall conform to ASTM C260. The agent and the cement proposed for use shall be selected well in advance of concrete placing, and the Subcontractor shall provide satisfactory facilities for ready procurement of adequate test samples. Air entrainment shall be produced by either adding an air-entraining agent at the mixer or by use of mill-produced are-entraining cement. When necessary to increase the air content to within the specified range, additional air-entraining admixtures compatible with that already in the mixture shall be added at the mixer. Air content shall be based on measurements in concrete mixtures at point of discharge at the job site.

5. DESIGN OF CONCRETE MIXES.

A. General. The design of the coacrete mix or mixes shall be in accordance with ACI 211.1 to attain the properties of strength, slump, entrained air and rate of hardening in conformance with rhe following requirements. Ready-mixed concrete shall be manufactured and delivered fa accordance with the requirements of ASTM c94.

B. Strength. All concrete, reinforced or unreinforced, shall have a minimum compressive strength of 1950 psi at 7 days and 3000 psi at 28 days, unless otherwise indicated on the drawings or specified herein. Concrete fill, 2000 psi at 28 Gays.

C. Slump. Concrete mixes shall be designed for the following slump:

	Slump in Inches	
	Max.	Min.
For all Concrete Work:	4	2

6. COLD WEATHER REQUIREMENTS:

When the temperature is below 40°F, or is likely to fall below 40°F before placing the concrete, and/or during the 24 hour period after placing, the Subcontractor shall strictly adhere to the recommendations of ACI 306.

7. HOT WEATHER REQUIREMENTS:

Concrete placed during hot weather shall have a temperature of not more than 90°F. The use of hot cement shall be avoided insofar as practicable, and cold mixing water shall be used fa the mix. The Subcontractor shill strictly adhere *to* the recommendations of ACI 305.

8. FORMWORK:

A. General. Formwork shall be in accordance with ACI 347.

B. Materials. Forms shall be of fiber, wood, metal, structural hardboard or other suitable material that will produce the required surface finish.

1) Concrete surfaces to be exposed or coated: Form surfaces that will be in contact with concrete shall be of material that is nonreactive with concrete, and that will produce concrete surfaces equivalent in smoothness and appearance to that produced by new plywood panels conforming to PS 1, exterior type, Grade B-B, concrete form.

2) Concrete surfaces to be unexposed: Form surfaces that will be in contact with concrete shall be of No. 2 common or better lumber, or other material producing equivalent finish.

C. Chamfer Strips. Chamfer strips not less than 3/4 inch in size shall be used at external cotters chat will be exposed.

D. Removal of Forms. Forms shall be removed in a manner which ensures complete safety of the structure.

9. JOLTS:

A. Construction Joints. Unless indicated or specified otherwise, construction joints shall be made and located so as to least impair the strength of the structure and shall be subject to approval of the Contractor. The surface of the concrete shall be roughened, thoroughly wetted and slushed with a coat of neat cement grout immediately before placing of new concrete.

B. Expansion Joints. Provide premolded expansion joint where concrete slab on grade abuts vertical surfaces, installed full depth of slab. Where joint sealer is indicated, joint filler strip shall be held down not less than *3/4* inches From top of slab to receive sealer.

10. REINFORCEMENT:

Reinforcement shall be placed in the position indicated on the drawings, securely fastened and supported to prevent displacement before and after placement of concrete. Cleaning, bending and placing of reinforcement shall be done in accordance with the requirements of ACI 318.

11. CONVEYING:

Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss or' the materials. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such *size* and design so as to insure a practically continuous flow of concrete at the delivery end without separation of materials. All of this shall be done in accordance with ACI 304.

12. PLACING AND FINISHING CONCRETE:

A. General. Placing of concrete shall be done in accordance with the requirements or' ACI 304. Concrete shall not be allowed to drop freely more than 5 fret in unexposed work, nor more than 3 feet in exposed work; where greater drops are requited, a tremie or other approved means shall be employed. Concrete shall be placed in the forms, as nearly as practicable in the final position, in uniform, approximately horizontal, layers not over 12 inches deep.

B. Earth-Foundation Placement. Concrete footings shall be placed upon undisturbed surfaces prepared in accordance with Paragraph 12A. The surfaces shall be clean and free from frost, ice, mud, and water. Concrete piers may be placed directly on impervious surfaces that are thoroughly moistened but not muddy at the time the concrete is placed.

C. Vapor Barrier Installation. Vapor barrier shall be installed under all slabs on grade. Under the building slab, the vapor barrier shall be lapped down the inside or' the grade beam 8 inches and then folded over onto the granular base. Lap all. joints 6 inches. Caution shall be exercised during placement of reinforcing and concrete to avoid tearing the vapor barrier.

D. Placing Concrete Through Reinforcement. Where congestion of the steel or other conditions will make placing or compaction of concrete difficult, a layer of mortar shall be first deposited in the forms to a depth of approximately 1 inch. Mortar shall consist of equal parts of Portland Cement and fine aggregate by weight and not more than 6 gallons of vater per sack of cement.

E. Compaction. Immediately after placing, each layer of structural concrete shall be compacted by internal concrete vibrators supplemented by handspading, rodding, and tamping. Air entrained concrete shall not be vibrated for over 12 seconds. Tapping or other external vibrations of forms will not be permitted. Vibrators shall not be used to transport concrete inside forms. Internal vibrators submerged in concrete shall maintain a speed of not less than 7,000 impulses par minute. The vibrating equipment shall at all times be adequate in number of units and power *to* properly consolidate all concrete; spare units shall be on hand as necessary to insure such adequacy. Duration *of* vibration shall be limited to time necessary to produce satisfactory consolidation without causing objectionable segregation. The vibrators shall ROC be inserted into lower courses that have begun to sat. Vibrators shall be applied at uniformly spaced points not farther apart than the visible effectiveness of the machine.

F. Surface Finishing Other Than Slabs. All *exposed* surfaces of foundations and grade beams shall be finished within 12 hours after forms are removed, and surface defects shall be corrected. Fins and loose material shall be removed. Honeycomb, aggregate pockets, voids over 1/2 inch in diameter, and holes left by the rods and bolts shall be cut out to solid concrete, thoroughly wetted, brush coated with neat cement grout, and filled with mortar.

C. Concrete Slab Finish. Except where otherwise indicated, the concrete for slabs shall be screeded and floated with straightedge to bring the surface to the required finish level with no coarse ag- *gregate* visible. The concrete, while still green but sufficiently hardened to bear a man's weight without deep imprint, shall be wood-floated to a true, even plane with no deviations in excess of 1/8 inch when tested with a 10-foot straightedge. Sufficient pressure shall be used on the wood-floats to bring moisture to the surface. After the surface moisture has disappeared, surfaces shall be steel-troweled to a smooth, even, dense finish, Free from trowel marks. The floor shall be an ACI 302 Class *4* floor.

a. imbedded Items. All embedded and anchorage items including anchor bolts, dowels and sleeves, shall be installed in sufficient number and size as indicated. Coordinate with work under other sections of the specifications to insure that items not furnished under this specification have been provided prior *to* placing concrete. All anchor bolt threads shall be protected with a coat of grease before placing concrete, after which they shall be cleaned, regreased, and wrapped in burlap.

I. Placing Water Stop.

I.. The location in joints shall be as shown on Design Drawings.

2. Each piece of 24 oz copper water stop shall be of maximum practicable length so that the number of end joints will be a minimum.

3. Joints at intersections shall be soldered to form a watertight seal.

13. CURING:

A. General. Immediately after placing or finishing, concrete surfaces not covered by forms shall be protected against moisture loss for not less than 7 days after placing. Curing shall be accomplished by one of the following methods or combinations thereof, as approved.

B. Moist Curing. Unformed surfaces shill be covered with burlap, cotton, or other approved fabric mats or sand, kept in intimate contact with the surface, and shall be kept continually vet. If the forms are removed before the end of the curing period, curing shall be continued as on unformed surfaces, using suitable materials.

C. Waterproof-Paper Curing. Surfaces shall be coveted with waterproof paper lapped 4 inches at edges and ends, and sealed with mastic or pressure-sensitive tape not less than 3 inches vide. Paper shall be weighted to prevent displacement, and tears or holes shall be patchcd.

D. Membrane-Forming Compound. Membrane-forming compound shall be applied in accordance with manufacturer's directions. Membrane-forming compound shall not be used on the building floor surface.

14. SAMPLES AND TESTING:

A. Samples.

I) During the progress of the work three compression test cylinders shall be made from the concrete as mixed and at the direction of the Subcontractor for each day's pour of concrete. If more than 50 yards are placed in a day, three additional cylinders shill be made for each 50 cubic yards plus any fraction thereof. One cylinder shall be tested at 7 days and one cylinder at 28 days. The third shall be for contingency.

2) The Subcontractor shall furnish the molds for taking concrete test specimens and shall furnish the labor and facilities required to take the test specimens, handle and store the same at the site.

3) Test specimens shall be made aod cured in accordance with ASTM C 31. The Subcontractor shall perform initial curing of the specimens and shall deliver the specimens to the Testing Laboratory as directed by the Contractor.

B. Testing.

1) General. Testing will be accomplished by the Contractor.

2) Slump Tests. A minimum of one test shall be made for each class of concrete used in a day, or if more than *50* cubic yards are placed in a day, one test shall be made for each SO yards plus any fraction over *50* yards. Additional tests shall be made when visual inspection indicates that the consistency of the concrete being placid may exceed the limit for slump as specified. Excess slump will be cause of rejection of concrete, Slump will be determined in accordance with ASTM C *143*, or ASTM C360. When the penetration method is used for field control specified, slumps shall be converted to equivalent penetrations by factors established in advance. The Subcontractor shall provide all materials and equipment required for the Slump Test.

3) Cylinder Compression Testing. Compression testing of cylinders will be Lo accordance with ASTM C 39.

4) teak Test. Fill sump to top with water, allow 1 hour to reach equilibrium, adjust water level back to top of sump and hold for *24* hours. It is recommended that the Subcontractor place a plastic cover over the sump area to minimize evaporative losses. If leakage exceeds 0.40 inches during the test period, the Subcontractor shall remove th8 water, repair and retest at his expense until the leakage rate does not exceed the above cited criteria. Results will be verified by the Construction Engineer.

5) Unsatisfactory Test Results. Where the strength of test specimens falls below specified values fot 28 drys strength, the Contractor may order removal of the concrete in question, at the Subcontractor's expense, or may approve alternate strength tests at the Subcontractor's expense. These may be either compression tests made with specimens secured from the structure in accordance with ASTM C *42*, or actual load tests of the structure made in accordance with ACI 318. The Cootractor may also approve additional con-trolled curing of the concrete in question, not to exceed 21 days before making either of the alternate tests. The basis for acceptance or rejection of the concrete in question *as* determined by these alternate tests shall be agreed upon by the Subcontractor and the Contractor before making the *tests.* All additional tests shall *be* made at the expense of the Subcontractor.

6) A log of all concrete pours shall be carefully kept by the Subcontractor. In general, the log shall contain the following data: Identifying number of pour, data made, time, weather and temperature at start of pour, weather and temperature at finish of pour, number of cubic pards in pour, slump record, identifying number of cylinders, test results at 7 days, test results at 28 days.

15. ANCHOR BOLTS:

Set all anchor bolts to template with required projection. Do not handset. Recheck after setting and correct all errors.

4.820 - PRE-ENGINEERED SHELTER AND BUILDING

1. GENERAL

This specification covers furnishing and installing a pre-engineered shelter and a pre-engineered building and related work as shown on the drawings and as specified.

2. CODES AND STANDARDS

Codes and standards which are called for or referred to herein are hereby made a part of this specification to the extent indicated by the reference thereto. In the event of discrepanies between the specification and the codes and standards, this specification shall govern.

3. SHOP DRAWINGS

Submit shop drawings and manufacturer's technical data for approval, in accordance with the requirements of the Special Conditions.

4. DESCRIPTION OF PRE-ENGINEERED SHELTER

The pre-engineered shelter shall consist of structural steel rigid frames erected on concrete footings and shall include all roof support steel, roof panels, required bracing, closures and all miscellaneous items as required and specified. Roof slope shall be 1-inch in 36 inches.

5. DESCRIPTION OF PRE-ENGINEERED BUILDING

A. The pre-engineered building shall consist of a structural self-framing system erected on a concrete floor slab and foundation specified in Technical Specification 4.310 CONCRETE FOR STRUCTURAL USE. Included shall be insulated walls and roof panels, Coors, windows, and frames and other miscellaneous items as indicated and specified.

B. The building shall be clear span single slope roof with a slope or' 1½-inch rise in 12-inch run.

6. DESIGN

A All cold formed members, including exterior covering, shall be designed in accordance with AISI's "Specifications for the Design of Cold Formed Steel Structural Members."

B. The shelter and building shall be designed for the following live loads in accordance with Metal Building Manufacturer's Association (MBMA) "Recommended Design Practices Manual": Roof - 30 lbs/ft^2; Wind 20 lbs/ft^2; Seismic - Zone 3. Design loading shall also include requirements for support of piping, mechanical and electrical as shown on the drawings.

7. FRAMING MEMBERS

A. Base channel and eave plate 14-gauge steel.

B. Purlins: 14-gauge steel secured with 14 gauge steel clips both sides with shop coat of print.

C. Fasteners: All bolts, nuts and sheet metal screws shall be zinc plated steel with zinc chromate finish except anchor bolts. Anchor bolts shall be black steel. All exposed sheetmetal screws shall be stainless steel.

D. Rigid-Frame Members: Welded plate "I" Sections, hot-rolled structural steel plate with shop coat of paint.

E. Bracing Members: All brace rods shall be of black steel having a minimum yield point of 63,000 psi. Threads shall be rolled or cut. Nuts shall be semi-finished hex herds. Turnbuckles, if required, shall be standard.

8. FLASHING

All flashing shall be 22-gauge steel except base channel flashing shall be 26-gauge.

9. INSULATION

Wall and roof insulation for the pre-engineered building (12'x12'x10') shall be minimum 3-inch thick glass fiber blanket, 1-1/2 pound density with 3 mil white vinyl foil facing. The insulation shall be UL or FM apprwcd for the fire hazard rating or' 25 or less for flame spread or 50 for smoke development. The maximum heat transfer coefficients (U-factor) for roofs and walls shall be 0.13 Btu/hr/sq ft/degree Fahrenheit.

10. WALL PANELS

Exterior walls for the pre-engineered building (12'x12'x10') shall consist of embossed sculpturd panels, 16 inches wide with two 3-inch deep ribs and 1-1/2 inch by 4 inch trapezoidal return, 24-gauge zinc coated steel with factory applied acrylic enamel color coating. A noncombustible 7/8" rigid glass fiberboard liner panel shall be minimum 24-gauge zinc coated steel, with factory-applied enamel color coating on the exposed side. Exterior wall panels shall be Cougar Tan in color. Interior panels shall be full length and Parchment in color.

11. ROOF PANELS

The roof shall be interlocking 24-gauge panels 16 inches vide with 3-inch deep ribs, with factory color coating, white.

12. DEFLECTION SHIELD

A. The deflection shield shall be corrosion-resistant. Reinforcement shall be of fiberglass and shall be approximately 27% by weight. Resins shall be high quality light-stabilized polyester. Finish shall be smooth, with a nominal thickness of 0.056 inches. Configuration shall be corrugation and color, clear. All panels shall be classified by Underwriters' Laboratory with a flame spread of 25. Each panel shall have Underwriters' label.

13. SEALANT

Sealant shall be a one-component butyl rubber base type meeting the requirements of Federal Specification TT-C-598; Type 1.

14. ACCESSORIES

A. Door and frame shall be manufacturer's standard complete with hardware. Locksets will be supplied and installed by the Contractor.

15. ERECTION

Buildings shall be erected in accordance with manufacturer's standards and approved shop drawings. The pre-engineering building shall be a complete weather-tight structure with all accessories.

SECTION 5

PIPING

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5.100 - PIPING INSTALLATION - GENERAL SECTION

1. GENERAL

This specification outlines the materials of construction, fabrication and installation requirements necessary for installing piping systems. The specification is composed of a general section supplemented by other sections.

2. MATERIALS

Unless noted otherwise on the drawings, materials shall be provided as specified herein or referenced in supplemental specifications. All materials shall be in strict accordance with the required American National Standards Institute (ANSI), ASTM Standards or other approved standards and specification referenced. All valves shall be as specified in the supplemental sections, and each shall be individually tagged and identified with its respective V-number in accordance with paragraph 6, Technical Specification 5.510.

3. FABRICATION AND INSTALLATION

The following details of fabrication and installation apply to this specification. Additional requirements, if any, will be detailed within the supplemental sections or on the drawings.

A. General

Piping material, including valves and fittings, shall be delivered to the site in a clean and protected condition. End seals of pipe and valves and flange covets shall be maintained in place, being removed only as necessary for cleaning, fabrication, erection or for inspection. Handling and storage of all piping materials and prefabricated piping shall be done in a manner to prevent contamination by moisture, grease, dirt or injurious foreign Patter.

Piping specified on the drawings shall follow the routing shown on the drawings. The pipe shall be cut accurately to measurement specified on the drawings and to suit field conditions and it shall be carefully worked into place without forcing or springing.

Below ground piping specified on the drawings shall follow the route specified. At points where lines being installed cross existing lines, a minimum clearance of one foot between pipe surfaces shall be maintained.

Where underground lines pass through floors, sleeves shall be used and shall allow 1/4 inch annular clearance. All sleeves shall extend 3 inches above the floor surfaces unless otherwise specified on the drawings.

The interior and exterior surfaces of all piping shall be kept clean at all times. Pipe shall be free of fins and burrs and shall be cleaned in accordance with cleaning procedures specified in Technical Specification 5.310.

Flanges, unions, and valves shall be installed as specified and shall be located where they will be accessible after erection.

Valves shall be properly packed and made leak proof under the test pressure described.

Valves which are to be soldered, brazed, or welded shall be disassembled prior to heating. Valves shall be allowed to cool, shall be cleaned if necessary, and shall be reassembled.

B. Cutting

Pipe and tubing shall be cut accurately to measurements as specified on the drawings and to suit field conditions. Tube or pipe cutters, or other methods approved by the Contractor, shall be used; and all cuts shall be reamed to remove burrs. Any objectionable defects shall be removed by machining, chipping, or grinding.

C. Joining Methods

The following methods shall be used as applicable to the individual subsections of this specification.

1) Threading. Threading of pipe shall conform to ANSI 32.1. Pipe dope shall be applied *to* the male threads only.

a. Teflon ribbon, when used as thread dope, shall not be applied *to* the first two threads on pipe.

2) Welding

a General

1) All welds are subject to inspection by the Contractor. The Contractor reserves the right *to* accept, reject, *or* demand removal of welds which are in violaton or believed *to* be in violation of these specifications. Welders performing velds found to be unsound shall be subject *to* appropriate retest provisions of the ASME Boiler Code or other applicable standards.

2) Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1/16-inch or no more than 1/8-inch.

3) Welded branch connections to headers shall be made by the use of welded outlet fittings, such as reducing teas, weldolets, sockolets, and threadolets, as shown on the drawings in compliance with the ANSI Code For Pressure Piping B31.1.0, paragraph 127.4.8.

b. Welding Rods and Electrodes

1) All bundles, boxes, or kegs in which rods and electrodes are delivered shall be legibly marked with the following information.

Classification
Trade designation
Manufacturer's name
Standard size and length
Heat number

2) All welding rods shall be identified with at least one imprint per rod showing the AWS classification number in accordance with AWS A5.1(15). In addition, welding rods 1/8 inches in diameter shall be marked or stamped with positive identification marks at intervals of not more thin 18". Such marks shall be clearly distinguishable and shall include the classification number of the welding rod and the trade designation of the manufacturer.

3) Welding rods and electrodes shall be stored, handled, and identified at all times to assure the use or the proper welding rod in a welding process.

c. Welding Standards. Welding procedures and welders' qualifications for the various carbon steel and nonferrous service piping systems listed in Table A shall be in accordance with the applicable UCC ND Welding Specifications specified.

TABLE A
WELDING SPECIFICATION

CARBON STEEL PIPING

Specification Section	Service	Welding Procedure
122	Waste Liquids	The following procedures apply to all services shown at the left.

Subsection	Service	Welding Procedure
		For grooved butt welds on pipe and fittings 1 1/2-inches and smaller and fillet welds on socket weld fittings 3/8-inch and smaller, use Oxyacetylene Welding process or Gas Tungsten-Arc Welding process.
		For grooved butt welds on pipe and fittings 2 inches and larger; fillet welds on socket weld fittings 3/4-inch and larger; and fillet welds on all sizes of slip-on flanges, weldolets, sockolets, and threadolets; use Shielded Metal-Arc Welding process, Shielded Metal-Arc Welding of Steel with Combination 6010 and Low Hydrogen Electrodes process, or Gas Tungsten-Arc Welding process.. A minimum of two passes shall be used on all fillet welds. An 1/8-inch electrode must be used for all passes on 3/4-inch socket weld fittings.
		The first pass for grooved butt welds on pipe and fittings 2 inches and larger may be made in accordance with Gas Tungsten-Arc Welding process.

3) Soldering. This is covered in the applicable subsections.

4) Flanging

a. Where steel flanges mate with cast iron flanged fittings, valves, or equipment, they shall be provided with flat faces and full face gaskets. Provide full face gaskets between cast iron flanges. Flat ring type gaskets shall be used between steel flanges equipped with raised serrated faces.

b. Flanges shall be made up with meeting face in a plane that is exactly perpendicular to the axis of the pipe. Upon erection, flanges shall be so positioned in rotation that the bolt holes shall straddle the vertical flange centerline. All gaskets shall be evenly centered between the flange faces with ring gaskets engaging fully upon raised face flanges. The meeting flanges shall mate flush and true, and the bolts shall be tightened uniformly to draw the flanges evenly and firmly upon the gasket. All bolt threads shall be coated with high temperature thread compound prior to installation. When made up, the bolts shall extend through nuts by at least one full thread.

D. Hangers and Anchors

1) In general, the location and design of pipe hangers will be shown on the drawings.

2) The location and spacing of hangers shall be such that the piping or tubing is held in position without swaying, vibrating, or sagging.

E. Laying Underground Piping

1) Detailed requirements for excavation, backfill, and grading shall be as outlined in Technical Specification 3.133 "Earthwork for Utilities."

2) The ditch shall be cleaned of debris and other foreign matter immediately before the pipe is lowered into the ditch. Where the ditch is in rock, gravel, or like material, it shall be padded by filling with sufficient earth to form a cushion on the bottom of the ditch before the pipe is lowered.

3) Before backfilling, the line shall be inspected to make sure that it lies evenly on the bottom of the ditch, that no debris is present and that joints are not covered until tests are completed.

F. Blanking off Isolation Valves

Valved connections provided on headers or branch lines for future connections or extensions shall be blanked off as follows.

1) Flanged Valves. Install a blind flange.

2) Threaded Valves. Install a 4-inch nipple acd screwed pipe cap.

3) Solder Type Valves. Install a copper-to-MPT adapter and a screwed brass pipe cap.

5.103 - ABOVE GROUND SANITARY AND SAFETY SHOWER WATER

1. SERVICE RATING

Maximum Pressure - 125° psi
Maximum Temperature - 140°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those required for the work shall be selected from this listing unless otherwise shown on the drawings.

A. Codes. Where details of fabrication are not shown on the drawings or specified in this other specifications, fabrication shall be in accordance with the applicable fabrication requirements of "National Plumbing Code," ANSI, A40.8.

B. Materials.

Item	Size (incl)	Specifications
Pipe	To 2"	Steel, butt welded, galvanized, Sch. 40, ASTM A-120
Fittings	To 2"	M.I., galvanized, 150 lb, ASTM A-197, screwed ends, ANSI B16.3.
Unions	To 2"	M.I., galvanized, 150 lb, ASTM A-197, screwed ends, brass-to-iron seats. Dimensions per Mfgr's. standard.
Caps	To 2"	M.I., galvanized, 150 lb, ASTM A-197, screwed ends ANSI B16.3.
Dope		Red lead.
Gaskets	All	Red rubber sheet, 1/16 in. thick, full face, ASTM D-2000, No. 2AA705A13L14, Sepco Corp. No. 20.
Valve Stem Packing	1/16"	Garlock No. 117B.
Bolts and Nuts		Steel, heavy hex or square head machine bolts with semifinished heavy hex nuts, ASTM A-307, Grade B.

C. Valves.

Service	Size (Incl)	Valve No.	Make and Figure No.	Materials Body	Materials Trim	Type of Ends
Shut-Off						
Gate	1/4" to 2"	V-1	Lunk. 2125	Brz	Brz	Scrd
Gate	1/2" to 2"	V-6055	Crane 441 (Lock shield) Complete with key	Brs	Brz	Scrd
Control Globe	1/4" to 2"	V-6036	Crane 7	Brz	No. 6 Disc	Scrd
Hose Bibb	1/2" and 3/4"	V-6079	American Rad. & Std Sanitary Corp., R-7233	Brs	Brs	Scrd
Angle	1/4" to 3"	V-6089	Powell 151	Brs	Composition	Scrd
Check Swing	1/4" to 2"	V-201	Crane 34	Brz	Brt	Scrd

Backflow Preventer
1" AERGAP by BEECO, Model FRP II w/Vent & Block Valves (Do Not Substitute). Backflow preventor shall be turned over to Contractor for setting prior to installation.

Note: All 1/2" to 2" shut-off valves in safety shower and eyewash lines shall be locked shield type.

3. PIPING AND FABRICATION AND INSTALLATION

General. Adequate provisions shall be made to prevent water hammer, rattling of the pipe, chattering of valves and faucets, and other objectionable noises in the system. Valves shall be installed in all branches and at the take-off from the main, as shown on the drawings. All other details of fabrication and installatin shall be as specified in Technical Specification 5.100.

4. CLEANING AND STERILIZATION

Cleaning and sterilization shall be as specified in Technical Specification 5.310.

5. TESTING AND INSPECTION

Testing and inspection shall be as specified in Technical Specification 5.410, Class a.

6. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Technical Specification 5.510.

7. PAINTING

Painting shall be as specified in Technical Specification 11.310.

5.110 - STORM SEWERS OUTSIDE OF BUILDINGS

1. SERVICE RATINGS

Maximum Temperature: 150°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those required for the work shall be selected from this listing unless shown on the drawings.

A Coder, Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable requirements of ANSI A40.8, "National Plumbing Code."

B. Materials

Item	Size (incl)	Specifications
Concrete		
Pipe	15" and over	Reinforced concrete sever pipe, shall be class IV, wall B, ASTM C-76, with bell and spigot joints Ar joints for circular concrete sewer and culvert pipe using flexible, watertight, rubber gaskets per ASTM C-443.

3. PIPE JOINTS

A. Reinforced concrete sewer pipe with factory-applied compression joints shall be made up using rubber o-ring gaskets in accordance with ASTM C-425 and ASTM C-443.

4. INSTALLATION

Pipe in trenches shall be laid I a true to line and grades shown on the drawings, Conduit installation shall proceed upstream with the bell ends upstream. The sections shall be joined in such a manner that there will be as little unevenness as possible along the inside of the conduit. Pipe shall. be supported evenly and firmly across the underside, up to the spring line, and above to furnish lateral pressure against the sides of the pipe.

5. CLEANING AND INSPECTION

Prior to erection the inside of all pipe and fittings (including the external surfaces of spigot ends) shall be cleaned of all dirt and foreign materials. After installation, but prior to backfilling, all drain lines shall be cleaned free of foreign deposits and inspected for broken or cracked pipe and fittings. Defective pipe or fittings shall be replaced at Subcontractor's expense.

60 EXCAVATION, BACKFILL AND GRADING

Excavation, backfill and grading shall be as specified in Technical Specification 3.133.

1. SERVICE RATING

Pressure Range	-	50 to 400 psig
Maximum Temperature	-	200°F
Operating Pressure	-	50 psig

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those required for the work shall be selected from this listing unless otherwise shown on the drawings.

a. Codes. Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI, "Code for Pressure Piping, 831.3, Petroleum Refinery Piping," and the "National Fluid Power Association (NFPA) Hydraulic Standards."

b. Materials.

Item	Size (incl)	Specifications
Pipe	1/4" to 4"	Steel, seamless, ASTM A-106, Grade B, Schedule 40.
Fittings	1/4" to 2"	Steel, ASTM A-105 or A-181, Grade 2, with socket veld ends, ANSI B16.11, 3000 psi
	3- to 4"	Steel, standard weight, ASTM A-234, Grade WPA or WPB, but: veld ends, ANSI B16.11.
Flanges	All	Steel, ASTM A-105 or A-181, Grade 1, socket veld type, ANSI 316.5, 300 psi.
Flexible Hose	1/4" to 2" ID	For petroleum-based hydraulic oils: Buna N or neoprene inner tube, multiple wire wrap or braid reinforcement, cotton or Neoprene cover, Aeroquip number 1503 for 1/4" to 1" and 1500 for 1 1/2" and 2".

b. Materials. (Coat'd)

Item	Size (incl)	Specifications
Fittings for Flexible Hose		Fittings for flexible hose and hose lengths shall be as specified on the drawings.
Gauge Snubber	1/4"	Crosby-Ashton, style 400SS-D, stainless steel.
Gaskets	All	Teflon, 1/16 in. thick, ring type.
Dope		Teflon tape.
Valve Stem Packing	All	Teflon.
Bolts & Nuts		Alloy steel bolt-studs, ASTM A-193, Grade B7; semifinished heavy hex nuts, ASTM A-194, Grade 2 or 2H.

c. Valves.

Service	Size (Incl)	Valve No.	Make and Figure No.	Materials Body		Type of Eads
Shut-Off Globe	1/2"	V-6413	Hoke 2111F2E,F4E, F6E & F8E Teflon 3116 SS. Packing	F.S.	Type 303 S.S. Spindle	Scrd
Gate	3/4" to 2"	V-6161	Vogt SW-1034-1038	F.S.	11½ to 132 Cr S.S.	Si

3. PIPING FABRICATION AND INSTALLATION

Piping fabrication and installation shall be as specified in Technical Specification 5.100.

4. CLEANING

Cleaning shall be as specified in Technical Specification 5.310.

5. TESTING AND INSPECTION

The Subcontractor shall hydrostatically test the piping system at 1-1/2 times maximum operating pressure, using system fluid as test medium. The Contractor shall visually inspect all joints and connections for leaks. The Subcontractor shall repair all leaks and retest repaired joints.

6. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Technical Specification 3.510.

7. PAINTING

Painting shall be as specified in Technical Specification 11.310.

5.124 SANITARY WATER (COPPER TUBING) (SW)

1. SERVICE RATING

Maximum Pressure: 150 psig
Maximum Temperature: 130°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required but that those required for the work shall be selected from this listing unless otherwise shown on the drawings.

A. Codes

Installation shall be in accordance with ANSI A40.8, "National Plumbing Code".

B. Materials

Item	Size (incl)	Specifications
Tubing	To 2" nominal	Copper, seamless water tube, hard drawn ASTM B-88, type L.
Fittings	To 2" nominal	Copper, seamless, wrought type, solder joint, per ANSI B16.22.
Dope		Red lead.

C. Valves.

Service	Size (Incl)	Valve No.	Make and Figure No.	Materials Body	Materials Trim	Type of Ends
Shut-Off Gate	1/4" to 2"	V-1	Lunk. 2125	Bronze	Bronze	Screwed
Ball	1/4" to 2"	V-6468	Apollo 70-300 Series	Bronze	Bronze	Screwed
Control Globe	1/4" to 2"	V-6036	Crane 7	Brass	No. 10 Disc	Screwed
Angle Valve	1/2" to 2"	V-570	Powell 2614	Bronze	11.5 to 13% CR. S.S.	Screwed
Curb Stop	1"		Mueller H-10302	Brass		Screwed

Service	Size (Incl)	Valve No.	Make and Figure No.	Materials Body	Materials Trim	Type of Ends
Curb Box	2"		Mueller H-10208			

3. CLEANING AND STERILIZATION

Cleaning and sterilization shall be as specified in Technical Specification 5.310.

4. TESTING AND INSPECTION

Testing and inspection shall be as specified in Technical Specification 5.410.

5.310 - CLEANING, CONDITIONING, AND STERILIZATION OF PIPING SYSTEM

1. GENERAL

This section of the specification describes the cleaning requirements for piping systems, and includes the sterilization requirements for piping systems conveying sanitary water.

The Contractor will furnish the water for cleaning and testing pipe or piping systems.

Valves shall be in the open position during the cleaning process. Introduce the flushing medium at the remote end of the piping system. Flush from the upstream side of check valves. Alternately open each extremity of the line so that the entire system is flushed.

Tools For assembling the piping must be degreased.

2, PIPING WHICH DOES NOT REQUIRE CHEMICAL CLEANING BEFORE ERECTION

A. All pipe, valves, and fittings used in fabricating piping systems under this classification for conveying services other than those listed will not require chemical cleaning. However, each component of any piping system under this classification shall be cleaned and inspected before erection as follows:

B. Inspect all pipe, valves, and fittings tor physical defects and replace broken, chipped, cracked, or defective items with new.

C. Remove all loose scale, rust, dirt, mud, and other foreign materials from interior surfaces by wire-brushing, scrubbing, or flushing with air or water.

D. Remove excess dirt, rust, grease, and oil From exterfor surfaces.

F. Provide ups or protective covers over ends of pipe, valves, and fittings until ready to install.

3. PIPING SYSTEMS NOT REQUIRING CLEANING AFTER ERECTION AND TESTING

A. Piping systems conveying he following services do not require cleaning after erection and testing.

Specification Section	Services
5.122	Waste Liquids

4. PIPING SYSTEMS REQUIRING CLEANING AND TESTING AFTER ERECTION

A Piping system conveying the following services shall be cleaned after erection and testing by flushing with initial test medium for five minutes.

Specification Section	Services	Test Medium
5.103	Above Ground Sanitary and Safety Shower Water	Water
5.124	Sanitary Water	Water

5. PIPING SYSTEMS WHICH REQUIRE STERILIZATION

The following piping *system* conveying sanitary water shall be sterilized after erection and testing.

Specification Section	Services
5.103	Above Ground Sanitary and Safety Shower Water
5.124	Sanitary Water (copper tubing)

Prior to sterilization, the system shall be flushed with sanitary water as specified in Paragraph 4A. After flushing, drain the system and thea sterilize.

6. STERILIZATION MATERIALS AND METHODS

A. Materials. Commercial high-test hypochlorite, known as HTH, or commercial laundry bleach shall be used in preparing the disinfecting solution.

B. Method. The piping system *to* be sterilized shall be filled, after flushing with sanitary water to which the chlorinating material for disinfection is added. Suitable connections and/or caps shall be provided at the extremities of all Liner for testing and shall be at the Subcontractor's expense.

Sufficient chlorinating material shall be added so that a minimum of *50 ppm of* chlorine is combined in the disinfecting solution when sampled at any point in the system being sterilized. The *system* shall be allowed to set for 24 hours and tested again, *at* which time the chlorine content in the system shall not be less than 25 ppm at any point.

Testing, sterilization, approval and/or acceptance of any sanitary water system will be performed by the Sanitary Water Supervisor, when requested by the Subcontractor through the Construction Engineer.

5.410 - TESTING AND INSPECTION OF PIPING SYSTEMS

1. GENERAL

This specification covers the testing and inspection of piping systems. Subcontractor shall furnish all labor, materials, equipment, tool., and services necessary for testing except for work, materials, and/or equipment *to* be furnished by the Contractor.

The class of test *to* be applied is specified in the applicable technical specification.

2. DEFINITION FOR MAXIMUM WORKING PRESSURE OF A SYSTEM

The maximum working pressure of a system is defined as the predetermined value at which the piping system's safety relieving devices are set to prevent overpressurizing the system. Either the set pressure of the relieving devices or the maximum operating pressure of the piping system shall be used.

3. GENERAL TESTING REQUIREMENTS

General requirements for tests to be performed on installed piping systems under this specification shall be as follows:

A. Blank off, or replace with spool pieces, items of equipment (e.g., vessels, pumps, instruments, controls, and valves razed for pressures below the test pressure. Before performing final operating pressure test on a system, remove test blanks and spool pieces, aad reconnect protected instruments and equipment.

B. Inspect all parts of the system for leaks, especially at valves, flanges, welds, and threaded connections. All leaks shall be repaired and the repaired joints retested.

C. Soap solution for soap testing shall be a soapless lather, leak detector solution as manufactured by Industrial Colloids & Chemical, Inc. Knoxville, Tennessee, or Contractor approved equal.

D Use adequate precautions during pneumatic pressure testing. Clear the installation area of personnel not engaged in testing operations. Visually inspect the system installation for compliance with the design drawings and specifications.

E. Sanitary water shall be used as the test medium when testing piping systems handling sanitary or safety shower water.

F. The test shall be performed in the presence of an authorized representative of the Contractor.

4. WORK, MATERIALS, AND/OR EQUIPMENT FURNISHED BY THE CONTRACTOR

The Contractor will furnish the test gauges and testing media required to conduct Class B, Tests.

5. CLASS B TESTING (HYDROSTATIC TEST)

Class B testing consists of hydrostatically pressure testing piping systems or isolated sections of piping systems with water. Test pressures and test procedures shall be as follows:

A. Test Pressure. Test pressure shall be 1.5 times the maximum working pressure, unless specified otherwise on the drawings, but not less than 50 psig.

B. Test Procedure. With equipment items protected in accordance with paragraphs 3.A. and 3.E., pressurize systems to test pressure. Hold pressure while visually inspecting all welds, joints, and connections for leaks. Repair leaks and retest repaired joints.

Drain system and, after instruments and equipment are reconnected, refill with service medium and apply maximum operating pressure. Hold pressure while visually inspecting these joints and connections for leaks. Repair leaks and retest repaired joints.

5.510 - IDENTIFICATION OF PIPE AND VALVES

1. GENERAL

This specification outlines details of identifying valves and exposed piping after erection, and painting are completed. Exposed piping is defined as all piping which is visible in the open or may be exposed by the removal of covers or panels designed to provide access for inspection or maintenance. The tabulation included herein is comprehensive in nature. It is not intended that all flowing mediums listed will necessarily be required but that those required for the work shall be identified as shown with the labels having a background color as indicated under the color coda.

2. DESCRIPTION OF MARKERS

Identification markers shall be vinyl cloth having a self-adhesive backing that is resistant to moisture, oils, and most solvents and that will hold tight within a temperature range of -40 to 250°F. Label shall be weather and fade resistant and similar to those manufactured by W. H. Brady Company, Milwaukee, Wisconsin.

The labels shall be of specified background color upon which are printed the name of the flowing medium with specified letter color. The direction of flow in each pipe shall be indicated by an arrow on a label adjacent to the identification label and of the same color as the identification label.

Where additional information is required, a separate label shall be applied adjacent to the service identification label. Background color, letter color, and letter height shall be the same 2s service identification.

These labels and acrylic overcoating will be furnished by the Subcontractor.

Letter heights for use in titles ate governed by the outside diameter of the pipeline including insulation. The minimum letter heights to be used are:

Outside Diameter	Letter Heights
1/2 - 3 inches included	5/8 in&
3-1/2 inches and up	1-1/4 inches

3. EXPLANATION OF COLOR CODE

The type of hazard of the flowing medium is indicated by the colors listed below.

Background Color	Flowing Medium	Letter Color
Yellow	Dangerous Materials	Black
Green	Generally Safe Liquids	Black
Blue	Generally Safe Gases	White

4. LOCATION OF MARKERS

Straight sections of pipelines, inside buildings, shall bear identification markers at maximum intervals of 40 feet. Straight sections of pipelines, outside buildings, shall bear identification markers at maximum intervals of 100 feet.

Branch lines shall be identified with a marker located not more than 5 feet from the main line.

5. METHOD OF APPLYING LABELS

Surface to which labels are adhered must be fret of scale, dirt, *dust,* grease, and moisture. Press the label firmly in place, rubbing thoroughly, particularly along the edges, until the adhesive makes a good bond.

Overcoat the entire label including 1/2-inch overlap at the edges with a heavy coat of Glidden Clear Silk Screen Acrylic Y-7135.

Mastic coatings on insulated lines, such as Vimasco's WC-1, Insul-Coustic's IC-551, and Benjamin Foster's 60-60, *must* be completely dry before applying labels.

6. IDENTIFICATION OF VALVES

All valves identified on the drawings and specifications with V-numbers shall be permanently identified with stainless steel tags embossed with the applicable V-numbers. Tags shall not be attached to handwheels or levers or other parts of valves which would interfere with operation. Tags and wire will be furnished by the Contractor. The Subcoattactor shall submit a list of the required V-number tags to the Contractor.

Service and Label Wording	Label Background Color	Subsection Number
Waste Liquids	Yellow	5.122
Sanitary Water	Green	9.103

SECTION 6

HEATING AND VENTILATION

SECTION	DESCRIPTION	PAGE
6.101	ENVIRONMENTAL CONTROL SYSTEMS INSTALLATION AND EQUIPMENT	6-2
	1. General	6-2
	2. Shop Drawings and Manufacturer's Data	6-2
	3. Specifications, Standards and Equipment	6-2
	4. Execution	6-3
	Data Sheet - Roof or Wall Ventilator	6-4
	Data Sheet - Electric Heating Convectors	6-5
	Data Sheet - Air Louver	6-6
6.401	CONTROLS - CONTROL SYSTEM	6-7
	1. General	6-7
	2. Codes, Standards, and Regulations	6-7
	3. Materials and Products	6-7
	4. Shop Drawings and Manufacturer's Data	6-7
	5. Execution	6-8
	6. Inspection After Installation	6-8
	7. System Testing	6-9
	8. Start-up and Calibration	6-9
	9. Data Sheet - Thermostat	6-10

6.101 - ENVIRONMENTAL CONTROL SYSTEMS INSTALLATION AND EQUIPMENT

1. GENERAL

In general, the work *in* the 12' X 12' enclosed building consists of the installation of electric unit heaters to provide winter freeze protection, and an intake louver and exhaust fan for summer ventilation,

A. Related Work Specified or Shown Elsewhere

The following related items are normally shown on other drawings and specified elsewhere in these documents, but they shall be coordinated with the requirements of this Specification.

1) Openings in walls

2) Electrical Work

3) Painting

2. SHOP DRAWINGS AND MANUFACTURER'S DATA

Furnish certified record copies of drawings and data in accordance with the General Conditions.

3. SPECIFICATIONS, STANDARDS AND EQUIPMENT

A. Specifications

The following related specifications are made a part of this Specification.

Description	Technical Specification
Controls	6.401

B. Equipment

1) The equipment to be furnished and installed shall be in accordance with the following data sheets:

Equipment Description	Data Sheet No.
Roof or Wall Exhauster	PEC-15757-1
Unit Heater, Electric	PEC-15757-2
Air Louver	PEC-15757-3
Thermostat	PEC-15757-4

4. EXECUTION

A. Correlation of Work and Access

1) Correlate all work to avoid interferences.

2) A minimum headroom of 6'-8" above finished floor shall be maintained in all areas unless otherwise specifically shown on the drawings.

3) All parts of the system requiring maintenance shall be installed in an accessible location and position. The location of all pipes, conduit and other obstructions shall be carefully coordinated to reserve space for equipment removal and maintenance.

4) System components shall be Located as shown on the drawings, Advise the Construction Engineer of all interferences.

B. Equipment Installation

1) The published recommendations of the equipment manufacturer shal be followed while assembling and installing all equipment and accessory items. If a conflict should exist between the drawing and the manufacturer's instructions, the Contractor shall be consulted to determine the arrangement to be used.

2) Flexible connections in piping, tubing and conduit systems shall be installed as close as possible to the equipment being isolated, No hard connected service piping or electrical condui shall be installed in a manner that would void the isolation, The end of the connection farthest from the equipment shall be securely supported and anchored to the building structure.

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
OAK RIDGE, TENNESSEE 37830

DATA SHEET

ROOF OR WALL VENTILATOR

REVISIONS		
REV.	APPROVAL	DATE

PROJECT: INTERIM STORAGE OF HAZARDOUS MATERIALS SHELTER.			DATA SHEET NO. PEC-15757-1 PAGE 1 OF 1
PLANT: PGDP	BUILDING: C-733	PREPARED BY: E C HARPER	THIS SHEET PART OF: Spec. 6.101
W.I. OR E.S.D.: 15757		APPROVAL	DATE: 10-28-81
REQUISITION NO.		PROCURED BY: SUB-CONTRACTOR	INSTALLED BY: SUB-CONTRACTOR

EQUIPMENT NUMBERS	EF-1			
SELECTION - Manufacturer	PENN VENT CO			
Model	DOMEX WALL			
Size	WXR94			
TOTAL QUANTITY REQUIRED	1			
FAN SPECIFICATIONS & PERFORMANCE				
Airflow, CFM	500			
Static pressure, "W.G.	0.25			
RPM, max	1550			
Brake HP, Max	0.10			
Type of wheel	CENTRIFUGAL			
Material of construction	ALUMINUM			
Finish	NATURAL			
Roof or Wall mounting	WALL			
MOTOR SPECIFICATIONS				
Electrical type	MFR'S STD.			
Enclosure	SEE NOTE 1			
Duty rating	CONSTANT			
Bearings	MFR'S STD.			
Lubrication	PERMANENT			
Frame Number	--			
Rated HP	1/10			
Volts, phase, Hz	120/1/60			
ACCESSORIES				
V-Belt drive	--			
Fixed	--			
Adjustable	--			
Backdraft damper	STYLE EDB-12			
Inlet grille	--			
Belt guard	--			
Bird screen	--			
Acoustical roof curb	--			

NOTE 1: FAN AND MOTOR SHALL BE SUITABLE FOR OPERATION IN CLASS I, GROUP D, DIVISION 1 HAZARDOUS ATMOSPHERE.

REMARKS:

Alternate Vendors: Jenn-Air, Inc.
Loren Cook Co.

Furnish the following manufacturer's data in quantities indicated:	NUMBER OF COPIES W/Bids	Approval	Certified	TYPE OF DATA (CONTINUED)	NUMBER OF COPIES W/Bids	Approval	Certi
1. Outline dimension drawings		7	10	5. Descriptive literature			
2. Weight of equipment		7	10				
3. Performance curves or tables		7	10				
4. Installation instructions		7	10				

*Information to be supplied by equipment manufacturer.

DATA SHEET

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
OAK RIDGE, TN - PADUCAH, KY

DATA SHEET NO.	REV.	ISSUE DATE
PEC-15757-2		10-28-81
PAGE 1 OF 1		REQUISITION NO. Spec. 6.101
PROCURED BY SUBCONTRACTOR		INSTALLED BY SUBCONTRACTOR
PROJECT NO.		E.S.G. OR W.O. 15757
BUILDING C-733		PLANT PGDP

OBJECT TITLE
INTERIM STORAGE OF HAZARDOUS MATERIALS SHELTER

JOB TITLE

EQUIPMENT
UHE-1 & UHE-2

CHROMOLOX ELECTRIC HEATING CONVECTOR

MODEL FTEP-3

RATED CAPACITY: 3KU @ 277/1/60

2.225 @ 208/1/60

FOR OPERATION @ 208/1/60

THIS EQUIPMENT SHALL BE SUITABLE FOR OPERATION IN CLASS I, GROUP D, DIVISION I HAZARDOUS ATMOSPHERE.

TOTAL QUANTITY REQUIRED: 2

Furnish the following manufacturer's data in quantities indicated:	NUMBER OF COPIES W/Bids	Approval	Certified	TYPE OF DATA (CONTINUED)	NUMBER OF COPIES W/Bids	Approval	Certified
Outline dimensional drawings		7	10	6. Test & Inspection Reports			
Operation & Performance data		7	10	7. Materials Certification			
Literature & Parts list		7	10	8.			
4. Operating & Maint. Instructions		7	10	9.			
5. Installation Instructions -		7	10	10.			
PREPARED BY	APPROVED BY			PRINCIPAL ENGINEER	PROJECT ENGR. (MANAGER)		

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
OAK RIDGE, TENNESSEE 37830

DATA SHEET

AIR LOUVER

PROJECT: INTERIM STORAGE OF HAZARDOUS WASTE			DATA SHEET NO. PEC-15757-3 PAGE 1 OF 1
ORIGINATOR: R. S. HAMBY	PLANT: PGDP	BUILDING: C-733	PREPARED BY: E. C. Harper
	W.O. OR E.S.S.: 15757	APPROVAL:	DATE: 10-28-81
	REQUISITION NO.:	PROCURED BY: Sub-contractor	INSTALLED BY: Sub-contract

REVISIONS

REV.	APPROVAL	DATE

THIS SHEET: Spec. 6.101

EQUIPMENT NUMBERS		WL-1			
SELECTION:	MANUFACTURER	Ruskin Mfg. Co.			
	Model No.	ELF-375D			
TOTAL QUANTITY REQUIRED		1			
PHYSICAL:	LENGTH (INCHES)	13-1/2			
	Height (Inches)	27-1/2			
	Depth (Inches)	6			
	Air Quantity (CFM)	560			
	Press. Drop (In. W. C.)	0.04			
	Face Velocity (FPM)	500			
CONSTRUCTION:	TYPE LOUVER				
	Application	INTAKE			
	Blade Type	DRAINABLE			
	Blade (Oper. or Fixed)	FIXED			
	Material	ALUM.			
	Material Thickness (Min.)	0.100			
	Frame Type: Head	EXTRUDED			
	Jamb	EXTRUDED			
	Sill	EXTRUDED			
	Frame Thickness (Min.)	0.125			
	Mullions (Exposed) or Concealed)	—			
ACCESSORIES:	SCREEN MATERIAL	ALUM.			
	Screen Location	OUTSIDE			
	Screen Size	1/8" MESH			
	Type Operator	1			
	Damper (Manual or Air)	C3D-2 PRESSURE OPERATED, AIR IN			
	Fasteners	—			
FINISH:	MFG. STANDARD	YES			
	Special (Describe)	--			

Remarks: Louvers Shall Prevent Moisture Carry Over At The Face Velocity Indicated.

LOUVER AND PRESSURE RELIEF DAMPER TO BE COMBINATION, WITH WALL SLEEVE SUITABLE FOR PREFABRICATED BUILDING WALL MOUNTING.

Alternate Vendors: Airolite, Co.
American Warming & Ventilation, Inc.
ARMCO

Furnish the following manufacturer's data in quantities indicated:	NUMBER OF COPIES W/Bids	Approval	Certified	TYPE OF DATA (CONTINUED)	NUMBER OF COPIES W/Bids	Approval	Certi
1. Outline dimensional drawings		7	10	5. Installation instructions		7	
2. Performance data		7	10				
3. Weight of equipment		-					
4. Descriptive literature		7	10				

*Information to be supplied by equipment manufacturer.

6.401 - CONTROLS - CONTROL SYSTEM

I. GENERAL

A. This specification relates to the procurement, fabrication, and installation of controls for environmental control systems.

a. Related Work Specified Elsewhere.

2. APPLICABLE CODES AND STANDARDS

All materials, equipment and work performed shall be in accordance with the applicable sections of the following documents and the documents issued by the following organizations:

American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
Institute of Electrican and Electronic Engineers (IEEE)
Instrument Society of America (ISA)
Insulated Power Cable Engineers Association (IPECA)
National Electrical Code (NEC)
National Electrical Manufacturers Association (NEMA)
National Fire Protection Association (NFPA)
Underwriter's Laboratories, Inc. (UL)

3. MATERIALS AND PRODUCTS

A. Items specified herein shall be furnished and installed complete with all fittings and/or accessories unless otherwise noted.

B. The controls to be furnished and installed shall be in accordance with the attached data sheets.

4. SHOP DRAWINGS AND MANUFACTURER'S DATA

A. Submit control system brochures for approval prior to installation of any part of the system. The brochures shall contain the manufacturer's descriptive literature for each piece of proposed equipment.

B The approval drawings shall include a schematic layout and inter-relationship of tach control item including model numbers, flow rates, capacities, operating ranges, set points, throttling ranges, spring ranges, calibration instruction, and any other pertinent data for describing the system operation.

5. EXECUTION

A. Storage *and* Handling of Controls

1) Care shall be taken to prevent damage to the delicate parts while storing, handling, installing, and adjusting the instruments.

2) Capped openings for exclusing dirt and moisture from internal parts shall be removed only to make final connections to the instrument.

3) Instrument installation shall be delayed until heavy equipment and associated services *are* in place unless adequate protective covers are provided during construction.

4) All damaged instruments and accessories shall be repaired or replaced by the Subcontractor.

B. Equipment Installation

1) Room-type temperature controllers shall be mounted with centerline 5 feet 0 inches above the finished floor.

2) All parts of the control system requiring maintenance shall be installed in an accessible location and position. The location of all pipes, conduit, and other obstructions shall be carefully coordinated to reserve space for instrument removal and maintenance.

C. Interconnecting Wiring and/or Tubing Systems

1) Electrical conduit and wiring shall be installed In accordance with the drawings and specifications far the electrical work.

6. INSPECTION AFTER INSTALLATION

A. After the systems art installed, inspect them to insure that:

1) All controls have been properly installed and located as specified.

2) System components have been spaced for instrument removal and maintenance,

7. SYSTEM TESTING

A. Electrical control wiring shall be tested in accordance with the tests required in the specifications for electrical work, Section 7.

8. START-UP AND CALIBRATION

A. The control system including installed individual components shall be calibrated by the Subcontractor.

B. All thermometers used for instrument calibration shall be precision plain mercury in glass conforming to ASTM standards. The thermometers shall be at least 12 inches long with 60 degrees F maximum ranges and 0.2 degrees F scale graduations.

C. The operating ranges, action, and correct operation of each component in the control system shall be individually verified and selected to match the controlled device to make certain that the equipment will perform the intended function specified or shown on the drawings.

D. The instruments shall be calibrated to the se3 p i n t s shown on the drawings.

E. Any defective instruments found during the calibration period shall be repaired or replaced at no expense to the Contractor.

UNION CARBIDE CORPORATION NUCLEAR DIVISION OAK RIDGE, TN - PADUCAH, KY	PAGE 1 OF 1	REQUISITION NO. Spec. 6.401
	PROCURED BY SUBCONTRACTOR	INSTALLED BY SUBCONTRACTOR
PROJECT TITLE INTERIM STORAGE OF HAZARDOUS MATERIALS SHELTER	PROJECT NO.	E.S.O. OR W.O. 15757
JOB TITLE	BUILDING C-733	PLANT PGDP

EQUIPMENT
TC-1, TC-2

Chromalox Model PIT-15EP - Wall Mounted Thermostat. 0 - 150°F range. Contact rating 9.2 AMPS at 208 Volts AC. SPDT switching action. In enclosure suitable for Class I, Group D, Division I Atmospheres. Furnish with perforated metal protective cover for capillary tube and sensing bulb.

Total quantity required: 2

Alternate Vendors: Johnson Controls, Inc.
Barber-Coleman Co.

Furnish the following manufacturer's data in quantities indicated:	NUMBER OF COPIES W/Bids	Approval	Certified	TYPE OF DATA (CONTINUED)	NUMBER OF COPIES W/Bids	Approval	Certified
1. Outline dimensional drawings		7	10	6. Test & Inspection Reports			
2. Operation & Performance data		7	10	7. Materials Certification			
3. Literature & Parts list		7	10	8.			
4. Operating & Maint. Instructions		7	10	9.			
5. Installation Instructions		7	10	10.			

PREPARED BY	APPROVED BY	PRINCIPAL ENGINEER	PROJECT ENGR. (MANAGER)

UCN-2641T

SECTION 7

ELECTRICAL

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7.110 - ELECTRICAL CONSTRUCTION

I. GENERAL

A. Application

This specification covers the complete installation of all electrical material and equipment in accordance with the Subcontract drawings, as hereinafter specified, and as described in the General and Special Conditions.

B. Subcontractor's Responsibility

1) The Subcontractor shall be responsible for furnishing labor, equipment and material necessary for or incidental to the complete installation of all electrical services and equipment.

2) The Subcontractor shall be responsible for performing the required tests on all electrical equipment. The Subcontractor shall also provide all labor, material and equipment for making adjustments whenever necessary to ensure proper performance of all electrical equipment.

3) It shall be the Subcontractor's responsibility to ensure that all electrical equipment is identified in accordance with the Subcontract drawings and this specification.

C. Contractor

1) The Contractor will inspect all electrical construction including equipment, materials, and workmanship.

2) The Contractor will evaluate and accept or reject substitutions submitted by the Subcontractor in lieu of items of material and equipment specified.

D. Installation

The Subcontractor shall install all work to conform to recommendations contained in the National Electrical Code (NEC) and the National Electrical Safety Code (NESC) and to the applicable rules of national standards and codes hereinafter referred to.

2. APPLICABLE CODES AND STANDARDS

All materials, equipment and work performed shall be in accordance with the applicable sections of the following documents:

Edison Electrical Institute (EEI)
National Electrical Code (ANSI-C1, 1981)

Underwriters' Laboratories, Inc.
National Electrical Manufacturers' Association
Association of Edison Illuminating Companies
American Society of Testing and Materials
Occupational Safety and Health Administration (OSHA)
National Electrical Safety Code (ANSI-C2, 1977)
American National Standards Institute
Insulated Power Cable Engineers Association
Institute of Electrical and Electronic Engineers Standards
Federal Specifications
American Wood Preservers Association (AWPA)

3. MATERIALS AND EQUIPMENT

A. General

All materials and equipment furnished, unless otherwise noted, shall be new and shall be listd by the Underwriters' Laboratories, Inc., or other nationally recognized testing laboratories, whenever standards have been established by one of these agencies.

B. Substitutions

Wherever a trade name or catalog number of a particular manufacturer is used on the contract drawings and specifications to describe any item of equipment or material, the term "or Contractor approved equal" shall be implied and assumed. References to a particular manufacturer's product, either by name or limiting description, are intended to clearly indicate the minimum standard of quality acceptable, and any other make substantially similar in design and performance duty may be submitted to the Contractor for approval.

4. MISCELLANEOUS INSTALLATION METHODS

A. Fastenings

Fastenings to wood shall be by means of wood screws or bolts; to masonry by means of threaded metal inserts, metal expansion shields or bolts and to steel by means of machine screws, bolts or by welding. No wood or fiber plugs will be permitted. Fastenings to concrete may be accomplished with Phillips Red Head drill anchors or expansion anchors.

B. Hangers, Supports, and Equipment Racks

1) Hangers, supports, and equipment racks shall be furnished and installed by the Subcontractor as shown on the drawings and/or as specified in applicable sections of this specification.

2) Hangers for supporting conduit and electrical equipment shall be steel angle, steel channel, "Unistrut" or galvanized, or cadmium plated rods. Conduit hangers shall be spaced in accordance with paragraph 5.A.8).

3) Supports for electrical equipment shall be fabricated from steel angle, steel channel, or "Unistrut" and, when required, covered with steel plate. Supports shall be all welded construction. Equipment shall be fastened to plate with hex head bolts, hex nuts, and lock washers.

4) Equipment racks for mounting electrical equipment shall be fabricated from P-1000 "Unistrut" unless otherwise shown on the drawings. Racks shall be of bolted or welded construction. Equipment shall be mounted to the rack with hex head bolts, spring nuts, and lock washers.

5) Unfinished members used in the fabrication of hangers, supports, and equipment racks shall be cleaned of rust and scale and painted with one coat of metal primer after fabrication and then, if not concealed, shall be painted in accordance with Section 11.

C. Cutting and Patching

Existing work which is cut, removed or otherwise damaged during the operations shall be patched or replaced to match existing work.

D. Openings, Penetrations, and Inserts

1) The Subcontractor shall provide all openings required for his work.

2) The Subcontractor shall seal around all conduits penetrating floors.

3) The Subcontractor shall seal around all raceways penetrating exterior building walls of sheet metal with silicone rubber sealant, GE RTV-102 or Dow Corning 732.

5. RACEWAYS

A. General

1) All wiring shall be installed in galvanized or sherardized rigid steel conduit unless otherwise noted on the drawings. The use of nonmetallic sheathed cable (type NM), electrical metallic tubing (EMT), PVC conduit, and flexible cords will be permitted only where specifically called for on the drawings.

2) Conduit shall be delivered to the job site in 10' lengths, each length bearing the Underwriters' Laboratories, Inc., label and the name of the manufacturer.

3) When not shown in detail on the drawings, the *exact* locations and routing of conduit and the location and sizing of conduit sleeves passing through floors, walls, etc., shall be determined by the Subcontractor, subject to approval of the Contractor.

4) Conduit which *is* run exposed shall be run at right angles to or parallel to building structural members. Diagonal runs will be permitted only in concrete slabs or in special cases with prior approval *of* the Contractor.

5) Conduit shall in no case be secured directly to other piping. Conduit parallel to or crossing uninsulated hot water or *steam* pipes must be separated from them by 12 inches if parallel or 6 inches if crossing. Where these lines are insulated, conduit parallel to or crossing them must clear the insulation surface by 2 inches. Conduit shall not be run directly under cold water lines and shall be separated from them in other directions by at least 3 inches.

6) Conduit shall be cut square with an approved conduit cutter and threaded with an approved conduit threader. The ends shall be reamed of burrs, and all metal shavings and cutting lubricants shall be removed before the conduit is connected to the conduit system.

7) Bends, offsets, and bevels shall be avoided where practical; but where they are necessary, they shall be made with an approved bending device. In no case shall the radius of any conduit bend be less than that specified in the NEC or less than the allowable bending radius of the installed conductor. Any conduit crushed or deformed in bending will be rejected and the use of heat in bending conduit shall not be allowed. Where a number of conduits are run together, the radii of any required bends shall be such that the installation will be neat in appearance.

8) Rigid metal conduit, whether concealed or exposed, shall be adequately supported in accordance with paragraph 346-12 of the NEC.

9) Rigid steel conduit shall be secured to walls, building framing, etc., by the use of malleable iron galvanized U bolts, beam clamps, conduit straps or "Unistrut" fittings where "Unistrut" racks or supports are used. Conduit *shall* be securely fastened to all outlet boxes, pull boxes, cabinets and switch *boxes* with double lock nuts and insulating bushings unless boxes with conduit hubs are provided.

10) All conduit connections shall be made with appropriate fittings and securely tightened. Improperly made connections or terminations, as well as any which have not been adequately tightened, will be rejected.

11) Conduit openings into which dirt, plaster, mortar mix or debris may fall shall be closed with caps or tight fitting plugs during the construction period. Conduits in which such material has accumulated shall be thoroughly cleaned. Where such accumulations cannot be readily removed, the conduit shall be replaced.

12) Conduits to be sealed for the purpose of preventing air flow, rodent, and insect access shall be sealed where specified on the drawings with applicable duct sealing compound, such as "Chico Compound," "Duxseal," or "Kerite putty." "Chico Compound" shall be used with sealing conduit fittings. Installation shall be in accordance with Article 501 of the NEC.

13) Expansion couplings shall be installed in all conduit runs crossing building expansion joints and shall be located between conduit supports adjacent to the expansion joint,

14) Conduit runs in floor slab or underground shall be installed exactly as shown and dimensioned on the drawings. Any deviations from the locations shown on the drawings must be approved by the Contractor prior to installation of the conduit. The location of underground conduit shall be marked above ground in the manner specified on the drawings.

15) Conduit size 1 1/4-inch shall not be installed unless specified on drawings.

B. Heavy Wall Rigid Steel Conduit

1) Heavy wall rigid steel conduit shall be hot-dipped galvanized or electro-galvanized inside and outside. Conduit shall be National Electric or Triangle.

2) All fittings, boxes, etc., used with steel conduit shall be approved for such use.

3) All field cut threads in steel conduit shall be coated with electrically conductive anti-seize compound, Thomas & Betts "Kopr-shield" or approved equal.

C. Flexible Metal Conduit

Flexible steel conduit shall be explosion proof, rated for NEC Class 1, Division 1, Group D.

6. BOXES, COVER PLATES AND CONDUIT FITTINGS

A. Junction, Terminal and Pull Boxes

1) Junction and pull boxes shall be sized as indicated on the drawings Where not specifically sized on the drawings, all boxes shall be si

in accordance with the NEC.

2) Terminal boxes shall be provided with a removable panel for mounting relays, wiring devices, and terminal blocks. Terminal boxes shall be NEMA Type specified on drawings.

B. Device and Outlet Boxes

Surface mounted outlet boxes for receptacles, switches, etc., shall be cast type and fitted with rain tight covers.

C. Conduit Fittings

1) Cast malleable iron or steel conduit fittings used with rigid steel conduit shall be thoroughly coated with metallic zinc or cadmium inside and outside after all machine work is completed.

2) Cast conduit outlets used with rigid steel conduit shall be made of rust resisting alloys of iron or steel or shall be made of nonferrous materials, with threaded hubs for heavy wall rigid conduit. Fittings shall be Crouse-Hinds, Appleton or Killark.

3) Nonmetallic insulating type bushings used on rigid steel conduit shall be O.Z. type A, Thomas & Betts 200 series or Appleton type BBU.

7. WIRE AND CABLE

A. General

1) All wire and cable shall be delivered to the job site in complete coils bearing the manufacturer's name and approval tag, which shall indicate the wire size and type of insulation and shall bear the Underwriters' Laboratories, Inc., label.

2) All wire and cable furnished and installed shall be listed by Underwriters' Laboratories, Inc., for the specific type of installation (conduit, duct, cable tray, direct burial, aerial, etc.) shown on the drawings.

3) No wire and cable shall be pulled until the conduit system is complete from pull point to pull point.

4) Care shall be exercised while installing wire in conduits so as not to damage the conductor insulation. Ideal Industries "Yellow-77" or "Wire Lube" or Electro Compound Company's "Y-ER-EAS" compound may be used in pulling nonarmored conductors and shall be used if wire is pulled by mechanical means.

5) Bending radius of any insulated wire or cable shall not be less than the minimum recommended by the manufacturer. Maximum pull tension o any wire or cable shall not exceed manufacturer's values.

6) Temporary lighting and power circuits required for construction shall be installed in a safe manner and removed when the work is complete.

B. Conductors

1) The minimum size conductor to be used for power and lighting circuits shall be No. 12 AWG. Where specified on the drawings, No. 14 and No. 16 AWG conductors may be used for control circuits. Communications conductors shall be sized as specified on the drawings.

2) All conductors No. 4 AWG and smaller shall be copper. Conductors No. 2 AWG and larger shall be as specified on the drawings.

3) All wire No. 8 AWG and larger shall be stranded. Wire in size No. 10 AWG and smaller feeding lights and receptacles shall be solid. Wire No. 10 AWG and smaller installed for motor leads and control wiring shall be stranded.

4) Cables shall have standard stranding for sizes as follows: 7 strands up through No. 2; 19 strands from No. 1 through No. 4/0; 37 strands from 250 MCM through 500 MCM: and 61 strands from 600 MCM through 1000 MCM, unless otherwise noted on the drawings.

C. Color Coding

1) All grounding (neutral) conductors No. 2 AWG and smaller shall have white insulation. Grounded conductors larger than No. 2 AWG shall be identified at all terminal or junction points by wrapping with white, self adhesive, vinyl plastic electrical tape, Scotch No. 35. Sufficient length of cable nearest terminal or junction point shall be taped so that neutral conductor shall be easily identifiable when covers of lighting panels, transformers, junction boxes, safety switches, etc., are removed. Ungrounded (phase) conductors may be any available colors other than white, gray, or green.

2) Any insulated conductor intended solely for grounding purposes shall be identified by a continuous green color or a continuous green color with one or more yellow stripes.

3) Underground single conductor control circuit wiring may be a combination of any colors other than white, gray, or green. The grounded control circuit conductor shall be identified in accordance with 7.C.1).

4) Conductors of multi-wire branch power and lighting circuits shall have identifying colors in conformity with paragraph 210-5 of the NEC. A unique color scheme shall be used for each different voltage system.

D. 600 Volt Insulation

1) Wire and cable with a 600 volt insulation rating shall be furnished and installed for all power feeders, motor leads, lighting, and control circuits that are designed for operating voltages up to and including 550 volts.

2) All wiring installed in conduit and raceways, up to and including No. 10 AWG, shall be single conductor type TW (600C), unless otherwise specified on the drawings.

3) All wiring installed in conduit and raceways, No. 8 AWG and larger, shall be single conductor type THW (75°C) or type XHHW (75°C), unless otherwise specified on the drawings.

8. SPLICES, TAPS AND CONNECTORS

A. General

1) Splices and taps shall be made in junction boxes or wiring gutters. Solderless connectors shall be used exclusively except for fire alarm systems.

2) All compression connectors shall be installed in strict accordance with manufacturer's instructions, using properly sized and keyed connectors and dies. All compression connectors shall be Thomas & Betts or an approved equal.

B. Copper Conductor Connectors 300 Volts or Less

1) Splices, taps and terminations of stranded conductors No. 10 AWG and smaller shall be made with pressure connectors, Thomas & Betts "Sta-Kon" or equal. Splices and taps in solid No. 10 AWG and smaller shall be made with split-bolt connectors or with insulated wire nuts, Thomas & Betts "Piggy" or equal. Terminations of solid conductors No. 10 AWG and smaller may be made by forming the wire to fit under a screw head, thus requiring no connector.

2) Splices and taps in copper conductors No. 8 AWG through No. 1 AWG and terminations of these sizes of conductors other than in equipment lugs (i.e., molded case circuit breakers) shall be made with either copper mechanical connectors or with wrought copper compression connectors.

Type of Connection	Type of Connector	Thomas & Betts Series No.
Splice	Mechanical - Split-bolt	2T thru 8T
Tap	Mechanical - Split-bolt	2T thru 8T
Termination	Mechanical - One-hole lug	#31000
Splice	Compression - Two-way connector	#54500
Tap	Compression - "C" tap	#54700
Termination	Compression - One-hole lug	#54100

3) Splices and taps in copper conductors No. 1/0 AWG through 4/0 AWG and terminations of these sizes of conductors other than in equipment lugs (i.e., molded case circuit breakers) shall be made with wrought copper compression connectors.

Type of Connection	Type of Connector	Thomas & Betts Series No.
Splice	Two-way connector	#54500
Tap Termination	"C" tap	#54700
Termination	Two-hole lug	#54200

4) Copper conductors shall be thoroughly cleaned before connectors are installed.

C. Insulation of Splices and taps 500 Volts

1) Splices and taps in thermoplastic (TW, THW and XHHW) and rubber (RHW) conductors shall first be insulated with rubber tape, Okonite Company "Okonite" type No. 10. Connection shall then be wrapped with all weather vinyl plastic tape, 3M Company "Scotch" No. 88. Connections not housed in a junction box or other metal enclosure shall have an additional protective wrapping of three layers of friction tape, Okonite Company "Manson" type No. 5, to protect the connection from abrasions.

2) All outdoor splices and taps in type TW, THW, RHW, and XHHW insulated conductors, such as splices at service entrances and any connections which are subjected to high humidity, shall be insulated as specified in paragraph 8.C.1), then wrapped with linen cloth tape and painted with two brushed-on coats of General Electric Company "Glyptal."

3) On all splices and taps the tape applied directly over the connector shall be wrapped as tight as possible in a manner so as to pad the sharp edges and fill the indents of the connector. The outer tape shall be applied until the total area of the initial taping is covered with a minimum of four layers. The total thickness of the combination of tapes shall be at least equal to the thickness of the conductor insulation. Tape of an appropriate width shall be used.

4) Underwriters' Laboratories, Inc., approved insulators for splices and taps, similar to Burndy "Poly-tap", may be used only where specified on the drawings.

D. Fire Alarm Station and System Wiring

1) The fire alarm station shall be a three fold type manual coded, with micro-switch for local alarms. Systems timing shall be for one second and match the existing fire alarm system. The station shall be surface mounted and shall be a Gamewell Catalog Number 34-52 or approved equal with box number and code wheel being #143. The station shall be painted as shown on the Subcontract drawing.

2) All fire alarm system conductors shall be copper. All splices and taps shall be made in junction boxes only. All wiring connections shall be made by twisting and soldering conductors. No exceptions shall be made. Connections may be insulated by one of the two following methods.

a. By taping in accordance with paragraph 8.C.1) of this specification or,

b. By installing phenolic compound wire nut of appropriate size over soldered joints.

3) At terminal points, solid wire No. 12 AWG and smaller may be formed to fit under a screw head requiring no connector. Solid wire larger than No. 12 AWG and stranded conductors shall terminate with solder type connectors. Pressure type connectors and terminals (e.g., T&B "Sta-Kon", Burndy "Hydent", etc.) will not be accepted. Self stripping electrical connectors (e.g., "Scotch Lok" type UR) and wrap cap insulators, (e.g., Ideal No. 415) will also be rejected.

4) After all splices have been soldered and before insulating tape or wire nuts are installed, the Contractor shall inspect all joints to determine compliance with the specification. Any connections found which are made other than as directed herein will be rejected. Unacceptable connections shall be corrected. A final inspection of all connections will be made after installation of insulating tape or wire nuts.

9. GROUNDING

A. General

The grounding of electrical equipment, building steel, grounded electrical circuits, etc., shall be in accordance with the Subcontract drawings. In addition to the grounding specified herein or on the drawings, all ground connections required by the NEC shall be furnished and installed. Where grounding conductor sizes are omitted from the drawings, the minimum requirements of the NEC shall apply.

B. Electrical Equipment Grounding

1) All motor frames, panelboards and enclosures housing electrical devices, such as safety switches, motor starters, control devices, etc., shall be grounded to the building ground grid wit? an equipment grounding conductor.

2) The equipment grounding conductor shall be a continuous copper wire and shall be run in the same conduit with the current carrying conductors. Aluminum ground wires are not permitted and will not be accepted. Wire installed in rigid steel conduit may be either bare or green insulated. Wires No. 8 AWG and larger shall be stranded. Wires No. 10 AWG and smaller shall be solid.

3) Equipment grounding conductors shall connect to the building ground grid at ground busses and ground inserts or to existing equipment

grounding conductors as shown on the drawings. Grounding or bonding of equipment to building steel as a sole means of grounding will not be acceptable and the use of conduit as the equipment grounding conductor is not permitted.

4) Connections to ground busses and connections of equipment grounding conductors to switch boxes, panelboards, cabinets, etc., shall be made with either bolted mechanical lugs or compression connectors. Before connections are made, all contact surfaces shall be clean and bright; and a compound to prevent oxidizing, such as "No-Oxide" or "Contact Aid" shall be applied to insure good electrical contact.

5) A ground bar is required in each lighting and distribution panel board for termination of all equipment grounding conductors. This bar shall be bolted directly to the panelboard cabinet. The ground bar shall be copper and shall be furnished and installed by the Subcontractor unless furnished as an integral part of the panelboard.

6) Neutral bars in lighting and distribution panelboards shall be ungrounded and shall be isolated from the panelboard cabinet.

C. Building Ground Grid

1) The building ground grid shall be buried stranded copper cable, sized and installed as shown on the drawings. All underground connections shall be made by a thermic process, such as the "Cadweld" method, or with the following cast copper compression connectors.

2) Taps and splices shall be made with compression ground grid connectors, Thomas & Betts series #53,000 or approved equal. Connections to ground rods shall be made with compression ground rod connectors, Thomas & Betts series #52,000, or approved equal.

3) Before installation of compression connectors, the points of connection shall be coated with Thomas & Betts "Kopr-Shield" compound or approved equal for improved conductivity.

4) Ground rods shall be 3/4-inch diameter and 15' long. They shall be copperweld type, Joslyn No. J8350. Ground rods shall not be placed underneath any sidewalk, roadway, or other locations which may become inaccessible.

5) Ground grid shall be inspected and approved in accordance with section 18.E before any backfilling is done.

D. Structural Grounding

1) The building steel shall be grounded and ground busses or ground inserts located as shown on the drawings,

2) Connections of ground cables to structural members shall be by bolting.

3) Ground cables shall be terminated on ground busses with copper compression fittings in accordance with paragraph 9.B.4).

E. Non-Electrical Equipment

Non-electrical equipment, such as metal tanks, platforms, supports, etc., shall be grounded in accordance with the drawings.

F. Grounded Conductors

The grounded conductor of any grounded electrical circuit shall be grounded in accordance with the drawings and paragraph 9.J.

G. Motor Grounding

1) The equipment grounding conductor, either bare or insulated green, shall be terminated under one of the bolts holding the junction box to the motor frame. On motors where the junction box is welded in place or cast as part of the frame, the box shall be drilled and tapped.

2) Terminations of motor equipment grounding wires shall be made in accordance with paragraph 9.B.4).

H. Lighting Fixture Enclosure Grounding

A continuous ground conductor, preferably a solid, bare wire sized in accordance with the drawings, shall be run in the same conduit as the circuit conductors and attached to the metal enclosure of each lighting fixture and related local switch box.

I. Receptacle Grounding

All receptacles, 120 volts, 208 volt, 240 volt, or 480 volt, shall be provided with a grounding pole, which shall be attached to a continuous ground conductor sized in accordance with the drawings. the ground conductor shall be permanently grounded to the building system.

J. Transformer Neutral Grounding

The secondary neutrals of all 120/240, 1 phase and 208Y/120 volt, 3 phase lighting transformers shall be grounded in accordance with section 250-26 of the NEC.

10. LIGHTING SYSTEM

A. General

1) Lighting fixtures for general lighting shall be of the type, size and kind specified in the fixture schedule or legend on the drawings.

2) The Subcontractor shall clean all lighting fixtures after installation.

3) At the time of final inspection, all fixtures and equipment shall be complete with the required glassware and/or reflectors which shall be clean and free of defects. Any glassware or reflectors damaged prior to the time of final acceptance shall be replaced.

B. Lighting Panelboards

1) Lighting and low voltage panelboards for operation on 208 or 240 volt shall be rated for 240 volt ac/250 volt dc service. Panelboards sha be dead-front safety type with a main circuit breaker and shall be provided with the type, number, and size of branch circuit breakers as indicated on the drawings. Each panelboard shall have a fully rated isolated neutral bus and be equipped with an equipment ground bus. Panelboards shall be equal to General Electric Company type NAB with type TEB bolt-in branch breakers and a type TE3 main breaker for main breakers 100 amp below or type TFJ from 110 amps to 225 amps; or Gould/ITE Company type NAB with type E2 branch breakers and a type E2 main breaker for main breakers 100 amps and below or type FJ from 110 amps to 225 amps, unless otherwise specified on the drawings. Panelboard design shall permit direct interchange in field of 1P branch breakers with ground fault interrupter "GFI" breakers. Panelboard conductors shall be tin plated copper.

2) The main circuit breaker shall be installed in the panelboard such that the breaker is closed when the operating handle is moved upward (for vertically mounted breaker) or to the right (for horizontally mounted breaker). The main and branch breakers shall have "off-on" markings to clearly indicate the handle position.

3) Cabinet boxes shall be constructed of zinc coated steel and shall conform to the requirements of the Underwriters' Laboratories, Inc., standard for cabinets and boxes. Panelboard fronts shall have door-in-door construction with combination catch and lock. The complete front assembly shall be constructed of code-gage steel with gray enamel finish. A directory holder shall be mounted on the inside of the door. A neatly typed directory properly identifying each circuit shall be mounted therein. Cabinets shall be surface or flush mounting as indicated on the drawings.

C. Circuit Identification

Electrical service (120 volt ac) for safety shower lights shall be supplied from a circuit exclusively for that purpose. These circuits shall be clearly identified as supplying emergency lighting. The circuit directory shall be marked "DO NOT TURN OFF," and clips shall be installed on the circuit breaker operating handles to assure that the circuit breakers are maintained in the "ON" position.

D. Lamps

All lamps shall be furnished and installed by the Subcontractor. Incandescent lamps for connection to 120 volt circuits shall be specifically rated for 125 volts unless otherwise specified. Quartz, metal halide, and high pressure sodium lamps shall be as specified on the drawings.

E. Wall Switches

1) Wall switches shall be specification grade flush tumbler type with the operating mechanism totally enclosed in a molded phenolic composition case rated at 20 amps, at 125 volts unless otherwise specified on th

drawings. Switches used on A.C. circuits shall be "ac only" rated.

2) Switch enclosures and cover plates shall be as specified on the drawings.

F. Fire Alarm Indicating Light

The fire alarm indicating light shall be a weatherproof incandescent fixture with red globe and cast guard, Crouse-Hinds catalog Number VD 2759 with red globe Catalog Number VN75, or equal.

11. RECEPTACLES

A. General

1) All receptacles shall be as specified on the drawings.

2) Receptacle enclosures and types of mounting, surface or recessed, shall be as specified on the drawings.

3) Receptacles and cover plates shall be installed only after walls are finished in the area.

12. DISTRIBUTION EQUIPMENT

A. Circuit Breakers

1) Circuit breakers shall be of the frame size, trip rating, and number of poles indicated on the drawings. Circuit breakers shall be supplied in NEMA 1 enclosures, unless otherwise noted on the drawings, with provisions for locking the handle in the open position.

2) Circuit breakers, unless otherwise noted on the drawings, shall be molded case, quick-make, quick-break, ambient compensated, thermal magnetic and capable of safely interrupting all loads up to and including interrupting rating listed below.

Frame Size Amps	Trip Amps	Poles	Voltage	Symmetrical Interrupting Rating Based on NEMA
100	15-100	1, 2	120/240	7,500
100	15-100	3	240	10,000

D. Contactors

1) Contactors for nonmotor loads shall be magnetic type without overload protection. Number of poles, current ratings and control device requirements shall be as shown on the drawings.

2) Enclosures shall be NEMA type noted on the drawings.

3) Contactors shall be Allen Bradley Bulletin 702L, Cutler Hammer series C10, Square D class 8502, or approved equal.

13. MOTOR CONTROLS

A. Magnetic Starters - Full Voltage

1) Magnetic motor starters shall be combination type, rated for 600 volts, with a circuit breaker or fused disconnect (as specified) mounted within the enclosure unless otherwise specified on the drawings.

2) Magnetic starters for 3 phase motors shall be equipped with three thermal overload relays for overload protection. Overload relay heater elements shall be sized and installed by the Subcontractor in accordance with motor nameplate full load current.

3) Operating coils shall be 120 volts, 60 Hz. When magnetic starters are used on the 480 volt system, a 480-120 volt, 1 phase, 60 Hz. control transformer shall be mounted within the enclosure. The X_1 terminal of the control transformer secondary shall be fused. The X_2 terminal of the control transformer secondary shall be grounded.

4) Enclosure shall be NEMA type noted on the drawings. The circuit breaker or disconnect switch shall be operable by hand from outside the enclosure and shall be so interlocked with the door that it must be turned in the "Off" position before the door can be opened. A semi-secret device shall be included to permit qualified personnel to open the enclosure with breaker closed.

5) Starters shall be Allen Bradley Bulletin 712 or 713, Cutler Hammer type A30 or A40 or Square D class 8538 or 8539.

B. Manual Starters - Full Voltage

Starters for single phase motors, 240 volts or less, shall be Allen Bradley Bulletin 600, General Electric CR 101, or Square D class 2510.

C. Control Devices

1) Push-buttons, selector switches, and indicating lights shall be heavy duty oiltight, surface mounted in NEMA type 13 enclosure indoors, NEMA type 4 enclosure outdoors, and NEMA type 7 enclosure in hazardous areas unless otherwise noted on the drawings.

2) Individual units shall be furnished with standard *size* legend plates. Markings *on* the plates shall be in accordance with the drawings.

3) Control devices shall be Allen Bradley Bulletin 800T, Square D class 9001, 04 General Electric form CR 2940.

D. Terminal blocks, where required and not specified on the drawing shall be Buchanan "Medium duty", sectional type, with tubular clamp type terminal sections, Cat. #515 and end pieces Cat. #530. Pressure sensitive white marking tape, Cat. #50, shall be used for terminal identifications.

14. MISCELLANEOUS EQUIPMENT

A. Motors

All motors will be furnished under other specifications. The Subcontractor shall furnish all motor control and protective devices unless otherwise specified.

B. Electric Heaters

Electric heaters shall be furnished under other specifications. The Subcontractor shall furnish and install all heater control and protective devices unless otherwise specified.

15. IDENTIFICATION - EQUIPMENT AND CIRCUITS

A. Equipment

1) Safety switches, circuit breakers, motor starters, lighting panels, power panelboards, and other similar electrical equipment shall be identified by means of "Dymo" No. 5134-09, 3/4-inch, black plastic adhesive tape having letters approximately 1/2-inch high.

2) The identification shall be in accordance with the one-line diagram and shall include the following:

a. Maximum voltage
b. Equipment designation
c. Source of supply
d. Equipment supplied

Example of power distribution panel identification:

(Item a) 480 volts ac
(Item b) Power dist. pnl. "PDP"
(Item c) Fed from MCC-1, Compt. 5K

3) Light switches, receptacles, and other similar electrical devices shall be identified by means of "Dymo" No. 158-9, 1/2-inch black plastic adhesive tape having letters approximately 5/32-inch high. The tape shall be applied to the front cover plates. For example, a lighting switch on circuit 15 from panel B would be marked "120 Volt, 1 phase, Circuit 15, LPB".

4) Surfaces shall be cleaned with a solvent such as Varsol prior to applying tape. After the tape has been applied to the equipment or device, a brush coat of clear lacquer shall be applied over the tape, making sure that all edges of the tape are well covered. The identification tape and seal coating of clear lacquer shall be applied prior to field painting. The identification tape shall then be masked until field painting is completed, after which the masking shall be removed.

3. Lighting and Distribution Panelboards

The panel directories in lighting and distribution panelboards shall be neatly filled out, showing for each circuit the equipment served, floor and column location, and room number where applicable. Spare circuits shall be identified on the schedule.

C. Conductors

1) All single conductor power and control wiring shall be identified in all readily accessible junction boxes in the wiring system as well as at all terminations. Conductors need not be identified in pull boxes where no taps or splices are made. Identification shall be by means of taped on numbers or letters attached to each conductor in accordance with the numbering system on the drawings.

2) All 3-phase power feeder conductors shall be identified by phase designations; e.g., ØA, ØB, ØC.

D. Conduits

1) Conduits shall be identified as shown on the drawings.

2) The conduits shall be identified at the switchgear, entry and exit points of all junction or pull boxes, on both sides of any walls or floors which conduits penetrate, and at equipment in which they terminate. Conduits run underground shall be identified at both ends. The identification tags shall be securely attached to conduit with "Tyraps". All "Tyraps" used outdoors shall be sunlight resistant.

16. PAINTING

All painting of exposed conduit, panels, cabinets, pull boxes, supports, etc., shall be accomplished in accordance with the various requirements of Section 11.

17. POLE LINES

A. General

All construction shall be accomplished in accordance with this specification, and the drawings.

B. Wood Poles

1) Wood poles shall be creosoted Southern Yellow Pine, conforming to ANSI Standard 05.1 and of the class and length shown on the drawings. Structural members shall be pressure creosoted and shall conform to the applicable requirements of the AWPA specifications. Poles shall be roofed, gained and bored before treatment wherever possible. Holes bored in gains cut in the field shall be thoroughly treated before bolts or cross-arms are installed.

2) Before treatment, all poles shall be permanently and legibly branded

with the manufacturer's name and/or symbol, class, length and year of treatment. This data shall be branded on the pole five feet above the ground line.

C. Cross-Arms

Cross-arms shall be straight-grained, air or kiln dried, standard cross-arm grade Douglas Fir, or close-grained creosoted or pentachlorophenol treated cross-arms grade Southern Pine. The vertical and longitudinal strength of cross-arms shall conform to the requirements of National Bureau of Standards Handbook H-30. Cross-arms shall be straight to within 1/10 inch per foot of length. Twist or bend within this limit shall be in one direction only. Cross-arms shall be drilled for pins, through-bolts, brace-bolting and double arming bolts as required for the application.

D. Hardware

1) Pole line hardware shall be provided as indicated on the drawings. All hardware such as nuts, bolts and washers or miscellaneous steel supports shall be hot dipped galvanized steel.

2) Bayonets for static wire installation shall be 48 inch, Joslyn straight bayonet J1132 or corner bayonet J1136, or approved equal.

E. Storage and Handling

Poles and structural members stored for more than two weeks shall be stacked on creosoted or decay-resisting skids of such dimensions and so arranged as to support the poles and structural members without producing noticeable distortion in any of them. Poles shall be piled in such a manner so as to permit free circulation of air, and the bottom members of the pile shall be at least 1 foot above the general ground level or any vegetation growing thereon. No decayed or decaying wood shall be permitted to remain underneath stored poles. Treated poles shall not be dragged along the ground. Pole tongs, cant hooks, and other pointed tools capable of producing indentations of more than 1 inch depth shall not be used in handling the poles. No tools shall be applied to the section 1 foot above and 2 feet below the ground line of any poles.

F. Setting Poles

The minimum depth of pole setting shall be as specified on the drawings. Should it become necessary to shorten a pole, this shall be done at the top end. If a pole is cut subsequent to treatment with preservative liquid, the bare portion of the pole shall be given a further application of perservative. When poles are to be set, holes of ample size shall be dug to allow the easy entrance of the poles, and the size of the hole at the bottom shall be large enough to permit the proper use of tamps. When backfilling holes, a minimum of three tampers shall be used for each shoveler in order to insure that the earth is tightly packed. In no case shall earth be thrown into a greater depth than 6 inches before being tamped hard. Surplus earth shall be packed around the pole in a conical shape to facilitate drainage. Poles on straight runs shall be carefully aligned, with

crossarms at right angles to the direction of the run. Poles shall be set vertically except at dead-ends, or where guyed, in which case they shall be raked 3 inches per 5 feet of pole height away from the direction of pull prior to the attachment of conductors. The pole shall retain some rake and shall be less than vertical after the conductors are installed.

G. Cross-Arm Installation

Cross-arms shall be bolted to poles by means of through-bolts, as shown on the drawings. Through-bolts shall be of proper lengths to extend at least 1/8 inch and not more than 2 inches beyond the nut after installation.

H. Guy Installation

Guys shall be furnished and installed as indicated on the drawings. Guys shall be attached as near as feasible to the center of the conductor load to be sustained. Guy wire shall be seven strand, high strength, extra-galvanized steel. Guy strain insulators shall be installed in each guy. Insulators shall be so positioned in the guy wire that in the event the guy wire is broken, the uninsulated upper portion of the guy cannot swing to any point less than 8 feet above the ground. Anchor rods shall be installed so as to be in line with the pull on the loaded guy wire. Whenever practicable anchors shall be located so that guy wires will form a 45 degree angle with the ground line. The holding power, transverse strength and longitudinal strength of guys shall conform to the requirements of National Electrical Safety Code, Handbook 81 for Grade "B" Construction. The end of each guy attached to the ground anchor shall be equipped with a half-round, galvanized steel protector, 8 feet long. Guy anchors shall be Joslyn J1484Y, or equal.

I. Static Wire

Static wire shall be steel 3/8 inch, 7 strand Class B galvanized, utility grade, with a breaking strength of not less than 11,500 pounds. Splices under tension shall be mechanically and electrically secure with a strength not less than the conductor. Splice materials, sleeves, fittings and connectors shall be non-corrosive and shall not adversely affect the conductor with which they are used. All dead ends shall be made with approved clamps designed for the purpose, with a strength not less than the conductor. Handling shall be identical to line conductors.

18. TESTS AND INSPECTIONS

A. General

1) This specification sets forth the electrical testing procedures required for the acceptance of electrical equipment as described in the paragraphs that follow.

2) The purpose of the specified tests and inspections is to determine that each piece of equipment is in satisfactory condition to successfully perform its intended function.

3) It is the intent of these procedures to insure that all workmanship and materials and the manner and method of erection and installation conform to manufacturer's instructions and, except as modified herein, IEEE, ANSI standards, the NEC, and ASTM.

3. Responsibility

1) The Subcontractor shall perform and supervise all tests unless specifically noted otherwise herein or on the drawings. The Subcontractor shall furnish all test equipment required for the tests performed by him and shall be responsible for providing such safety measures as are required for each test.

2) The Subcontractor shall schedule all testing with the Contractor and no testing of any kind shall be performed without the Contractor's approval.

3) The Subcontractor shall notify all involved non-Government parties prior to tests, advising them of the test to be performed and the scheduled date and time.

4) The Subcontractor shall give manufacturers sufficient notice to allow the necessary arrangements to be made and to have their engineer or representative present at tests where their presence is required. Where the manufacturer's responsibility includes both electrical and mechanical performance, the Subcontractor shall coordinate the tests with the other involved contractors.

5) The Contractor shall examine the Subcontractor's test equipment prior to use and may, at his discretion, require that the equipment be submitted to the Contractor for calibration.

6) The Subcontractor shall notify the Contractor at least 24 hours prior to test, advising him of test to be performed and the scheduled date and time of test. The parties notified shall be responsible for having their representative present at the designated time.

7) The Contractor shall ascertain that all tests specified are performed or waived and that all tests reports or waivers are retained in the Government file.

C. Test Reports

1) The Subcontractor shall prepare formal test reports for each piece of equipment, system, or cable requiring testing. The test reports shall contain as a minimum the following information:

a. Job title
b. Date of test
c. Equipment, system, or cable identification
d. Specific type of test
e. Description of test instrument and date of calibration
f. Section of specification defining test
g. Test results (correct all "Megger" readings to 20°C)
h. Signature of person supervising test

i. Signature of Subcontractor
j. Space for Contractor's signature

D. Acceptance

1) Acceptance of all electrical equipment and cables covered by the following test procedures shall be contingent upon proper execution of the required test and acceptable test results. Signing of the submitted test report by the Contractor shall certify Contractor's approval of the test and acceptance of the equipment, system, or cable listed on the test reports. The Contractor shall give the Subcontractor a copy of the signed test report. The Contractor shall retain all original test reports.

2) Acceptance of all electrical equipment not covered in the following test procedures and not requiring formal tests shall be dependent upon each piece of equipment satisfactorily performing its intended function as determined by the Contractor.

3) The Contractor may, at his discretion, prepare and issue an acceptance report for any accepted piece of equipment or system. The original copy shall be retained in the Contractor's file.

E. Grounding

1) This section of the specification sets forth the required electrical tests and inspections required for acceptance of ground systems.

Test No. 1 Individual Ground Rods

2) Before connecting the ground mat, each ground rod shall be tested for resistance to earth by a Biddle null balance "Earth Tester," using the "Three-Point-Method" described in IEEE Standard No. 81 using two auxiliary rods.

3) Individual ground rod resistance to earth shall be 15 ohms or less. If the resistance is found to be higher than 15 ohms, additional ground rods shall be driven and connected in multiplex with the rod under test until 15 ohms is obtained. Spacing of rods shall be a minimum of 10 feet.

Test No. 2 - Complete Ground Mat

4) After completion of Test No. 1, all ground rods shall be connected to the ground mat. Before any backfilling is done, the complete ground mat shall be visually inspected to insure that all connections have been made mechanically tight by the "Cadweld" or other approved process.

5) After a satisfactory visual inspection, backfilling shall be done; and the resistance of the complete ground mat to earth shall then be tested. The mat resistance shall be determined by use of the "Fall-of-Potential-Method," as described in the Standard Handbook for Electrical Engineers.

6) The maximum acceptable resistance for the complete ground mat shall be 1 ohm.

Test No. 3 - Ground Straps

7) Terminations of ground straps coming up from the buried ground mat, on ground busses, and building steel shall be visually inspected for solidness of connections, workmanship, and conformance with drawings and specifications.

Test No. 4 - Equipment Ground Busses

8) Equipment ground bus in distribution panel, shall be tested to assure low resistance bolted connection between bus and equipment enclosure.

9) Ohmmeter readings, using a "Kelvin Bridge" shall be taken between the equipment ground bus and the equipment enclosure. The maximum acceptable resistance shall be 0.01 ohm.

F. Lighting and Distribution Panelboards

1) This section of the specification details the electrical tests and inspections required for 120/208 volt, 3-phase and 120/240 volt, 1-phase ac lighting and distribution panelboards.

Test No. 1 - Mechanical

2) A physical check of the panelboard interior shall be made to verify clearances between live electrical parts, isolation of phases and neutral busses from cabinet and tightness of all mechanical connections.

Test No. 2 - Trip Rating

3) Check main and branch breaker trip element ratings for compliance with the panel schedule on the drawings. Check all breakers for correct mechanical and electrical operation. Test of breaker trip setting will not be required.

Test No. 3 - Wiring

4) Check that all wiring terminations and sizes of conductors are in accordance with the drawings and that all ground conductors terminate on the panelboard ground bus. Check that all wire connections are properly made and adequately tightened.

Test No. 4 - Phasing

5) Check phasing of incoming 3-phase feeder termination. Correct phase identification shall be 1-2-3, left to right; branch breakers shall be phased 1-2-3, top to bottom, as viewed from the front of the panelboard.

6) Panelboard phase identification 1-2-3 is equivalent to transformer phase identification X1-X2-X3.

G. Lighting Fixtures

1) Give all lighting fixtures an operational test. All fixtures must operate, all lenses and louvers must be clean, and all local switch must function properly.

H. 120 Volt Receptacles

1) After installation, all 120 volt receptacles shall be checked for correct wiring by the use of a Daniel Woodhead Model #1750 tester.

2) After completion of wiring test in paragraph 18.H.2), all 120 volt receptacles shall be given an "Equipment Ground Impedance Test." The test shall be performed using a Daniel Woodhead Model #7040 "Ground Loop Impedance Tester". The maximum allowable impedance shall be 1.0 ohms.

Caution : This test shall be performed at each receptacle with no loads plugged into other receptacles sharing the same equipment ground conductor.

3) All receptacle checks shall be made by the Subcontractor using test equipment furnished by the Subcontractor and in the presence of the Contractor. Any receptacles not passing the required tests shall be corrected by the Subcontractor and then verified by the Contractor as being acceptable.

I. 600 Volt Wire and Cable

1) This section of the specification covers the electrical testing of 600 volt insulated single and multi-conductor wire and cable.

Test No. 1 - Continuity

2) Make test to continuity and correctness of wiring and identification on all conductors of lighting and receptacle branch circuits, power and control circuits, and motor leads.

3) Test shall be made with a dc test device, such as a bell, a buzzer, or a light.

J. Low Voltage Motor Control Devices

1) This section of the specification details the required electrical tests and inspections required for acceptance of low voltage motor control devices.

2) Before any tests are made on motor control devices, ground busses shall have passed all tests specified in paragraph 18.E of this specification; and the following checks shall have been made.

a. A visual check of all starter locations, nameplates, etc.

b. A check of all wiring against manufacturer's and Contractor drawings.

c. Check ratings of and make settings on all over-current protective devices.

d. A operational check of control circuits.

e. A check for tightness of all connections.

Test No. 2 - Operational

3) Mechanical and electrical test shall be performed on all breakers and their starters and associated alarm and indicating devices. All interlock devices must be tested operationally.

SECTION 9 - EQUIPMENT

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9.300 - CARBON STEEL STORAGE TANKS

1. General

A. This Specification and the Storage Tank DESIGN DATA SHEETS prescribe the minimum requirements for the design, fabrication, inspection and testing of carbon steel storage tanks.

B. The Subcontractor shall provide design calculations, detail fabrication drawings, welding procedures and welder qualifications records for approval by the Contractor prior to start of fabrication. Fabrication should begin only after approval of certified calculations, drawings, welding procedures and welder qualifications records.

C. Deviations from this Specification are acceptable only as approved in writing by the Contractor. Any request for material substitution must have complete material description including ASTM designation, grade, type and correct thickness.

2. STANDARDS AND CODES

A. Unless otherwise specified, the storage tanks shall conform to the following applicable Codes, Standards and Specifications:

1) The 1980 Edition, latest addenda of the ASME Boiler and Pressur Vessel Code, Section VIII, Division I, for the design and construction of pressure vessels.

2) ANSI Standard B16.5, latest edition, for dimensional specifications and pressure ratings of flanges.

3) Standard Building Code, latest Edition.

4) OSHA Regulations and Requirements.

5) All state, local and municipal Codes, Laws, and Regulations where applicable.

3. MATERIAL

A. All material shall conform to the ASTM Specifications listed on the DESIGN DATA SHEET and as specified herein.

B. Material substitution must be approved by the Contractor.

C. Castings shall not be used for pressure parts.

D. Gasket material shall be Teflon or equal approved by the Contractor.

4. DESIGN

A. Pressure

Design pressure shall be as specified on the DATA SHEETS.

B. Temperature

Design temperature shall be as specified on the DESIGN DATA SHEETS

C. Corrosion Allowance

As specified on the DESIGN DATA SHEETS.

D. Shell, Roof and Other Elements

1) The minimum fabricated shell and head thickness of all storage tanks shall not be less than 3/16". This thickness is before the application of corrosion allowances.

2) Detailed engineering calculations substantiating the proposed design shall be provided by the Subcontractor and submitted to the Contractor for approval before starting fabrication. If part of the design calculations are computerized, the following must be submitted.

a. The name of the program used and its Developer if it is a commercially available computer program.

b. A synopsis of the program outlining the method used and date of development if the program is developed by the Subcontractor.

c. Printout of the input and output for the successful computer run that is used in the design.

3) All tanks shall have an external grounding lug attached at the lowest point.

4) All plate butt joints shall be full penetration continuous welds. Lap joints are not permitted.

E. Nozzles and Manways

1) Slip-on flanges shall be installed so that the face of the fla projects over the end of the pipe a distance equal to the pipe thickness plus 1/8" minimum. Minimum nozzle projection to be 6" unless noted on the DESIGN DATA SHEETS.

2) Number and size of nozzles required, and nozzle arrangements, will be as shown on the attached DESIGN DATA SHEETS.

3) Flange bolting should straddle the tank centerline. Vertical nozzles with horizontal flanges should have the bolting straddle the North-South centerline unless noted on the DESIGN DATA SHEETS.

4) Blinded nozzles shall be provided with a blind flange, pressure bolting, and a new service gasket of the type and material specified on the DESIGN DATA SHEETS.

5) Full penetration welds shall be used for all nozzle attachments. Details (c), (g), (h), (o), (v-1), (w-1), and (w-2) of Figure UW-16.1 of the Code are the acceptable nozzle attachment details. Reinforcing pad materials shall be the same material as the shell.

6) Nozzles, openings, and their reinforcements shall be outside the knuckle area of the heads.

7) Nozzles and manways on tanks to be lines or coated, except connections for internal piping, shall be installed flush with the inside of the tank. The interior surface shall be ground smooth and the nozzle neck provided with a minimum of 1/8" radius.

5. FABRICATION

A. Tolerances

Construction tolerances shall be per applicable items of Rust Standard P18-13.1 entitled "Dimensional Tolerances for Unfired Vessels", shown on page 9-7.

B. Welding

1) Qualification of Welders, Operators, and welding procedures must be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code.

2) Welding procedures, welding procedure qualifications, and welder qualification records shall be submitted in triplicate to the Contractor for approval prior to fabrication.

3) Tanks shall not have welds made with the following electrodes: E-6012, E-6013, E-7014, E-7020, and E-7024.

4) Electrodes and filler wires shall be kept clean, dry and properly stored according to the Manufacturer's recommendations. No electrodes or filler wire shall be used which are damp, greasy or oxidized.

5) All welding inside tank shall be continuous on all surfaces. Welds to be smooth and free of porosity. All heavy protrusions shall be ground out, and the weld shall not extend above the adjacent surface more than 1/16", merging smoothly into the base metal.

B. Surface Preparation

1) After completion and before final inspection, the Subcontractor shall thoroughly clean the tanks. Remove all the weld spatter, dirt, weld rod stubs, scale, grease, oil, and other foreign material from inside and outside of the tanks.

2) On the inside and outside of the tanks (including nozzles), all weld spatter, or tacks used for attaching scaffold brackets, key plates or any other temporary attachments shall be ground off smooth. Any pits resulting from the removal of said items shall be filled with sound weld metal and ground smooth.

3) The following shall apply to the inside surfaces:

a) All inside welds to be ground smooth. All corners and edges shall be ground to remove points and sharpness.

b) Any edge cut of alignment shall be ground to a smooth contour.

c) All welding on the tank must be completed before coating is applied.

6. TESTING METAL SHELL

A. Radiography shall be as per ASME Section VIII, Division I, for examination of welded joints. Additional radiographs shall be made of questionable welds when requested by the Contracting Officer.

B. A pneumatic test consisting of 20 - 25 psig air and soap shall be performed on all reinforcing pads.

7. INSPECTION

A. The responsibility for inspection and testing rests with the Subcontractor; however, the Contractor reserves the right

to inspect the tanks at any time during the fabrication to ensure that the materials and workmanship are in accordance with this Specification. A minimum of 10 days advance notice for schedules tests shall be given to the Contractor.

B. The approval of any work by the Contractor and/or his release of the part for shipment shall in no way release the Subcontractor of any responsibility for carrying out all provisions of this Specification.

C. The Subcontractor shall notify the Contractor at least ten days prior to the date the tanks are completed and ready for final inspection.

D. Written certification of inspection and tests shall be provided by the Subcontractor to the Contractor.

8. REPORTS AND RECORDS

A. The Subcontractor shall maintain a file of all documents required for this job including mill test reports on all material used. These mill test reports shall state the Specifications to which the material complies and shall include results of chemical analysis and physical tests.

B. Within ten (10) days after completion of fabrication the Vendor shall furnish two copies each of the following to the Contractor:

1) Summary report of all NDT examinations

2) Certified mill test reports

C. Within ten (10) days after completion of fabrication the Contractor shall furnish seven sets of certified drawings to the Contractor.

9. GUARANTEE

A. The Subcontractor shall be responsible for incorporating in his design the latest modifications which have been found necessary or desirable based on experience with similar tanks.

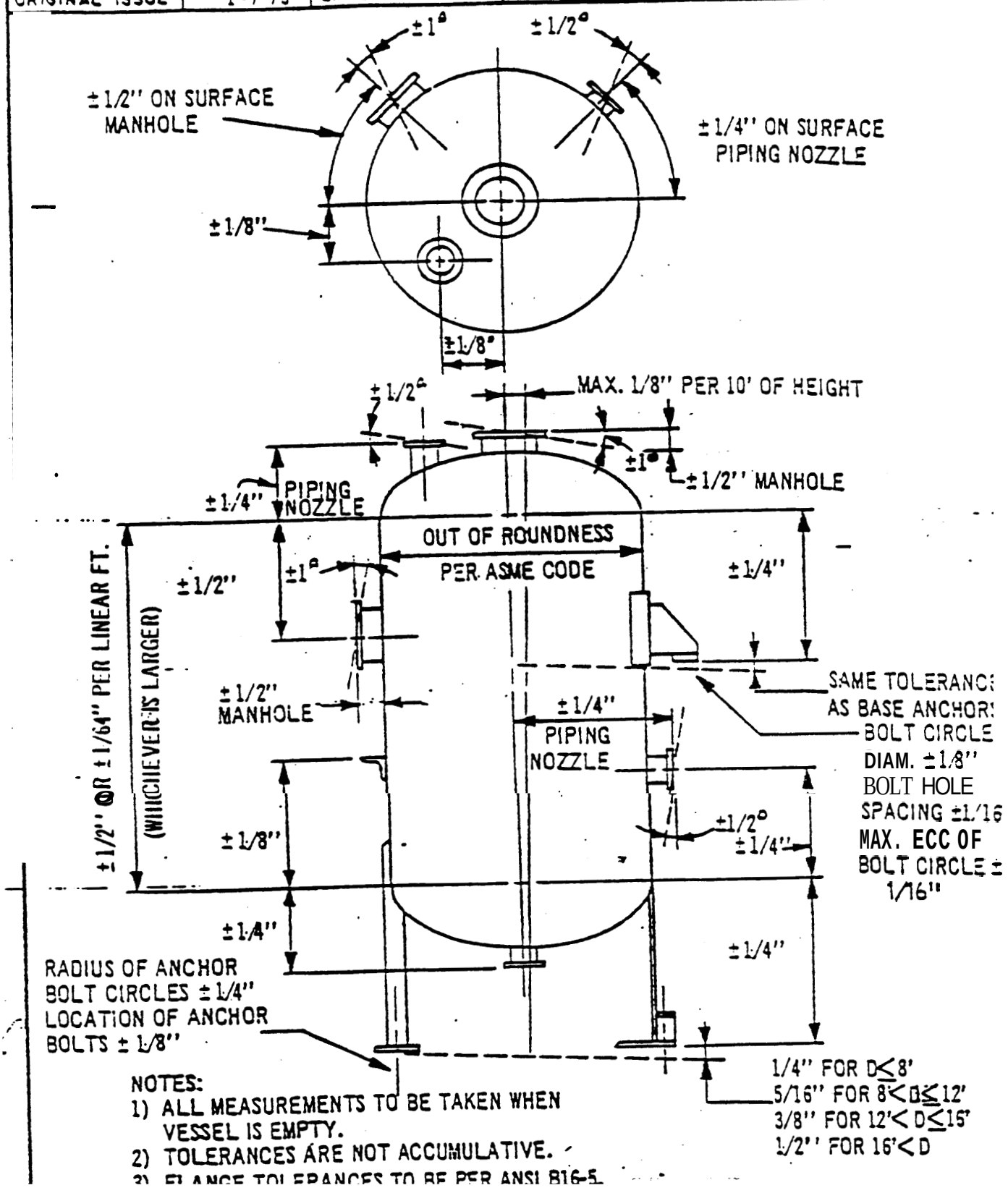
B. The Subcontractor shall guarantee that all tanks furnished shall be free from defects in material, workmanship, and design for a period of one year from the date of satisfactory completion of delivery and acceptance by the Contractor. The Subcontractor guarantees to repair or replace, at his own expense, the tanks or any part thereof found to be defective during said one-year period. All replacement parts and repairs shall be warranted for one year from date of replacement or repair.

10. SURFACE COATINGS

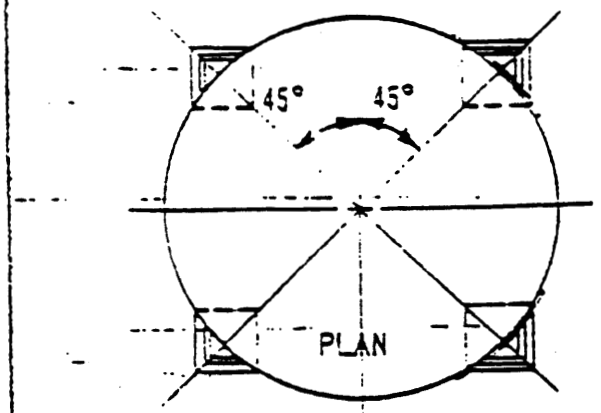
Surface coatings shall be primed and painted in accordance with Section 11 - Painting.

[redacted] [redacted]

The Rust	DIMENSIONAL TOLERANCES FOR UNFIRED VESSELS	P18-13.1
ORIGINAL ISSUE 1-7-75	LATEST REVISION	



NOTES:
1) ALL MEASUREMENTS TO BE TAKEN WHEN VESSEL IS EMPTY.
2) TOLERANCES ARE NOT ACCUMULATIVE.
3) FLANGE TOLERANCES TO BE PER ANSI B16-5.



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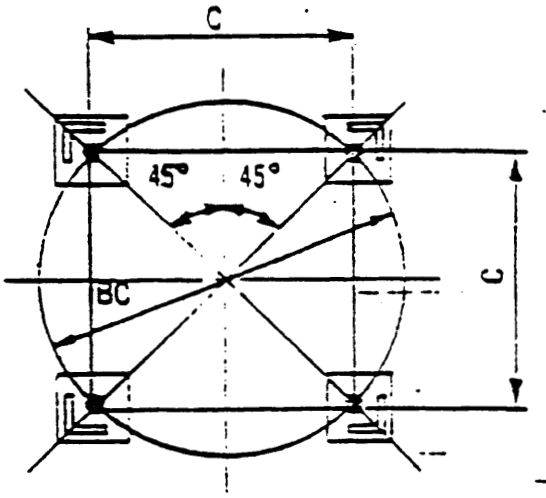
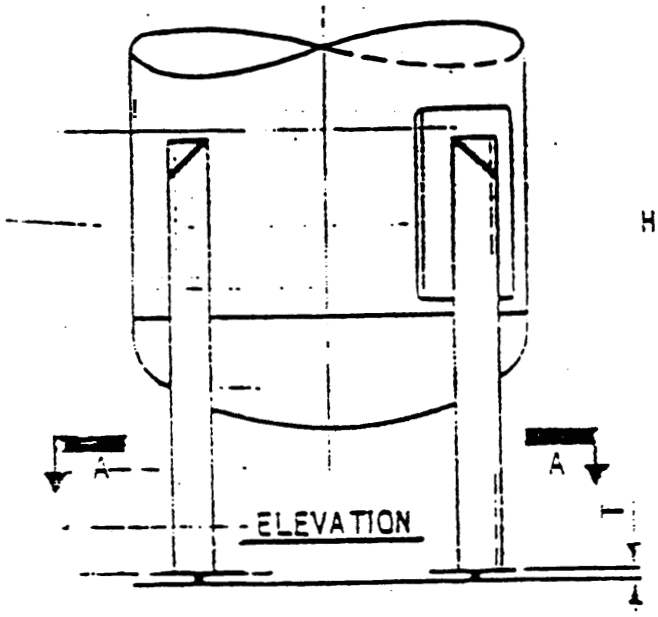
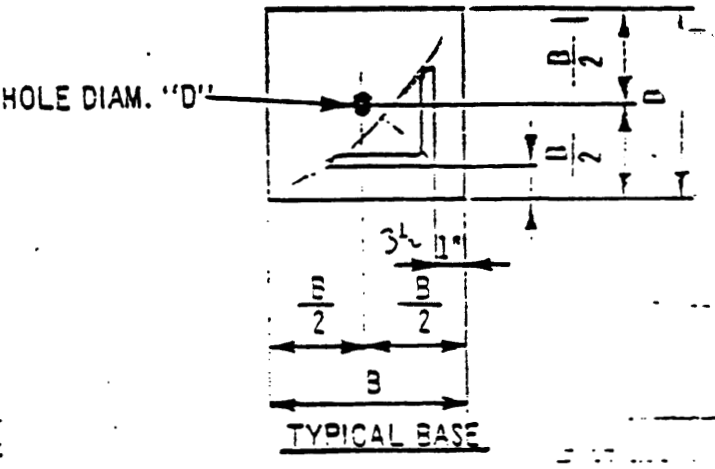
TYPICAL -NO PAD ℄'S



SECTION A-A





O.D. = OUTSIDE DIAMETER OF SHELL OR OF PAD ℄'S WHEN PAD ℄'S ARE USED (IN).

ANGLE LEGS	BASE ℄ B X B X T	BOLT CIR. DIM. BC	BOLT CTRS. C	HOLE DIAM. D
2½" X 2½"	5½" X 5½" X ½	O.D - 1"	.707 X BC	1-1/8"
3" X 3"	6" X 6" X ½"	O.D. - 1"	.707 X BC	1-3/8"
4" X 4"	7" X 7" X ⅜"	O.D. - 1"	.707 X BC	1-3/8"
5" X 5"	8" X 8" X 7/8"	O.D. - 1"	.707 X BC	1-5/8"
5" X 5"	9" X 9" X 1"	O.D. - 1"	.707 X BC	1-5/8"

22-006
8-4-81

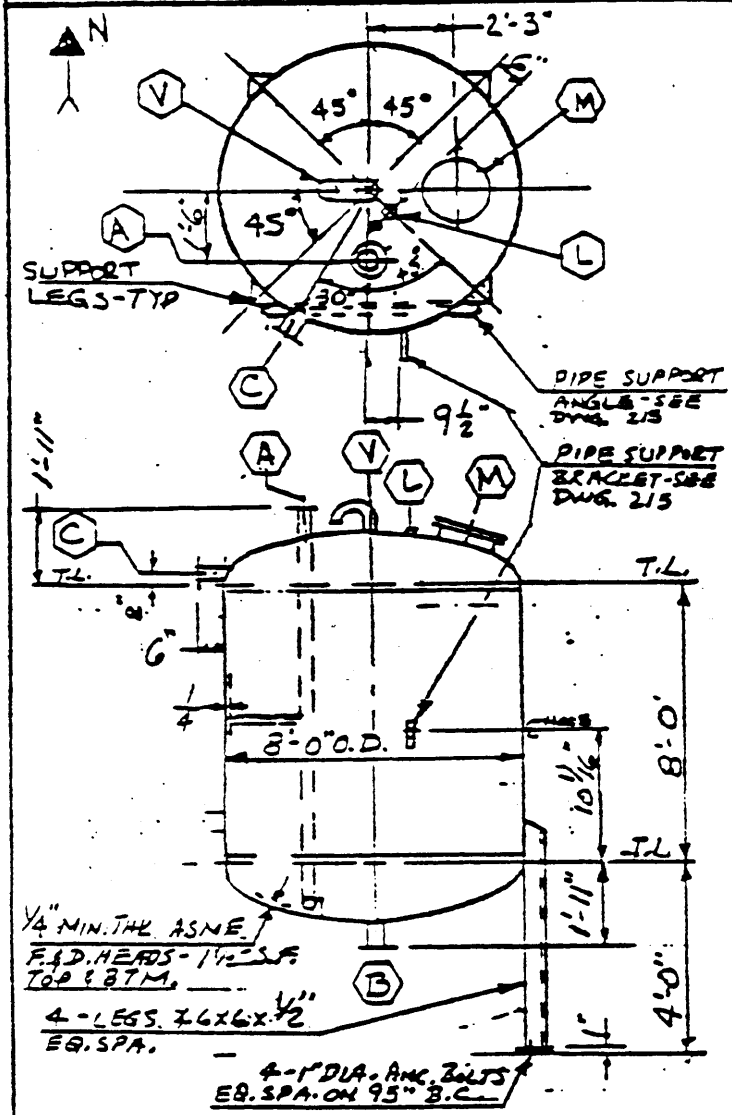
The Rust Engineering Company
A Subsidiary of Wheelabrator-Frye Inc.

PRESSURE VESSEL & STORAGE TANK DESIGN DATA SHEET

CONTRACT NO. 21-2115
SHEET NO. 2 1 1

REV.	BY	DATE	
1	JWB	12/10/81	APPL C-6

CUSTOMER : U.S. DEPT. OF ENERGY PADUCAH, KY.
DESCRIPTION : WASTE STORAGE TANKS
CAPACITY : 3,000 GAL. NOM. ITEM: F-501
NO. REQUIRED: ONE(1) AREA:



DESIGN CRITERIA

Oper Press. psig	ATMOS	Oper. Temp. °F	AMBIEN
Design Press. psig	ATMOS	Design Temp. °F	200
Sp.G. of Contents	1.0	Lethal	NO
Code	ASME	Code Stamp	↓
Postweld H.T.	NO	Radiography	SPOT
Joint Eff. Shell	85 %	Joint Eff. Heads	100%
Corr. Allow. Shell	1/16"	Corr. Allow. Heads	1/16"
Corr. Allow. Bott.	—	Corr. Allow. Roof	—
Hydro. Test psig	FULL WATER	Air Test psig	NO
Wind Loading (1)	YES	Seismic Loading (1)	ZONE
Top Head - [redacted]	F & D	Bott. Head - [redacted]	F & D
Matls: Shell	A-283-C	Matls: Heads	A-283-
Roof	—	Bottom	—
Jacket	—	Internal Hd.	—
Noz. Necks	A-53-B	Noz. Flanges	A-105
Mhd. Necks	A-283-C	Mhd. Flanges	A-283-
Mhd. Covers	A-283-C	Noz. Blinds	—
Internal Pipe	—	Internal Figs.	—
Couplings	A-105	Handholes	—
Bolts-Studs	A-307	Nuts	A-307
Gaskets	TEFLON	Structural	A-36
Mhd. Davits	NO	Mhd. Hinges	YES
Platforms	↓	Platform Clips	NO
Ladder-Cage	↓	Ladder Clips	↓
Stair	↓	Stair Clips	↓
Insulation	↓	Insulation Suppts.	↓
Fireproofing	↓	Fireproofing Suppts.	↓
Trays	↓	Tray Supports	↓
Stiffener Rings	↓	Lining (3)	YES
Vessel Support (2)	4-LEGS	Allow. Soil Bearing	—
Surface Prep. Ins. (3)	YES	Surface Prep. Outs.	(4) YE
Shop Paint Inside	NO	Shop Paint Outside	
Field Paint Inside	NO	Field Paint Outside	NO
Jack. Design Press.	—	Jack Design Temp.	—
Jack. Type	—	Jack. Corr. Allow.	—

SCHEDULE OF APPURTENANCES

NOZZLES	ROD	SIZE	SER.	TYPE	MK.	MISC. FITTINGS	ROD	SIZE	SER.	TYPE	MK.
INLET (5)	1	2	150#	R.F.	A	LEVEL GA. (6)	1	1½	3000#	HALF COLD	L
OUTLET	1	2	↓	↓	B						
OVERFLOW	1	3	↓	↓	C	VENT	1	2	GOOSENECK		V
						MANHOLE	1	18	150#	RF	M

NOTES:
(1) STD BLDG. CODE
(2) PER RUST STD. P18-8.0. (SEE PAGE: 9-8)
(3) SEE SPEC. SEC. 9 & 11
(4) SEE SPEC. SEC. 11
(5) W/LEG - SEE DWG. 216
(6) W/ ACCESSORIES - SEE DWG. 217

VENDOR PROVIDE LIFTING LUGS

DESIGNED BY: JWB DATE: 10/27/81 CHECKED BY: WRK DATE: 11/2/81 APPROVED BY: DATE:

22-006
8-4-81

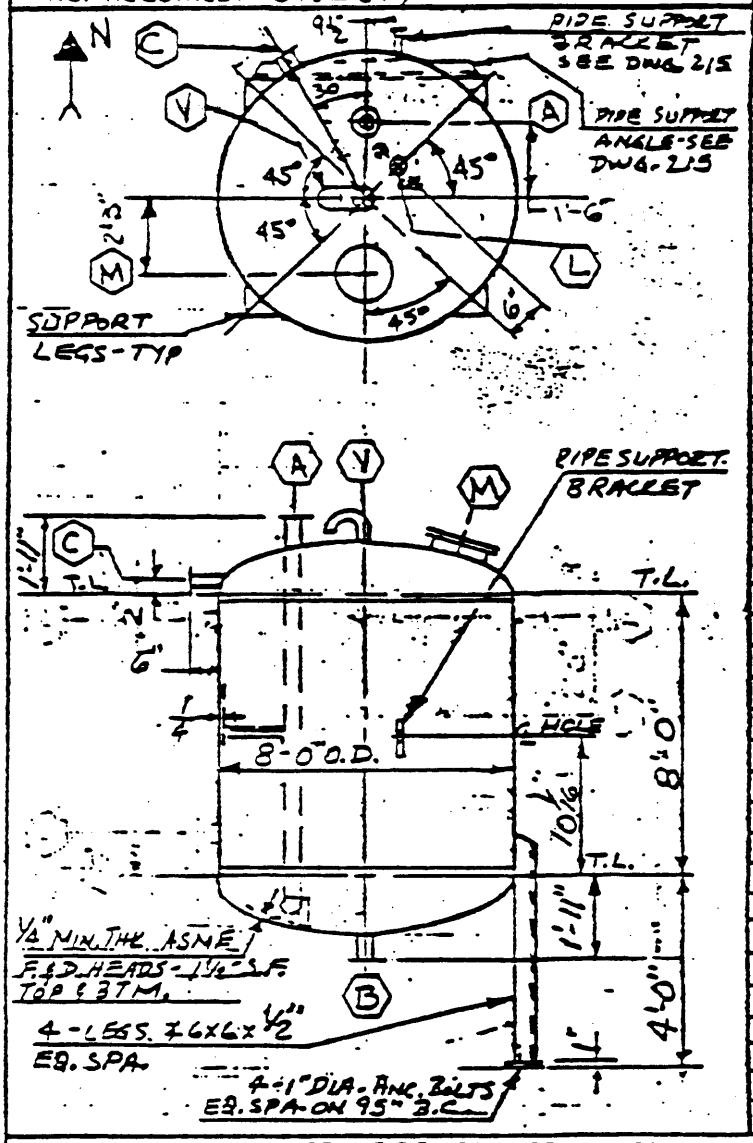
The Rust Engineering Company
A Subsidiary of Wheelabrator-Frye Inc.

PRESSURE VESSEL & STORAGE TANK DESIGN DATA SHEET

CONTRACT NO. 21-2115
SHEET NO. 212

REV.	BY	DATE

CUSTOMER : U.S. DEPT. OF ENERGY PADUCAH, KY.
DESCRIPTION : WASTE STORAGE TANKS
CAPACITY : 3,000 GAL. NOM.
NO. REQUIRED: ONE(1)
ITEM: F-502
AREA:



DESIGN CRITERIA

Oper Press. psig	ATMOS	Oper. Temp. °F	AMBIENT
Design Press. psig	ATMOS	Design Temp. °F	200
Sp.G. of Contents	1.0	Lethal	NO
Code	ASME	Code Stamp	↓
Postweld H.T.	NO	Radiography	SPOT
Joint Eff. Shell	85%	Joint Eff. Heads	100%
Corr. Allow. Shell	1/16"	Corr. Allow. Heads	1/16"
Corr. Allow. Bott.	—	Corr. Allow. Roof	—
Hydro. Test psig	FULL VAC	Air Test psig	NO
Wind Loading (1)	YES	Seismic Loading (1)	ZONE 3
Top Head —	F&D	Bott. Head —	F&D
Matls: Shell	A-283-C	Matls: Heads	A-283-C
Roof	—	Bottom	—
Jacket	—	Internal Hd.	—
Noz. Necks	A-53-B	Noz. Flanges	A-105
Mhd. Necks	A-283-C	Mhd. Flanges	A-283-C
Mhd. Covers	A-283-C	Noz. Blinds	—
Internal Pipe	—	Internal Flgs.	—
Couplings	A-105	Handholes	—
Bolts-Studs	A-307	Nuts	A
Gaskets	TEFLON	Structural	A
Mhd. Davits	NO	Mhd. Hinges	YES
Platforms		Platform Clips	NO
Ladder-Cage		Ladder Clips	
Stair		Stair Clips	
Insulation		Insulation Supps.	
Fireproofing		Fireproofing Supps.	
Trays		Tray Supports	
Stiffener Rings		Lining (3)	YES
Vessel Support (2)	4-LEGS	Allow. Soil Bearing	—
Surface Prep. Ins. (3)	YES	Surface Prep. Out. (4)	YES
Shop Paint Inside	NO	Shop Paint Outside	
Field Paint Inside	NO	Field Paint Outside	NO
Jack. Design Press.	—	Jack Design Temp.	—
Jack. Type	—	Jack. Corr. Allow.	—

SCHEDULE OF APPURTENANCES

NOZZLES	ROD	SIZE	SER	TYPE	MK	MISC. FITTINGS	ROD	SIZE	SER	TYPE	MK
INLET	1	2	150#	R.F.	A	LEVEL GA.	2	1½"	3000# SCRD		L
OUTLET	1	2			B						
OVERFLOW	1	3	↓	↓	C	VENT	1	2	GOOSENECK		V
						MANHOLE	1	18	150#	RF	M

NOTES:
(1) STD BLDG. CODE
(2) PER RUST STD. PIP-8.0 UNLESS NOTED (SEE PG. 9-8
(3) SEE SPEC. SEC. 9 & 11
(4) SEE SPEC. SEC. 11

VENDOR PROVIDE LIFTING LUG

DESIGNED BY: JWB	DATE: 10/27/81	CHECKED BY: WRK	DATE: 11/2/81	APPROVED BY:	DATE:

22-006
14-81

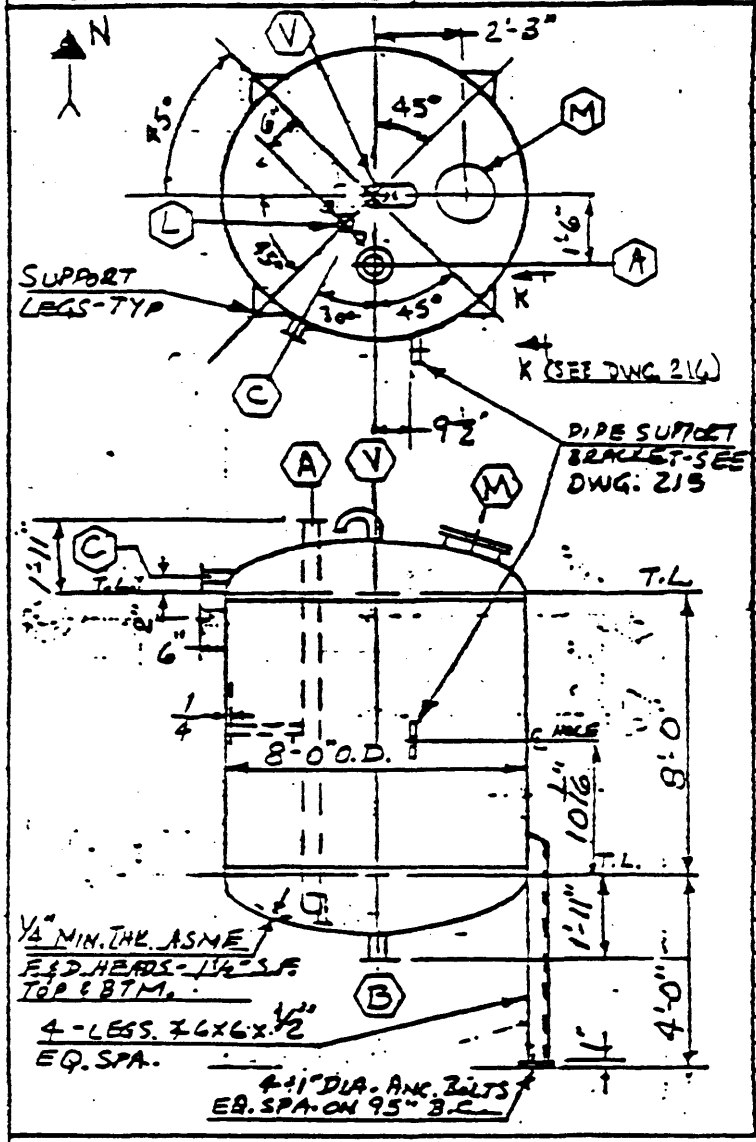
The Rust Engineering Company
A Subsidiary of Whessoe Rust-Pyle Inc.

PRESSURE VESSEL & STORAGE TANK DESIGN DATA SHEET

CONTRACT NO. 21-211
SHEET NO. 213

REV.	BY	DATE

CUSTOMER : U.S. DEPT. OF ENERGY PADUCAH, KY.
DESCRIPTION : WASTE STORAGE TANKS
CAPACITY : 3,000 GAL. NOM.
NO. REQUIRED: ONE(1)
ITEM: F-503
AREA:



DESIGN CRITERIA

Oper Press. psig	ATMOS		Oper. Temp. °F	AMBIE.	
Design Press. psig	ATMOS		Design Temp. °F	200	
Sp.G. of Contents	1.0.		Lethal	NO	
Code	ASME		Code Stamp	↓	
Postweld H.T.	NO		Radiography	SPOT	
Joint Eff. Shell	85%		Joint Eff. Heads	100%	
Corr. Allow. Shell	1/16"		Corr. Allow. Heads	1/16"	
Corr. Allow. Bott.	—		Corr. Allow. Roof	—	
Hydro. Test psig	FULL WATER		Air Test psig	NO	
Wind Loading (1)	YES		Seismic Loading (1)	ZONE 1	
Top Head —	F&D		Bott. Head —	F&D	
Matls: Shell	A-283-C		Matls: Heads	A-283-C	
Roof	—		Bottom	—	
Jacket	—		Internal Hd.	—	
Noz. Necks	A-53-B		Noz. Flanges	A-105	
Mhd. Necks	A-283-C		Mhd. Flanges	A-283-C	
Mhd. Covers	A-283-C		Noz. Blinds	—	
Internal Pipe	—		Internal Flgs.	—	
Couplings	A-105		Handholes	—	
Bolts-Studs	A-307		Nuts	A-307	
Gaskets	TEFLON		Structural	A-36	
Mhd. Davits	NO		Mhd. Hinges	YES	
Platforms			Platform Clips	NO	
Ladder-Cage			Ladder Clips		
Stair			Stair Clips		
Insulation			Insulation Supports		
Fireproofing			Fireproofing Supports		
Trays			Tray Supports	Y	
Stiffener Rings	↓		Lining (3)	YES	
Vessel Support (2)	4-LEGS		Allow. Soil Bearing	—	
Surface Prep. Ins. (3)	YES		Surface Prep. Outs.	(4) YES	
Shop Paint Inside	NO		Shop Paint Outside		
Field Paint Inside	NO		Field Paint Outside	NO	
Jack. Design Press.	—		Jack Design Temp.	—	
Jack. Type	—		Jack. Corr. Allow.	—	

SCHEDULE OF APPURTENANCES

NOZZLES	ROD	SIZE	SER	TYPE	MK	MISC. FITTINGS	ROD	SIZE	SER	TYPE	MK
INLET	1	2	150#	R.F.	A	LEVEL GA.	1	7½"	3000#	SCH 40 PIPE	L
OUTLET	1	2	↓	↓	B						
OVERFLOW	1	3	↓	↓	C	VENT	1	2	GOOSENECK		V
						MANHOLE	1	18	150#	RF	M

NOTES:
(1) STD 3 LDS. CODE
(2) PER RUST STD. PIP-9.0 UNLESS NOTED (SEE PG. 9-4)
(3) SEE SPEC. SEC. 9 & 11
(4) SEE SPEC. SEC. 11

VENDOR PROVIDE LIFTING LUGS

DESIGNED BY: JWB | DATE: 10/27/81 | CHECKED BY: WRK | DATE: 11/2/81 | APPROVED BY: | DATE:

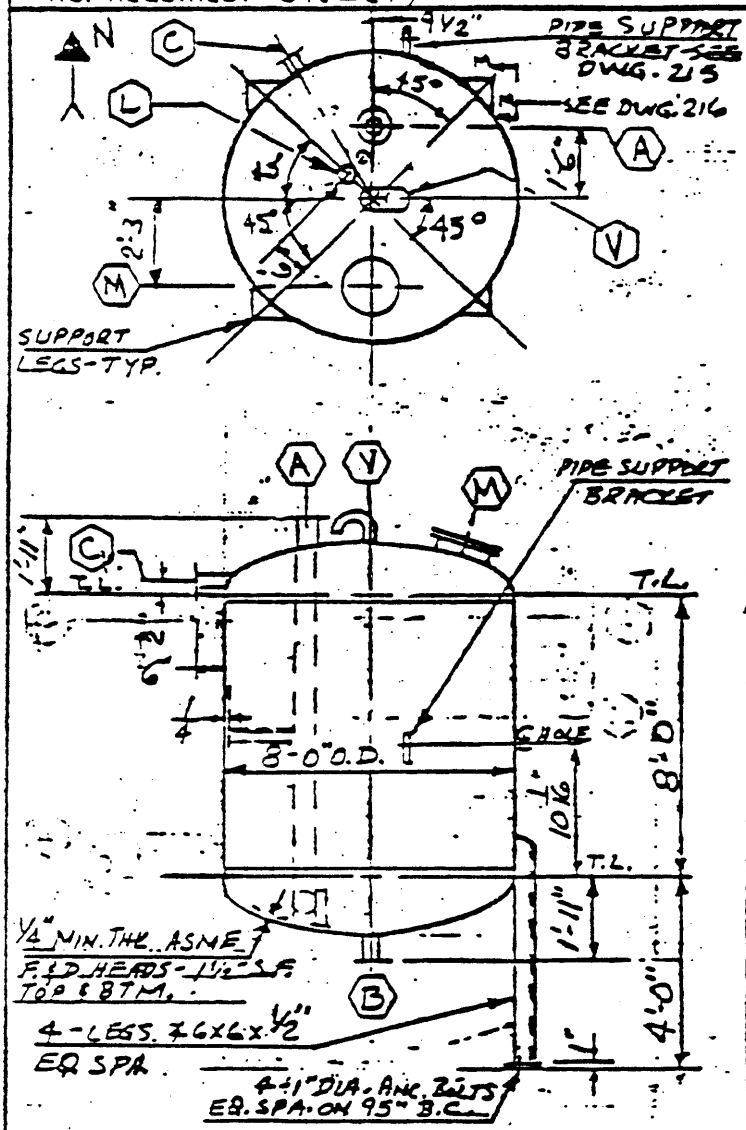
The Rust Engineering Company
A Subsidiary of Wheelabrator-Frye Inc.

PRESSURE VESSEL & STORAGE TANK
DESIGN DATA SHEET

CONTRACT NO. 21-2115
SHEET NO. 2 / 4

REV.	BY	DATE

CUSTOMER : U.S. DEPT. OF ENERGY PADUCAH, KY.
DESCRIPTION : WASTE STORAGE TANKS
CAPACITY : 3,000 GAL. NOM.
NO. REQUIRED: ONE(1)
ITEM: F-504
AREA:



DESIGN CRITERIA

Oper Press. psig	ATMOS	Oper. Temp. °F	AMBIE
Design Press. psig	ATMOS	Design Temp. °F	200
Sp.G. of Contents	1.0	Lethal	NO
Code	ASME	Code Stamp	↓
Postweld H.T.	NO	Radiography	SPOT
Joint Eff. Shell	85%	Joint Eff. Heads	100%
Corr. Allow. Shell	1/16"	Corr. Allow. Heads	1/16
Corr. Allow. Bott.	—	Corr. Allow. Roof	—
Hydro. Test psig	FULL WATER	Air Test psig	NO
Wind Loading (1)	YES	Seismic Loading (1)	ZONE
Top Head — ~~Press.~~	F & D	Bott. Head — ~~Press.~~	F&D
Matls: Shell	A-283-C	Matls: Heads	A-283-
Roof	—	Bottom	—
Jacket	—	Internal Hd.	—
Noz. Necks	A-53-B	Noz. Flanges	A-105
Mhd. Necks	A-283-C	Mhd. Flanges	A-28
Mhd. Covers	A-283-C	Noz. Blinds	—
Internal Pipe	—	Internal Flgs.	—
Couplings	A-105	Handholes	
Bolts-Studs	A-307	Nuts	
Gaskets	TEFLON	Structural	A-36
Mhd. Davits	NO	Mhd. Hinges	YES
Platforms		Platform Clips	NO
Ladder-Cage		Ladder Clips	
Stair		Stair Clips	
Insulation		Insulation Supports	
Fireproofing		Fireproofing Supports	
Travs		Trav Supports	Y
Stiffener Rings		Lining (3)	YES
Vessel Support (2)	4-LEGS	Allow. Soil Bearing	—
Surface Prep. Ins. (3)	YES	Surface Prep. Outs.	(4) YE
Shop Paint Inside	NO	Shop Paint Outside	
Field Paint Inside	NO	Field Paint Outside	NO
Jack. Design Press.	—	Jack Design Temp.	—
Jack. Type	—	Jack. Corr. Allow.	—

SCHEDULE OF APPURTENANCES

NOZZLES	ROQ	SIZE	SER.	TYPE	MK.	MISC. FITTINGS	ROQ	SIZE	SER.	TYPE	MK.
INLET	1	2	150#	R.F.	A	LEVEL GA.	1	1½	Boss	Screwed	L
OUTLET	1	2	↓	↓	B						
OVERFLOW	1	3	↓	↓	C	VENT	1	2	GOOSENECK		V
						MANHOLE	1	18	150#	RF	M

NOTES:
(1) STD BLDG. CODE
(2) PER RUST STD. PIP-9.0 UNLESS NOTED (SEE PG. 9
(3) SEE SPEC. SEC. 9 & 11
(4) SEE SPEC. SEC. 11

VENDOR PROVIDE LIFTING LUG

DESIGNED BY: JWB	DATE: 10/27/81	CHECKED BY: WRK	DATE: 11/2/81	APPROVED BY:	DATE:

THE RUST ENGINEERING COMPANY. BIRMINGHAM. ALA.

PROPOSAL OR JOB NO. 21-2115

FOR U.S. DEPT. OF ENERGY

AT PADUCAH, KENTUCKY

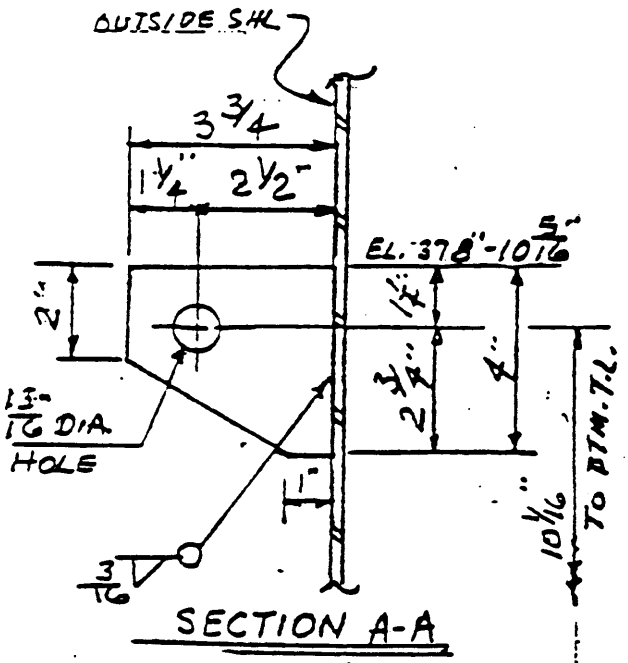
DESCRIPTION PIPE SUPPORT BRACKET AND ANGLE
WASTE STORAGE TANKS F501 F502 F503 F504

DATE 11/11/81

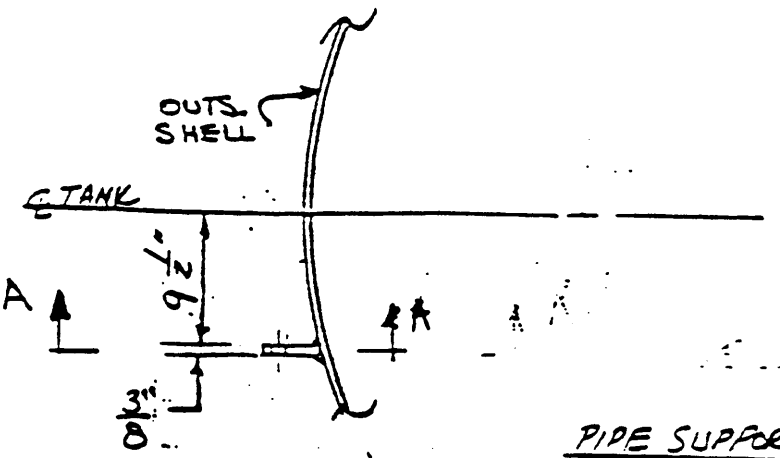
BY JWB CKD.

DWG. 215-

1 11/18/81 JWB ADDENDA CHG'S.



SECTION A-A

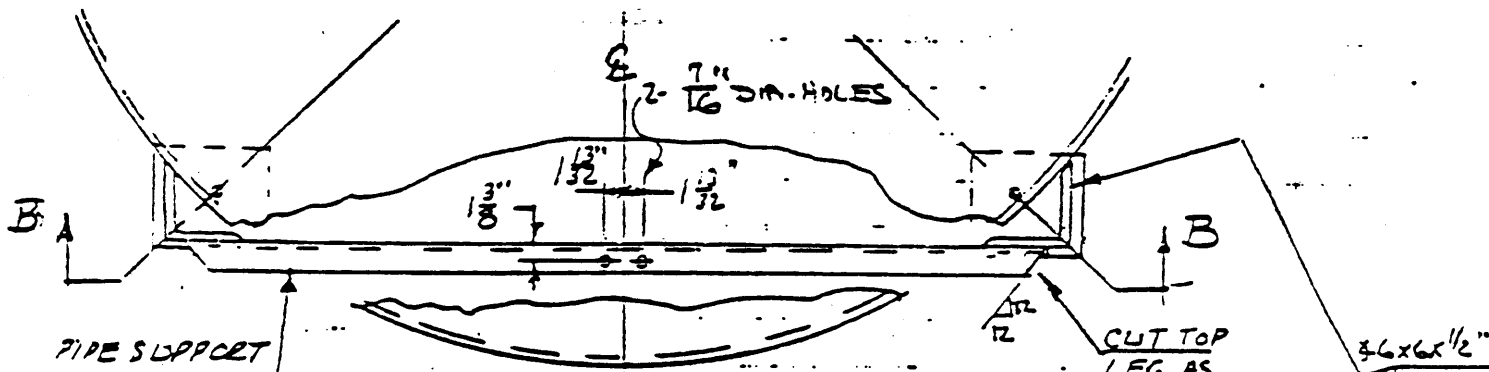


PIDE SUPPOR

PLAN VIEW — BRACKET

(NOTE: SEE DESIGN DATA SHEETS #211, #212, #213 & #214 FOR PROPER ORIENTATION.)

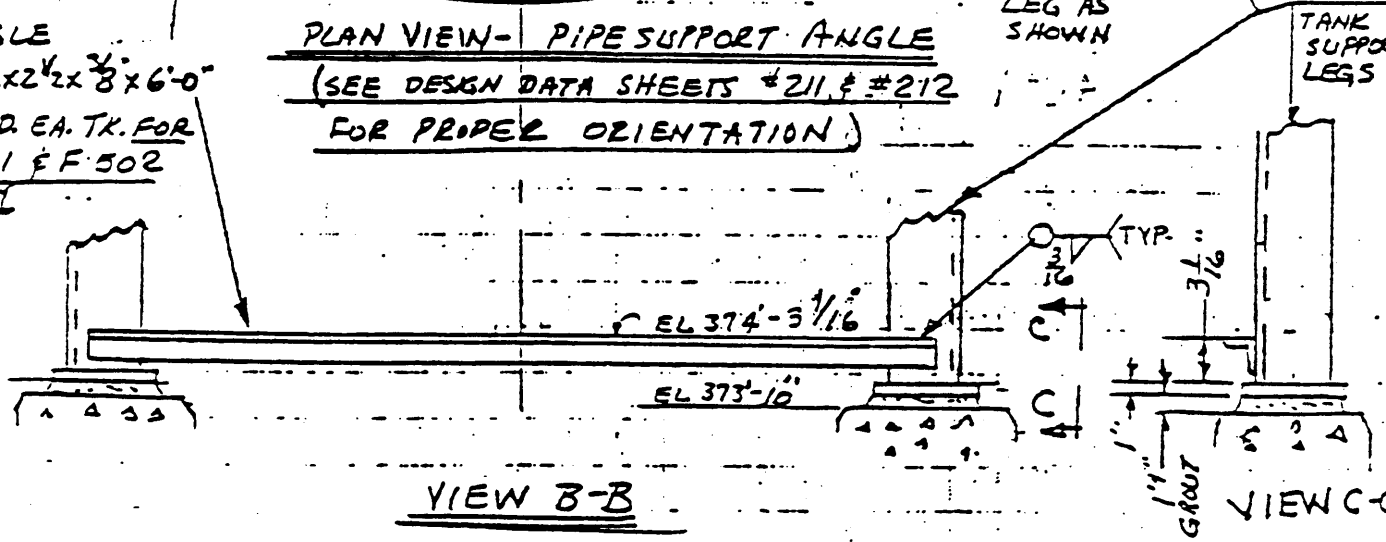
1 REQ'D. EA. TK. F-501, F-502, F-503 & F-50



PLAN VIEW- PIPE SUPPORT ANGLE

(SEE DESIGN DATA SHEETS #211 & #212 FOR PROPER ORIENTATION.)

PIPE SUPPORT ANGLE
4 L 2 1/2 x 2 1/2 x 3/8 x 6'-0"
1 REQ'D. EA. TK. FOR F-501 & F-502 ONLY

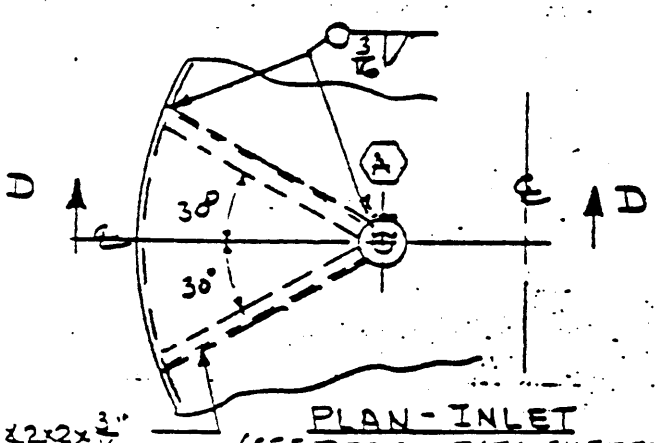


VIEW B-B

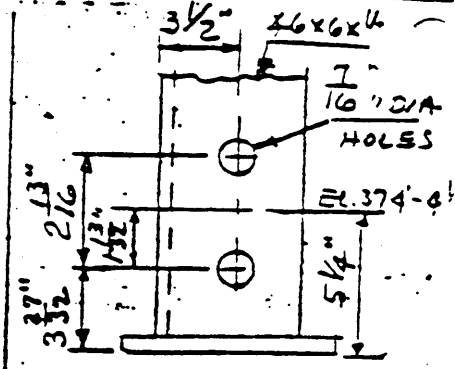
VIEW C-

FOR U.S. DEPT. OF ENERGY
AT PADUCAH, KENTUCKY
DESCRIPTION INLET DETAILS & SUPPORT LEG DRILLING

DATE 12/2/81
BY JWB CKD.
DWG. 216

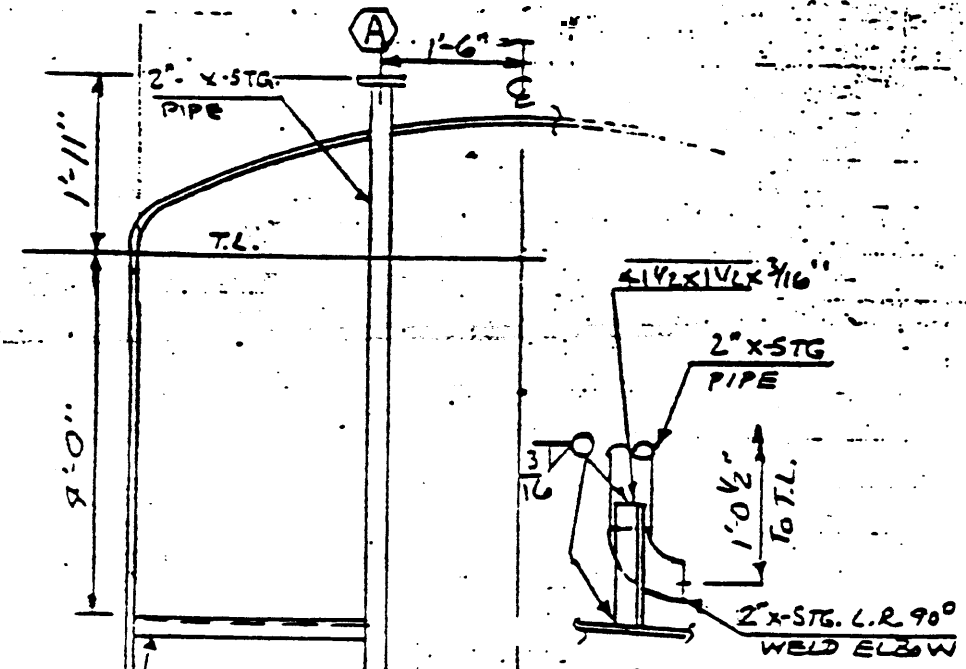


PLAN - INLET
(SEE DESIGN DATA SHEETS #211, #212, #213 & #214 FOR TRUE ORIENTATION)

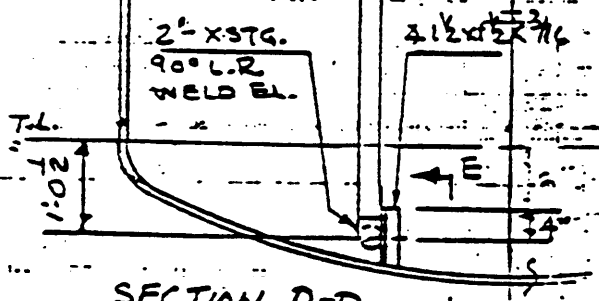


VIEW K-K AS SHOWN
1-PLACE F-503 ONLY
(SEE DESIGN DATA SHT. #213

VIEW M-M-OPP. HAND
1-PLACE F-304 ONLY
(SEE DESIGN DATA SHT. #21



SECTION E-E



SECTION D-D

E

THE RUST ENGINEERING COMPANY. BIRMINGHAM. ALA.

PROPOSAL OR JOB NO. 21-2115

FOR U.S. DEPT. OF ENERGY

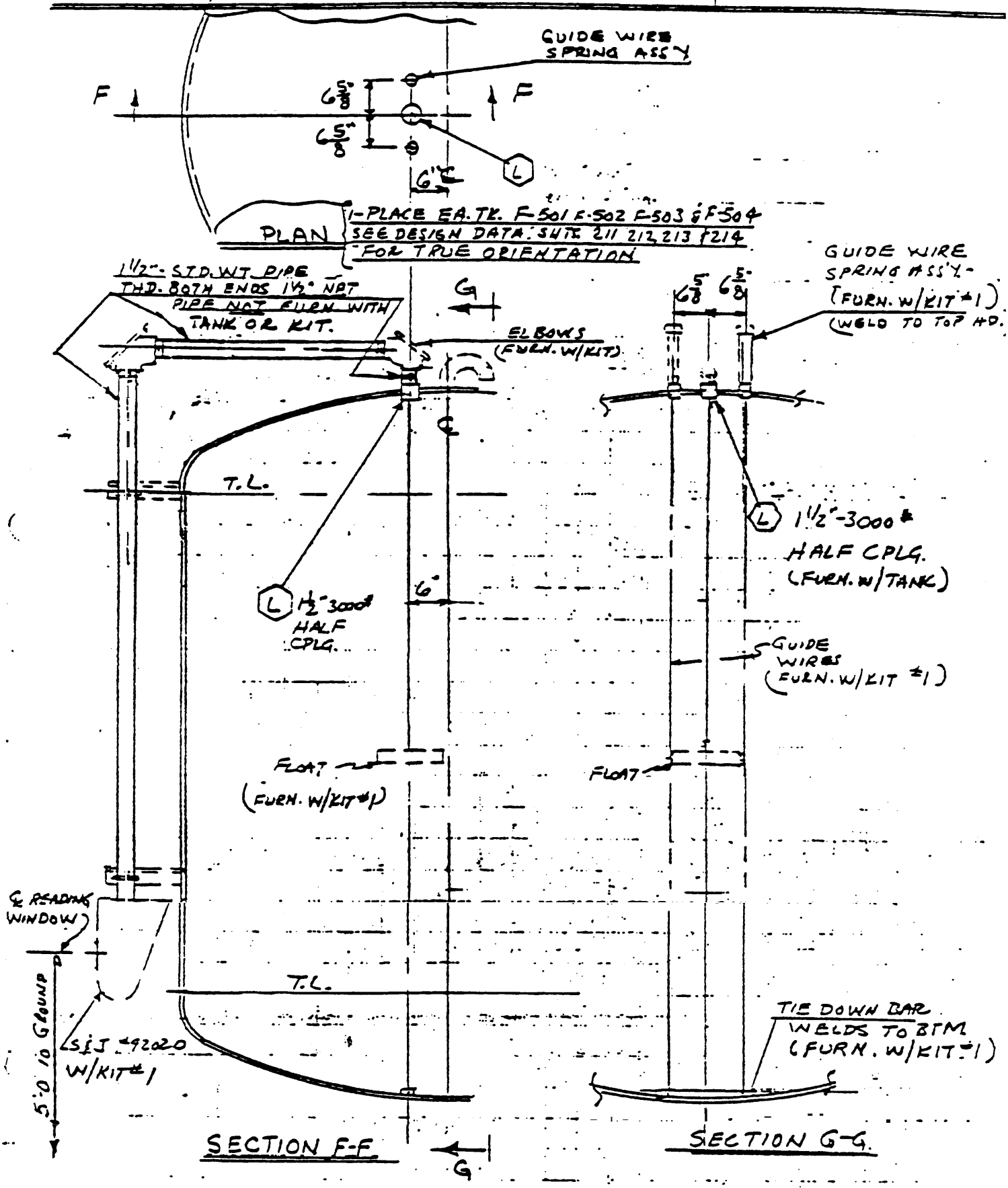
AT PADUCAH, KENTUCKY

DESCRIPTION LEVEL GAGE INSTALLATION

DATE 12/2/81

BY JWB CKD.

DWG. 217



9.301 - PROPORTIONING PUMPS

1. General

The attached Data Sheet prescribes the minimum requirements for the furnishing of pumps for this project.

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
OAK RIDGE, TENNESSEE 37830

DATA SHEET

PROPORTIONING PUMP

Equip. No. J501 & J502 No. Req'd.

PROJECT

DATA SHEET NO. 15757.1 PAGE 1 OF 1

REVISIONS		
REV.	APPROVAL	DATE

PLANT / BUILDING: PGDP	PREPARED BY: G. G. Killian	THIS SHEET PART:	
W.O. OR E.S.S.	APPROVAL	DATE: 11/16/81	
REQUISITION NO.	PROCURED BY: Subcontractor	INSTALLED BY: Subcontract	

PUMPING CONDITIONS

FLUID PUMPED	(Trichloroethylene, Trichloroethane, Mineral Spirits, Petroleum Lubrication				
PUMPING TEMP. (PT)	°C	70 °F	VISCOSITY AT PT	1.0	CP
SPECIFIC GRAVITY AT PT	1.0		DENSITY AT PT	8.34	LBS/GAL
VAPOR PRESSURE AT PT	mmHg .3631 PSI		SOLIDS CONTENT	0	%WT.

PERFORMANCE CHARACTERISTICS

CAPACITY, US GPM/GPH AT PT MIN.		MAX.	RATED 30
SUCTION PRESSURE, PSIG	RATED		MAXIMUM
DISCHARGE PRESSURE, PSIG	50 RATED		MAXIMUM (R.V. SET) @ 55PSIG
NPSH, FEET ABS: AVAIL (NORMAL)	2.0Ft (RATED)	REQD	BY PUMP CURVE NO.
BHP (NORMAL)	(RATED)	EFFICIENCY (NORMAL)	(RATED)

PUMP DESCRIPTION		MATERIALS AND CONSTRUCTION	
SIZE & TYPE - MFR Viking Gear Pump		LIQUID END (BARREL)	
		DIAPHRAGM	
		PLUNGER	
		LINER	
		BODY	FRAME
TYPE HL 195 D		VALVE CAP	GASKETS
		VALVES	BALLS/CONES
		VALVE SEATS	BODY
BRAKE H.P. 2 HP @ 1800 RPM		VALVE SLEEVE	CAP
CYL. DESIGN PRESS.		BASE PLATE (PUMP & DRIVER) 145T	
RELIEF VALVE SIZE	SETTING 55 PSIG		

SUCTION ☐ FLGD ☒ SCRD	SIZE 1/2	LB ASA	FACING		
DISCHARGE ☐ FLGD ☒ SCRD	SIZE 1/2	LB ASA	FACING		
COUPLING TYPE *		MAKE		GUARD	
BEARINGS (MFR AND TYPE): RADIAL	BALL	THRUST		VERTICAL THRUST ☐ UP ☐	
BEARING HOUSING ☐ JACKETED NPT	☐ GLAND COOLING NPT CONN.		GAGE CONN	☐ SUCTION	☐ DISCHARGE
STUFF BOX: ☐ TAP FOR FLUSH	NPT: ☐ TAP FOR DRAIN	NPT	☐ JACKETED NPT CONN: COOL WATER REQD		
☐ PACKING TYPE	SIZE	NO. OF RINGS	SEAL CAGE ☐ YES ☐ NO		
☒ MECH. SEAL MFR AND MODEL Roto-Ring					
LUBRICATION					
WEIGHT, LB: PUMP	DRIVER	HYDROSTATIC TEST PRESSURE (MIN)			
PUMP SERIAL NO.					
GEAR MGR/TYPE M.A.	RATIO M.A.	H.P. RATING M.A.			

DRIVER

☒ ELECTRIC MOTOR	1800 RPM	2 HP	V 480	PH 3	HZ 60
MFR *		CLASS		GROUP	
☐ OTHER: TYPE & MGR					

9.302 - STORAGE CABINETS

1. This specification covers furnishing and installing four (4) steel storage cabinets.

   A. Three cabinets shall be 24" deep, 36" wide and 78" high. Each cabinet shall be industrial quality with 16 gage frame, 22 gage doors and 22 gage shelves. All parts shall be phosphatized prior to enameling. Gray in color.

   B. One cabinet shall be 44" high, 43" wide and 18" deep. Cabinet shall be made of 18 gage sheet metal with 1-1/2" air space between double walls. Each shelf shall be 14-3/4" deep. Cabinet shall comply with National Fire Protection Association's Flammable and Combustible liquid Code #30. Color shall be safety yellow.

SECTION 11

PAINTING

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11.430 - PAINTING - GENERAL SECTION

1. GENERAL

This specification covers the preparation of surfaces and the furnishing and application of paint and primers.

This specification is composed of a general section supplemented by sections vhfch provide detailed specifications for preparation of surface and application for each type of, paint to be applied. Only those sections applicable to the work are included.

2. MATERIALS

A. Paints and primers shall be "Speedhide" (Pittsburgh Paints) as manufactured by PPC Industries, Inc. Equivalent painting systems as manufactured by Sherwin-Williams, Devoe Paint Division, Celanese Coating Co., The Glidden Company, or an approved alternate, will satisfy this specification.

Specific materials required in the work shall be provided by the Subcontractor as specified in each individual specification section contained herein.

B. Approval: Before delivery of any material to the site, the Subcontractor shall submit to the Contractor the name of the ufacturer, the brand, and quality of the materials he proposes to use. Only materials which have been approved by the Contractor may be delivered to the site and used in the work.

C. Tests: In cases of dispute, test data shall be provided by the Subcontractor comparing alternate paint-primer systems to those specified. Tests shall compare paint composition; solids content, by volume; coverage; film thickness; and total applied coats. Tests shall be made by a nationally recognized testing laboratory, and a written report giving results of the tests shall be furnished to the Contractor by the Subcontractor.

D. Sealed Packages: All materials shall be delivered *to* the site in the manufacturer's sealed packages and containers, with labels intact and seals unbroken. All materials shall be in covered containers with the descriptive labels of the material contained therein. Materials shall not be opened until required for use or for sampling.

E. Storage: Paint materials and equipment shall be stored only in such places as may be approved by the Contractor. The Subcontractor shall maintain the storage area and leave it free from fire hazards due to improperly stored rags, waste, or other combustible materials.

F. Colors: Colors shall be as specified in the PAINT SCHEDULE, Section 11.436.

3. METHODS AND WORKMANSHIP

The following specifications of methods and workmanship shall apply to all work. Additional requirements shall be as called for in the various sections.

A. Preparation of Surfaces :

General: Painting on any surface shall not be started until all preparation of the surface is completed.

Minimum preparation: As a minimum preparation, surfaces to be painted shall be brushed clean of all dust, dirt, or loose paint before paint is applied. Dull all glossy surfaces with sandpaper, steel wool, or liquid sanding aid. The surfaces shall be smooth, free of grease, scale, rust, welding spots and slag or other adhering matter which would prevent a proper paint bond. Bare steel shall be coated with Pittsburgh Zinc Chromate Primer 6-204 or approved equal. All manufacturer's recommendations shall be part of the requirements of this specification.

B. Application:

In general, all print shall be applied as specified by the manufacturer and shall be don8 in a workmanlike manner, leaving the finished surfaces free from drops, ridges, waves, slips, laps and brush marks. Paint shall be applied under dry and dust-free conditions and shall not be applied when the ambient temperature is below that recommended by the manufacturer.

All primer and intermediate coats of paint shall be unscarred and completely integral at the time of application of each succeeding coat. Each coat of paint shall have a slight variation or' color to distinguish it from the preceding coat. Sufficient time shall be allowed between coats to insure proper drying.

Spray or roller painting may be employed where practicable if approved by *the* Contractor. Paints shall be thoroughly stirred and kept at a uniform consistency during application and shall aot be thinned in excess of the printed directions *of* the manufacturer. Solvents and thinners used shall be of the type recommended by the paint manufacturer.

C. Coating Thickness:

A minimum of three coats (primer and two finish coats) shall be applied. Additional coats shall be applied to obtain complete coverage and in accordance with total thickness recommended by the manufacturer for the particular coating system. The finish coat of paint shall completely obscure the previous coat.

D. Protection: During painting operations the Subcontractor shall furnish and maintain in place adequate protective covers and drop cloths. Sprayed application shall be in conformity with all safety regulations in effect at the work site and the Subcontractor shall be responsible for protecting all adjoining work from spray particles. Any paint spots or spillage which may occur shall be promptly removed. "WET PAINT" signs shall be posted to protect newly painted surfaces.

E. Cleaning: During the work, or upon completion, the Subcontractor shall go over all areas and clean off misplaced paint from finished surfaces. Finishes of affected items shall be restored to their original condition. Doors shall be left free to move without damaging paint finish.

F. Touch-up Painting: Where prime coats have been applied as a shop coat or in the field, as specified in other specifications, only spot priming and two finish coats shall be applied to provide the total protective finish required by this specification. A primer shall be applied to worn places and bare spots, skips of original painting and surfaces from which paint has to be removed by cleaning, peeling and scaling.

G. Preparation of New Surfaces: Steel surfaces shall be prepared in accordance with Steel Structures Painting Council Specification No. SP2-63.

H. Interior of Tanks: The interior steel surfaces shall be sandblasted in accordance with the Steel Structures Painting Council "Surface Preparation Specification No. 6, Commercial Blast Cleaning To White Metal."

I. Exterior of Tanks: The exterior or' tanks shall be sandblasted it accordance with the Steel Structures Painting Council 'Surface Preparation Specification No. 6, Commercial Blast Cleaning."

3.1 EXTERIOR STEEL COATING

A. Included in this system are all metal surfaces outside 'of the steel tank, including the exterior surface of the tank.

B. All surfaces shall be primed with one (1) coat Carbo Zinc 11. Color shall be green, applied with a MDMTC of 3.0. This shall be followed by a second coat of Carboline 190 HB. Color shall be green 339, applied with • MDMTC of 4.0. The final coat shall be Carboline 1294. Color shall be gray 724, applied with a MDMTC of 2.0. The total minimum dry mil thickness shall be 9.0.

11.436 - PAINT SCHEDULE (METAL ITEMS)

1. GENERAL

All bare piper, pipe enclosures, hangers, supports, anchors, wall sleeves, structural *steel* and other Farrow metal surfaces shall, unless otherwise specified or required by virtue of material incompatibility, be finish-painted with the same color as on new or existing surfaced, whichever is more suitable. All bare metal surfaces shall receive one prime coat in accordance with Section 11.430. Color numbers refer to the chips of Federal Standard *595.*

A. Prefinished items such as construction materials and equipment, instrument cabinets, Vendor supplied control panels, control consoles, lockers, etc. shall not be painted unless specifically noted otherwise on the drawings.

B. In an area where piping offers a safety hazard such as tripping, possible head injury, or possible overhead interference with vehicular traffic, the pipe shall be primed in accordance with Specification 11.430, General Section and stripped with alternate yellow, color chip No. 54-302 and black, color chip No. 6-253, strips three (3) inches wide at an angle of 45° to the horizontal.

C. Painting Schedule (Metal Items)

Surface	Color	PPG Number
Metal items not against or integral with new surfaces	Match adjacent surface	
Exposed	Vista Green	55-306
Supporting Brackets & Members	Gray	*97-4*
Storage Tanks		
Exterior	Gray	97-4
Bumper Post	Yellow	54-302
	Black	6-253
Fire Alarm Box	Red	23-800
Piping	Gray	97-4

APPENDIX D

SPECIFICATIONS FOR C-746-R

(SEE ATTACHMENT 11, APPENDIX C FOR REFERENCED DRAWINGS)

APPENDIX D

SPECIFICATIONS FOR C-400

(SEE APPENDIX C FOR REFERENCED DRAWINGS)

SPECIFICATIONS FOR

ENVIRONMENTAL PROTECTION AND SAFETY MODIFICATIONS

AT

THE PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH, KENTUCKY

INVITATION NO. 8139

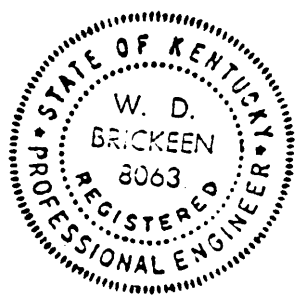
SUBCONTRACT SPECIFICATIONS 16209

MARTIN MARIETTA ENERGY SYSTEMS, INC.

Post Office Box 1410

Paducah, Kentucky 42001

January 25, 1985



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3.130 - EARTHWORK - GENERAL SECTION

1. GENERAL:

This specification covers clearing, stripping, excavation, trench excavation, fill, backfill, and grading.

This specification is composed of a general section supplemented by sections which provide detail specifications for earthwork for structures, roads, parking lots, grounds and utilities. Only those specification sections applicable to the work are included.

2. DEFINITIONS:

A. Earth excavation consists of the removal of material to the lines, elevations and dimensions shown oa the drawings and specified herein, and disposition of all materials encountered in the grading and excavation work, except that classified as rock. Rock excavation is not anticipated.

B. Unauthorized excavation consist3 of excavation not required by the specifications or drawings or not authorized in writing by the Contractor.

C. Fill consists of earth or other material as specified, used to bring an existing grade to a specified grade.

D. Backfill consists of earth, crushed stone or other material as specified, used to replace material excavated during construction.

E. Subgrade is the compacted fill or backfill of embankments or the undisturbed soil of *cut* sections which supports the base course and wearing surface.

F. Undercutting consists of removal of soft or undesirable materials encountered in the undisturbed subgrade below grades specified for cxcavation.

G. Spot Subgrade Reinforcement consists of placing approved fill or backfill in areas where authorized undercutting has been performed.

H. Borrow is the excavation from designated areas and transporting of suitable earth for fill or backfill required to bring subgrade up to the specified grades.

3. MATERIALS:

Materials suitable for use as fill and backfill shall be as follows:

A. Earth shall be soil of such gradation and moisture content that is will compact to specified density and remain stable under the final conditions of use. Earth shall be free of boulders and organic matter and may be earth excavatfoa or borrow.

B. Sand shall be natural sand or crushed stone passing a No. 10 sieve.

C. Crushed stone shall be DGA as specified by the Kentucky. Department of Highways (KDH) Standard Specifications for Road and Bridge Construction.

4. PROTECTION OF EXISTING FACILITIES:

Existing utility lines and structures in the work area and existing roadway surfaces, and other features adjacent to the work area shall be protected by the Subcontractor during prosecution of the work. Damages occurring shall be repaired by the Subcontractor at his expense.

Work for the *C-406* and *C-407* sections of this subcontract *is* located in the C-400 dust palliative area.

The Subcontractor shall be responsible for repairing the dust pallia— tive area if disturbed or damaged.

When determined by the Construction Engineer, all areas where existing contours have been disturbed shall be brought to a uniform contour by discing and blading approximately 2" deep and cultivated so the exist— ing asphalt and stone cover materials are reduced to no larger than 2" square. The repaired surfaces shall be primed uniformly with undi— luted emulsified asphalt, grade SS-1h, at the rate of 0.5 to 0.8 gallons per square yard at application temperature, and then an application of 9M limestone uniformly spread at the rate of 25 to 40 pounds per square yard shall follow immediately.

All crushed stone shall be produced in accordance with applicable pro— visions of Section 805 of the 1983 Edition of Standard Specifications for Road and Bridge Construction as published by the Kentucky Depart— ment of Highways (KDH).

Emulsified asphalt shall be grade SS—1h and shall meet the requirements of Section *407* of the KDH Specificattons. This material shall be certi- fied to contain no detectable concentration (<5 ppm) of polychlorinated biphenyls (PCB's).

Care shall be taken to keep asphalt off all building walls, grade beams, pipe supports, manhole covers, driver, roads, fire hyrants, post indicator valves, and to prevent asphalt-from entering storm sewer inlets.

5. CLEARING:

The area within the limits of the work shall be cleared of all trees, bushes, stumps, and other organic matter and obstructions.

6. EXCAVATION:

A. Excavation shall ha carried through whatever material is encountered to depths shown on the drawings. Excavated material not required or not suitable for fill or backfill shall be removed from the site to an approved disposal area. Unauthorized excavation shall be backfilled at the Subcontractor's expense with compacted earth, sand, crushed stone or concrete, as directed by the Contractor.

B. The Subcontractor shall maintain excavations free from water and dispose of the excess water by methods approved by the Contractor. Spring or seepage water encountered in the excavation shall be reported to the Coatrrctor.

C. When additional material is required for fill or backfill, it shall be provided by the Subcontractor.

D. Existing concrete slabs or foundations and asphaltic concrete toad surfacing shall be removed prior to placing fill or backfill. Material removed shall be disposed of in designated spoil area.

E. Newly graded areas shall be maintained by the Subcontractor until final acceptance by the Contractor. Areas showing settlement or washes shall be restored to specified grades by the Subcontractor at no additional cost to the Contractor prior to final acceptance.

1. METHODS AND WORKMANSHIP:

A. Excavation : Excavation shall consist of removal of materials to the lines, elevations, and dimensions specified and disposition of any or all material encountered as specified.

1) Unauthorized excavation shall consist of excavation not specified or not approved in writing by the Contractor.

2) The limits of excavation shall be that required to provide a minimum of a 2 foot working space around the structure, except where authorized by the Contractor to deposit concrete directly against excavated surfaces. In areas where the excavated walls are unstable, walls shall be shored or sloped in accordance with the Special Conditions.

3) Excavation in the vicinity of existing buildings and structures shall not be carried below the existing foundations until underpinning and shoring have been installed. Existing structures, piping or foundations which are to be incorporated into the final work shall be protected or replaced by the Subcontractor.

4) Excavation for foundations shall be carried to elevations specified. If satisfactory load-beating soil is not reached at depth specified, excavation shall be carried deeper as directed in writing by the Contractor. When freezing temperatures are expected, no excavatf on shall be made to the full depth specified unless either the foundatton can be poured immediately after excavation has been completed, or bottom of the excavation is adequately protected from frost.

5) Excavatfon below elevations or beyond other required limits as specified or as approved in writing by the Contractor shall be restored at the Subcontractor's expense as follows: If under slabs, the excavation shall be restored in accordance with the procedure specified for backfill; if under footings, the footing shall be increased in depth. Backfill under concrete footings shall not be permitted, unless otherwise specified.

B. Fill : The entire area of the original ground to be occupied by fill shall be scarified and rolled thoroughly with a sheepsfoot or tamping roller prior to placing new fill.

1) Earthfill shall be spread in layers which do not exceed 6 inches in thickness before compaction. Water shall be added or excess moisture shall be removed if required to obtain desired compaction. Compaction shall be obtained by use of sheepsfoot tamping roller or pneumatic tired rollers where possible, or by use of hand-maneuvered power tamping tools.

2) Crushed stone or sand fill shall be spread in layers which do not exceed 3 inches before compaction. The proper amount of moisture shall be present in the fill to obtain maximum-compaction using three-wheel or tandem rollers where possible, or by use of hand-maneuvered power compacting tools.

3) Fill, unless otherwise specified on the drawings, shall be compacted to a minimum of 90% of maximum density at optimum moisture content, as determined in accordance with the provisions of ASTM D 698-78. The required compaction shall be verified by in-place density tests using any one of the following provisions of ASTM D 1556-82, D 2167-66 (R77) or D 2922-81. Maximum density determinations and in-place density tests will be performed by the Contractor.

C. Backfill : After the completion of construction below grade, forms shall be removed and the excavation shall be cleaned of all waste material and debris. The excavation shall be backfilled as soon as, in the opinion of the Contractor, work can be done without injury to the structure. When backfill is placed on each side of piers, walls and free-standing structures, it shall be deposited and compacted evenly on all sides at the same time. Proper provisions shall be made to prevent wedging action against the walls or structures. If directed by the contractor, slopes bounding or within areas to be backfilled shall be stepped as necessary to prevent wedging action.

1) Backfill shall be spread and compacted in the same manner as fill.

D. Grading : The Subcontractor shall control grading in the vicinity of excavations to prevent water from running into excavated areas.

1) All areas shall be finished to a smooth compact surface at specified grades.

3.133 - EARTHWORK FOR UTILITIES

1. **METHODS AND WORKMANSHIP:**

A. Utility Structure Excavation : Excavation for manholes and other accessories shall clear the finished structure not less than 24 inches. The foundation shall be on undisturbed earth. Backfill shall be placed when the structure has attained sufficient strenght to prevent damage from compaction by hand-maneuvered power tamping tools.

B. Trench Excavation : Trenches shall be a width necessary for proper installation of pipe, duct run or other utility to be accomodated. Clearance between pipe and the trench wall, except where indicated othervise on the drawings or specifications, shall be 6 inches for trenches less than 2 feet deep and 12 inches for trenches mote than 2 feet deep. The bottom of trench shall be accurately graded to provide uniform bearing and support for the utility either on undisturbed soil or properly compacted backfill throughout its entire length except where it is necessary to excavate for bell or coupling holes and for proper sealing of pipe joints. Bell and coupling holes shall be excavated after the trench bottom has been fine graded. Where rock is encountered, it shall be removed to a depth of 6 inches below the bottom of the pipe, and the under-cut shall be back-filled with thoroughly compacted crushed rock. Soft, spongy, or otherwise unstable material encountered at the elevation of the pipe, which will not provide a firm foundation for the pipe, shall be removed and replaced as directed in writing by the Contractor with suitable selected materials and compacted. Removal of this undesirable material shall be considered "Undercutting" and replacement with suitable material shall be considered "Spot Subgrade Reinforcement."

C. Shoring : Trench and structure excavations shall be in accordance with OSHA Safety Regulations, Subpart P, 1926.650, 1651 and .652, and the Special Conditions.

D. Backfilling : Backfill of utility trenches shall be done promptly after all required tests on the utilities have been approved by the Contractor.

1) Backfill material shall be earth, unless othervise specified in this specification or on the drawings. Selected fine graded earth shall be used to back fill around the pipe and to a depth of 12 inches above the pipe. Earth shall be deposited in 6-inch thick layers and shall be carefully rammed or tamped until the utility has a cover of not less than 1 foot. The remainder of the backfill shall be placed in horizontal layers 12 inches in depth and compacted by hand-maneuvered power tamping tools to a density equal to that of the surrounding earth. In areas where paving is to be done, stop the fill or backfill the required distance below finish grade to permit installation of these items.

2) Fill and backfill, unless otherwise specified on the drawings, shall be compacted to a minimum of 90% of maximum dry density at optimum moisture content as determined in accordance with the provisions of ASTM D 698-78. To insure that the required compaction has been obtained, in-place density tests shall be in accordance with any one of the following provisions of ASTM D 1556-82, D 2167-66 (R77), or D 2922-81. Maximum density determinations and in-place density tests will be performed by the Construction Engineer.

E. Repair of Surfaces : Where asphaltic concrete pavements have been cut for utility line trenches, the asphaltic concrete surfacing shall be cut back 12 inches from each side of the trench wall. The utility trench shall be backfilled for its entire depth with stablized aggregate base to an elevation 1-1/2 inches below the finished paved surface, and 1-1/2 inches of hot asphaltic concrete wearing course shall be installed the subcontractor.

Concrete pavement removal for utility trenches shall be accomplished in such a manner that adjacent existing pavements are not damaged. After installation of the utility, the trench shall be backfilled with stabilized aggregate base to the same elevation as the existing base. Concrete shall be placed to match the existing concrete pavement.

3.140 - EARTHWORK FOR ROADS AND STREETS

1. GENERAL:

This specification covers clearing, excavation, filling, backfilling, and grading for roads and streets.

2. DEFINITIONS:

Definitions shall be as specified in 3.130 - Earthwork - General Section.

3. MATERIALS, METHODS AND WORKMANSHIP:

Excavation, fill, structure excavation, subgrade work and all related work shall be in accordance with the Kentucky Department of Highways "Standard Specification for Road and Bridge Construction," latest editioa, Section 203 through 213. Unless other wise specified on the drawings, fill and backfill shall be compacted to a minimum of 90% of maximum dry density at optimum moisture coatent as determined in accordance with the provisions of ASTM D 698-78. To insure that the required compaction has been obtained, inplace density tests shall be made by the Subcontractor at locations specified by the Coatractor. In-place density tests shall be in accordance with any ode of the following provisions of ASTM D 1556-82, D 2167-66 (R77), or D 2922-81. Maximum density tests will be made by the Contractor.

4. MAINTENANCE OF AREAS:

Newly graded areas shall be maintained by the Subcontractor until final acceptance. Areas showing settlement or washes shall be restored to the specified grades by the Subcontractor, at no additional cost to the Contractor, prior to final acceptance.

3.210 - STABILIZED AGGREGATE BASE COURSE

1. **GENERAL:**

This specification covers the construction of a stabilized base course on a prepared subgrade for roads or other paved areas.

2. **DESCRIPTION:**

Stabilized aggregate base course shall consist of a pre-mixed base material of crushed stone mixed with binder material and water and shall be deposited, spread, processed and compacted in layers on a previously prepared subgrade to a finished thickness and in areas specified on the drawings.

3. **MATERIALS, METHODS AND WORKMANSHIP:**

A. The materials, methods of construction and workmanship shall be in accordance with the Kentucky Department of Highways "Standard Specifications for Road and Bridge Construction," Section 303 - Dense Graded Aggregate Bare, unless otherwise specified in this specification or on the drawings.

B. When additional base material is to be added to existing stabilized aggregate base, the existing base shall be scarified to a depth of 2 to 3 inches. New stabilized base material shall be added, thoroughly mixed with the old material by blading, and compactioa continued as for a new aggregate base.

C. The surface of the top layer shall not show any deviation in excess of 3/8 inches when tested with a 10-foot straight edge applied parallel to and at tight angles to the center line of the paved area.

D. Compaction of each layer shall continue until a density of not less than 83 pet cent of the solid volume has been achieved. The density determination will be baaed on the bulk specific gravity, AASHTO Designations T-84 and T-85, and the dry weight of the aggregate. The required compaction shall be verified by in-place density tests using any one of the following provisions of ASTM D 1556-82, D 2167-66 (R77), or D 2922-81. Maximum density determinations and In-place density tests will be performed by the Contractor.

4. **MAINTENANCE:**

The finished base course shall be maintained by the Subcontractor La a condition satisfactory to the Contractor until installation of asphaltic concrete surfacing or final acceptance by the Contractor. Area8 shoving washes or looseness shall be repaired or restored to the specified condition at no expense to the Contractor.

3.230 - ROT ASPHALTIC CONCRETE PAVEMENT

1. **GENERAL:**

This specification covers the construction of hot-mixed, hot-laid bituminous pavement on a prepared base or an existing pavement course.

2. **DESCRIPTION:**

Major components of the asphaltic concrete pavement are as follows: prime coat, tack coat, base course and wearing course.

3. **MATERIALS, METHODS AND WORKMANSHIP:**

Materials, methods of construction and workmanship shall be in accordance with the following sections of the Kentucky Department of Highways (KDH) "Standard Specifications for Road and Bridge Construction," and these specification%

A. Rime Coat : Prime coat shall be either MC30 or MC70 and shall meet the requirements of Section *407,* KDH. Prime coat shall-be applied at the rate of *0.20* to 0.50 gallons per square yard as directed by the Contractor.

B. Tack Coat : Tack coat shall be either RC250 or emulsified asphalt SS-1h and shall meet the requirements of Section 407, KDH. Tack coat shall be applied at a rate as directed by the Contractor but not to exceed 0.10 gallons per square yard.

C. Bituminous Hot Mix Base : Bituminous hot mix base, of thickness specified, shall be installed on a stabilized aggregate base-when specified on the subcontract drawings and shall be in accordance with Section *401* and *403,* KDH. Bituminous for the base course shall be AC20 and shall meet the requirements of Section 806, KDH.

D. Asphaltic Concrete Surfacing : Asphaltic concrete surface course shall be 1-1/2 inches thick and shall be in accordance with Section 401 and *402,* KDH, face type A The surface course shall be installed on a hot mix base in areas specified on the drawings. After final rolling, no vehicular traffic of any kind shall be permitted oa the pavement until it has cooled and hardened. Bituminous material for the surfacing material shall be AC20 and shall meet the requirements of Section 806, KDH.

E. Protectioa of Existing Surfaces : The Subcontractor shall take every precaution to protect existing surfaces of roads and other areas adjacent to the site and shall repair all areas damaged at no additional expense to the Coattactor.

SECTION 4

ARCHITECTURAL

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4.310 - CONCRETE FOR STRUCTURAL USE

1. GENERAL

This section of the Specifications relates to the furnishing and installation of all poured-in-place Concrete and related work as shown on the drawings and as specified.

2. CODES AND STANDARDS

Codes and standards which are called for or referred to herein are hereby made a part of this Specification to the extent indicated by the reference thereto. In the event of discrepancies between this Specification and the codes and standards, thfs Specification shall govern.

A. American Concrete Institute (ACI) Standards:

ACI 211.1-81	Recommended Practice for Selecting Proportions for Normal Weight Concrete
ACI 302.1 R-80	Guide for Concrete Floor and Slab Construction
ACI 304-73	Recommended Practice for Measuring, Mixing,. Transporting and Placing Concrete
ACI 305 R-82	Hot Weather Concreting
ACT 306 R-78	Cold Weather Concreting
ACI 315 R-80	Details and Detailing of Concrete Reinforcement
ACI 318-83	Building Code Requirements for Reinforced Concrete
ACI 347-78	Recommended Practice for Concrete Formwork

B. American Society for Testing and Materials (ASTM) Standards:

ASTM A 185-79	Specification for Welded Steel Wire Fabric for Concrete Reinforcement
ASTM A 663-82	Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties

ASTM A 675-82 Specification for Steel Bars, Carbon, Hot Wrought, Special Quality, Mechanical Properties

ASTM A 615-82 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C 31–83 Method of Making and Curing Concrete Test Specimens in the Field

ASTM C 33-82 Specification for Concrete Aggregates

ASTH C 39-83 Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C 94–83 Specificatioa for Ready–Mixed Concrete

ASTH C 109–80 Test Method for Compressive Strength of Hydraulic Cement Mortars

ASIM C 143-78 Test Method for Slump of Portland Cement Concrete

ASTM C 150–83 Specification for Portland Cement

ASTM C 157–80 Test Method for Length Change of Hardened Cement Mortar and Concrete

ASTM C 231-82 Test Method for Air Content of Freshly Mixed Coacrete by the Pressure Method

ASTX C 260-77 Specification for Air-Entraining Admixtures for Coacrcte

ASTH C 309-81 Specification for Liquid Membrane-Forming Compounds for Curing Coacrctc

ASTM C 494-82 Specfffcatfoa for Chemical Admixtures for Concrete

ASTM C 827-82 Test Method for Early Volume Change of Cemcntitious Mixtures

ASTH D 461 Standard Methods of Testing Felt

ASTM D 2103–81 Specification for Polyethylene Film and Sheeting

C. Federal Specifications (FS):

SS-S-164 Sealing Compound; Hot Poured Type, for Joints in Coacrete

CCC-C-463 Cloth, Burlap, Jute, (or Kenaf)

U.S. Department of Commerce, National Bureau of Standards (NBS) Product Standards :

PS-1 Softwood, Plywood, Construction and Industrial

3. SHOP DRAWINGS

A. Shop drawings shall be submitted for approval in accordance with SPECIAL CONDITIONS paragraph: SUBCONTRACTOR'S SUBMITTALS.

B. The Subcoatractor shall submit completed and checked shop drawings for approval, including bar lists and bending and erection drawings, detailed in accordance with ACI 315. The approval of shop drawings will be for general arrangement and general conformance with design concept only, and shall not relieve the Subcontractor of the responsibility of errors, omissions, or the accuracy of hi8 own dimensions.

4. MATERIALS

A. General. Except as otherwise specified herein, all materials shall conform to ACI 318 and ACT 211.1.

B. Aggregates. Aggregates shall conform to ASTM C 33 and have the following physical properties:

1) Coarse aggregate shall be gravel or crushed stone, well graded from fine to coarse within the prescribed limits. Maximum nominal coarse aggregate shall be 1 inch, except for slabs on grade and mass or foundation concrete, where the maximum size shall be 1-1/2 inch.

2) Fine aggregate shall be sand, clean and sharp.

C. Reinforcement :

I) Reinforcing hats shall conform to ASTM A 615 Crade 60 unless otherwise indicated on the design drawings.

2) Plain, smooth rods or dowels shall conform to ASTM A 663, vith minimum yield of *40,000* psi.

3) Provide metal accessories, including all spacers, chairs, ties, and other devices necessary for properly placing, spacing, and supporting reinforcement in place.

4) Wire mesh shall be welded wire fabric conforming to ASTM A 185.

D. Cover Materials for Curing:

1) Burlap cloth shall conform *to* the requirements of FS *CCC-C 467.*

2) Liquid membrane-forming compounds shall conform to the requirements of ASTM C 309.

E. Vapor Barrier: Vapor barrier shall be 6 mil polyethylene conforming to ASTM D 2103.

F. Grout: Refer to paragraph 17.

G. Joint Sealer: Joint sealer shall be the hot-poured elastic type conforming to ASTM D 1190, FS SS-S-164, or Section 807.02 of KDH Standard Specifications for Road and Bridge Construction,

5. ADMIXTURES

A. The use of admixtures in the concrete shall be restricted to the specific applications outlined hereafter.

B. All concrete shall be air-entrained. Air content by volume shall be 5% to 7% as determined in conformance with ASTM C 231. Air entraining agents shall conform to ASTM C 260. The agent and the cement proposed for use shall be selected well in advance of concrete placing, and the Subcontractor shall provide satisfactory facilities for ready procurement of adequate test samples. Air entrainment shall be produced by either adding an air-entraining agent at the mixer or by use of mill-produced aft-entraining cement. When necessary to increase the air content to within the specified range, additional air-entraining admixtures compatible with that already in the mixture shall be added at the mixer. Air content shall be based on measurements in concrete mixtures at point of discharge at the jobsite.

C. All concrete for encasement of underground conduit shall be per Section 7.011.

D. The use of flyash as an admixture will not be permitted.

6. DESIGN OF CONCRETE MIXES

A. General: The design of the concrete mix or mixes shall be in accordance with ACI 211.1 to attain the properties of strength, slump, entrained air and rate of hardening in conformance with the following requirements. Ready-mixed concrete shall be manufactured and delivered in accordance with the requirements of ASTM C 94.

B. Strength: All concrete, reinforced or plain shall have a minimum compressive strength of 3000 psi at 7 days and 4000 psi at 28 days, unless otherwise indicated on the design drawings or specified herein.

C. Slump: Concrete mixes shall be designed for the following slump:

	Slum in Inches	
	Max.	Min.
For all Concrete Work:	4	2

7. COLD WEATHER REQUIREMENTS

When the temperature is below 40°F, or is likely to fall below 40°F before placing the concrete, and/or during the 24-hour period after placing, the Subcontractor shall strictly adhere to the recommendations of ACI 306.

a. HOT WEATHER REQUIREMENTS

Concrete placed during hot weather shall have a temperature of not more than 75°F. The use of hot cement shall be avoided insofar as practicable, and cold mixing water shall be used in the mix. The Subcontractor shall strictly adhere to the recommendations of ACI 305.

9. FORMWORK

A. General: Formwork shall be in accordance with ACI 347.

B. Materials: Forms shall be of fiber, wood, metal, structural hardboard or other suitable material that will produce the required surface finish.

1) Concrete surfaces to be exposed or coated: Form surfaces that will be in contact with concrete shall be of material that is nonreactive with concrete, and that will produce concrete surfaces equivalent in smoothness and appearance to that produced by new plywood panels conforming to PS 1, exterior type, Grade B-R, concrete form.

2) Concrete surfaces to be unexposed: Form surfaces that will be in contact with concrete shall be of No. 2 common or better lumber, or other material producing equivalent finish.

C. Chamfer Strips: Chamfer strips not less than 3/4 inch in size shall be used at external cornets that will be exposed.

D. Removal of Forms: Forms shall be removed in a manner to insure complete safety of the structure.

10. JOINTS

Construction Joints: Unless indicated or specified otherwise, construction joints shall be made and located so as to feast impair the strength of the structure and shall be subject to approval of the Contractor. The surface of the concrete shall be toughened, thoroughly wetted and slushed with a coat of neat cement grout immediately before placing of new concrete.

11. REINFORCEMENT

Reinforcement shall be placed in the position indicated on the drawings, securely fastened and supported to prevent displacement before and after placement of concrete. Cleaning, bending, and placing of reinforcement shall be done in accordance with the requirements of ACI 318.

12. CONVEYING

Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of the materials. Equipment for chuting, pumping, and pneumatically conveying Concrete shall be of such size and design so as to insure a practically continuous flow of concrete at the delivery end and without separation of materials. All of this shall be done in accordance with ACI 3@4.

13. PLACING AND FINISHING CONCRETE

A. General. Placing of concrete shall be done in accordance with the requirements of ACI 304. Concrete shall not be allowed to drop freely more than 4 feet in unexposed work and not more than 3 feet in exposed work; where greater drops are required, a tremie or other approved means shall be employed. Concrete shall be placed in the forms, as neatly as practicable in the final position, in uniform approximately horizontal layers not over 12 inches deep.

B. Earth-Foundation Placement. Concrete footings shall be placed upon undisturbed surfaces prepared in accordance with Section 3.132. The surfaces shall be clean, free from frort, ice, mud, and water. Concrete piers may be placed directly on impervious surfaces that are thoroughly moistened but not muddy at the time the concrete is placed.

C. Vapor Barrier Installation. Vapor barrier shall be installed under all slabs on grade. Lap all joints 6 inches. Caution shall be exercised during placement of reinforcing and concrete to avoid tearing the vapor barrier.

D. Compaction. Immediately after placing, each layer of structural concrete shall be compacted by internal concrete vibrators supplemented by handspading, rodding, and tamping. Air entrained concrete shall not be vibrated for over 12 seconds. Tapping or other external vibrations of fonns will not be permitted. Vibrators shall not be used to transport concrete inside forms. Internal vibrators submerged in concrete shall maintain a speed of not less than 9,000 vibrations per minute for head diameters up to 2-1/2" and 7,000 vibrations per minute for head diameters between 2-1/2" and 4-1/2". The vibrating equipment shall at all times be adequate in number of units and power to properly consolidate all concrete; spare units shall be on hand as necessary *to* insure such adequacy. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing objectionable segregation. The vibrators shall not be inserted into courses that have begun to set. Vibrators shall he applied at uniformly space points not farther apart than the visible effectiveness of the machine.

E. Surface Finishing Other Than Slabs. All *exposed* surfaces of foundations and grade beams shall be finished within 12 hours after forms are removed, and surface defects shall be corrected. Fins and loose

material shall be removed. Honeycomb, aggregate pockets, voids over 1/2 inch in diameter, and holes left by the rods and bolts shall be cut out to solid concrete, thoroughly wetted, brush coated with neat cement grout, and filled with mortar.

F. Concrete Slab Finish. Except where otherwise indicated, the concrete for slabs shall be screeded and floated with straightedge to bring the surface to the required finish level with no coarse aggregate visible. The concrete, while still green but sufficiently hardened to bear a man's weight without deep imprint, shall be woad-floated to a true, even plane vith no deviations in excess of 1/8 inch when tested with a 10 foot straightedge. Sufficient pressure shall be used on the wood-floats to bring moisture to the surface. After the surface moisture has disappeared, surfaces shall be steel-troweled to a smooth, even, dense finish, free from trowel marks. The floor shall be an ACI 302 Class 4 floor.

G. Embedded Items. All embedded and achorage items including anchor bolts, dowels and sleeves, shall be installed in sufficient number and site as Indicated or as required for the purpose intended, Coordinate with work under other sections of the Specifications in order to insure that items not furnished under this Specification have been protected with a coat of grease before placing concrete, after which they shall be cleaned, regreased and wrapped in burlap.

14. CURING

A. General. Immediately after placing or finishing, concrete surfaces not covered by forms shall be protected against moisture loss for not less than 7 *days* after placing. Curing shall be accomplished by one of the following methods or combinations thereof, as approved by the Construction Engfneer.

B. *Moist* Curing. Unformed surface shall be covered with burlap, cotton, or other approved fabric mats or sand, kept in intimate contact with the surface, and shall be kept continually wet. If the forms are removed before the end of the curing period, curing shall be continued *as* on unformed surfaces, using suitable materials.

C. Waterproof-Paper Curing. Surfaces shall be covered with waterproof paper lapped *4* inches at edges and ends, and sealed with mastic or pressure-sensitive tape not less than 3 inches wide. Paper shall be weighted to prevent displacement, and tears or holes shall be patched.' Alternate curing methods shall be employed if the paper becomes deteriorated to a state that its' effectiveness is lost.

D. Membrane-Forming Compound. Membrane-forming compound shall be applied in accordance with manufacturer's directions.

E. Edge Protection. In the event that forms are removed or loosened within the first 7 days of curing, the concrete edges shall be protected and cure4 in accordance with the above method.

15. SAMPLES AND TESTING

A. Samples.

1) During the progress of the work three compression test cylinders shall be made from the concrete as mixed aad at the direction of the Contractor for each day's pour of concrete. If more than 10 yards are placed in a day, three additional cylinders shall be made for each 10 cubic yards plus any fraction thereof. One cylinder shall be tested at 7 days aad one cylinder at 28 days. The third shall be for contingency.

2) The Construction Engineer will furnish the molds for taking concrete test specimens. The Subcontractor shall furnish the labor and facilities required to take the test specimens, and the handling and storing of same at the site.

3) Teat specimens shall be made and cured in accordance with ASTM C 31. The Subcontractor shall perform initial curing of the specimens and deliver the specimens to the Construction Engineer.

B. Testing.

1) General. The Construction Engineer has the option of making slump tests..

2) Slump Tests. A minimum of one test shall be made for each class of coacretc used in a day, or if more than 15 cubic pards are placed in a day, one test shall be made for each 15 yards plus any fraction over 15 yards. Additional tests shall be made when visual inspection indicates that the consistency of the concrete being placed may exceed the limit for slump as specified, Excess slump will be cause of rejection of concrete. Slump will be determined in accordance with ASTM C 143, or ASTM C 360. When the penetration method is used for field control specified, slumps shall be converted to equivalent penetrations by factors established Lo advance. The Contractor shall provide all equipment required for the Slump Test.

3) Air Content. Prior to placing a batch of concrete, the Contractor has the option of making air content tests. At least four air content tests will be made oa randomly selected batches of concrete during each day's pour. Additional tests will be made when excessive variatioa in workability or other inspection methods indicate that the air coatent of the concrete may exceed the limit as specified in Paragraph 5.B. The air content by volume based on measurements made immediately after discharge from the mixer shall be determined by ASTM C 231-82. Excess air content will be cause for rejection of the concrete.

4) Cylinder Compression Testing. Compression testing of cylinders will be in accordance with ASTM C 39.

5) Unsatisfactory Test Results. Where the strength of test specimens falls below specified values for 28 days strength, the Construction Engineer may order removal of the concrete in question, at the Subcon-

tractor's expense, or may approve alternate strength tests at the Subcontractor's expense. These may be either compression tests made with specimens secured from the structure in accordance with ASTM C 42 or actual load tests of the structure made in accordance with ACI 318. The Construction Engineer may also approve additional controlled curing of the concrete in question, not to exceed 7 days, before making either of the alternate tests. The basis for acceptance or refection of the concrete in question as determined by these alternate tests shall be agreed upon by the Subcontractor and the Construction Engineer before making the tests. All additional tests shall be made at the expense of the Subcontractor.

6) A log of all coacrete pours shall be carefully kept by the Subcontractor. In general, the tog shall contain the following data: Identifying number of pour, data made, time, weather and temperature at start of pour, weather and temperature at finish pour, number of cubic yards in pour, slump record, identifying number of cylinders, test results at 7 days, test results at 28 days.

7) Hydrostatic Testing.

After the concrete has attained its specified strength, but no sooner than twenty-eight (28) days after placing, concrete sumps and curbed containment area shall be hydrostatically tested for leakage as follows:

a) Concrete Sumps.

(1) Prior to placing backfill around sumps and before the sump lining is applied to the sump walls and floor, the sump shall be filled to one hundred (100) percent of the wall height with clean potable water and let stand for twenty-four *(24)* hours.

(2) After *24* hours, if there is no lowering of the water head in the sumps and if there *is* no seepage from the sump walls or floor, the sump shall be drained.

(3) Sumps shall be backfilled after draining and before the sump lining is applied.

(4) After backfilling has been completed the sumps shall be thoroughly cleaned and dried, and the lining specified in the Specification and on the drawings shall be applied in accordance with the manufacturer's instructions.

(5) If leakage is detected during the testing period, the Subcontractor shall drain the sumps and make repairs as directed by the Contractor. After repairs have been made, the sumps shall be retested as specified above. Rydrostatic tests shall be performed until no leakage is detected.

(6) After all detectable leakage has been corrected, sumps shall be drained, backfilled, cleaned, dried and lined as previously specified.

b) Curbed containment Areas.

(1) Concrete containment area8 including trenches and sumps within the containment areas shall be hydrostatically tested in the same manner as concrete sumps. The water level shall be brought up to one-hundred (100) percent of the curb height of the curb encompassing the containment area and trenches and sumps within the containment area shall be flooded.

(2) If no leakage can be detected after twenty-four *(24)* hours, the containment area shall be drained, dried and the lining specified in the Specifications and on the drawings shall be applied in accordance with the Manufacturer's instructions.

(3) If leakage is detected during the testing period, the Subcontractor shall drain the containment area and make repairs as directed by the Contractor. After repairs have been made the containment shall be retested as specified.

(4) After all detectable leakage has been corrected, the Subcontractor shall drain, clean, dry and seal the containment area as previously specffied.

c) Notification and Approvals.

(1) The Subcontractor shall notify the Contractor seventy-two (72) hours in advance of the Subcontractor's intent to begin hydrostatic testing.

(2) The Subcoatractat shall receive written approval from *the* Contractor prior to discontinuing testing and again prior to backfilling and before lining or sealing work begins.

16. ANCHOR BOLTS

Set all anchor bolts to template with required projection. Recheck after setting and correct all errors to the satisfaction of the Construction Engineer.

17. GROUT

All grout beneath load-bearing baseplates shall be of the nonmetallic, non-shrink variety with a minimum compressive strength of 6900 psi as determined pet ASTM C 109. The grout shall exhibit no shrinkage prior to initial setting as determined in accordance with ASTM C 827 and shall exhibit no shrinkage in the hardened state as determined in accordance with ASTH C 157. The effective bearing area between newly placed grout and the load-bearing baseplate shall not be Less than 95%. Grouting shall be performed in accordance with ACI Recommendations and the.manufacturet's published specification for mixing and placing.

4.710 - FABRICATION AND ERECTION OF STRUCTURAL STEEL AND MISCELLANEOUS METALS

1. GENERAL

This specification relates to the technical requirements for the furnishing, fabrication, and erection of all structural steel and miscellaneous metals.

2. CODES AND STANDARDS

Codes, specifications and standards referred to by number or title shall form a part of this specificatioa to the exteat required by the references thereto.

A. American Institute of Steel Construction (AISC) Publications:

Specificatioa for the Design, Fabticatioa and Erection of Structural Steel for Buildings. *Code* of Standard Practice for Steel Buildings and Bridges, Eighth Edition.

B. American National Standards Institute (ANSI) Standards:

B18.22.1-65 (R 1981)	Plain Washers
B18.23.1-67 (R 1975)	Beveled Washers

C. American Society for Testing and Materials (ASTM) Standards:

ASTM A 36-81a	Specification for Structural Steel
ASTM A 53-83	Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
ASTM A 304-79	Specification €or Alloy Steel Bars Subject to End Quench Hardenability Requirements
ASTM A 307-84	Specification for Carboa Steel Externally Threaded Standard Fasteners
ASTM A 325-83	Specification for High-Strength Bolts for Structural Steel Joiats
ASTM A 501-83	Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

D. American Welding Society (AWS) Publications:

A5.1-81	Specification for Coveted Carboa Steel Arc-Welding Electrodes
A5.4-81	Specification for Alloy Steel Arc-Welding Electrodes
D1.1-83	Structural Steel Welding Code

E. Research Council on Riveted and Bolted Structural Joints (RCRBSJ) of the Engineering Foundatioa Specification:

Specification for Structural Joints Using ASTM A 325 or A 490 Bolts

F, Structural Steel Painting Council (SSPC) Specifications:

SP3 Power Tool Cleaning

3. SHOP DRAWINGS

A, Shop drawings shall be submitted for approval in accordance with SPECIAL CONDITIONS paragraph: SUBCONTRACTOR'S SUBMITTALS.

B, The Subcontractor shall submit completed and checked shop drawings for approval, The approval of shop drawings will be for size and arrangement of principal and auxiliary members and strength of connections only, and shall not relieve the Subcontractor of the responsibility of errors, omissions, or the accuracy of his own dimensions.

4. MATERIALS

A General.

Except as otherwise specified herein, all material shall conform to the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings. Material shall be new. Substitutioaa of materials, sizes or shapes shall not be made without prior approval of the Contractor.

B. Structural Steel Shapes, Bars and Plates.

Structural steel shapes, bars and plates shall conform to ASTM Specification A 36.

C. Fasteners.

1) Standard Threaded Fasteners

Standard threaded fasteners shall be machine bolts and nuts of the unfinished type conforming to ASTM Specification A 307, Grade A, Plain washers shall conform to ANSI 818.22.1-65 (R 1981); beveled washers shall conform to ANSI B18.23.1-67 (R 1975).

2) High Strength Threaded Fasteners

High tensile bolts, nuts, and washers. shall conform to ASTM Specification A 325.

D. Filler Metal for Welding Structural Steel (ASTM A 36)

Welding electrodes for manual shielded metal-arc welding shall conform to AWS Specification A5.1.

E. Filler Metal for Welding Structural Steel (ASTM A 304)

Welding electrodes for manual shielded metal-arc welding shall conform to AWS Specification A5.4.

F. Anchor Bolts.

Anchor bolts shall conform to ASTM Specification A 36 and shall be set to the line grade as detailed on the design drawings.

G. Pipe.

Pipe to be used for handrails shall conform to ASTM A 53.

H. Bar Grating.

Bat grating shall be as specified on design drawings.

5. DETAILING

A. General.

All detailing by the fabricator shall be in accordance with the AISC Specification for the Design, Fabricatioa and Erection of Structural Steel for Buildings, Eighth Edition, AWS D1.1 Structural Welding Code and ASTM Specification A 36.

B. Connections.

1) strength

In the absence of specific design data concerning the stresses developed, the connections, either welded or bolted, shall be sufficiently. strong to develop the full strength of the weakest member. Where connections are shown on the design drawings, however, the fabricator shall be governed accordingly.

2) Shop Connections

Shop connections shall be welded or high strength bolted.

3) Field Connections

Field connections shall be made with minimum 3/4 inch diameter high tensile bolts, except as otherwise shown on the drawings. These connections shall be considered the bearing type with threads included in the shear plane.

6. FABRICATION

A. General.

All structural steel shall be fabricated in accordance with the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, Eighth Edition.

B. Structures shall be shop fabricated so as to form assemblies of the largest practicable sizes economically suitable for transportation, and possible to be handled and erected.

C. Bolting.

High strength bolts shall be tightened to a bolt tension not less than the proof load given in the ASTM Specification for the bolt, Tightening shall be done with properly calibrated wrenches or by the turn-of-nut method.

D. Welding.

All butt welding shall be of the full-penetration type, either double welded or welded against a backing structure. Welds between abutting members at right angles to each other shall not be considered as *butt* welds.

7. SHOP FINISH

A. General.

Except as otherwise indicated or specified, all structural steel, miscellaneous metal, and collateral material provided under this section shall be shop painted. Shop painting system shall consist of surface preparation, pretreatment where specified, and shop application of prime print. Contact surfaces *to* be welded shall not be coated within 3" *of* the weld, prior *to* welding. All operations required for shop printing shall be in accordance SSPC-PA 1-82 and Section 11 of this specification.

B. Shop Primer.

1) Surface preparation of structural steel and miscellaneous metal for normal painting shall be in accordance with SSPC-SP 3-82.

2) All cleaned surfaces shall be primed, before deterioration of cleaned surface has taken place, with one shop coat of Pittsburgh No. 6-204 zinc chromate or approved equal.

8. ERECTION

A. General.

Unless otherwise specified herein, erection of structural steel shall conform with the applicable sections of the AISC Specification for the Design, Fabrication and Erectioo of Structural Steel for Buildings, Eighth Edition, and the AISC Code of Standard Practice for *Steel* Buildings and Bridges.

B. Temporary Bracing,

Temporary bracing shall be used whenever necessary to support all loads to which the structure may be subjected, including equipment and operation thereof, and piles of materials. Such bracing shall be left in place as tong as may be required for safety, The various members

forming parts of a completed frame or structure after being assembled shall be aligned and adjusted accurately before being fastened. No welding or bolting shall be done until as much of the structure as will be stiffened thereby is properly aligned. All erection bolts used in welded construction shall be tightened securely and left in place.

C. Field Connections

Field connections shall be made by either bolting or welding in accordance vith the design drawings.

1) Bolted Connections

Bolted connections shall be tightened to a bolt tension not less than the proof load given in the ASTM Specification for the bolt. Tightening shall be done with properly calibrated wrenches or by the turn-of-nut method.

2) Welded Construction

Welding of structural steel work shall be done by the shielded metal arc process in accordance with the American Welding society AWS D1.1, Structural Welding *Coda,* except where directed otherwise. Qualification of the welding procedures and welders shall be in strict accordance with the requirements of this code and the Special Conditions.

The Contractor Will visually check any of the welding at his discretion and observe the veld area preparation and the technique and performance of each welder. The welds shall be visually examined for compliance with the stated code, and in particular, *to* assure that the welds are free of unacceptable defects, properly contoured and sized, and located as specified by the drawings. Where visual evidence so indicates, the contractor may requite that welds be sectioned by chipping with a mechanical round-nosed chipping tool. If the quality of any welder's work is found to be unsatisfactory, a complete requalification of the welder may be required.

The Subcontractor shall repair, or correct as instructed by the Contractor, all welds which do not comply with the provisions of the contract drawings and specifications at no additional cost to the Con-t*tactor*.

3) Pipe Handrails

a Pipe handrails shall be of flush, welded construction and shall be fabricated of steel pipe section8 as indicated on the drawings. Material for pipe handrails, including sleeves shall be standard weight (Schedule 40) steel pipe conforming to ASTM A 53, Type E or S, Grade B.

b. Joining of post, rail and corners shall be by one of the following methods:

1. Mitered and welded joints made by fitting post to the top rail and intermediate rail to the post, mitering the corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by tight-fitting interior sleeves not less than 6 inches long.

2. Railings may be bent at corners in lieu of jointing, providing bends are made in suitable jigs and that the pipe is not crushed.

c. Handrails shall be set accurately to line with posts plumb and handrails and intermediate longitudinal members parallel to the stair or floor line. Changes in direction of the handrails shall be made with smooth bends accurately formed.

4) Bar Grating

a. Bar grating shall be fabricated to the size stated on design drawings.

b. Maximum clip or weld spacing shall be 3'-0" with individual sections of grating having a minimum of 4 clips or welds. Clips shall be located so that the grating does not "rock" under pedestrian traffic.

5) **Rejection**

All work or parts thereof and materials entering therein, indicating irremediable or injurious defects, improper fabrication, excessive repairs, or that is not in accordance with the requirements of this specification, shall be subject to rejection.

9. MARKING AND SHIPPING

A. All structural steel shall be prominently paint marked for identification in assembly with piece marks applied right side up on the end corresponding to the left end of the members shown in horizontal or inclined position, and at the lover end for members that are shown in a vertical position. The markings shall be placed in protected areas such as the web of beams, to avoid their obliteration.

B. Markings on galvanized surfaces shall be made with a material that can easily be removed with a commercial paint solvent that will not damage the zinc coating.

C. All bolting, nuts, and washers shall be shipped prior to or with the first lot of structural steel. Baseplates shall be shipped with the steel requiring their use.

D. All metal shall be properly protected and so loaded as to prevent damage in transit. Bolts, nuts, washers, etc. shall be packed in boxes or kegs, Bevelled clips and other small structure parts shall be either boxed or wired together and to larger parts.

10. FIELD PAINTING

Field painting shall be performed in accordance with Section 11.

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5.100 - PIPING INSTALLATION - GENERAL SECTION

1. GENERAL

This specification outlines the materials of construction, fabrication, and installation requirements necessary for installing piping systems. The specification is composed of a general section supplemented by subsections.

2. MATERIALS

Unless otherwise noted on the drawings, materials shall be provided as specified in each individual subsection included herein. All materials shall be in strict accordance with the requited American National Standards Institute (ANSI) Standards, ASTM Standards, or other approved standards and specifications. All valves shall be as specified in the various subsections, and each shall be individually tagged and identified with its respective V-number in accordance with paragraph 6, Technical Specificatioa 5.510.

3. FABRICATION AND INSTALLATION

The following details of fabrication and installation apply to all subsections of this specification. Additional requirements, if any, will be detailed within the various subsections or on the drawings.

A. General

1) Piping materials, including valves and fittings, shall be delivered 'to the site in a clean and protected condition. End seals of pipe and valves and flange covers shall be maintained in place and may be removed only as necessary for cleaning, fabrication, erection, or for inspection. Care shall be exercised in the handliag and storage of all piping materials and prefabricated piping so that contamination by moisture, grease, dirt, or injurious foreign matter shall not occur.

2) Piping specified on the drawings shall follow the routing shown on the drawings. The pipe shall be cut accurately to measurements specified on the drawings and to suit field conditions, and it shall be carefully worked into place without forcing or springing.

3) Below ground piping specified on the drawings shall follow the route specified. At points where lines being installed cross existing lines, a minimum clearance of one foot between pipe surfaces shall be maintained. Where potable water lines cross or pass close to sanitary, chemical, or radioactive liquid waste lines, they shall be encased in concrete or provided with special protection as shown on the drawings.

4) Piping and tubing passing through floors, walls, and ceilings shall be provided with pipe sleeves of sufficient size to allow 1/4-inch annular clearance around the pipe or pipe insulation.

5) Where underground lines paea through walls, similar sleeves shall be used but shall be of sufficient diameter to allow 1/2-inch annular clearance. All sleeves shall be flush with walls and ceilings but shall extend 3 inches above the floor surfaces, unless otherwise specified on the drawings.

6) The interior or exterior surfaces of all piping shall be kept clean at all times, Pipe shall be free of fins and burrs and shall be cleaned in accordance with cleaning procedures specified in Technical Specification 5.310.

7) Flanges, unions, and valves shall be installed as specified and shall be located where they will be accessible after erection.

8) Valves shall be properly packed and made leak-proof under the test pressure described.

9) Valves which are to be soldered, brazed, or welded shall be disassembled prior to heating. Valves shall be allowed to cool, shall be cleaned if necessary, and shall be reassembled.

B. Cutting

Pipe and tubing shall be cut accurately to measurements as specified on the drawings and to suit field conditions. Tube or pipe cutters, or other methods approved by the Contractor, shall be used; and all cuts shall be reamed to remove burrs. Any objectionable defects shall be removed by machining, chipping, or grinding.

C. Bending

1) Changes of direction should be made by bending, wherever possible, in steel, aluminum, copper, or alloy pipe and tube, unless specifically disallowed in the subsections of this specification.

2) Radius, Beading radii shall in no case be less than the minimum radii recommended in the "Pipe Fabrication Institute Standard ES3," latest edition.'

3) Cold Bending. Cold bending shall be done only with approved standard bending methods.

4) Hot Bending.

a. Hot bending shall be subject to the limitations of the subsections of this specification.

b. The pipe or tube to be bent shall be completely and compactly filled with dry, sulphur-free, high-temperature silica sand of a suitable grade and fineness. The ends of the pipe or tube to be bent ahall be tfghtlp plugged or capped to confine the sand, The section to be bent shall be heated uniformly and bent to the desired configuration, cooled, and the sand removed. Bent section shall be free from wrinkles, flats, or humps.

D. Joining Hethods

The following methods shall be used as applicable to the individual subsections of this specificationo

1) Threading. Threading of pipe shall be done preferably after any bending, forging, or heat treating operations. Where threading must be performed first, threads shall be protected during such operations, Threads shall conform to ANSI B2.1. Pipe dope shall be applied to the male threads only.

a. When threading chemically cleaned pipe, use trichlorethane (methyl chloroform), inhibited, as the cutting fluid.

h Teflon ribbon, when used as thread dope, shall not be applied *to* the first *two* threads on pipe.

2) Welding

a. General

(1) All welding, qualification procedures, and qualification of welders' shall be in strict compliance with ASME Boiler and Pressure Vessel Code, Section IX, AWS D10.9 Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing, and applicable ANSI Code for Pressure Piping. All welding procedures and welders' qualifications shall be approved by the Contractor before vork is started. Each welder shall be assigned an identification number, letter, or symbol which shall be used to identify his work when specified in applicable codes, standards, or specifications.

(2) All welds are subject to inspection by the Contractor. The Contractor reserves the right to accept, reject, or demand removal of welds which are in violation or believed to be in violation of these specifications. Welders performing welds found to be unsound shall be subject to appropriate retest provisions of the ASME Boiler Code or other applicable standards.

(3) Unless otherwise specified on the drawings, line-up clamps shall be used for fabrication of all pipe 6 inches and larger with 15 psig and higher working pressure, and on all pipe 12 inches and larger regardless of pressure. On piping sizes 18

inches and smaller, outside clamps shall be used. On sizes 20 inches through 36 inches, inside clamps shall be used, except at such locations as final tie-in where the inside clamps cannot be removed from the pipe. In these locations, outside clamps shall be permitted. For piping larger than 36 inches, internal hydraulic jacks shall be used with suitable bearing pads to prevent damaging the pipe.

(4) Socket weld joints ehall be assembled so that the space between the end of the pipe and the bottom of the socket *is* no less than 1/16-inch or no more than 1/8-inch.

(5) Welded branch connections to headers shall be made by the use of welded outlet fittings, such as reducing tees, weldolets, sockolets, and threadolcts, as shown on the drawings in compliance vith the ANSI Ccode for Pressure Piping 831.1.0, paragraph I27.4.8.

(6) Welded miter bends shall not be used unless so specified on the drawings.

(7) Backup rings shall not be used unless specified on the drawings. When required, backup rings shall be of the size, type, and material specified. CRC Croee International, Post Office Box 3227, Roustoo, Texas 77001, manufactures equipment that is acceptable for this work.

b. Welding Rods and Electrodes

(1) All bundles, boxes, or kegs in which rods and electrodes are delivered shall be legibly marked vith the following information:

Classification
Trade designation
Manufacturer's name
Standard size and length
Heat number

(2) All welding rods shall be identified with at least one imprint pet rod showing the AWS classification number in accordance with AWS AS. 1(15). In addition, welding rods 1/8-inch and over in diameter shall be marked or stamped vith positive identification marks at intervals of not more than 18 inches. Such marks shall be clearly distinguishable and shall include the classification number of the welding rod and the trade designation of the manufacturer.

(3) Welding rods and electrodes shall be stored, handled, and identified at all times to assure the use of the proper welding rod in a welding process.

c. Welding Standards. Welding procedures and welders' qualifications for the various carbon steel and nonferrous service piping systems listed in Table A shall be in accordance with the applicable Welding Specifications specified.

TABLE A
WELDING SPECIFICATIONS

CARBON STEEL PIPING

Technical Specifications	Service	Welding Procedure
5.130	Sulfuric Acid (90% and up)	The following procedures apply to all services shown at the left.
5.136	Dry Compressed Air, Plant and Instrument	For grooved butt welds on pipe and fittings 1 1/2-inches and smaller, and fillet welds on socket weld fittings 3/8-inch and smaller, use Oxyacetylene Welding or Gas Tungsten-Arc Welding. For grooved butt velds on pipe and fittings 2 iaches and larger; fillet welds on socket weld fittings 3/4-inch and larger; and fillet welds on all sizes of slip-on flanges, weldolets, sockolets, and threadolets; use Shielded Metal-Arc Welding of *Steel* with Combination 6010 and Low Hydrogen Electrodes or Gas Tungsten-Arc Welding. A minimum of two passes shall be used on all fillet welds. A 1/8-inch electrode must be used for all passes on 3/4-inch socket weld fittings. The first pass for grooved butt welds on pipe and fittings 2 inches and larger may be made with Gas Tungsten-Arc Welding.
5.128	Nitric Acid, Process Fluids	All welds shall be made with Gas Tungsten-Arc Welding Process for Chromium Nickel Stainless Steel Materials.

4) Flanging

a. Where steel flanges mate with cast iron flanged fittings, valves, or equipment, they shall be provided with flat faces and full face gaskets. Provide full face gaskets between cast iron flanges. Flat ring *type* gaskets shall be used between steel flanges equipped with raised serrated faces.

b. Flanges shall be made up with meeting face in a plane that is exactly perpendicular to the axis of the pipe. Upon erection, flanges shall be so positioned in rotation that the bolt holes shall straddle the vertical flange centerline. All gaskets shall be evenly centered between the flange faces with ring gaskets engaging fully upon raised face flanges. The meeting flanges shall mate flush and true, and the bolts shall be tightened uniformly to draw the flanges evenly and firmly upon the gasket. All bolt threads shall be coated with high temperature thread compound prior to installation. When made up, the bolts shall extend through nutr by at Least one full thread,

S) Joining Cast Iron Bell and Spigot Pipe

a, Joints shall be firmly packed with the type material specified in the subsections of this specification. The remaining space shall then be filled with molten lead at the proper temperature and, when cool, caulked to a thoroughly compacted water-tight joint, In cold weather, the hubs shall be preheated with a torch before the lead is pouted,

b. Threaded pipe which is to be connected to cast iron soil piping shall have a ring of half-coupling screwed on to form a spigot end.

c. For soil pipe, the space filled with lead shall not be less than 1 inch deep; and the surface of the lead shall not be more than 1/8 inch below the rim of the hub.

d, Pot water pip., the space for leading shall not be less than 2 1/4 inches in depth for pipe having a nominal diameter of 20 inches or less; 2-1/2 inches for 24-inch, 30-inch, and 36-inch pipe; and 3 inches for pipe larger than 36 inches. Maximum joint deflection shall not exceed figures shown in Table B.

TABLE B

LIMITING FACTORS

Bell and Spigot Pipe				Mechanical Joint Pipe			
Nominal Pipe Dia.	Joint Opening	Maximum Deflectioa in Inches with Pipe Lengths of 12 ft	18 ft	Size of Pipe	Bend in One Joint Angle	Maximum Deflection in Inches with Pipe Lengths of 12 ft	18 ft
3	0.43	14.8	22.2	3	8°-18'	21	31
4	0.41	11.1	16.7	4	8°-18'	21	31
6	0.58	11.1	16.7	6	7°- 7'	18	27
8	0.65	9.7	14.6	8	5°-21'	13	20
10	0.75	9.3	14.0	10	5°-21'	13	20

1. Joint opening not to exceed 0.75 inch.
2. Caulking space at fact of bell to be not less than 0.25 inch in width.

6) Mechanical Joints

a. The effectiveness of the mechanical joints depends greatly on the care and installation of the rubber gasket 'seal. When this type of joint is used, the following procedure shall be followed:

b. All surfaces that are or will be in contact with the rubber gasket shall be thoroughly vire brushed just prior to assembly, The main purpose of this operation is to remove all loose rust, scale, or other foreign material. All surfaces that are or will be in contact with the gasket shall be lubricated with a solution of clean, soapy water.

c. The follower gland shall be installed on the spigot end of the pipe and shall be followed with the gasket. The spigot end of the pipe shall be bottomed in the socket and shall be properly centered to provide an annular space that will be approximately equal at all points around the circumference of the pipe. The gasket shall be seated in its proper place, and the follower gland shall be brought up to the flange of the socket, maintaining approximately the same distance between the gland and the flange of the pipe at all points around the socket. The bolts shall be inserted in the properly spaced holes, and each nut shall be run up hand tight.

d. The following size wrenches and torque in Table C shall be used to tighten the nuts.

TABLE C

Pipe Size (inches)	Bolt Diameter (inches)	Wrench Length (inches)	Range of Torque (foot pounds)
3	5/8	a	40-60
4 - 24	3/4	10	60-90

e. Bolts shall be tightened by drawing up on opposite pairs beginning at the bottom, then the top, the sides, and lastly the remaining bolts.

f. The cycle of tightening the bolts shall be repeated until all bolts are within the allowable torque range.

g. If effective sealing is not attained at the maximum torque indicated, the joint shall be disassembled, thoroughly cleaned, and then reassembled. Overstressing the bolts in order to effect a seal shall be avoided.

7) Solvent Welded Joints. Solvent welded joints in plastic piping shall be joined as specifled in subsections.

Em Tolerance

The tolerance on overall dimensions of all shop-fabricated piping shall not exceed ± 1/8-inch.

F. Hangers and Anchors

1) In general, the location and design of pipe hangers will be shown on the drawings. In some cases for pipe 2 inches and smaller, hangers may not' be shown. The Contractor shall then provide suitable hangers selected from those shown on the drawings.

2) The location and design of anchors shall be as shown on the drawings.

3) The location and spacing of hangers shall be such that the piping or tubing is held in position without swaying, vibrating, or sagging excessively. Spacing shall not exceed maximum spans shown on drawings,

4) When supporting pipe which is subject to thermal expansion, hanger rods shall be act at a slight angle so that when pipe expands the rods will be plumb.

5) All horizontal runs of cast iron and high-silicon cast iron hub and spigot drain piping shall be supported at maximum intervals of 5 feet, or at each hub, if hub intervals do not exceed 5 *feet.* Unless otherwise specified on the drawings, use adjustable clevis hangers. See drawings for typical method of fastening hanger rods to the building structure.

G. Laying Underground Piping

1) Detailed requirements for excavation, backfill, and grading shall be as outlined in Technical Specification 3.133 "Earthwork for Utilities."

2) The ditch shall be cleaned of debris and other foreign matter immediately before the pipe is lowered into the ditch. Where the ditch is in rock, gravel, or like material, it shall be padded by filling with sufficient earth to form a cushion on the bottom of the ditch before the pipe is lowered.

3) Coated Piping. The pipe shall not be lowered into the ditch before the coating has hardened. The pipe shall be lowered Into the ditch without unnecessary strain so that the pipe is centered in the ditch. Only approved equipment shall be used to handle and lap the pipe. Chain or wire rope slings which may damage the coating or beveled ends of pipe shall not be used.

4) Before backfilling, the line shall be inspected to make sure that it lies evenly on the bottom of the ditch, that no debris is present, and that joints are not covered until testa are completed. Protect coated piping during backfilling by either hand placing selected earth, free from rock or other injurious materials, around the pipe to a minimum depth of 12 inches above the pipe top surface, or wrapping the pipe with 1/4-inch minimum thickness-asphalt impregnated fiber wrapping; and hold in place with banding clamps.

H. Blanking off Isolation Valves

Valved connections provided on headers or branch lines for future connections or extensions shall be blanked off as follows.

I> Flanged Valves. Install a blind flange.

2) Threaded or Socket Weld Valves Install a 4-inch nipple and screwed pipe cap.

3) Solder Type Valves. Install a copper-to-MPT adapter and a screwed brass pipe cap.

5.107 - THIN WALL STAINLESS STEEL SYSTEMS- CHEMICAL DRAINS AND VENTS

1. SERVICE RATING

Maximum Pressure: 15 psig for Chemical Drains and Vents

Maximum Temperature: 150°F for Chemical Drains and Vents

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those requited for the work shall be selected from this listing unless otherwise shown on the drawings.

A. Codes

Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable requirements of ANSI B31.3, "Code for Pressure Piping, Chemical Plant and Petroleum Refinery Piping."

B. Materials

Item	Size (incl.)	Specification
Pipe	6"	Stainless steel, Type 304L, Schedule 10S, ASTM A 312 seamless or welded or ASTM A 358, Class 4, welded.
Pipe Fittings	6"	Wrought stainless steel, Schedule 10S, ASTM A *403*, Grade WP-304L or WP-W-304L, butt weld ends, ANSI B16.9.
Unions	6"	Use flanges.
Flanges	6"	Stainless steel, Type 304L, slip-on or veld neck, ASTM A 182 and ANSI B16.5, 130 lb standard.
Gaskets	Vent Service	RTFE, ring type, 1/8" thick
Bolts and Nuts		Semifinished regular hex head cap screws (bolts), Type *304* stainless steel, ASTM A 193 Grade B8, NC thread, with semi-finished regular hex head nuts, Type 303 stainless steel, ASTM A 194 Grade 8F, NC thread.

C, A requirement for material passing ASTM A 262 Practice A (oxalic acid test) or Practice C (nitric acid test) is not required unless indicated on the drawings or bills of material.

3. PIPING FABRICATION AND INSTALLATION

Piping fabrication and installation shall be as specified in Technical Specificatioa No. 5.100.

4. CLEANING

Cleaning shall be as specified in Technical Specification No. 5.310

5. TESTING AND INSPECTION

Testing and inspection shall be as specified in Technical Specification No. 5.410, Class A for lab vacuum, Class B for demineralized and distilled water, and Class C for chemical drains.

All welds shall be visually inspected in accordance with UCN WSO. Additional tests and inspections may be indicated on the drawings.

All weld impaction shall be done by personnel qualified under the provisions of SNT-TC IA and/or AWS.OCI.

6. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Technical Specification No. 5.510.

5.112 - COPPER TUBING
INSTRUMENT AIR

1. SERVICE RATING

Maximum Pressure - 100 psig
Maximum Temperature - 150°F

2. MATERIALS AND EQUIPMENT

The materials list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those required for the work shall be selected from this listing unless otherwise shown on the drawings,

A. Codes

Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI, "Code for Pressure Piping, 831.3, Petroleum Refinery Piping."

B. Haterials

Item	Size (incl.)	Specificatfons
Tubing (Soft Drawn)	1/4" OD x 0.030" Wall 3/8" OD x 0.032" Wall	Copper No, 122, seamless, per ASTM B 280, with the following exceptions: tubing shall be light annealed temper with grain size no less than 0,015 mm nor greater than 0.040 mm.
Tubing (Hard (Drawn)	1/4" OD x 0.025" Wall 3/8" OD x 0.032" Wall	Copper No. 122, seamless, hard drawn, ASTM B 75, in straight lengths.
Compression		Brass , Parker Intru-Lok, MS-07-AJ-3
Tubing Supports		Tubing supports or tube racks shall be of the size and type specified on the drawings.

C. Valves

Service Shut-Off	Site (incl.)	Valve Number	Make and Figure Number	Materials Body	Trim	Type of Ends
Globe	1/4"	V-6193	Hoke 3211G4B	Brs	Buna N or Teflon	Compression
Globe	3/8"	V-6193	Hoke 3312G6B	Brs	Buna N or Teflon	Compression

2. TUBING FABRICATION AND INSTALLATION

Unless otherwise specified, either type of tubing and fittings may be used,

Fittings shall be minimized by the use of bends where practical, When fittings are required for racked tubing, they shall be grouped together to simplify *system* leak testing.

All exposed and concealed tubing shall be run in horizontal and vertical planes. All horizontal lines shall be parallel to the building walls and partitioas.

Silver soldered joints shall be used, when specified on the drawings,

All other details of fabrication and installation shall be as specified in Technical Specification Number 5.100.

3. CLEANING

Cleaning shall be as specified in Technical Specification Number 5.310.

4. TESTING AND INSPECTION

Testing and inspection shall be as specified in Technical Specification Number 5.410, Class A

3.128 - STAINLESS STEEL SYSTEMS, HIGH QUALITY (NITRIC ACID, URANIUM PROCESS SYSTEMS)

1. SERVICE RATING

Maximum Pressure - 150 psig
Temperature Range - 32°F to 400°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be reauired but that those required for the work shall be selected from this listing unless otherwise shown on the drawings,

A. Codes

Where details of fabricatioa are aot shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI B31.3, "Code for Pressure Piping, Chemical Plant and Petroleum Refinery Piping."

B. Materials

All stainless steel tubing, pipe, weld end fittings, and flanges shall have a carbon content not exceeding 0.030% *(0.040%* €or tubing less than 0.500" O.D. or 0.049" wall thickness) heat analysis and shall meet the added requirements specified in Section 2.D through 2.G of this specification.

Item	Size (incl)	Specifications
Tubing	3/8" to 3/4"	Stainless steel, Grade TP 304L, seamless, ASTM 213, wall thickness as indicated on the drawings.
Pipe	1/2" to 3"	Stainless steel, Grade TP 304L, Schedule 40S, seamless, ASTM A 312.
Tubing Fittings	To 3/4" OD	Stainless steel, Grade 316, compression type ends, Hoke "Gyrolok," or Crawford "Swagelok,"
Pipe Fittings	1/2" to 3"	Wrought stainless steel, Schedule 40S, ASTM A 403 Grade WP 304L or UP-W 304L, butt weld ends, pet ANSI B16.9.

Item	Size (incl)	Specifications
Pipe Unions	All	Use flanges.
Flanges	1/2" to 3"	Stainless steel, Grade WP-304L, welding neck, ASTM A 182 a d ANSI B16.5, 150 lb standard.
Gaskets		RTFE, 1/8-inch-thick, ring type.
Valve Stem Packing (for repacking only)	1/8" and up	TFE, chevron type.
Valve Bonnet Gaskets (for replacement)		RTFE.
Bolts and Nuts		Regular hex head bolts, Type *304* stainless steel, ASTM A 193, Grade B8, UNC thread, with regular hex nuts, Type 303 stainless steel, ASTM A 194, Grade 8F, NC thread.,

C. Valves

All valves shall meet the added requirements specified in Section 2.D. through 2.G of this specification.

Service	Size (incl.)	Valve Number	Make and Figure Number	Material Body	Material Trim	Type of Ends
Shut-off						
Ball	1" to 3"	V-1182	Apollo 87-10X-02-13	316SS	RTFE/	Flanged
Plug	3"	V-6246	Xomox Corp. Figure 67 (1/2"-3") Figure 67 VEG (4"-6")	316SS	TFE Sleeve	Flanged
Check						
Swing	1" to 2"	V-1101	Cooper 315	316SS	316SS	Flanged

D. Material Requirements - General

All material shall be full-annealed or solution heat-treated in conformance with the ASTM standards referenced.

All material shall be degreased, clean and free from scale. Material containing water soluble chlorides shall not come in contact with the material or shall be removed before subsequent operations involving heating.

E. Examinations and Tests

1) Susceptibility to Intergranular Attack

All pipe and flanges shall pass a tert for susceptibility to intergranular attack in accordance with ASTM A 262 Practice C (nitric acid teat) as follows:

a. A specimen shall be taken from each lot of material. The term "lot" shall be as defined by the ASTM specification referenced.

b, The specimen shall be sensitized by heating for one hour at 1250°F ± 10°F and water quenched.

c. The specimen shall then be subjected to the nitric acid test,' ASTM A 262, Practice C.

d. The nitric acid test shall consist of subjecting a specimen to five 48-hour boiling periods. The average corrosion rate for the five periods shall not exceed 0.0020 inches per month. The corrosion rate for each test period shall be reported. Material which passes the teat shall be acceptable; material which fails the test shall be rejected.

e. The results of the corrosion test(s) shall be submitted to the' Company.

2) Ultrasonic Examination

Each tube and pipe shall be ultrasonically examined in the two circumferential and axial directions in accordance with ASTM E 213 with Calibration reference specimens as required in Subsection 17.3 of ASTM A 655.

3) Liquid Penetrant Examination

Each fitting, flange, and valve body shall be liquid penetrant examined in accordance with Article 6 of the ASME B and PV Code, Section 5 with acceptance standard3 as stated in Subrectioa 15.3 of ASTM A 652. Welding or repair welding of the valve body is not acceptable.

Certified Data: Manufacturer's certified material test reports, and reports of required inspections, examinations, and tests are required from the manufacturar for all valves.

F. Markings

1) Pipe, fittings, flanges, and valves shall be marked with the appropriate ASTM markings, the heat number, and, in addition, all pipe and tubing shall be continuously marked per Federal Standard 183.

2) The following additional electro-etch marking will be performed at 3-foot Intervals on all tubing and pipe by the Contractor:

Inspection Request (I.R.) Number
ASIM Designation and Grade
Size and Schedule or Wall Thickness

and all fittings, flanges, and valves will be electro-etch marked with the inspection request (I.R.) number and ASTM designation and grade,

G. Certified Data

Manufacturer's certified material teat reports, conforming to Section 20 to ASTM A 530, and report3 of required inspections, examinations, and tests are required for all stainless steel pipe, fittings, flanges, and valves.

3. PIPING FABRICATION *AND* INSTALLATION

Piping fabrication and instillation shall be as specified in Technical Specification 5.100. Identification shall be maintained on all materials for traceability. Pipe markings (I.R. No., ASTM designation, size, and schedule or wall thickness) shall be transferred by electro-etch marking onto any length of pipe to be cut prior *to* the cutting operation to ensure that each length of pipe bears the markings.

4. CLEANING

Cleaning shall be as specified in Technical. Specification No. 5.310.

5. TESTING AND INSPECTION

Testing and inspection shall be as specified in Technical Specification No. 5.410, Class A.

All bends in pipe shall be 100 percent Liquid Penetrant examined in accordance with W51.

All welds will be visually examined, all first pass and completed welds shall be Liquid Penetrant examined and all butt velds shall be radiographically examined in accordance with ASTM Boiler and Pressure Vessel *Code*, Section IX, AWS D10.9 Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing, and applicable ANSI Code for Pressure Piping. Unacceptable defects shall be repaired and the repairs inspected and re-examined.

All weld inspection shall be done by personnel qualified under the provisions of SNT-TC IA and/or AWS.QCI.

6. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Technical Specification 5.510.

5.130 - SULFURIC ACID (CONCENTRATION, OVER 90 WEIGHT PERCENT)

1. SERVICE RATING

Maximum Pressure — 150 psig
Maximum Temperature — 100°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those required for the work shall be selected from this listing, unless otherwise shown on the drawings.

a. Codes.

Where details of fabricatioa arc not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of the ANSI, "Code for Pressure Piping, B31.3, Petroleum Refinery Piping".

b. Materials.

Item	Size (incl.)	Specifications
Pipe	To 3"	Steel, seamless, Schedule 80, ASTM A 106, Grade B.
Fittings	To 1-1/2"	Steel, 3000 lb, ASTM A 105 or A 181, Grade 2, socket weld ends, ANSI B16.11.
	2" to 3"	Steel, seamless, Schedule 80, ASTM A 234, Grade WPA or WPB, butt weld ends, ANSI B16.9.
Flanges	1/2" to 3/4"	Steel, 130 lb, socket type, ASTM A 105 or A 181, Grade 1, per ANSI B16.5.
	1" and over	Steel, 150-lb, slip-on or welding neck, ASTM A-105 or A-181, Grade 1, per ANSI B16.5.
Unions	All	Use flanges.
Dope		Pipetite-Stik* or Teflon ribbon thread sealant, Permacel, or Scotch brand.
Gaskets	All	Teflon or Garlock 901 blue asbestos, 1/8 in. thick, ring type.

Item	Size (incl.)	Specifications
Valve Stem Packing		Teflon or blue asbestos,
Bolts & Nuts		Steel, heavy hex or square head machine bolts, with semifinished heavy hex nuts, ASIM A 307, Grade B.
Flexible Hose	1-1/2"	Uniroyal H-100 or approved equal.

* As manufactured by Lake Chemical Company, Chicago, Illinois.

c. Valves.

Service	Size (incl.)	Valve Number	Make and Figure Number	Material Body	Material Trim	Type of Ends
Shut-off						
Gate	1/2" to 3"	V-835	Aloyco 117TPG	Alloy 20	TFE and Alloy 20	Flgd
Ball	1/2" to 3"	V-332	Contromatics	Alloy 20	TFE	Flgd
Check						
Swing	2"	V-362	Aloyco 377TPG	Alloy 20	TFE and Alloy 20	Flgd

3. PIPING FABRICATION AND INSTALLATION

Piping fabrication and installatian shall be as specified in Technical Specification No. 5.100.

4. CLEANING

Cleaning shall be as specified in Technical Specification No. 5.310.

5. TESTING AND INSPECTION

Testing and inspection shall be as specified in Technical Specification No. 5.410,

6. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Technical specification No. 5.510.

7. PAINTING

Painting shall be as specified in Technical Specification No.. 11.430.

* ** Use only where H_2O is permanently absent.
V-6422 is for low pressure special appllcatioa only.

5.136 - DRY COMPRESSED AIR PLANT AND INSTRUMENT

1. SERVICE RATING

Maximum Pressure - 150 psig
Maximum Temperature - 200°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required but that those required for the work shall be selected from this listing unless otherwise shown on the drawings.

A. Codes

Where details of fabricatioa are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI B31.3, "Code for Pressure Piping, Petroleum Refinery Piping."

B. Materials

Item	Size (incl)	Specifications
Pipe	1/2" - 1"	Steel, welded, Schedule *40*, ASTM A 53.
Pittings	1/2" - 1"	MI, 150 lb, ASTM A 197, with screwed ends, ANSI B16.3.
Unions	1/2" - 1"	MI, 150 lb, ASIM A 197, with brass-to-iron seats, screwed ends, dimensions per manufacturer's standard,
Gaskets	All	Compressed asbestos, 1/16-inch-thick, ring type. ASTM F 104 grade P1161A, Sepco Corp. No. 200.
Dope		Tyte-Unyte, J. C. Whitlam Manufacturing Co.
Bolts and Nuts		Steel, heavy hex or square head machine bolts with semifinished heavy hex nuts, ASIM A 307 grade B
Air Hose Couplings		Universal type, cadmium-plated, MI, Air King hick-Acting, style AKM. Dixon.

C. Valves

Service	Size (incl.)	Valve Number	Make and Figure Number	Material Body	Material Trim	Type of Ends
Shut-off						
Gate	1/2" - 1"	V-1	Lunk. 2125	Bronze	Bronze	Screwed

D. Pressure Relief and Reducing Valves

Safety relief and pressure reducing valves shall be of the type and size specified on the drawings, All safety valves shall have lever operators. Safety valves for air service shall be National Board stamped, Safety valves shall be turned over to the Contractor for pressure setting prior to installatioa,

E. Air Hose Outlets

Air hose outlets shall be provided where specified on the drawings and at the air pressure specified.

3. PIPING FABRICATION AND INSTALLATION

Details of fabrication shall be as specified in Technical Specification No. 5.100.

4. CLEANING

Cleaning shall be as specified in Technical Specification No. 5.430.

5. TESTING AND INSPECTION

Testing and inspection shall be as specified in Technical Specification No. 5.410, Class A.

6. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Technical Specification 5.510.

7. PAINTING

Painting shall be as specified in Technical Specification No. 11.430.

I. SERVICE RATING

Pressure Range - 0 to 150 psig
Maximum Temperature - 150 °F
Operating Pressure - 50 psig

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those required for the work shall be selected from this listing unless otherwise shown on the drawings.

a. Codes.

Where details of fabrication are not shown on the drawings, or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI "Code for Pressure Piping, 831.3, Petroleum Refinery Piping," and the "National Fluid Power Association (NFPA) Hydraulic Standards."

b. Materials.

Item	Size (incl.)	Specifications
Pipe	2"-12"	Polyethylene, high density, ASTM D 1248 Type III, Class C category 5, Grade *P34* Schedule 40,
Fittings	2" to 6"	Polyethylene, high density, high molecular wefght molded line fittings to match pipe.
	8" to 12"	Fabricated from pipe.
Flanges	2" to 12"	Steel, ASTM A 105 Grade 1, 150 lb back-up type, ANSI B16.5
Gaskets	All	Red Rubber Sheet, 1/16 inch thick, ring or full face as required. ASTM D 2000 (2AA705A13L14), gaskets are not .required with butterfly valves.
Valve Stem Packing	All	Teflon.
Bolts & Nuts		Steel, heavy hex or square head machine bolts wfth semifinished heavy hex nuts, ASTM A 307 Grade B.

3. PIPING FABRICATION AND INSTALLATION

Piping fabrication and installation shall be as specified in Technical Specification 5.100.

4. CLEANING

Cleaning shall be as specified in Technical Specification 5.310.

5. TESTING AND INSPECTION

The Subcontractor shall hydrostatically test the piping system at 1-1/2 times maximum operating pressure, using water as test medium. The Contractor shall visually inspect all joints and connections for leaks. The Subcontractor shall repair all Leaks and retest repaired joints.

60 IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Technical Specification 5.510.

5.310 CLEANING, CONDITIONING, AND STERILIZATION OF PIPING SYSTEMS

1. scope

This section of the specification describes the cleaning requirements for piping systems listed under Technical Specification subsections and includes the sterilization requirements for piping systems conveying potable water,

2. GENERAL

A. The Contractor will furnish the water, and plant or compressed oil-free dry air, as required, for cleaning pipe or piping systems.

B. Block control valves in the open position; remove orifice plates, traps, and strainers prior to or during the process of cleaning. Introduce the flushing medium at the remote end of the piping system, Flush from the upstream side of check valves. Alternately open each extremity of the line so that the entire system is flushed.

C. The following piping system (after chemical cleaning) must be kept absolutely free of oil, grease, dirt, paint, and other foreign materials before and after erection.

Subsection	Services
5.136	Air - Plant and Instrument

D. Tools for assembling the piping must be degreased.

3. PIPING WHICH REQUIRES CHEMICAL CLEANING BEFORE ERECTION

A. Pipe, valves, and fittings for the following services shall be chemicallp cleaned.

Subsection	Services
5.136	Air - Plant and Instrument

B. The Contractor will do all chemical cleaning, and cap or seal off all ends of pipe, valves, or fittings. Piping shall be cleaned in the largest practical assemblies, but dimensions shall not exceed 20' x 4' x 4' nor contain more than two fittings, and shalt not contain any valves. Weld two (2) each lifting lugs, minimum 2" hole diameter, to each pipe or piping assembly to be cleaned by the Contractor. Lugs shell be spaced to provide for a balanced lift. Lugs shall be removed after cleaning and before installation of the piping. Lifting lugs shall be installed when the following conditions exist:

1. Straight length of pipe 4" in diameter or larger and 6' in. length or longer.

2. Any assembly of pipe and fittings regardless of pipe diameter, number of fittings, or length.

C. The Subcoatractor shall pay for any recleaning required because of his negligence in handling and storage.

D. The Subcontractor shall deliver all material which requires chemical cleaning to the Contractor's C-400 chemical cleaning building and shall return it to the work site when cleaniag is complete.

4. PIPING WHICH DOES NOT REQUIRE CHEMICAL CLEANING BEFORE ERECTION

All pipe, valves, and fittings used in fabricating piping systems under this classification for conveying services other than those listed in paragraph 3 will not requite chemical cleaning. However, each component of any piping system under this classification shall be cleaned and inspected before erection as follows.

A, Inspect all pipe, valves, and fittings for physical defects; and replace broken, chipped, cracked, or defective items with new.

B. Remove-all loose scale, rust, dirt, mud, and other foreign materials from interior surfaces by wire-brushing, scrubbing, or flushing with air or water.

C. Remove excess dirt, rust, grease, and oil from exterior surfaces.

D. Provide caps or protective covers over ends of pipe, valves, and fittings until ready to install.

5. PIPING SYSTEMS REQUIRING CLEANING AFTER ERECTION AND TESTING

A. Methods Specified in Technical Specification

Piping systems conveying the following services shall be cleaned after erection and testing in accordance with applicable instructions specified in their respective technical specification subsections.

Subsection	Services	Description
None	Sanitary and Storm Sewers	ASTM C *14* Non-Reinforced Concrete Pipe as Called Out on Drawings

B. Flushing With Initial Test Medium

Piping systems conveying the following services shall be cleaned after erection and testing by flushing with initial test medium for five minutes.

Subsectioa	Services	~~Test Medium~~,
5.112	Instrument Air	Nitrogen or Dry Air
5.128	Nitric Acid	Nitrogen or Dry Air
5.130	Sulfuric Acid (Over 90%)	Nitrogen or Dry Air

C. Purging

Piping systems conveying the following services shall be cleaned after erection and testing by purging with dry compressed air (DCA) or nitrogen (N) until the specified dew point is reached and held for 30 minutes.

Subscction	Services	Purge Gas	Dew Point
5,136	Dry Compressed Air-Instrument Air	DCA	-40°F

6. PIPING SYSTEMS NOT REQUIRING CLEANING AFTER ERECTION AND TESTING

Piping systems conveying the following services do not require cleaning after erection and testing since this function is accomplished during initial start-up operations.

Subsection	Services
5.151	Process Drains

5.410 TESTING AND INSPECTION OF PIPING SYSTEMS

1. GENERAL

A. This specification covers the testing and inspection of piping system. The Subcontractor shall furnish all labor, materials, equipment, tools, and services necessary for testing, except for work, materials, and/or equipment to be furnished by the Contractor. Four classes of tests are included.

Clara A - Pneumatic Test
Class B - Hydrostatic Test
Class C - Water Test, Drainage Systems
Class D - Vacuum Test

B. The class of test to be applied is specified in the applicable technical specification subsections.

2. DEFINITION FOR MAXIMUM WORKING PRESSURE OP A SYSTEM

The maximum working presourc of a system is defined as the predetermined value at which the piping system's safety relieving devices are set to prevent overpressurizing the system. Either the set preseure of the relieving devices or the maximum operating pressure of the piping system shall be specified on the drawings.

3. GENERAL TESTING REQUIREMENTS

General requirements for tests to be performed on installed piping systems under this specification shall be as follows.

A Blank off or replace with spool pieces, items of equipment (e.g., vessels, pumps, instruments, controls, safety and relief valves) rated for pressures below the test pressure. Before performing final operatiag pressure test on a system, remove test blanks and spool piece's; and reconnect protected instruments and equipment.

B. Inspect all parts of the system for leaks, especially at valves, flanges, welds, threaded connections, and packed joints. All leaks shall be repaired and the joints retested.

C. Check that safety and relief valves have been inspected and set by the Contractor at the required set pressure and that rupture discs are installed by the Contractor.

D. Soap solution for soap testing shall be a soapless lather, leak detector solution, as manufactured by Industrial Colloids & Chemical, Inc., Knoxville, Tennessee, or Company approved equal.

E. Use adequate precautions during pneumatic pressure testing. Clear the installation area of personnel aot engaged in testing operations. Visually inspect the system installation for compliance with the design drawings and specifications.

F. Potable water shall be used as the teat medium when testing piping systems handling potable or safety shower water.

G. The test shall be performed in the presence of an authorized representative of the Company.

4. WORK, MATERIALS, AND/OR EQUIPMENT FURNISHED BY CONTRACTOR

The Contractor will furnish the test gauges and testing media required to conduct Class A, Class B, and Class C tests,

5. CLASS A TESTING (PNEUMATIC PRESSURE TEST)

Class A testing consists of pneumatically pressure testing piping systems or isolated sections of piping systems with compressed air or nitrogen as specified in Table I. Test preseures and test procedures shall be as follows:

A. Test Pressure

1) Test pressure for pneumatically testing pipe sizes 6 inches and under shall be 1.5 times the maximum working pressure, but in no case less than SO psig.

2) Pipe sizes 8 inches and larger shall be pneumatically tested at 50 psig. However, when the test pressure (1.5 x maximum working pressute) exceeds 50 pslg, piping shall be hydrostatically tested in accordance with Class B test procedures, unlesr otherwise noted on the drawings.

B. Test Procedure (When Test Pressure is 50 psig)

1) With equipment items protected and safety precaution8 taken in accordance with paragraphs 3.A. and 3.E., pressurize system to 50 psig. Soap test all welds, joints, and connections. Repair leaks, and retest repaired joints.

2) After instruments and equipment have been reconnected, these connections shall be pressurized and soap-tested at maximum operating pressure. Repair leaks, and retest repalred joints.

C. Test Procedures (When Test Pressure Exceeds 50 psig)

1) With equipment items protected and safety precautions taken in accordance with paragrapha 3.A. and 3.E., gradually pressurize system to 50 percent of the teat pressure. Thereafter, the teat pressure shall be increased in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Then reduce pressure to 75 percent of the test pressure, Ssoap test all welds, joints, and connections. Repalr leaks, and retest repaired joints.

2) After instruments and equipment have been reconnected, these connections shall be pressurized and soap-tested at maximum operating pressure. Repair leaks, and retest repaired joints.

6. CLASS B TESTING (HYDROSTATIC TEST)

Class B testing consists of hydrostatically pressure testing piping systems or isolated sections of piping systems with water or another liquid aa specified in Table I. Test pressures and test procedures shall be as follows.

A. Test Pressure

Teat pressure shall be 1.5 times the maximum working pressure, unless otherwise specified on the drawings, but not less than *50* psig.

B. Teat Procedure

1) With equipment items protected in accordance with paragraphs 3.A. and 3.E., pressurize system to test pressure. Hold pressure while visually inspecting all velds, joints, and connections for leaks. Repair leaks, and retest repaired joints.

2) Drain system; and after instruments and equipment are ttcoanected, refill with service medium and apply maximum operating pressure. Hold pressure while visually inspecting these joints and connections for leaks. Repair Leaks, and retest repaired joints.

7. CLASS C TESTING (WATER TEST, DRAINAGE SYSTEMS)

A, Class C testing consists of testing building drains and building sewers with a 20-foot head of water as follows.

B. *Test* building drain and vent system in accordance with ANSI A40.8, "National Plumbing Code," paragraph 14.9, "Water Test," Final test may be either smoke or peppermint test;

C. Test building sewer in accordance with ANSI A40.8, "National Plumbing Code," paragraph 14.10.

a CLASS D TESTING (VACUUM TEST)

A. Class D testing consists of testing piping systems or isolated portions of piping systems at a pressure below atmospheric pressure.

B. Class D vacuum tests, when required, will be performed by the Subcontractor. The Subcontractor will also furnish all equipment required for the teats. The Subcontractor shall repair all leaks until tests requirements arc met.

C. The leak rate for systems requiting Class D tests shall be specified on the drawings,

TABLE 1

(Showing Test Media for Piping Systems
Included under 5.100 Subsections)

Subscction	Service	Test Medium		
		Class A Teat	Class B Teat	Class C Test
5.112	Instrument Air (Capper Tubing)	Dry Air/Nitrogen		
5.128	Nitric Acid	Dry Air Nitrogen		
5.130	Sulfuric Acid (Above *90%)*	Dry Air Nitrogen		
5.136	Dry Compressed Air	Dry Air		
5.151	Process Drains			Water

5.510 IDENTIFICATION OF PIPING AND COLOR CODE

1. GENERAL

This specification outlines-details of identifying valves and exposed piping after erection, insulation, and painting are completed. Exposed piping is defined as all piping which is visible in the open or may be exposed by the removal of covers or panels designed *to* provide access for inspection or maintenance. The tabulation included herein is comprehensive in nature. It is not intended that all flowing mediums listed will necessarily *be* required but that those required for the work shall be identified as shown with the labels having a background color as indicated under the color code.

2. DESCRIPTION OF MARKERS

A. Identification markers shall be vinyl cloth having a self-adhesive backing that is resistant to moisture, oils, and most solvents, and that will hold tight within a temperature range of *-40* to 250°F. Label shall be weather and fade resistant and similar to those manufactured by W. H. Btady Company, Milwaukee, Wisconsin.

B. The labels shall be of specified background color upon which are printed the name of the flowing medium with specified letter color. The direction of flow in each pipe shall be indicated by an arrow on a label adjacent to the identification label and of the same color as the identification label.

C. Where additional information is required, a separate-label shall be applied adjacent to the service identification label. Background color, letter color, and letter height shall be the same as service identification.

D. Service listed below requires addition of line operating pressure information which will consist of individual numeral labels indicating normal line operating pressure plus a label containing the letters PSIG.

Dry Plant Air
Plant Air
Dry Instrument Air

E. The following service requires addition of temperature information which will consist of individual numeral labels indicating nominal Line operating temperature and a label containing the symbol °F.

None

F. Labels shall conform to ANSI A13.1, "Schemes for the Identification of Piping Systems."

G. These labels and acrylic overcoating will be furnished by the Subcontractor.

H. Letter heights for use in titles are governed by the outside diameter of the pipeline including insulation. The minimum letter heights to be used are:

Outside Diameter	Letter Heights
1/2 - 3 inches included	5/8 inch
3-1/2 inches and up	1-1/4 inches

3. EXPLANATION OF COLOR CODE

The type of hazard of the flowing medium is indicated by the colors listed below.

Background Color	Flowing Medium	Letter Color
Yellow	Dangerous Materials	Black
Green	Generally Safe Liquids	Black
Blue	Generally Safe Gases	White
Red	Fire Protection	White
Purple	Radioactive	Yellow

4. LOCATION OF MARKERS

A. Straight sections of pipelines inside buildings shall beat identification markers at maximum intervals of 40 feet. Straight sections of pipelines outside buildings shall beat identification markers at maximum intervals of 100 feet.

B. Branch Lines shall be identified with a marker located not more than 5 feet from the main line.

C. Lines passing through walls or floors shall be identified on each side by a marker located not more than 5 feet from the wall or floor.

D. Markers on banks of piping shall be placed in a row, side by side, for ease of reference.

5. METHOD OF APPLYING LABELS

A. Surface to which labels are adhered must be free of scale, dirt, dust, grease, and moisture. Press the label firmly in place, tubbing thoroughly, particularly along the edges, until the adhesive makes a good bond.

B. Overcoat the entire label including 1/2-inch overlap at the edges, with a heavy coat of Glidden Clear Silk Screen Acrylic Y-7135.

C. Mastic coatings on insulated lines, such as Vimasco's WC-1, Insul-Coustic's IC-551, and Benjamin Foster's 60-60, must be completely dry before applying labels.

60 IDENTIFICATION OF VALVES

All valves identified on the drawings and specifications with V-numbers shall be permanently identified with stainless steel tags embossed with the applicable V-numbers. Tags shall not be attached to handwheels or levers or other parts of valves which would interfere with operation.

Service and Label Wording	Label Background Color	Subsection Number
Air		
Dry Instrument Air	Blue	5.112, 5.136
Dry Plant Air	Blue	5.136
Nitric Acid	Yellow	5.128
Sulfuric Acid, Concentrated	Yellow	5.130

5,610 VALVE INDEX AND ACCEPTABLE MANUFACTURERS

This section of the Piping Technical Specifications contains a tabulation of valves used by the Contractor.

The following information is given in the valve tabulation for each valve number included:

1. Valve number.

2. Valve body material.

3. Type of end connections and flange pressure ratings.

4. Type of valve.

5. Technical Specification Piping Numbers in which the valves are specified.

6. List of acceptable valves giving manufacturer's name, figure number, and available sizes. Underlines name denotes a typical acceptable standard valve; others listed are approved equals.

Identification of Valves. All installed valves shall be permanently identified with stainless steel tags embossed with applicable V-numbers.

MATERIAL ABBREVIATIONS USED IN INDEX

Material	Abbreviation
Alloy 20	A20
Aluminum	Al
Brass or Bronze	Br
Cast Carbon Molybdenum Steel	CCMoS
Cast Chromium Molybdenum *Steel*	CCrMoS
Cast Iron	CI
Cast Iron Glass Lined	CIG
Cast or Forged Carbon Steel	CFCS
Cast Molybdenum Steel	CMS
Cast Steel	CS
Chromium Molybdenum Stcel	CrMS
Chromium Nickel Molybdenum Steel	CrNiMoS
Duriron	Duriron
Forged Brass	FBr
Forged Bronze	FBz
Forged Steel	FS
Forged Chrome–Moly Steel	FCrMoS
Hastelloy Alloy	Hast. A, B, or C
Monel	M
Nickel Alloy Steel	NiS
Silicon Bronze	SiBr
Stainless *Steel*	SS
Teflon	TFE

Valve End Connections	Abbreviation
Butt Weld	BW
Flanged Ends	FE
Flanged Ead - Ring Joint	RJ
Hub End	HE
Mechanical Joint	MJ
Screwed Ends	SE
Socket Weld	SW
Solder Joint	SJ
Tubing, Compression Type (Flareless)	CT
Tubing, Flare Type	FT
Wafer	W

Valve No.	Material	Ends and Rating	Manufacturer and Number
V-1	Br	SE 125	GATE
			Crane *430*, 1/2" to 3"
			Fairbanks 0253, 1/4" - 3"
			Hammond IB643, 1/4" - 3"
			Jenkins *620*, 1/4" - 3"
			Lunkenheimer 2125, 1/4" - 3"
			Powell Fig, 500, 1/4" - 3"
			Stockham Pig. B114, 1/4" - 3"
			Walworth No. 3 or 5, 1/4" - 3"

V-5	CI	FE 125	GATE (5.100, Sub, 136 American-Darling No. 52, 3" - 14" Crane No, 465-1/2, 2" - 48" Dresser, N & H Fig, 81F, 2 1/2" - 14" Fairbanks No. 0405, 2" - 24" Hammond IR-160, 2" - 24" Hammond No, IR1140, 2" - 16", No. IR160 2" -24" ITT Grinnell Fig. 6020, 2" - 14" Jenkins Special Fig. 651A, 2" - 24" Lunkenheimer Fig, 1630, 2" - 14" Milwaukee Fig. F-2885, 2" - 12" Nibco Scott fig. F617-0, 2" - 12" Powell Fig. 1793, 2" - 24" Stockham Fig. G-623, 2" - 24"
V-362	A20	FE 150	CHECK 5,130 Cooper Pig, 315, 1/2" - 24" Crane No. 21676, 1/2" - 6" Jenkins Pig. 2331, 1/2" - 8" Ladish No. 5272, 1/2" - 12" Pacific Fig, A-1100, 1/2" - 6" Powell No. 2342, 1/4" - 12" Stockham 15-SF-20, 1/2" - 3" Walworth Fig, 377, 1/2" - 12"
V-835	A20	FE 150	GATE 5.130 Cooper 115, 1/2" - 12" Crane 21275, 1/2" - 8" Jenkins 2327; 1" - 8" Ladish 8272, 1/2" - 12" Pacific A-0550-14, 1/2" - 12" (1 1/4" excepted) Powell 2495, 1/4" - 2" Powell 2456-DG, 2 1/2" - 20" Stockham 15-OF-20, 1/2" - 6" Walworth 117-TPG or 127-TPG, 1/2" - 12"
V-1101	SS 316	FE 150	CHECK 5.128 Cooper Fig. 315, 1/2" - 12" Crane Fig, 61675, 2 1/2" - 6" Jenkins Fig. 1331, 1/2" - 8" Ladish Fig. 5272, 1/2" - 12" Pacific Pig, S-1100, 1/2" - 6" Powell Pig, 2342, 1/4" - 4" Powell Fig, 2633, 6" - 12" Stockham Fig. 15-SF-316, 1/2" - 6" Walworth 377, 1/2" - 12"

V-1182	SS 316	FE 150	BALL 5.128 ACF, W.K.M. B100-SL-01,* 1/2" - 8" Apollo 87-10X-02-15, *1/2" - 4" Crane 951-TRE, 1/2" - 12" (except 3/4" and 2") Hills-McCanna F or S-151-S6-R-S6, special * 3/4" - 10" ITT Grinnell Camtite 3011-1-1, 1/2" - 4" Jamesbury Series 5150-31-3600TT, *1/2"-16" Jenkins 1337, special * 1" - 6" KTM E0132-32TT-15-L-UC, * 1/2" - 2 1/2" KTM E0832-32TT-15-L-UC, * 3" - 6" KTM E0832-32TT-15-G-UC, * 8" - 10" Ladish 4202, special * 1/2" - 12" Mar Pac, SS-C470-RT, * 1/2" - 4" Powell 4226R, special * 3" - 8" Smith 315 GCE, 1/2" - 6" Watts SF-25400-150, 1/2" - 6" Worcester AF51-6-6-RR-150 special * 1/2"-10"
V-6193	Br	CT	BLUNT NEEDLE (In Line) (P-1.1, Sub. 112) Hoke Fig. 3212G4B, G2B, G6B, 1/8" - 3/8", Gyrolok Ends Parker Hannifin Pig. 2Z-V4LR-B, 4Z-V4LR-B, 6Z-V6LR-B, 8Z-V8LR-B, 12Z-V12LR-B, 1/8" - 3/4", CPI ends Whitey Fig. 1VS4, 1VS6, OVS2, Swagelok Ends, 1/8" - 3/8"
V-6246	SS 316	FE150	PLUG 5.128 Duriron Co. - Durco Fig, G411, 1/2" - 3" Duriron Co. - Durco Fig. G411H, 4" - 12" Union Unichem 15A3LLV, 1/2" - 4" Walworth Aloycoseal 257A, 1/2" - 4" Xomox Corporation Fig. 067V, 1/2" - 3" Xomox Corporatfoa Fig. 067VEG, 4" - 12"

* All externals and non galling bolting, type 300 series stainless steel. Gear operator and handle may be manufacturers standard. Seats and Seals RTFE.

Note: Certified Data is required from the manufacturer for all valves,

7.000 - ELECTRICAL CONSTRUCTION GENERAL SECTION

1. GENERAL

A. Application

This specification covers the complete installation of all electrical material and equipment in accordance with the contract drawings, as hereinafter specified, and as described in the General Conditions.

B. Installation

1) The Subcontractor shall install all work to conform to recommendations contained in the most recent issue of the National Electrical Code (NEC) and the National Electrical Safety Coda (NESC) and to the applicable rules of national standards and coder hereinafter referred to. In the event of conflict between the requirements of the specifications and any standard or code, the specifications shall govern.

2) All labor required for the installation of electrical material and equipment shall be performed by craftsmen skilled in the electrical trade.

3) Temporary lighting and power circuits required for construction shall be installed by the Subcootractor in accordance with Article 305 of the National Electrical Code.

2. APPLICABLE CODES, STANDARDS, AND REFERENCES

All materials, equipment, and vork performed shall be in accordance with the applicable sections of the following documents:

AMERICAN NATIONAL STANDARDS INSTITUTE

NO.	DATE	SUBJECT
ANSI/NFPA 70	1984	Rational electrical Code (NEC)
ANSI A449	1980	Steel Bolts
ANSI B18.2.2	1972	Square and Hex Nuts
ANSI B18.22.1	1963	Plain Washers
ANSI C57.12.90	1980	Transformer Tests
ASTM D 877	1980	Dielectric Breakdown Voltage of Insulating Liqulda
ASTM D 92	1978	Flash and Fire Points - Cleveland Open Cup Method
ASTM D 971	1977	Interfacial Tension of Oil - Ring Method

ASTM D 974	1980	Neutralization Number by Color-Indicator Titratioa
ASTM D 1273	1981	Corrosive Sulphur in Electrical Insulating Oils
ASTM D 96	1977	Water and Sediment in Crude Oils - Test Method

UNDERWRITERS LABORATORY

Subject 1242	1982	Standard for Intermediate Metal Conduit,
UL 651	1981	Schedule 40 and 80 PVC Conduit

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

NEMA BC1	1982	Bituminous Fiber Duct for U.G. Installation
NEMA ST20	1972	Dry Type Transformers for General Application
NEMA WC-5 (ICEA S-61-402)	1983	Thermoplastic Insulated Wire and Cable
NEMA WC-7 (ICEA S-66-524)	1982	Cross-Linked-Thermo-setting-Polyethylene Insulated Wire and Cable
NEMA WC-8 (ICEA S-68-516)	1980	Ethylene-Propylene Rubber Insulated Wire and. Cable

ASSOCIATION OF EDISON ILLUMINATING COMPANIES

AEIC 1-68	1980	Solid Type Impregnated-Paper-Insulated Lead Covered Cable Spec.
AEIC-CS3-82	1982	Thermoplastic end Cross-Linked Polyethylene Insulated Shielded Pwer Cable Rated 3 through 69 kV
AEIC-CS6-82	1982	Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 69 kV

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS

IEEE 81	1983	Guide For Measuring Ground Resistance and Potential Gradient8 in Earth

STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS
(Eleventh Edition) (McGraw-Hill)

Section 17-38 C.	Ground-Resistance Test Methods "Fall of Potential Potential Method"

3. MATERIALS AND EQUIPMENT

A General

1) All materials and equipment furnished, unless otherwise noted, shall be new and shall be listed by the Underwriters' Laboratories, Inc., or

other nationally recognized testing laboratories, whenever standards have been established by one of these agencies.

2) All materials and equipment shall be specified on the drawings or in this Specification. In the event of conflicts between the drawings and specifications, the specifications shall govern.

B. Equipment - Specified Elsewhere

1) Large items of electrical equipment, such as high voltage switchgear, distribution transformers, feeder bus duct, etc., and special equipment, such as transfer switches, solid state controllers, battery chargers, motor-generator sets, etc., shall be specified in equipment schedule on the drawings or in separate equipment specifications or data sheets.

2) The equipment shall be installed where shown on the drawings in full compliance with details, wiring diagrams, and notes on the drawings and manufacturer's instructions and wiring diagrams furnished with the equipment.

3) Identification, wiring, and testing of this equipment shall comply with applicable paragraphs of thir Specification.

4. MISCELLANEOUS INSTALLATION METHODS

A. **Fastenings**

Fastenings to wood shall be by means of wood screws or boltr; to masonry by means of threaded metal inserts, metal expansion screws, metal expansion shields or bolts; and to steel by means of machine screws, bolts, or by welding. Wood or fiber plugs will not be permitted. Fastenings to coacretc may be accomplished with "Ramset" low powered gun fasteners, 'bolts, or expansion anchors.

B. Hangers, Supportera, and Equipment Racks

1) Hangers, supports, and equipment racks shall be furnished and installed by the Subcontractor as shown on the drawings and/or specified in applicable sections of this Specification.

2) Hangers for supporting conduit and electrical equipment shall be angle iron, channel iron, "Unistrut", galvanized, or cadmium plated rods. Conduit hangers shall be opacad in accordance with Specification 7.011.

3) Supports for electrical equipment shall be fabricated from angle iron, channel iron, or "Unistrut", and when required, covered with steel plate. Supports shall be of all welded construction. Equipment shall be fastened to plate with hex head bolts, hex nuts, and lockwashers.

4) Equipment racks for mounting electrical equipment shall be fabricated from P-1000 "Unistrut" unless otherwise shown on the drawings. Racks shall be of bolted or vcldsd construction. Equipment shall be mounted to the rack with hex head bolts, spring nuts, and lockwashers.

5) Unfinished members used in the fabrication of hangers, supports, and equipment racks shall be cleaned of rust and rule and painted with one coat of metal primer after fabrication and then, if not concealed, shall be painted in accordance with part 6 of this Section.

C. Cutting and Patching

1) All cutting and patching, repairing, and other similar alterations required for the installation of electrical material and equipment shall be performed by craftsmen skilled in the trade involved.

2) Existing work that is cut, removed, or otherwise damaged during the operations included in paragraph 1) above shall be patched or replaced to match existing work.

D. Openings, Penetrations, and Inserts

1) The Subcoatractot shall provide all openings required for the Subcontractor's work.

2) The Subcontractor shall seal around all conduits penetrating floors and concrete or masonry fire zone walls in accordance with the drawings or by installing three-hour fated, flanged conduit fireseals, O-Z/Gedney Company Type CFSP, or an approved equal.

3) The Subcontractor shall seal around all raceways penetrating exterior building walls of wood, sheet metal, etc., with silicone rubber sealant, GE RTV-102 or Dow Corning 732.

4) All chases, sleeves, inserts for hangers, supports, and fastenings should be located in advance of new construction by the Subcontractor in order to minimize Fnterferences.

5. IDENTIFICATION - EQUIPMENT AND CIRCUITS.

A Equipment

1) Safety switches, circuit breakers, motor starters, lighting panels, power panelboards, and other similar electrical equipment shall be identified by means of "Dymo" No. 5134-09, 3/4-inch, black plastic adhesive tape having letters approximately 1/2-inch high.

2) The identification at PGDP shall be in accordance with the oat-line diagram and shall include the following:

a. Maximum voltage.
b. Equipment designation.
c. Source of supply.
d. Equipment supplied.

The maximum voltage and/or source of supply may be omitted on branch circuits in motor centers, switchgear, panelboards, and unit substations when these are shown on the equipment.

Example of motor control center identification:

(Item a) 480 volts ac
(Item b) MCC-1

Example of MCC compartment identification:

(Item b) Compt. 5K
(Item d) Power dist. pal. "PDP"

Example of povcr distribution panel identification:

(Item a) 480 volts ac
(Item b) Power dist. pal. "PDP"
(Item c) Fed from MCC-1, Compt. 5K

3) Light switches, receptacles, and other similar electrical devices shall be identified by means of "Dymo" No. 158-9, 1/2-inch black plastic adhesive tape having letters approximately 5/32-inch high. The tape shall be applied to the front cover plates. For example, a lighting switch on circuit 15 from panel B would be marked "120 Volt, 1 Phase, Circuit 15 LPB."

4) Surfaces shall be cleaned with a solvent *such* as Varsol prior to applying tape. After the tape has been applied to the equipment or device, a brush coat of clear lacquer shall be applied over the tape making sure that all edges of the tape are well covered. The identification tape and seal coating of clear lacquer shall be applied prior to field paint-ing. The identification tape shall then be masked until field painting is completed, after which the masking shall be removed.

B. Conductors

1) All single conductor power and control wiring shall be identified in all readily accessible junction boxes in the wiring system and at all terminations. Conductors need not be identified in pull *boxes* where no taps or splices are made. Numbers and letters shall be attached to each conductor in accordance with the numbering system on the drawings, using 3M Company "Scotch Code" wire markers or W. H. Brady "Quick Label" labels.

2) All 3-phase power feeder conductors shall be identified by phase designations; e.g. ØA, ØB, ØC.

3) Multi-conductor cables installed in conduits, wireways, cable trays, etc., shall be identified at each termination point with "Panduit" flag-type plastic ties.

C. Conduits

1) conduits at PGDP shall be identified as shown on the drawings.

2) The conduits shall be identified at the switchgear, entry and exit points of all junction or pull boxes, on both sides of any walls or floors which conduits penetrate, and at equipment in which they terminate. Conduits run underground shall be identified at both ends. The identification tags shall be securely attached to conduit with "Tyraps." All "Tyraps" used outdoors shall be sunlight resistant.

6. PAINTING

All painting of exposed conduit, panels, cabinets, pull boxes, supports, etc., shall be accomplished in accordance with the requirements of Section 11.

7. TEST AND INSPECTIONS

A. General

1) This specification sets forth the electrical testing procedures required for the acceptance of electrical equipment as described in the specifications that follow.

2) The purpose of the specified tests and inspections is to determine that each piece of equipment is in satisfactory condition to successfully perform the intended function.

3) It is the intent of these procedures to insure that all workmanship and materials and the manner and method of erections and installation conform to manufacturer's instructions, and except as modified herein, IEEE, ANSI, the NEC, ASTM, UL, NEMA, and AEIC standards.

B. Responsibility

1) The Subcontractor shall perform and supervise all tests unless specifically noted otherwise herein or on the drawings. The Subcontractor shall furnish all teat equipment required for the tests performed by the Subcontractor and shall be responsible for providing such safety measures as are required for each teat.

2) The Subcontractor shall schedule all testing with the Contractor, and no testing of any king shall be performed without the Contractor's approval.

3) The Subcontractor shall notify the Construction Engineer prior to a tent, advising of the test to be performed and the scheduled date and time.

4) The Subcoatractor shall give manufacturers sufficient notice to allow the necessary arrangements to be made and to have manufacturer's engineer or representative present at tests where their presence is requited. Where the manufacturer's responsibility include both electrical and mechanical performance, the Subcontractor shall coordinate the tests with the others involved.

5) The Contractor shall examine the Subcontractor's test equipment prior to use and may, at his discretioa, require that the equipment to be submitted to the contractor for calibration check. Equipment that fails to be within acceptable limits shall be submitted by the Subcontractor to an approved testing Laboratory for proper calibration. The Subcontractor shall then submit evidence of proper calibration to the Construction Engineer.

6) The Construction Engineer shall notify all concerned personnel at least 24 hours prior to test, advising of the the test to be performed and the scheduled date and time of test. The parties notified shall be responsible for having their representatives present at the designated time.

7) The Construction Engineer shall ascertain that all testa specified are performed or waived and that all test reports or waivers are retained in the Contractor's file.

C. Test Reports

1) The Subcoutractor shall prepare formal test reports for each piece of equipment, system, or cable requiring testing. The test reports shall contain as a minimum the following information.

a. Job title.
b. Date of test.
c. Equipment, system, or cable identification.
d. Specific type of test.
a. Description of test instrument and date of calibration.
f. Section of specification defining test.
g. Test results (correct all "Megger" readings to 20°C).
h. Signature of person supervising test.
i. Signature of Subcoatractor.
j. Space for Construction Engineer's signature.

2) Engineering Standard ES-1.11-1 is an appropriate test report form. Upon request, a copy of this form will be furnished to the Subcontractor by the Contractor. The Subcoatractor shall submit the signed test report to the Construction Engineer, for approval.

D. Acceptance

1) Acceptance of all electrical equipment and cables covered by test procedures shall be contingent upon proper execution of the required tests and acceptable test results. Signing of the submitted test report by the Construction Engineer shall certify Contractor approval of the test. The Construction Engineer shall give the Subcontractor a copy of all signed test reports and distribute copies to the Contractor. The Construction Engineer shall retain all original test reports.

2) Acceptance of all electrical equipment shall be dependent upon each place of equipment satisfactorily performing the intended function as determined by the Construction Engineer.

3) The Contractor may, at the Contractor's discretioa, prepare and issue an acceptance report for any accepted piece of equipment or system. The original copy shall be retained in the Coatractor'a file.

7,011 - CONDUIT AND RACEWAYS

1. **GENERAL**

A. All wiring rhall be installed in rigid steel conduit unless otherwise noted on the drawings, The use of electrical metallic tubing (EMT), PVC conduit, and fiber conduit will be permitted only where specifically called for on the drawings.

B. Conduit shall be delivered to the jobsite in 10-foot lengths, each length bearing the Underwriters' Laboratories, Inc. label and the name of the manufacturer.

C. When not shown in detail on the drawings, the exact locations and routing of conduit and the location and sizing of conduit sleeves passing through floors, walls, etc., shall be determined by the Subcontractor subject to approval of the Construction Engineer,

D. Conduit which is run exposed shall be run at right angles to or parallel to building structural members. Diagonal runs will be permitted only in concrete slabs or in special cases with prior approval of the Construction Engineer.

E. Conduit shall in no case be secured directly to other piping. Conduit parallel to or crossing uninsulated hot water or steam pipes must be separated from the pipes by 12 inches if parallel or 6 inches if. crossing. Where these lines are insulated, conduit parallel to or crossing the lines must clear the insulation surface by 2 inches. Conduit shall not be run directly under cold water liner and shall be separated from the lines in other direction by at least 3 inches.

F. Conduit rhall be cut square with an approved conduit cutter and threaded with an approved conduit threader. The ends shall be reamed free of burrs, and all metal shavings and cutting lubricants shall be removed before the conduit is connected to the conduit system.

G. Bends, offsets, and bevels shall be avoided where practical; but where necessary, they shall be made with an approved bending device. In no case shall the radius of any conduit bend be less than that specified in the Article 346 of the NEC or less than the allowable bending radius of the installed conductor. Any conduit crushed or deformed in bending will be rejected, and the use of heat in bending conduit rhall be rertrictcd to PVC conduit only. Where a number of conduits are run together, the radii of any required bends shall be such that the installation will be aeat in appearance.

H. Rigid metal conduit, whether concealed or exposed, rhall be adequately supported in accordaaca with paragraph 346-12 of the NEC.

I. Metallic conduit shall be secured to walls, building framing, etc., by the use of malleable iron galvanized U-bolts, beam clamps, conduit straps, or "Unistrut" fittings where "Unistrut" racks or supports are used.

J. Rigid metal conduit shall be securely fastened to all outlet boxes, pull boxes, cabinets, and switch boxes with double locknuts and insulating bushings unless boxes with hubs are provided.

K. All field cut threads in rigid steel coaduit shall be coated with electrically conductive anti-seize compound, Thomas & Betts "KOPR-SHIELD" or approved equal.

L. All coaduit coanectioas shall be made with appropriate fittings and securely tightened. Improperly made connections or terminations, as well as any which have not been adequately tightened, will be rejected.

M. Conduit openings into which dirt, plaster, mortar mix, or debris may fall shall be closed with caps or tight fitting plugs during the construction period, Conduits in which such material has accumulated shall be thoroughly cleaned. Where such accumulations cannot be readily removed, the conduft shall be replaced.

N o Conduits *to* be sealed for the purpose of preventing air flov, rodent, and insect access shall be sealed where specified on the drawings vith applicable duct sealing compound, such as "Duxseal," or "Kerite" putty. "Chico Compound" which solidifies shall be used with sealing type conduit fittings.

O. Expansion couplings shall be installed in all coaduit runs crossing building expansion joints and shall be located between conduit supports adjacent to the expansion joint.

P. Conduit runs in floor slab or underground shall be installed exactly as shown and dimensioned on the construction drawings. Any deviations from the locations shown on the drawings must be approved by the Construction Engineer prior to installation of the conduit. The location of underground conduit shall be marked above ground in the manner specified on the drawings.

2. HEAVY WALL RIGID STEEL CONDUIT

A. Heavy wall rigid steel conduit shall be hot-dipped galvanized or electrogalvanized inside and outside. Conduit shall be National Electric or Triangle.

B. All fittings, boxes, etc., used with steel conduit shall be approved for such use.

3. LIQUID-TIGHT FLEXIBLE METAL CONDUIT

A. Liquid-tight flexible metal conduit shall be fabricated of galvanized steel flexible tubing vith a synthetic jacket extruded over the tubing, similar to "Sealtite EF" manufactured by American Metal Hose Division of the American Brass Company.

B. All flexible coaduit exposed to weather, water, or other liquids shall be Ifquid-tight vith connectors approved for this use.

C. Liquid-tight conduit assemblies shall include on each end an insulated straight or 90 degree angle connector equal to Thomas & Betts Company series No. 5300. This shall be the conduit assembly intended wherever a liquid-tight assembly is called for on the drawings or in these specifications.

D. Liquid-tight coaduit assemblies shall be used between motor terminal boxes or other equipment subject to vibration and/or mechanical adjustment, the rigid conduit systems, or elsewhere as shown on the drawings. Liquid-tight conduit used to connect to motor terminal boxes for housing motor conductors shall be not less than twelve times the trade *site* in length but in no case less than 12 inches.

4. UNDERGROUND CONDUIT

A. All underground conduits, unless otherwise specified on the drawings, shall be encased in concrete. All such encasements and configurations shall conform to the drawings.

B. All encasements (except under roadways) shall be regular duct bank construction unless otherwise noted on the drawings. Installations (other than under roadways) requiring reinforcing shall be noted on the drawings. The drawings shall also rpecify whether regular reinforcing or heavy reinforcing is required.

C. All duct banks passing under roadways shall be of heavy reinforced type construction. Each duct bank shall be reinforced beneath the roadway and within 10 feet of *each* side of the roadway.

D. The concrete shall be a 1:3:6 mixture of cement, sand, and coarse aggregate of 1/2-inch pea gravel developing a minimum compressive strength of 2300 psi after 28 days. Coloring shall be provided by uniformly dusting red iron oxide over the top of the freshly poured concrete at the rate of 1 pound per square yard of surface.

E. All threaded connections in conduits installed in building floor slabs or underground shall be sealed watertight with "Permaflex" type 2 nonhardening sealant. Conduit must be clean and dry and must pass standard sizing test after concrete is poured. All unused conduits shall be capped. Conduits rubject to being filled with water shall have watertight caps.

F. Underground conduit shall be rigid galvanized steel as specified on the drawings.

5. WIREWAYS

Wireways shall be installed only where shown on the drawings. Size, construction, and installation of wireways and appropriate fttings shall be as specified on the drawings.

7.021 - BOXES, COVER PLATES, AND CONDUIT FITTINGS

1. JUNCTION, TERMINAL, AND PULL BOXES

   A. Junction and pull *boxes* shall be sized as indicated on the drawings. Where not specifically sized on the drawings, all boxes shall be sized in accordance with Article 370 of the NEC.

   B. Junction and pull boxes located indoors in nonhazardous areas shall be code gauge galvanized sheet steel, welded construction, with conduit knockouts or raceway openings, and hinged or screwed covers as noted on the drawings. Boxes located outdoors shall have screwed, gasketcd covers and watertight hubs.

   C. Terminal boxes shall be provided with a removable panel for mounting relays, wiring devices, and terminal blocks. Terminal boxes shall be Hoffman NEMA 12 enclosures.

2. DEVICE AND OUTLET BOXES

   Surface mounted outlet boxes for receptacles, switches, etc., located in industrial areas shall be cast type (Crouse-Hinds, Appleton or Killark).

3. COVER PLATES

   Cover plates for installation on receptacles, switches, etc., ahall be as specified on the drawings.

4. CONDUIT FITTINGS

   A. Cast malleable iron or steel conduit fittings used vith rigid steel conduit shall be thoroughly coated with metallic zinc or cadmium inside and outside after all machine work is completed.

   B Cast conduit outlets used with rigid steel conduit shall be made of rust resisting alloys of iron or steel or shall be made of nonferrous materials with threaded hub8 for heavy wall rigid conduit. Fittings shall be Crouse-Hinds, Appleton, or Killark.

   C. Nonmetallic insulating type bushings used on rigid steel conduit shall be O.Z. type A, Thomas & Betts 200 series, or Appleton type BBU.

7.031 - WIRE AND CABLE - 600 VOLT INSULATED

1. GENERAL

A Each reel or coil of wire and cable shall beat the manufacturer's name and approval tag, which shall indicate the wire size and type of insulation and shall bear the Underwriters' Laboratories, Inc., label.

B All wire and cable furnished and installed shall be listed by Underwriters' Laboratories, Inc., for the specific type of installation (couduit, duct, cable tray, dfrcct burial, aerial, etc.) shown on the drawings.

C. No wire and cable shall be pulled until the couduit system is complete from pull point to pull point.

D. Care shall be exercised while installing wire in conduits so as not to damage the conductor insulation. Ideal Industries "Yellow-77" or "Wire Lube" or Electro Compound Company's "Y-ER-LAS" compound may be used in pulling nonarmored conductors and shall be used if wire is pulled by mechanical means.

E. The bending radius of any wire or cable shall not be less than the minimum recommended by the manufacturer.. Maximum pull tendon and sidewall pressure of any wire or cable shall not exceed manufacturer's recommended values.

2. CONDUCTORS

A. The minimum size conductor to be used for power and lighting circuits shall be No. 12 AWG. Where specified on the drawings, No. *14* and No. 16 AWG conductors may be used for control circuits. Communications conductors shall be *sized* as specified on the drawings.

B. All conductors No. 4 AWG and smaller shall be copper. Conductors No. 2 AWG and larger shall be as specified on the drawings.

C. All wire No. 8 AWG and larger shall be stranded. Wire in size No. 10 AWG and smaller feeding lights and receptacles shall be solid. Wire No. 10 AWG and smaller installed for motor leads and control wiring shall be stranded.

D. Cables shall have standard stranding for sizes as follows: 7 strands up through No. 2 and 19 strands from No. 1 through No. 4/0 unless otherwise noted on the drawings.

3. COLOR CODING

A All grounded (neutral) conductors No. 2 AWG and smaller shall have white insulation. Grounded conductors larger than No. 2 AWG shall be identified at all terminal or junction points by wrapping with white, self-adhesive, vinyl plastic electrical tape, Scotch No. 35. Sufficient length of cable nearest terminal or junction point shall be taped so that

neutral conductor shall be easily identifiable when covers of lighting panels, transformers, junction boxes, safety switches, etc., are removed. Ungrounded (phase) conductors may be any available colors other than white, gray, or green.

B. Any insulated coaductor intended solely for grounding purposes shall be identified by a continuour green color or a continuous green color vith one or more yellow striper.

C. Ungrounded single conductor coatrol circuit wiring may be a combination of any colors other than white, gray, or green. The grounded control circuit conductor shall be identified in accordance with paragraph 3.A.

D. Conductore of multi-wire branch power and lighting circuits shall have identifying colors in conformity with paragraph 210-5 of the NEC. A unique color scheme shall be used for each different voltage system,

4. 600 VOLT INSULATION

A. Wire and cable with a 600 volt insulation rating shall be furnished and installed for all power feeders, motor leads, lighting, and control circuits that are designed for operating voltages up to and including 550 volts.

B. All wiring installed in conduit and raceways, up to and including No, 10 AWG shall be single conductor type THHN-THWN unless otherwise specified on the drawings.

C. All wiring installed in conduit and raceways, No. 8 AWG and larger, shall be single conductor type THW or type XHHW unless otherwise specified on the drawings.

5. 600 VOLT CONTROL CABLES

A. Multi-conductor control cables shall be moisture-resistant, small diameter type unless otherwise specified on the drawings. Cables shall meet NEMA WC-5 standards and be approved by Underwriters' Laboratories, Inc., for conduit, cable tray, and underground duct installations.

B. Conductors shall be stranded copper with heat and moisture resistant PVC insulation, 15 mils thick minimum, and covered with clear nylon jacket, 5 mils thick minimum. Conductors shall be color coded in accordance with NEMA WC-5 Method 1. Cables shall have an overall flame-resistant sheath of PVC, 45 mils thick minimum.

C. The number and size of conductors and the exact color coding requirements shall be as specified on the drawings.

D. Cables shall be rated for 600 volts and 75°C operation.

6. TESTING

A. This section of the specification covers the electrical testing of all 600-volt insulated single and mufti-conductor wire and cable.

Test No. 1 - Continuity

B. Make test for continuity and correctness of wiring and identification on all conductors of lighting and receptacle branch circuits, povcr and control circuits, and motor leads.

C. Test shall be made with a dc test device, including a ball, a buzzer, or light.

7.041 - SPLICES, TAPS, AND CONNECTORS - 600 VOLTS OR BELOW

1. GENERAL

A. Splices and taps shall generally be made in junction boxes or wiring gutters, Solderless connectors shall be used exclusively,

B, All compression connectors shall be installed in strict accordance with manufacturer's instructions, using properly sized and keyed connectors and dies, All compression connectors shall be Thomas & Betts or an approved equal.

2. COPPER CONDUCTOR CONNECTORS 300 VOLTS OR LESS

A Splices., taps, and terminations of stranded conductors No. 10 AWG and smaller shall be made with pressure connectors, Thomas & Betts "Sta-Kon" or equal. Splices and taps in solid No. 10 AWG and smaller shall be made with split-bolt connectors or with insulated wire puts, Thomas & Betts "Piggy" or equal. Terminations of solid conductors No. 10 AWG and smaller may be made by forming the wire to fit under a screw head, thus requiring no connector.

B. Splices and taps in copper conductors No, 8 AWG through No. 1 AWG and terminations of these sizes of coaductors other than in equipment lugs (i.e., molded case circuit breakers) shall be made with either copper mechanical connectors or with wrought copper compression connectors.

Type of Connection	Type of Connector	Thomas & Bctts Series No.
Splice	Mechanical - Split-bolt	2T thru 8T
Tap	Mechanical - Split-bolt	2T thru 8T
Termination	Mechanical - One-hole lug	31000
Splice	Compression - Two-way coancctot	*54500*
Tap	Compression - C-tap	54700
Termination	Compression - One-hole lug	54100

C. Splices and taps in copper conductors No. 1/0 AWG through No. 4/0 AWG and terminations of these sizes of conductors other than in equipment lugs (i.e., molded case circuit breakers) shall be made with wrought copper compression connectors.

Type of Connection	*Type* of Connector	Thomas & Bette Series No.
Splice	Two-way connector	54500
Tap	C-tap	54700
Termination	Two-hole lug	*54200*

D. Copper conductors shall be thoroughly cleaned before connectors are installed,

3. COPPER CONDUCTOR CONNECTORS OVER 300 VOLTS

All connectors specified for use with copper conductors carrying 300 volts or less are applicable for use with conductors carrying up to 600 volts, except insulated wire nuts shall not be used. Splices in coaductors No. 10 and smaller shall be made vith split-bolt connectors.

4, INSULATION OF SPLICES AND TAPS *600* VOLTS OR LESS

A, Splices and taps in thermoplastic and rubber insulated conductors shall be insulated in accordance with 1) or 2) below.

1) The connection shall first be insulated vith rubber tape, 3M Company No. 130C, Plymouth Rubber Company "Plyvolt", or Okonite Company No, 10. The connection shall then be wrapped vith all weather vinyl plastic tape, 3H Company No. 88 or Plymouth Rubber Company "Premium Grey." The inner tape shall be wrapped in a manner so as to pad the sharp edges and fill the indents of the connector. The outer tape shall be applied until the total area of the inear taping is covered with a minimum of four layers. The total thickness of the combination of tapes shall be at least equal to the thickness of the conductor insulation.

2) The sharp edges and indents of the connection rhall first be padded vith 3M Company "Scotchfil" insulation pad, Plymouth Rubber Company "Plyseal" insulation pad, or Okonite Company No. 75 filler tape. The connection shall then be covered with an appropriately sized heat-shrinkable sleeve, Raychem Company Type "WCS" or Thomas and Betts *Type* "HS" or vith prc-stretched tubing, 3M Company Type "PST."

B. Connections insulated in accordance with 4.A.1) or 4.A.2) which are not housed in a junction box or other metal enclosure ehall have an additional protective wrapping of friction tape, Plymouth Rubber Company "Special ASTM" or Okonite Company "Manson" No. 5 to protect the connection from abrasions.

C. All outdoor splices and taps, such as splices at service entrances and any connections which are subjected to high humidity shall be insulated in accordance with 4A and 4.B. and then wrapped with linen cloth tape and printed with *two* brushed-on coats of General Electric Company "Glyptal."

D. Underwriters' Laboratories, Inc., listed insulators for splices and taps, similar to Burndy "Poly-Tap", may be used only where specified on the drawings.

7.051 - GROUNDING

1. GENERAL

The grounding of electrical equipment, grounded electrical circuits, etc., shall be in accordance with the construction drawings. In addition to the grounding specified herein or on the drawings, all ground connections required by the NEC shall be furnished and installed. Where grounding conductor sizes are omitted from the drawings, the minimum requirements of Article *250* of the NEC shall apply.

2. ELECTRICAL EQUIPMENT GROUNDING

A. All motor frames, panelboards, and enclosures housing electrical devices, such as safety switches, motor starters, control devices, etc., shall be grounded to the building ground grid with an equipment grounding conductor.

B. The equipment groundfng conductor shall be a continuous copper wire and shall be run in the same conduit with the current carrying conductors. Aluminum ground wires are not permitted and will not be accepted. Wire. installed lo steel conduit may be either bare or green insulated. Wires No. 10 AWG and smaller shall be solid. Wirer No. 8 AWG and larger shall be stranded.

C. Equipment grounding conductors shall connect to the building ground grid at ground busses and ground inserts or to existing equipment grounding conductors as shown on the drawings. Grounding or bonding of equipment to building steel as a sole means of grounding will not be acceptable, and the use of conduit as the equipment grounding conductor is not permitted.

D. Connections to ground busses and connections of equipment grounding conductors to switch boxer, panelboards, cabinets, etc., shall be made with either bolted mechanical lugs or compression connectors. Before connections are made, all contact surfaces shall be clean and bright; and a compound to prevent oxidizing, such as "No-Oxide" or "Contact Aid" shall be applied to insure good electrical contact.

3. NONELECTRICAL EQUIPMENT

Nonelectrical equipment, such as metal tanks, platforms, supports, etc., shall be grounded in accordance with the drawings.

4. GROUNDED CONDUCTORS

The grounded conductor of any grounded electrical circuit shall be grounded n accordance vith the drawings and Section 250-26 of the NEC.

5. MOTOR GROUNDING

A. The equipment grounding conductor, either bare or insulated green, shall be terminated under one of the bolts holding the junction box to the motor frame. On motors where the junctioa box is velded in place or cast as part of frame, the box shall be drilled and tapped.

B. Terminations of motor equipment groundfng wires shall be made in accordance vith paragraph 2.D.

7.121 - MISCELLANEOUS DISTRIBUTION EQUIPMENT

1. CIRCUIT BREAKERS

A Circuit breakers shall be of the frame size, trip rating, and number of poles indicated on the drawings. Circuit breakers shall be supplied in NEMA 1 enclosures unless otherwise noted on the drawings, with provisions for locking the handle in the open position.

B Circuit breakers, unless otherwise noted on the drawings, shall be molded care, quick-make, quick-break, ambient compensated, thermal magnetic, and capable of safely interrupting all loads up to and including the maximum interrupting rating listed below.

Frame Size Amps	Trip Amps	Poles	Voltage	Symmetrical Interrupting Rating Based on NEMA
100	15-100	1,2	120/240	7,500
100	15-100	3	240	10,000
100	15-70	3	480	14,000
225	70-225	3	480	22,000
400	250-400	3	480	30,000

2. SAFETY SWITCHES

A. Safety switches shall be heavy duty type, single throw, with visible blader in NEMA 1 enclosure for indoor use and in a NEMA 3B enclosure for all switches located outdoors unless otherwise noted on the drawings. Switches shall have quick-make, quick-break mechanism, front cover interlock and indicator handle. Switches shall be of the ampere and voltage ratings, number of poles, fusible or nonfusible, etc., as indicated on the drawings. Switches shall have horsepower rating equal to motor horsepower when used on motor circuits.

B. Switches shall be equivalent to General Electric Company type TH.

3. FUSES

A The Subcontractor shall provide a complete set of fuses for all fuse holders to which he makes electrical connections including those in utility equipment furnished by others.

B. Unless specifically noted otherwise on the drawings, all fuses shall be cartridge type, dual element, with a minimum of 200,000 amps interrupting capacity as listed below.

Voltage	Amperage	Bussman	Chase-Shawmut
250	1/10-200	FRN	TR
250	223-600	LPN	AT-DE
600	1/10-200	FRS	TRS
600	225-600	LPS	ATS-DE

7.141 - MOTOR CONTROLS

1. MAGNETIC STARTERS - FULL VOLTAGE (REVERSING AND NON-REVERSING)

A Magnetic motor starters shall be combination type, rated for 600 volts with a circuit breaker or fused disconnect (as specified), mounted within the enclosure unless otherwise specified on the drawings.

B. Magnetic starters for 3-phase motors shall be equipped with three thermal overload relays for overload protection. Overload relay heater elements shall be sited and installed by the Subcontractor in accordance with motor nameplate full load current.

C. Operating coils shall be 120 volts, *60* Hz. When magnetic starters are used on the *480* volt system, a 480-120 volt, 1 phase, 60 Hz control transformer shall be mounted within the enclosure. The X_1 terminal of the control transformer secondary shall be fused. The X_2 terminal of the control transformer secondary shall be grounded.

D. Reversing starters shall include both mechanical and electrical interlocking to prevent simultaneous energizing of the forward and reversing contactors.

E Enclosures shall be NEMA *type* 1 except where otherwise noted on the drawings. The circuit breaker or disconnect switch shall be operable by hand from outside the enclosure and shall be *so* interlocked with the door that it must be in the "Off" position before the door can be opened. A semisecret device shall be included to permit qualified personnel to open enclosure with breaker closed.

F. Starters shall be Allen Bradley Bulletin 712 or 713, Cutlet Hammer type A30 or *A40,* or Square D class 8538 or 8539.

2. MANUAL STARTERS - FULL VOLTAGE

A. Manual starters for 120 volt, *208* volt, *240* volt, and *480* volt motors shall be a toggle operated switches with trip-free overload protection in suitable enclosure unless otherwise noted on the drawings. Overload relay heater elements shall be *sited* in accordance with the motor nameplate full load current.

B. Starters for single phase motors, *240* volts or less, shall be Allen Bradley Bulletin *600,* General Electric CR 101, or Square D class 2510.

C. Starters for 3-phase, 480 volt motors shall be Allen Bradley Bulletin 609, General Electric Form CR 1062, or Square D class 2510.

3. CONTROL DEVICES

A Push buttons, selector switches, and indicating lights shall be heavy-duty oiltight, surface mounted in NEMA type 13 enclosure indoors, NEMA type 4 enclosure outdoors, and NEMA type 7 enclosure in hazardous areas unless otherwise noted on the drawings.

B. Individual units shall be furnished with standard size legend plates. Markings on the plates shall be in accordance with the drawings.

C, Control devices shall be Allen Bradley Bulletin 800T, Square D class 9001, or General Electric Form CR2940.

4. CONTRQL RELAYS

A, Relays shall have 120 volt, 60 Hz coils with convertible contacts rated for 10 amps at *600* volts unless otherwise noted on the drawings.

B. Relays shall be Allen Bradley Bulletin *700,* Square D class 8501 type D, or General Electric Form CR 2810-A14.

5. TERMINAL BLOCKS

Terminal blocks, where required and not specified on the drawings, shall be Buchanan "Medium duty", sectional type, with tubular clamp *type* terminal sections Cat. No. 515, and end pieces Cat. No. 530. Pressure sensitive white marking tape, Cat. No. *50,* shall be used for terminal identifications.

7.151 - ROTATING EQUIPMENT

1. MOTORS

All motors will be furnished under other specifications. Generally, motors less than 1/2 horsepower shall be 120 volt, 1Ø, 60 Hz. Motors 1/2 horsepower and larger shall be *480* volt, 3Ø, *60* Hz. The Subcontractor shall furnish all motor control and protective devices unless otherwise specified.

2. TESTING

A. Test No. 1 - Insulation Resistance

1) Teats that are required for any motors smaller than 100 horsepower shall be specified on the drawings.

2) Motors in the *460* volt range *(440, 460, 480)* shall be tested using a 1000 volt motor driven "Megger".

3) The tests shall be made with motor windings at ambient temperature. The voltage shall be applied between all phases of the motor winding tied together and ground. The voltage shall applied for a minimum of 3 minutes and until the reading reaches a nearly constant value.

4) Minimum acceptable insulation resistance readings shall be as follows.

. 480 volts	S megohms

Teat No. 2 - Air Gap

B. An "Air Gap Measurement" shall be made on any motor when requested by the Construction Engineer.

C. Test No. 3 - Miscellaneous Checks

The following checks shall be performed.

1) *check* grounding of all equipment.
2) Check alignment with driven equipment.
3) Check couplings and bearings.
4) Check lubrication system.

Test No. *4* - Operational

D. An "Operational Test" shall be performed on all motors with load on motor and under normal operating conditions. To be acceptable, the test must prove proper rotation, lubrication, and alignment. It must also show that motors do not have excessive vibration and do not exceed nameplate currant rating.

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8.000 - INSTRUMENTATION CONSTRUCTION

1. GENERAL

The instrumentation work described herein provides for the acquisition, fabrication, and assembly of modular units and for installation of the instrumentation systems for the project in accordance with the instrumentation drawings and specification.

2. SUBCONTRACTOR RESPONSIBILITY

A, Work to be Performed by Subcoatractor

1) The Subcontractor shall install control cabinets, instrument panels, transmitter tach, and aiscellaneous designated field and process instruments and hardware. In addition, the Subcoatractor shall make all pneumatic tubing and electrical field connections to the bulkhead and terminal points as indicated on drawings and specifications.

2) Instrumentation components and installation shall be in accordance with Instrument Specification sheets and drawings. Substitutes for specified components shall be submitted to the Contractor for approval. The formal "change and/or modification" requests shall become a permanent part of the project documentation.

3) The Subcontractor shall maintain a complete act of current project drawings and Instrumentation Specification sheets. Approved changes shall be marked in red. At the end of the project, marked-up documents shall be submitted for the "as built" configuration.

B. Materials to be Supplied to the Subcontractor by the Contractor

None

C. Equipment Transfer to Construction Site

The Subcontractor shall be responsible for on-loading, delivery, and off-loading of the items from the Contractor Instrument Shop to the construction site. Adequate steps shall be taken to protect the equipment from physical and weather damage.

D. Testing

1) Inspection of Incoming Components

a. All instruments procured by the Subcontractor shall be sent *to* the Contractor to be checked for compliance to specifications. The manufacturer's instructions shall be provided with the instruments. Each rhipping container shall have a list identifying the contents of the containers, purchase order number, and the name of the supplier. The exterior of each shipping coatainer shall be marked with:

(1) The supplier's name and address.

(2) The number of units contained.

(3) Special handling requfrements to optimize safe delivery.

b. Manufacturer's test reports of incoming components shall list deviations and calibration data and shall he submitted *to* the Contractor for approval prior to installation.

2) Fabricated Assemblies

The Subcontractor rhall visually inspect for damage or defects assemblies submitted by the Contractor. The Subcontractor shall not accept any assembly unless it fs free from damage or defects.

3) Pre-Acceptance Testing

a. Field Testing . *An* instrumentation system installed in the field shall be tested by the Subcontractor as follows:

(1) Test all: pneumatic lines for correct connections, identity, and leakage. Repair or replace all tubing and fittings that were found to be leaking. The test for leaks and plugs shall be in compliance with ISA Standard RP-7.1.

(2) Test all electrical interconnecting wiring for continuity, correct termination, and correct Identification.

(3) Test a11 thermocouple and thermocouple-lead wire for identity, continuity, and correct termination.

(4) Test all instruments for proper installation and wiring.

b. Test Reports . A test report shall be provided on each system indicating the foflaving:

(1) A system test was made.

(2) Deviations, if any, in the test procedure for the system.

(3) Results of the testa.

(4) difficulties encountered in getting the system under test to meet specified requirements.

c. These test reports shall become a permanent part of the project documentation.

E. Equipment Protection at Construction Site

The Subcontractor shall be responsible for the protection of the instrumentation system during construction to prevent physical damage, paint splatter, and dirt accumulation on the instruments. At the completion of construction, the instruments and control panels shall be clean.

F. Installation Requirements

1) General

a. Instruments shall not be installed until all heavy construction work in the immediate area has been completed. Instruments and accessories mounted on panelboards, racks, or other mounting structure shall be leveled, aligned, and securely fastened. Care should be taken at all times to protect the instruments from shock, vibration, dust, chemicals, unauthorized personnel, and construction materials.

b. All instrumentation process and pneumatic lines shall be clean and dry and shall be free from oil, grease, or other foreign materials.

c. Individual tubing shall be identified with the line number shown on the drawings and impressed fnto a stainless steel tag which shall be wired or chained to the tube at its origin, destination, and on both sides of intervening wall or ceiling penetrations.

d. Instrument wiring shall be labeled at each termination point with the wire numbers shown on the instrument electrical schematics. Brady B-400 self-sticking electronic wiring markers or approved equal shall be used to Identify wires and cables.

e. Instrument signal and temperature sensor wiring shall be contained la conduit or wireways, free of conductors carrying alternating current unless otherwise specified on the drawings.

2) Valves, Accessories, and Special Pitting8

Valves must be handled in such a manner as to protect the bellows and diaphragm housing as well as any item previously assembled on the valves, such as capillaries, positioners, solenoids, etc. Where the installation requires the application of heat, as in welding, soldering, or silver brazing, precautions shall be taken to ensure that the internal part of these items are not damaged by heat. 'In cases where such damage is possible and the body of the item cannot be kept cool to the touch at 'all times, permission in writing from the Coatractor shall be obtained to completely disassemble the item before heat is applied.

3) Tubing . Copper tubing and fittings shall be used for all instrumentation pneumatic line8 and connections, unless otherwise specified on the drawings. Compression fitting8 shall be used only for connections to instruments as rpecified on drawings. Line joints shall be made with swaged fittings, unless otherwise specified on the drawings.

a. Copper Tubing . Technical Specification 5.112 shall govern pneumatic tubing with the following additions.

(1) Tubing shall be supplied dehydrated and capped.

(2) All tubing shall 'be cut and beat using standard tubing cutters and bending tools. Tubing shall not be sawed. After cutting, all tubing shall be reamed to establish full diameter, and all burn shall be removed. All tubing shall be blown out using clean, dry air to ensure the removal of all chips that may have entered. All tubing shall be capped immediately after cutting to ensure cleanliness. Caps shall not be removed except at the time of installation.

b. Plastic Tubing . Plastic tubing and fittings shall not be used except when specified on the drawings.

4) Wire and Cable Systems .

a. The measurement and control signals include both 120 Vac and a variety of dc signals which are less than 30 Vdc. Protection of these signals from electrical interference is necessary. Mechanical protection shall be provided by selecting cable rupport systems. Multi-signal cables shall be routed via cable trayr, trenches, or conduit between field terminal devices and control building interface boxes. The less-than-30 Vdc signal cables shall be routed in a separate enclosure from power and ac control cables.

b. Connections rhall be made by compression connectors applied with a locking-type hand tool. Terminal strip. shall be of the tubular clamp type for all terminal boxes. connections shall be limited to two wires per terminal maximum.

c. Wire and cable identification shall be by uniform labels, and each wire and cable shall be identified at every terminal point with a permanent marker.

(1) AC Signal Systems . AC coutrol signals, except those used for motor control, shall be transmitted between field and control cabinets via cable trays designated for 120 Vac control. Wiring from field junction boxes to individual devices shall be via single-pair cables installed in conduit. All conductors shall be stranded copper, 600 V class, 16 AWG minimum.

(2) DC Signal Systems . Requirements for the various dc signals are as follows.

(a) mA Signals . The negative side of each signal shall be connected to control systems ground at one point in the control building and isolated from ground elsewhere.

(1) The drain wires of single-pair cables shall be connected to the drain wires of multi-pair cables so as to be continuous from the field device to the control building.

(2) Individual drain wires shall be isolated from ground at the field device by use of electrical tape.

(3) Overall cable-shield-drain wirer shall be connected to the equipment ground at one point in the control building and irolatcd from ground elsewhere.

(b) Voltage Signals - Greater Than 100 mV . Requirements are same as mA signals.

3. CONTRACTOR RESPONSIBILITY

A. Work to be Performed by the Contractor

None

B. Materials To Be Supplied To The Subcontractor By The Contractor

None

C. Testing

Inspection of Incoming Components . All Contractor-supplied instruments shall be inspected, tested, and calibrated.

4. GENERAL MATERIAL REQUIREMENTS

A. Tubing

1) Capper, Soft Anneal Temper

Copper tubing shall be 1/4-inch OD x 0.030-inch wall, 3/8-inch OD x 0.032-inch wall, or 1/2-inch OD x 0,032-inch wall as specified on drawings. Copper tubing shall be seamless copper UNS #C12200, refrigeration service tube type in 50-foot-minimum coils and shall be in accordance with ASTM Specification B 280.

B. Fittings

1) Copper Tube

a. Compression fittings shall be either of "Intrulok" as manufactured by Parker-Hannifin, "Swagelok" as manufactured by Crawford Fitting Company, "Hi-Duty" as manufactured by Imperial Eastman, or approved equal.

C, Racks and Supports for Tubing

1) Racks and supports located in valve pits, cells, pump rooms, vaults, and exposed to the weather shall be *(5000* series aluminum alloys).

2) Racks and supports not exposed to the weather or contamination shall be carbon steel painted with one prime coat of Amercoat #71 and *two* finish coats of Amercoat 666, Alkali and Acid Resistant paint,

5. CODES, *STANDARDS,* PROCEDURES, AND SPECIFICATIONS

A, . General

Coder, standards , procedures, and specifications referred to herein are hereby made part of this specification. In the event of discrepancies between this specification and the referenced documents, this specification shall apply.

B. Specific

Item	Paragraph
ISA Standard RP-7.1	2.D.3)a.(1)
Technical Specification 5.112	2.A
ANSI Specification MC96.1	2.F.4)a.
ASTM Specification B-280	4.A.1)
ASTM Specification A-269	4.A.2)
ANSI Specification B16.22	4.B.1)
ASTM Specification B-260	4.C.1)
Navy Specification 51-F-4A	4.C.2)

TAG NUMBER / REVISION	LOOP NO. OR DWG #	S:P H:C U:R	DESCRIPTION	MANUFACT.	VENDOR	SPEC NO.	P.O. NO.	L: P&I DWG NO. / A: DETAIL DWG.	M:N T F:I L:A C:Y S:L	REMARKS	N.
LEL-101		X X	UNCONTAMINATED	DREXELBROK		DS-CMD-		F: P5E-16209-A		PART OF	
0			SOLUTION SUMP	CR CONTRACT		16209-10				LSL-101	
			LOW LEVEL ELE.	APP'D EQ'L							
LSL-101		X X	UNCONTAMINATED	DREXELBROK		DS-CMD-		F: P5E-16209-A		MODEL NO.	
0			SOLUTION SUMP	CR CONTRACT		16209-10				506-600-5	
			LOW LEVEL	APP'D EQ'L							
EV-102		X X	F-100 OUTLET	ASCO OR		DS-CMD-		F: P5E-16209-A		SUPPLIED	
0			VALVE SOLENOID	CONTRACTOR		16209-16				WITH HV-102	
			VALVE	APP'D EQ'L							
HV-102		X X	F-100 OUTLET	EZ URIK		DS-CMD-		F: P5E-16209-A		MODEL NO.	
0			VALVE	CR CONTRACT		16209-16				003, F16131,	
				APP'D EQ'L						F,2,AC67	
LEH-102		X X	UNCONTAMINATED	DREXELBROK		DS-CMD-		F: P5E-16209-A		PART OF	
0			SOLUTION F-100	CR CONTRACT		16209-10				LSH-102	
			HIGH LEVEL ELE.	APP'D EQ'L							
LEL-102		X X	UNCONTAMINATED	DREXELBROK		DS-CMD-		F: P5E-16209-A		PART OF	
0			SOLUTION F-100	CR CONTRACT		16209-10				LSL-102	
			LOW LEVEL ELE.	APP'D EQ'L							
LSH-102		X X	UNCONTAMINATED	DREXELBROK		DS-CMD-		F: P5E-16209-A		MODEL NO.	
0			SOLUTION F-100	CR CONTRACT		16209-10				506-600-5	
			HIGH LEVEL	APP'D EQ'L							
LSL-102		X X	UNCONTAMINATED	DREXELBROK		DS-CMD-		F: P5E-16209-A		MODEL NO.	
0			SOLUTION STORAG	CR CONTRACT		16209-10				506-600-5	
			LOW LEVEL	APP'D EQ'L							
PI-102A		X X	C-400 HLD'G	U.S. GAUGE		DS-CMD-		F: P5E-16209-A		MODEL # 1980	
0			J-100A PUMP	CR CONTRACT		16209-13				AND DIAPHRAM	
			OUTLET PRESSURE	APP'D EQ'L						SEAL	
PI-102B		X X	C-400 HLD'G	U.S. GAUGE		DS-CMD-		F: P5E-16209-A		MODEL # 1980	
0			J-100B PUMP	OR CONTRACT		16209-13				AND DIAPHRAM	
			OUTLET PRESSURE	APP'D EQ'L						SEAL	
ZSC-102		X X	F-100 OUTLET	EZ URIK OR		DS-CMD-		F: P5E-16209-A		SUPPLIED	
0			VALVE CLOSE	CONTRACTOR		16209-16				WITH HV-102	
			LIMIT SWITCH	APP'D EQ'L							
ZSO-102		X X	F-100 OUTLET	EZ URIK OR		DS-CMD-		F: P5E-16209-A		SUPPLIED	
0			VALVE OPEN	CONTRACTOR		16209-16				WITH HV-102	
			LIMIT SWITCH	APP'D EQ'L							
LEL-105		X X	C-407 SUMP LOW	DREXELBROK		DS-CMD-		F: P5E-16209-A		PART OF	
0			LEVEL ELEMENT	CR CONTRACT		16209-10				LSL-105	
				APP'D EQ'L							
LSL-105		X X	C-407	DREXELBROK		DS-CMD-		F: P5E-16209-A		MODEL NO.	
0			SUMP	CR CONTRACT		16209-10				506-600-5	
			LOW LEVEL	APP'D EQ'L							
EV-107		X X	SULFURIC ACID	ASCO OR		DS-CMD-		F: P5E-16209-A		SUPPLIED	
0			TC FIG LOADING	CONTRACTOR		16209-17				WITH HV-107	
			STATION S.V.	APP'D EQ'L							

TAG NUMBER / REVISION	LOOP NO. OR DWG #	S:P:H:C:U:K:P:R:	DESCRIPTION	MANUFACT.	VENDOR	SPEC NO.	P.O. NO.	L: P&I DWG NO.: DETAIL DWG.	P:N:I:I:A:Y:T:R:L:S:	REMARKS
HV-107		X:X:	SULFURIC ACID	LAMESBURY		DS-CMD-		F: P5E-16209-A		MODEL NO.
0			TO PIG LOADING	OR CONTRACT		16209-17				2" 5150-31-
			STATION	APP'D EQ'L						3573TT
LE-108		X:X:	C-616 BLD'G	DREXELBR'K		DS-CMD-		F: P5E-16209-A		MODEL NO.
0			F120A TANK	CR CONTRACT		16209-12				C508-25-7
			LEVEL ELEMENT	APP'D EQ'L						
LEL-108		X:X:	C-616 BLD'G	DREXELBR'K		DS-CMD-		F: P5E-16209-A		PART OF
0			F-120A LOW	CR CONTRACT		16209-11				LSL-108
			LEVEL ELEMENT	APP'D EQ'L						
LI-108		X:X:	C-616 BLD'G	DREXELBR'K		DS-CMD-		F: P5E-16209-A		PART OF
0			F120A TANK	CR CONTRACT		16209-12				LT-108
			LEVEL INDICATOR	APP'D EQ'L						
LSL-108		X:X:	C-616 BLD'G	DREXELBR'K		DS-CHC-		F: P5E-16209-A		MODEL NO.
0			F120A	CR CONTRACT		16209-11				506-600-5
			LOW LEVEL	APP'D EQ'L						
LT-108		X:X:	C-616 BLD'G	DREXELBR'K		DS-CMS-		F: P5E-16209-A		PART OF
0			F120A TANK	CR CONTRACT		16209-12				LE-108
			LEVEL TRANSMIT	APP'D EQ'L						
PI-108		X:X:	C-616 BLD'G	U.S. GAUGE		DS-CMD-		F: P5E-16209-A		MODEL # 1980
0			J-120A PUMP	CR CONTRACT		16209-13				AND DIAPHRAM
			OUTLET PRESSURE	APP'D EQ'L						SEAL
PSV-108		X:X:	F-120A PRESSURE	CONSOLI-		DS-CMC-		F: P5E-16209-A		MODEL NO.
0			RELIEF VALVE	DATED OR		16209-15				1905-30FC-H4
				APP'D EQ'L						
LE-109		X:X:	C-616 BLD'G	DREXELBR'K		DS-CMD-		F: P5E-16209-A		MODEL NO.
0			F120B TANK	CR CONTRACT		16209-12				C508-25-7
			LEVEL ELEMENT	APP'D EQ'L						
LEL-109		X:X:	C-616 BLD'G	DREXELBR'K		DS-CMD-		F: P5E-16209-A		PART OF
0			F-120B LOW	CR CONTRACT		16209-11				LSL-109
			LEVEL ELEMENT	APP'D EQ'L						
LI-109		X:X:	C-616 BLD'G	DREXELBR'K		DS-CMD-		F: P5E-16209-A		PART OF
0			F120B TANK	CR CONTRACT		16209-12				LT-109
			LEVEL INDICATOR	APP'D EQ'L						
LSL-105		X:X:	C-616 BLD'G	DREXELBR'K		DS-CMC-		F: P5E-16209-A		MODEL NO.
0			F120B	CR CONTRACT		16209-11				506-600-5
			LOW LEVEL	APP'D EQ'L						
LT-109		X:X:	C-616 BLD'G	DREXELBR'K		DS-CMD-		F: P5E-16209-A		PART OF
0			F120B TANK	CR CONTRACT		16209-12				LE-109
			LEVEL TRANSMIT	APP'D EQ'L						
PI-105		X:X:	C-616 BLD'G	L.S. GAUGE		DS-CWC-		F: P5E-16209-A		MODEL # 1980
0			J-120B PUMP	CR CONTRACT		16209-13				AND DIAPHRAM
			OUTLET PRESSURE	APP'D EQ'L						SEAL
PSV-109		X:X:	F-120B PRESSURE	CONSOLI-		DS-CMD-		F: P5E-16209-A		MODEL NO.
0			RELIEF VALVE	DATED OR		16209-15				1905-30FC-H4
				APP'D EQ'L						

*LEGEND
P=PANEL
B=BACK OF PANEL
B=BACK D=DCS
LD
MPUTER

THE
RUST INTERNATIONAL
CORPORATION

CONTRACT NO. 21-2519

INSTRUMENTATION LIST
FOR
DEPARTMENT OF ENERGY
PADUCAH, KY
C-400 AND 16
SPILL CON MENT

DWN: DERRYBERRY
CKD: CARTER
APP'D:

INSTRUMENT INDEX NO.

REV 0

SHEET 8-B

PAGE 00

CFC

DATE 12/13/84

TAG NUMBER REVISION	LCOF NO. OR CWG #	S P H C R	U	DESCRIPTION	MANUFACT.	VENDOR	SPEC NO.	F.O. NO.	L A	P&I DWG NO. DETAIL DWG.	M N T	F I F	W I R	C A L	S Y S	REMARKS
LEL-110		X	X	C-616 SUMP LOW	CREXELBROK		DS-CMD-		F	P5E-16209-A						PART OF
0				LEVEL ELEMENT	GR CONTRACT		16209-11									LSL-110
					APP'D EQ'L											
LSL-110		X	X	C-616	CREXELBROK		DS-CMD-		F	P5E-16209-A						MODEL NO.
0				SUMP	GR CONTRACT		16209-11									506-600-5
				LOW LEVEL	APP'D EQ'L											
PI-110		X	X	C-616	U.S. GAUGE		DS-CMD-		F	P5E-16209-A						MODEL NO.
0				AIR PURGE LINE	GR CONTRACT		16209-14									1919
				PRESSURE	APP'D EQ'L											

*LEGEND
P=PANEL
B=BACK OF PANEL
R=RACK D=DCS
F=FIELD
C=COMPUTER

THE RUST INTERNATIONAL CORPORATION

CONTRACT NO. 21-2519

INSTRUMENTATION LIST FOR DEPARTMENT OF ENERGY C-400 AND C-616 SPILL CONTAINMENT

DWN: DERRYBERRY
CKD: CARTER
APP'D:

INSTRUMENT INDEX NO.

SHEET 8-9

REV 0

CFC

PAGE 003

DATE 12/13/84

DATA SHEET

REVISIONS		
REV.	APPROVAL	DATE

LEVEL SWITCH DATA SHEET

PROJECT		DATA SHEET NO.	REV.
1.2.1 Spill Containment Paducah, KY		DS-CMD-16209-10 PAGE OF	O
PLANT BUILDING	PREPARED BY	THIS SHEET PART OF	
PGDP	M. Davis		
W.O. OR E.S.O.	APPROVAL	DATE	
		8/3/84	
REQUISITION NO.	PROCURED BY	INSTALLED BY	
	FPSC	FPSC	

(CAPACITANCE TYPE)

		Tag Number	LSH102	LSL102	LSL105	LSL101
	2	Service	Uncontaminated Sol'n Storage	Uncontaminated Sol'n Storage	C407 Sump	Uncontaminated Sol'n Sump
GENERAL	3	Line No./Vessel No.	F100	F100	-	-
	4	Application	Level	Level	Level	Level
	5	Function	Alarm Trip	Alarm Trip	Low Level Trip	Alarm Trip
	6	Fail-Safe				
PROBE	7	Model Number				
	8	Orientation	Horiz.-Side	Horiz.-Side	Vertical-Top	Vertical-Top
	9	Style	On - Off	On - Off	On - Off	On - Off
	10	Material	304L SS	304L SS	304L SS	304L SS
	11	Sheem	Teflon	Teflon	Teflon	Teflon
	12	Insertion Length	18"	18"	12'	5'-6"
	13	Inactive Length	-	-	2'	6"
	14	Gland Size & Mat'l.				
	15	Connection	4" 150# Flange	4" 150# Flange	Standard	Standard
	16	Conduit Connection				
AMPLIFIER	17	Location				
	18	Enclosure	NEMA 4X	NEMA 4X	NEMA 4X	NEMA 4X
	19	Conduit Connection				
	20	Pwr. Supply				
SWITCH	21	Type	Electronic	Electronic	Electronic	Electronic
	22	Quantity and Form	SPDT	SPDT	SPDT	SPDT
	23	Rating: Volts/Hertz	115 Vac 60 Hz	115 Vac 60 Hz	115 Vac 60 Hz	115 Vac 60 Hz
	24	Amps/Watts/HP	5 amp	5 amp	5 amp	5 amp
	25	Load Type				
	26	Contacts Open: On Incr.	Open On Incr	Open On	Open On	Open On
	27	Close Level Decr.	Level	Level Decr	Level Decr	Level Decr
TRANS.	28	Output				
	29	Range				
	30	Enclosure Class				
OPTIONS	31	Compensation Cable				
	32	Local Indicator				
	33	Trip Transducer				
	34	Signal Lights				
	35					
SERVICE	36	Upper Fluid				
	37	Dielectric Constant				
	38	Lower Fluid	Nitric Acid	Nitric Acid	Nitric Acid	Nitric Acid
	39	Dielectric Constant				
	40	Pressure Max. / Normal	ATM / ATM	ATM / ATM	/ ATM	/ ATM
	41	Temp. Max. / Normal	120°F / AMB	120°F / AMB	/ AMB	/ AMB
	42	Moisture	-	-	-	
	43	Material Buildup	-	-	-	
	44	Vibration	-	-	-	
	45	Manufacturer (Note 4)	Drexel Brook	Drexel Brook	Drexel Brook	Drexel Brook
	46	Model Number	506-600-5	506-600-5	506-600-5	506-600-5

Notes:
1. Provide SS tag permanently attached engraved with tag No.
2. Probes are to be furnished with grounding rod (attached).
3. Enclosures are to be NEMA 4X.
4. Or Contractor approved equal.
5. Supply 20' of interconnecting cable.

Furnish the following manufacturer's data in quantities indicated:	NUMBER OF COPIES W/Bids	Approval	Certified	TYPE OF DATA (CONTINUED)	NUMBER OF COPIES W/Bids	Approval	Certified
1. Outline dimensional drawings				5. Installation instructions			
2. Performance data							
3. Weight of equipment							
4. Descriptive literature							

*Information to be supplied by equipment manufacturer.

DATA SHEET

LEVEL SWITCH DATA SHEET

REVISIONS		
REV.	APPROVAL	DATE

PROJECT: 1.2.1 Spill Containment Paducah, KY		DATA SHEET NO.: DS-CMD-16209-11	REV.
PLANT: PGDP	BUILDING	PREPARED BY: M. David	THIS SHEET PART
W.O. OR E.S.O.			DATE: 8/3/84
REQUISITION NO.		PROCURED BY: FPSC	INSTALLED BY: FPSC

(CAPACITANCE TYPE)

	1	Tag Number	LSL 108	LSL 109	LSL 110	
	2	Service	C616 Facility	C616 Facility	C616 Sump	
GENERAL	3	Line No./Vessel No.	F120A	F120A	-	
	4	Application	Level	Level	Level	
	5	Function	Alarm Trip	Alarm Trip	Alarm Trip	
	6	Fail-Safe				
PROBE	7	Model Number				
	8	Orientation	Horiz - Side	Horiz - Side	Vertical -Top	
	9	Style	On - Off	On - Off	On - Off	
	10	Material	Alloy 20	Alloy 20	Alloy 20	
	11	Sheath	Teflon	Teflon	Teflon	
	12	Insertion Length	18"	18"	11'	
	13	Inactive Length	-	-	2'	
	14	Gland Size & Mat'l.				
	15	Connection	4" 150# Flange	4" 150# Flange	Standard	
	16	Conduit Connection				
AMPLIFIER	17	Location				
	18	Enclosure	NEMA 4X	NEMA 4X	NEMA 4X	
	19	Conduit Connection				
	20	Power Supply				
SWITCH	21	Type	Electronic	Electronic	Electronic	
	22	Quantity and Form	SPDT	SPDT	SPDT	
	23	Rating: Volts/Hz or dc	115 Vac 60 Hz	115 Vac 60 Hz	115 Vac 60 Hz	
	24	Amps/Watts/HP	5 amp	5 amp	5 amp	
	25	Load Type				
	26	Contacts Open / On / Incr.	Open / On	Open / On	Open / On	
	27	Close / Level / Decr.	Level / Decr	Level / Decr	Level / Decr	
TRANS.	28	Output				
	29	Range				
	30	Enclosure Class				
OPTIONS	31	Compensation Cable				
	32	Local Indicator				
	33	I/P Transducer				
	34	Signal Lights				
	35					
SERVICE	36	Upper Fluid				
	37	Dielectric Constant				
	38	Lower Fluid	Sulfuric Acid	Sulfuric Acid	Sulfuric Acid	
	39	Dielectric Constant				
	40	Pressure Max. / Normal	14 PSIG / ATM	14 PSIG / ATM	/ ATM	
	41	Temp. Max. / Normal	120°F / AMB	120°F / AMB	/ AMB	
	42	Moisture	-	-	-	
	43	Material Buildup	-	-	-	
	44	Vibration	-	-	-	
	45	Manufacturer (Note 4)	Drexel Brook	Drexel Brook	Drexel Brook	Drexel Brook
	46	Model Number	506-600-5	506-600-5	506-600-5	506-600-5

Notes:
1. Provide SS tag permanently attached engraved with tag No.
2. Probes are to be furnished with grounding rod (attached).
3. Enclosures are to be NEMA 4X.
4. or Contractor approved equal.
5. Supply 50' of interconnecting cable.

Furnish the following manufacturer's data in quantities indicated:	NUMBER OF COPIES W/Bids	Approval	Certified	TYPE OF DATA (CONTINUED)	NUMBER OF COPIES W/Bids	Approval
1. Outline dimensional drawings				5. Installation instructions		
2. Performance data						
3. Weight of equipment						
4. Descriptive literature						

*Information to be supplied by equipment manufacturer.

DATA SHEET

LEVEL **XMTR DATA** SHEET

REVISIONS		
REV.	APPROVAL	DATE

PROJECT 1.2.1 Spill Containment Paducah, KY		DATA SHEET NO. DS-CMD-16209-12 PAGE OF	REV.
PLANT BUILDING PGDP	PREPARED BY M. Davis		THIS SHEET PART OF
W.O. an E.S.O.	APPROVAL		DATE 8/3/84
REQUISITION NO.	PROCURED BY FPSC		INSTALLED BY FPSC

(CAPACITANCE TYPE)

	1	Tag Number	LE/LT 108	LE/LT 109	
	2	Service	C616 Facility	C616 Facility	
GENERAL	3	Line No./Vessel No.	F120A	F120B	
	4	Application	Level	Level	
	5	Function	Transmitting	Transmitting	
	6	Fail-Safe			
	7	Model Number			
	8	Orientation	Vertical-Top	Vertical-Top	
	9	Style	-	-	
	10	Material	Alloy 20	Alloy 20	
PROBE	11	Sheath	Teflon	Teflon	
	12	Insertion Length	10'	10'	
	13	Inactive Length	1'-6"	1'-6"	
	14	Gland Size & Mat'l.			
	15		4" 150# Flange	4" 150# Flange	
	16	Conduit Connection			
	17	Location	Remote	Remote	
AMPLIFIER	18	Enclosure	NEMA 4X	NEMA 4X	
	19	Conduit Connection	-	-	
(w/ XMTR)	20	Power Supply	115 Vac 60 Hz	115 Vac 60 Hz	
	21	Type			
	22	Quantity and Form			
	23	Rating: Volts/Hz or dc			
SWITCH	24	Amps/Watts/HP			
	25	Load Type			
	26	Contacts Open | On Incr.			
	27	Close | Level | Decr.			
	28	Output	4-20 MA	4-20 MA	
TRANS.	29	Range	-	-	
	30	Enclosure Class	NEMA 3	NEMA 3	
	31	Compensation Cable			
	32	Local Indicator	Yes	Yes	
OPTIONS	33	I/P Transducer			
	34	Signal Lights			
	35				
	36	Upper Fluid			
	37	Dielectric Constant			
	38	Lower Fluid	Sulfuric Acid	Sulfuric Acid	
	39	Dielectric Constant			
SERVICE	40	Pressure Max. | Normal	14 PSIG | ATM	14 PSIG | ATM	
	41	Temp. Max. | Normal	120°F | AMB	120°F | AMB	
	42	Moisture	-	-	
	43	Material Buildup	-	-	
	44	Vibration	-	-	
	45	Manufacturer (Note 4)	Drexel Brook	Drexel Brook	
	46	Model Number	C508-25-7	C508-25-	

Notes:
1. Provide SS tag permanently attached with tag No.
2. Probes are to be furnished with grounding rod (attached).
3. Supply 50' of interconnecting cable.
4. or Contractor approved equal

Furnish the following manufacturer's data in quantities indicated:	NUMBER OF COPIES W/Bids	Approval	Certified	TYPE OF DATA (CONTINUED)	NUMBER OF COPIES W/Bids	Approval	Certified
1. Outline dimensional drawings				5. Installation instructions			
2. Performance data							
3. Weight of equipment							
4. Descriptive literature							

*Information to be supplied by equipment manufacturer.

PRESSURE GAUGES

PROJECT: WBS 1.2.1 Spill Containment

DATA SHEET NO.: DS-CMD-16209-13

1. Type: Direct Read ■ 3-15 lb Receiver ☐
   Other _____
2. Mounting: Surface ☐ Local ■ Flush ☐
3. Dial: Diameter 4-½" Color White
4. Case: Cast Iron ☐ Aluminum ☐ Phenol ■
   Other _____
5. Ring: Screwed ☐ Hinged ☐ Slip ☐ Std ☐
   Other Snap-in
6. Blow-out Protection None ☐ Back ☐ Disc ☐
   Solid Front ■ Other _____
7. Lens: Glass ☐ Plastic ■
8. Options: Syphon ☐ Material
   Snubber ☐ _____
   Pressure Limit Valve ☐ _____
   Movement Damping ☐ _____
9. Nominal Accuracy Required 0.5% Span
10. MFR. & Model No. U.S. Gauge# 1980 (Note 1)
11. Press. Element: Bourdon ■ Bellows ☐
    Other _____
12. Element Mtl: Bronze ■ Steel ☐ _____ SS
    Other _____
13. Socket Mtl: Bronze ☐ Steel ☐ _____ SS
    Other Brass
14. Connection-NPT: ¼ in. ☐ ½ in. ■ Other _____
    Bottom ■ Back ☐
15. Movement: Bronze ☐ SS ■ Nylon ☐
    Other _____
16. Diaphragm Seal (Note 1)
    MFG. U.S.Gauge Type Threaded
    Wetted Part Mtl. * Other Mtl. Carbon Stl.
    Fill Fluid Silicone (Low Temp)
    Process Conn. ½" Gage Conn ½"

Req. Quan.	Tag No.	Range	Operating Pressure	Service
	PI 102A	0-30 PSIG	15 PSIG	J-100A Outlet
	PI 102B	0-30 PSIG	15 PSIG	J-100B Outlet
	PI 108	0-30 PSIG	17 PSIG	J-120A Outlet
	PI 109	0-30 PSIG	17 PSIG	J-120B Outlet

* HASTELLOY B for PI-108 and PI-109, 304SS for PI-102A and B.

Notes: 1 or Contractor Approved Equal

*Information to be supplied by equipment manufacturer.

DATA SHEET

PRESSURE GAUGES

PROJECT		DATA SHEET NO.	REV.
WBS 1.2.1 Spill Containment Paducah, KY		DS-CMD-16209-14 PAGE OF	O
PLANT BUILDING	PREPARED BY		THIS SHEET PART OF
PGDP	M. Davis		
W.O. OR E.S.O.	APPROVAL	DATE	
		8/3/84	
REQUISITION NO.	PROCURED BY	INSTALLED BY	
	FPSC	FPSC	

REVISIONS.

REV.	APPROVAL	DATE

1. Type: Direct Proc ■ 3-15 lb Receiver ☐ Other ____
2. Mounting: Surface ☐ Local ■ Flush ☐
3. Dial: Diameter 4½" Color
4. Case: Cast Iron ☐ Aluminum ☐ Phenol ■ Other ____
5. Ring: Screwed ☐ Hinged ☐ Slip ☐ Std ☐ Other Snap-in
6. Blow-out Protection None ☐ Back ☐ Disc ☐ Solid Front ■ Other ____
7. Lens: Glass ☐ Plastic ■
8. Options: Syphon ☐ Material ____ Snubber ☐ ____ Pressure Limit Valve ☐ ____ Movement Damping ☐ ____
9. Nominal Accuracy Required ____
10. MFR. & Model No. U.S. Gauge# 1919 (Note 1)
11. Press. Element: Bourdon ☐ Bellows ☐ Other Diaphragm
12. Element Mtl: Bronze ☐ Steel ☐ ____ SS Other Ni-Span
13. Socket Mtl: Bronze ☐ Steel ☐ ____ SS Other Brass
14. Connection-NPT: ¼ in. ☐ ½ in. ■ Other ____ Bottom ■ Back ☐
15. Movement: Bronze ☐ SS ■ Nylon ☐ Other ____
16. Diaphragm Seal MFG. ____ Type ____ Wetted Part Mtl. ____ Other Mtl. ____ Fill Fluid ____ Process Conn. ____ Gage Conn ____

Rev. Quan.	Tag No.	Range	Operating Pressure	Service
	PI 110	0-30" WC	3" WC	Air Purge Line

Notes: 1 or Contractor Approved Equal

*Information to be supplied by equipment manufacturer.

DATA SHEET

PRESSURE RELIEF VALVES

REVISIONS		
REV.	APPROVAL	DATE

PROJECT: WBS 1.2.1 Spill Containment Paducah, KY		DATA SHEET NO.: DS-CMD-16209-15	REV. 1
PLANT / BUILDING: PGDP	PREPARED BY: K. Carter		THIS SHEET PART OF
W.O. OR E.S.O.	APPROVAL	DATE: 8/6/84	
REQUISITION NO.	PROCURED BY: FPSC	INSTALLED BY: FPSC	

	1.	Tag Number	PSV 108	PSV 109		
	2.	Service	F120A	F120B		
GENERAL	3.	Line No./Vessel No.	F120A	F120B		
	4.	Full Nozzle/Semi Nozzle	Full	Full		
	5.	Safety or Relief	Safety Relief	Safety Relief		
	6.	Conv., Bellows, Pilot Op.	Bellows	Bellows		
	7.	Bonnet Type	Closed	Closed		
CONN.	8.	Size: Inlet / Outlet	1½" / 2"	1½" / 2"		
	9.	Flange Rating or Screwed	150 lb	150 lb		
	10.	Type of Facing				
MATERIALS	11.	Body and Bonnet	Hastelloy B or C	Hastelloy B or C		
	12.	Seat and Disc	Hastelloy B or C	Hastelloy B or C		
	13.	Resilient Seat Seal				
	14.	Guide and Rings	Hastelloy B or C	Hastelloy B or C		
	15.	Spring				
	16.	Bellows	By Vendor	By Vendor		
	17.					
OPTIONS	18.	C.S.: Screwed or Bolted	Screwed	Screwed		
	19.	Lever: Plain or Packed				
	20.	Test Gag				
	21.					
	22.					
	23.					
BASIS	24.	Code				
	25.	Fire				
	26.	Thermal Expansion	Yes	Yes		
	27.	Pumping In	Yes	Yes		
FLUID DATA	28.	Fluid and State	H_2SO_4: Vapor: Air	Air - H_2SO_4 Vapor: Air		
	29.	Required Capacity	4252 SCFH	4252 SCFH		
	30.	Mol. Wt. / Oper. Temp.	28.97	28.97		
	31.	Oper. Press. / Set Press.	.5" H_2O / .5 PSI	.5" H_2O / .5 PSI		
	32.	Oper. Temp. / Rel. Temp.	AMB / AMB	AMB / AMB		
	33.	Back Pressure (Constant)	0	0		
	34.	Back Pressure (Variable)	0	0		
	35.	Back Pressure (Total)	0	0		
	36.	% Allowable Overpressure	10%	10%		
	37.	Overpressure Factor				
	38.	Compressibility Factor	1.0	1.0		
	39.	Latent Heat of Vaporization				
	40.	Ratio of Specific Heats				
	41.	Operating Viscosity	1 CP	1 CP		
	42.	Barometric Pressure	14.7 PSIG	14.7 PSIG		
	43.					
	44.					
	45.	Calc. Area sq. in.	.258	.258		
	46.	Selected Area	.307	.307		
	47.	Orifice Designation	F	F		
	48.	Manufacturer (Note 2)	Consolidated	Consolidated		
	49.	Model No.	1905-30 FC-H4	1905-30-FC-H4		

NOTES: 1. Provide SS tag permanently attached to valve engraved with tag No. & set pressure.

2. or Contractor **approved equal.**

*Information to be supplied by equipment manufacturer.

VALVE, CONTROL

PADUCAH, KENTUCKY 42001

'NSTRUMENT SPECIFICATION SHEET

PROJECT	PLANT BUILDING
1.2.1 Spill Containment Paducah, KY	PGDP

REVISIONS REV.	APPROVAL	DATE

W.O. on E.S.O.	Data Sht. No.	DWG. REF
	DS-CMD-16209-16	P5216209A
PREPARED BY: K. Carter	APPROVAL	DATE: 8/6/84
REQUISITION NO.	PROCURED BY: FPSC	INSTALLED BY: FPSC

PROCESS FLUID

FLUID NAME: Nitric Acid

TEMPERATURE:
- OPERATING: AMB
- MAXIMUM: 120°F
- MINIMUM:

PRESSURE:
- OPERATING INLET: 3 PSIG
- MAXIMUM INLET: 5 PSIG
- MINIMUM INLET: 2 PSIG
- OPERATING DIFF.: 1 PSI
- MAXIMUM DIFF.: 5 PSI

FLOW:
- OPERATING: 50 GPM
- MAXIMUM: 100 GPM
- MINIMUM:

MAXIMUM AMBIENT TEMP.: 95°F

SPECIFIC GRAVITY AT OPERATING TEMP, AND PRESSURE: 1.0

VISCOSITY AT OPERATING TEMP. AND PRESSURE:

COMPONENTS

BODY:
- TYPE: Plug
- SIZE: 3"
- PRESS. RATING: 150 lb
- CONNECTION: Flange

TRIM:
- TYPE: Standard
- SIZE: Full Bore
- CHARACTERISTIC: Standard

TRIM (CONT.):
- APPROX. CV: 300
- RANGE:

SHAFT SEAL:
- PRIMARY: Packing
- SECONDARY:

ACTUATION:
- TYPE: Cylinder
- STROKE: Standard
- PRESS. RATING:

POSITION INDICATOR:

POSITIONER:
- TYPE:
- MOUNTING:
- SIGNAL FLANGE:

AIR SUPPLY PRESSURE:
- NORMAL: 80 PSIG
- MAXIMUM: 90 PSIG

AIR CONNECTIONS: 1/4" NPT

ELECl. CONNECTIONS: Standard

LEAK TESTING:
- SEAT: Standard
- BODY: Standard
- PROCEWRE: Standard

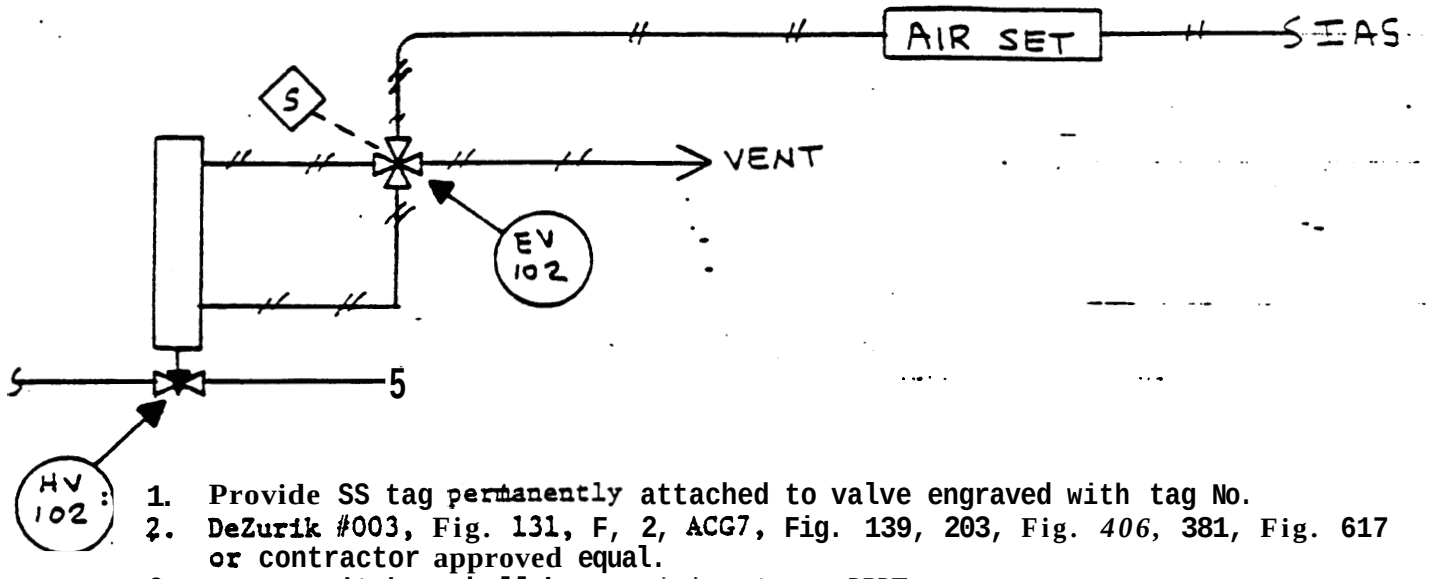
MATERIALS OF CONSTRUCTION
- BODY: 304 SS
- PLUG: 304 SS
- SEAT: 304 SS
- STEM: Standard
- PACKING: Viton

RECOMMENDED VENDORS	MODEL NO.	APPLICATION	TAG NO
See Note 2		F-100 Outlet	HV102
3.		ISS NO.	PAGE OF

UCN-12161A (1233 9-76)

OPTIONAL ACCESSORIES

I) Pipe with solenoid valve as shown below. Use ASCO No. *8344* or equal. Tag EV 102.
2) Provide air set
3) Valve opens when solenoid is energized.
4) Provide 2 limit switches. Tag ZSO-102 and ZSC-102. ZSO-102 contacts are closed when valve is open. ZSC-102 contacts are closed when valve is closed .



1. Provide SS tag permanently attached to valve engraved with tag No.
2. DeZurik #003, Fig. 131, F, 2, ACG7, Fig. 139, 203, Fig. *406*, 381, Fig. 617 or contractor approved equal.
3. Limit switches shall be proximity type, DPDT.

VALVE, CONTROL

PADUCAH, KENTUCKY 42001

INSTRUMENT SPECIFICATION SHEET

REVISIONS		
REV.	APPROVAL	DATE

PROJECT 1.2.1 Spill Containment Paducah, KY		PLANT BUILDING PGDP	
W. O. OR E.S.O.	Date Sht. No. D.-CMD-16209-..	DWG. REF. P5216209A	
PREPARED BY K. Carter	APPROVAL	DATE 8/6/84	
REQUISITION NO.	PROCURED BY FPSC	INSTALLED BY FPSC	

PROCESS FLUID

FLUID NAME: Sulfuric Acid

TEMPERATURE:
- OPERATING: AMB
- MAXIMUM: 120°F
- MINIMUM:

PRESSURE:
- OPERATING INLET: 16 PSIG
- MAXIMUM INLET: 30 PSIG
- MINIMUM INLET: 16 PSIG
- OPERATING OIFF.: 15 PSIG
- MAXIMUM DIFF.: 30 PSIG

FLOW:
- OPERATING: GO GPM
- MAXIMUM: 80 GPM
- MINIMUM:

MAXIMUM AMBIENT TEMP.: 95°F

SPECIFIC GRAVITY AT OPERATING TEMP. AND PRESSURE: 1.84

VISCOSITY AT OPERATING TEMP. AND PRESSURE:

COMPONENTS

BODY:
- TYPE: Ball
- SIZE: 2"
- PRESS. RATING: 150 lb
- CONNECTION: Flange

TRIM:
- TYPE: Standard
- SIZE: Full Bore
- CHARACTERISTIC:

TRIM (CONT.):
- APPROX. CV: 100
- RANGE:

WAFT SEAL:
- PRIMARY: Packing
- SECONDARY:

ACTUATION:
- TYPE: Cylinder
- STROKE: Standard
- PRESS. RATING:
- POSITION INDICATOR:

POSITIONER:
- TYPE:
- MOUNTING:
- SIGNAL FLANGE:

AIR SUPPLY PRESSURE:
- NORMAL: 80 PSIG
- MAXIMUM: 90 PSIG

AIR CONNECTIONS: 1/4" NPT

ELECT. CONNECTIONS: Standard

LEAK TESTING:
- SEAT: Standard
- BODY: Standard
- PROCEWRE: Standard

MATERIALS OF CONSTRUCTION

- BODY: Hastelloy B or C
- PLUG: Hastelloy B or C
- SEAT: Hastelloy B or C
- STEM: Hastelloy B or C
- PACKING: TFE

RECOMMENDED VENDORS	MODEL NO.	APPLICATION	TAG NO
See Note 2		Sulfuric Acid to Pig Loading Station	HV107
3.		ISS NO. —	PAGE OF

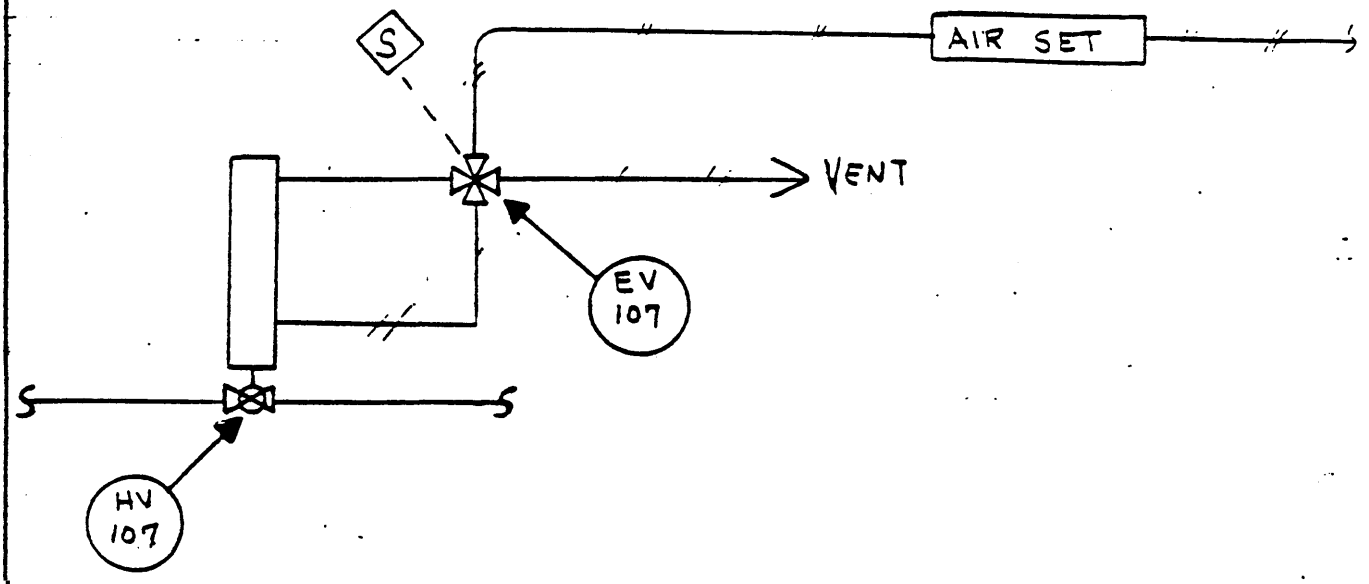
UCN-12181A (1235 8-78)

MATERIALS Of CONSTRUCTION (CONT.):

BELLOWS _____
ELEMENT _____
WELL _____
CAPILLARY _____

OPTIONAL ACCESSORIES

1) Pipe with solenoid valve as shown below. Use ASCO No. *8344* or Equal. Taa EV107.
2) Provide air set
3) Valve Opens when solenoid is energized.



NOTES: 1. Provide SS tag permanently attached to valve engraved with tag No.
2. Jamesbury #2" 5150-31-3573TT with type RP actuator or contractor contractor approved equal.

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9.100 MIXER FOR UNCONTAMINATED SOLUTION STORAGE TANK

1.0 GENERAL

A. This specification describes the motor driven mixer to be furnished.

B. Subcontractor shall design, fabricate, and furnish one motor driven mixer as described and specified herein.

2.0 STANDARDS AND CODES APPLICABLE

The following listed Standards and Codes and any subsections thereof, as applicable, shall govern the selection of equipment supplied under this specification:

ASTM - American Society for Testing and Materials

NEMA - National Electrical Manufacturer's Association

HSI - Hydraulic Standards Institute

3.0 DESCRIPTION OF PROCESS

Mixer will be used to keep solids in suspension in a 304L SS tank ten feet in diameter with an eight foot straight wall and a dished bottom, The mixer shall be mounted on top of the closed-top tank. Subcontractor will provide mixer supports and vertical tank baffles. The tank is vented to an existing gas collecting system and the liquid surface in the tank may be at any tank level,

4.0 DESIGN DATA

A. Impeller blades shall be pitched-bladed turbine-type to maintain a vertical circular flow pattern in the tank. Each impeller shall have a minimum of four turbine blades. Subcontractor shall recommend distance between tank bottom and impeller,

B. Shaft and impellers shall be made of 304L stainless steel.

C. Subcontractor shall recommend impeller speed.

D. Mixer motor shall be supported on the tank top,

E. Motor8 less than 1/4 HP shall use 120 VAC, 60 Hertz, single phase power. Motors 1/11 HP or greater shall use 240/480 V, 60 Hertz, 3 phase power.

F. Motors shall be totally enclosed.

5.0 DESIGN REQUIREMENTS

A. The specific gravities of the various solutions are as follows:

(1)	Wastewater	- 1.0
(2)	Nitric acid, 55% ±	- 1.5

B. The mixer shall be designed for 24 hours per day operation.

6.0 QUALITY ASSURANCE REQUIREMENTS

The Subcontractor shall submit for approval a list of inspections and testa (one referenced in the Code and Standards plus Subcontractor selected) to be performed during the fabrication of the system specified. This list shall be a breakdown of all major system components and include where they (inspection and teats) will be performed, when they will be performed (during construction, before shipment, on acceptance, on receipt, etc.), and who will responsible for performing the inspections and tests.

DATE 10/29/84 PAGE 3 OF3

COMPANY Martin Marietta
CONTRACT NO. Energy Systems, fnc.
SPECIFICATION NO.
AREA NO.
EQUIPMENT ITEM OR NO. Motor Driven Mixers

BID EVALUATION DATA SHEET

ITEM	DESCRIPTION
Make and Model No.	
No. of Impellers per Shaft	1
Dia. of Impellers & Attachment to Shaft	
No. of Blades per Impeller	
Type of Blades	
Dimension of Blades	
Diameter of Shaft	
Length(s) of Shafts	
Distance, End Impeller to tank Bottom	
Pumping Capacity of Mixer	
Material of Shaft and Impeller	
Motor, HP-V-H-phase	
Motor Enclosure	
Motor Support	
Method of Motor Attachment to Shaft	
Lubrication Requirements	
Recommended Location of Mixer in Tank:	
Delivery from P.O.	
Weight	

9.200 SEOP FABRICATED STEEL PRESSURE VESSELS AND STORAGE TANKS

1. GENERAL

A. This Specification and the Pressure Vessel and Storage Tank DESIGN DATA SHEETS prescribe the minimum requirements for the design, fabrication, inspection, testing and stamping of steel pressure vessels and storage tanka.

B. The Subcontractor shall provide design calculations, detail fabrication drawings, and welding procedures for approval by the Contractor prior to start of fabrication, Fabrication should begin only after approval of certified calculations, drawings, and welding procedures.

C. Deviations from this specification are acceptable only a4 approved in writing by the Contractor. Any request for material substitution *must* have complete material description including ASTM designation, grade, type and correct thickness.

2. STANDARDS AND CODES

A, Unless otherwise specified, the pressure vessels and storage tanks shall conform to the following applicable Codes, Standards and Specifications:

1) The 1983 Edition, latest addenda of the ASME Boiler and Pressure Vessel Code, Section VIII, Division I, for the design and construction of pressure vessels.

2) American Petroleum Institute (API) Standard 650 (1980).

3) ANSI Standard B16.5, latest edition, for dimensional specifications and pressure ratings of flanges.

4) ANSI A58.1 (1982)

5) OSHA Regulations and Requirements.

6) All State, local and municipal Codes, Laws, and Regulations where applicable.

B. Where conflicts exist between the Standards and Codes listed above (4.A.1 to 4.A.5) and this Specification, this Specification shall govern, Where Code and Standard Requirements are more stringent than this Specification, the Codes and Standards shall govern.

3. MATERIAL

A. All material shall conform to the ASTM Specifications listed on the DESIGN DATA SHEET and as specified herein.

B. Material substitution must be approved by the Contractor.

C. Castings shall not be used for pressure parts.

D. Gasket material shall be as noted on the DESIGN DATA SHEETS, or equal as approved by the Contractor.

4. DESIGN

A. Pressure

Design pressure shall be as specified on the DESIGN DATA SHEETS.

B. Temperature

Design temperature shall be as specified on the DESIGN DATA SHEETS.

C. Corrosion Allowance

As specified on the DESIGN DATA SHEETS.

D. Rating

The ASME Code pressure vessels shall be rated at the maximum allowable working pressure in accordance with paragraph UG-98 of the ASME code and at the maximum temperature based on stress value used in design. Subcontractor calculations shall include MAWP calculations. Nozzle reinforcement shall not limit MAWP.

E. Shell, Roof and Other Elements

1) The minimum fabricated shell and head thickness of all pressure vessels and tanks shall not be less than 3/16". This thickness is before the application of corrosion allowances.

2) It is the responsibility of the Subcontractor to design the vessels and tanks; Detailed engineering calculations substantiating the proposed design shall be provided by the Subcontractor and submitted to the Contractor for approval before starting fabrication. If part of the design calculations are computerized, the following must be submitted.

a. The name of the program used and its developer if it is a commercially available computer program.

b. A synopsis of the program outlining the method used and date of development if the program is not a commercially available computer program.

c. Printout of the input and output for the successful computer run that is used in the design.

3) All vessels and tanks shall have an external grounding lug attached at the lowest point.

4) The maximum tensile stress in steel plates in tanka designed by API 650 shall be 18,000 psi.

5) All plate butt joints shall be full penetration welds.

6) All vessels and tanka shall have at least two(2) lifting lugs.

F. Nozzles and Manways

1) Slip-on flanges on tanka shall be installed so that the face of the flange projects over the end of the pipe a distance equal to the pipe thickness plus 1/8" minimum. Minimum nozzles projection to be 6" unless noted on the DESIGN DATA SHEETS.

2) Flange bolting should straddle the tank 'centerline. Vertical nozzles with horizontal flanges should have the bolting straddle the North-South centerline unless noted on the DESIGN DATA SHEETS.

3) Each manway or blinded nozzle shall be provided with a blind flange, pressure bolting, and a new service gasket of the type and material specified on the DESIGN DATA SHEETS.

4) Full penetration welds shall be used for all nozzles and manway attachments. For pressure vessels, details *(a)*, (b), (c), (g), (h), (o) and (r-1) of Figure UW-16.1 *of* the Code are the acceptable nozzle attachment details.

5) Manways shall be located to avoid personnel hazards from internals, sumps and other required appurtenances. The size shown on the DESIGN DATA SHEETS for manways refers to the minimum inside diameter.

6) Nozzles, openings, and their reinforcements shall be outside the knuckle area of the head.

5. FABRICATION

A. Tolerances

Construction tolerances shall be per applicable items of RUST Standard V-6 entitled "Dimensional Tolerances for Vessels, Tanks, Bins and Silos."

B. Welding

1) Qualification of Welders, Operators and welding procedures must be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code,

2) Welding procedures and welding procedure qualifications shall be submitted in triplicate to the Contractor for approval before any fabrication is started.

3) Pressure vessels shall not have pressure retaining welds made with the following electrodes: E-6012, E-6013, E-7014, E-7020 and E-7024.

4) Electrodes and filler wires shall be kept clean, dry and properly stored according to the Manufacturer's recommendations. No electrodes or filler wire shall be used which are damp, greasy or oxidized.

5) Prior to welding on the pressure vessels or tanks, the Subcontractor shall make available to the Contractor the qualification records of the Fabricator's welders.

6) No carbon steel shall be welded to the body of a stainless steel, vessel or tank, A 1/8" thick minimum steel pad shall be welded to the vessel or tank and the carbon steel welded to the pad.

7) External attachment welds of carbon steel to stainless steel shall be made with AWS type E309 filler metal.

C. Surface Preparation

1) After completion, the Subcontractor shall thoroughly clean the pressure vessels and tanks. Remove all the grease, oil, and other foreign material from inside and outside walls and bottom of the vessels and tanks.

2) All weld tacks used for attaching scaffold brackets, key plates or any other temporary attachments shall be ground off. Any pits resulting from the removal of said items shall be filled with sound weld metal and ground smooth.

3) All inside welds are to be ground smooth to eliminate corrosion pockets.

6. TESTING METAL SHELL

A. Radiography shall be as per API 650 or ASME Section VXII, Division 1 as applicable for examination of welded joints. Additional radiographs shall be made of questionable welds when requested by the Contractor.

B. A pneumatic test consisting of 20-25 psig air and soap shall be performed on all reinforcing pads.

C. Water for testing 300-series stainless steel equipment shall preferably have a maximum chloride content of 20 ppm. If a higher chloride content is not practically avoidable, the test water shall be inhibited with sodium nitrate. The inhibitor dosage will depend on the chloride level and pH of the teat water, but as a guide a 0.1 percent solution (8.33 lb. of sodium nitrate per thousand gallons) will suffice for 400 ppm chloride, 8 pH water. Vessel and testing medium shall not be leas than 70°F.

7. INSPECTION

A. The responsibility for inspection and testing rests with the Subcontractor: however, the Contractor reserves the right to inspect the vessels or tanks at any time during the fabrication to ensure that the materials and workmanship are in accordance with this Specification. A minimum of 10 days advance notice for scheduled tests shall be given to the Contractor.

B. The approval of any work by any Inspector and/or his release of the part for shipment shall in no way release the Subcontractor of any responsibility for carrying out all provisions of this Specification.

C. The Subcontractor shall notify the Contractor at least ten Cays prior to the date the vessels or tanks are completed and ready for final inspection.

D. Written certification of inspection and tests shall be provided by the Subcontractor.

E. Before final inspection all vessels and tanka shall be thoroughly cleaned inside and out, and shall be free from all weld spatter, dirt, weld rod stubs, loose foreign materials, scale, etc.

8. REPORTS AND RECORDS

A. The Subcontractor shall maintain a file of all documents required for this job including mill test reports on all material used. These mill test reports shall state the Specifications to which the material complies and shall include results of chemical analysis, and physical tests.

B. Prior to any fabrication of pressure vessels, the Subcontractor shall furnish to the Contractor a copy of Certificate of Authorization from the ASME Boiler and Pressure Vessel Committee authorizing him to fabricate unfired pressure vessels.

C. Within ten(10) days after completion of fabrication the Subcontractor shall furnish six copies each of the following to the Contractor:

1) Summary report of all NDT examinations

2) Manufacturer's Data Report, if required

3) Vessel or tank name plate rubbing

4) Certified mill test reports

D. Within ten(10) days after completion of fabrication the Subcontractor shall furnish two sets of reproducible as-built drawings and the documents inc), if requested, to the Contractor.

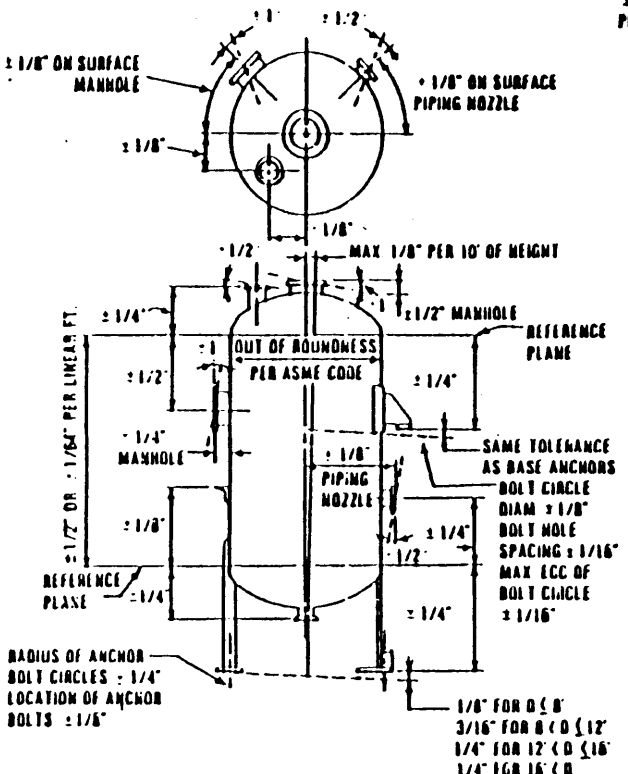
9. SUBCONTRACTOR RESPONSIBILITY

Subcontractor shall be responsible for incorporating in his design the latest modifications which have been found necessary and desirable based on experience with similar vessels and tanks.

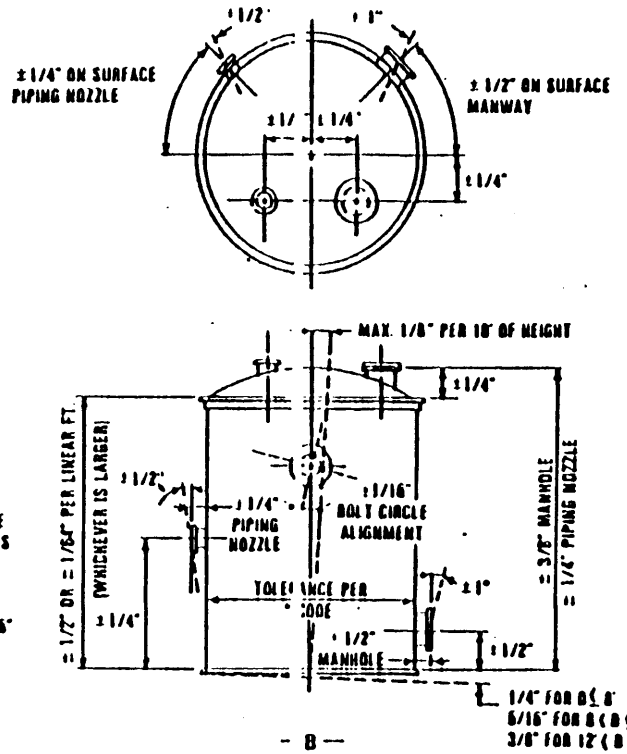
10. SURFACE COATING

Surface coating shall be performed in accordance with Section 11 of the Technical Specifications.

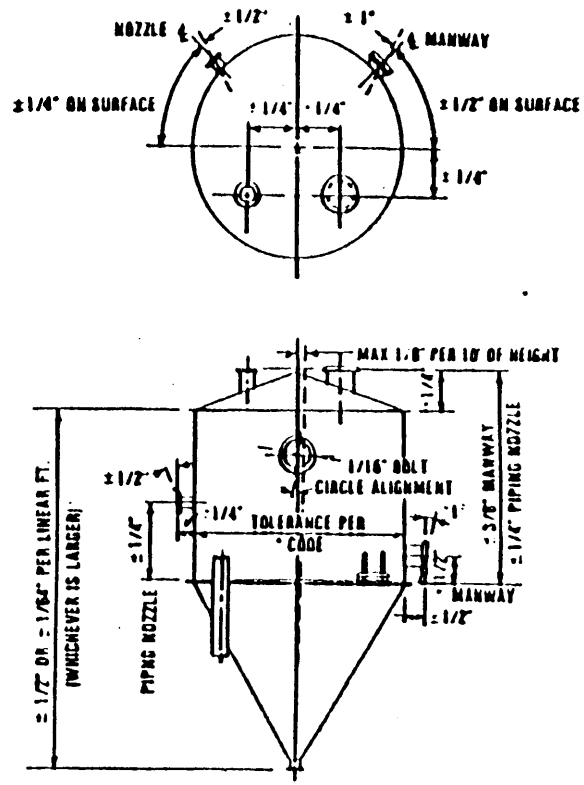
NOTES:
1) ALL MEASUREMENTS TO BE TAKEN WHEN VESSEL, TANK, OR BIN IS EMPTY.
2) TOLERANCES ARE NOT ACCUMULATIVE.
3) FLANGE TOLERANCES TO BE PER ANSI B16.5



— A —
PRESURE VESSELS & TANKS



— B —
STORAGE TANKS



— C —
BINS, SILOS & TANKS

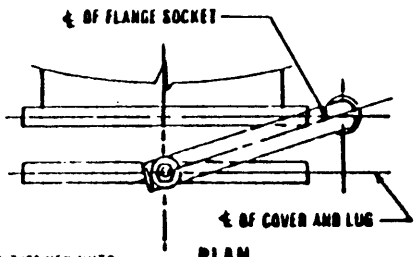
* API 650 OR 620 (AS REQUIRED)

Rust International Corporation	DIMENSIONAL TOLERANCES (FOR VESSELS, TANKS, BINS & SILOS)	V-6

9-10

ARM DIMENSIONS (FOR VERTICAL MANHOLE COVERS)

MANHOLE SIZE	150 LB SERIES			300 LB SERIES		
	R.F. FLANGES "A"	R.J. FLANGES "A"	"B"	R.F. FLANGES "A"	R.J. FLANGES "A"	"B"
18"	1'-3 9/16"	1'-3 11/16"	1'-8 1/2"	1'-5 3/16"	1'-5 5/16"	1'-10"
20"	1'-4 13/16"	1'-4 15/16"	1'-9 3/4"	1'-6 7/16"	1'-6 9/16"	1'-11 1/4"
24"	1'-7 1/8"	1'-7 3/16"	2'-0"	1'-8 3/16"	1'-8 3/8"	2'-2"



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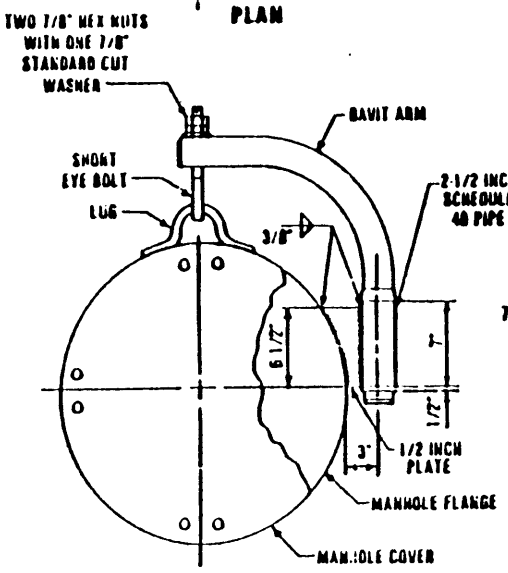
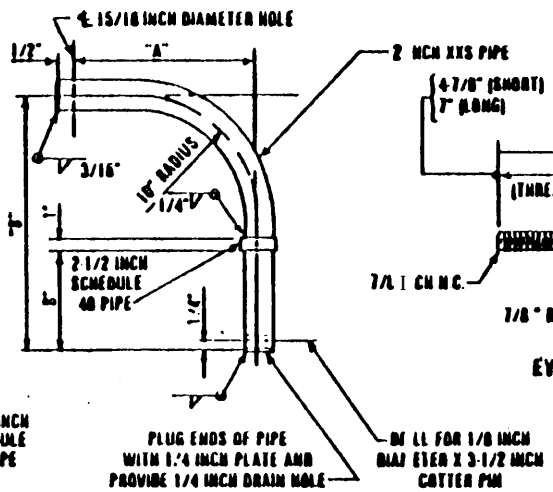
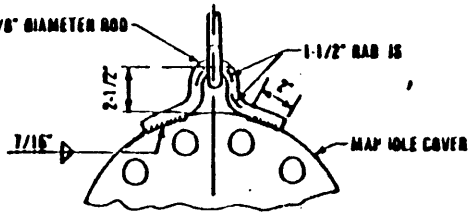


ELEVATION

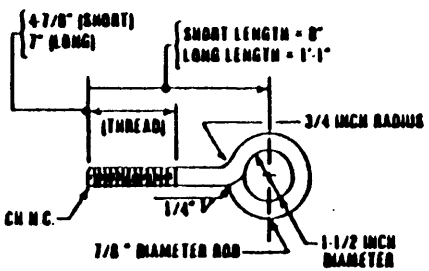
DAVITS DETAILS FOR VERTICAL MANHOLE COVERS



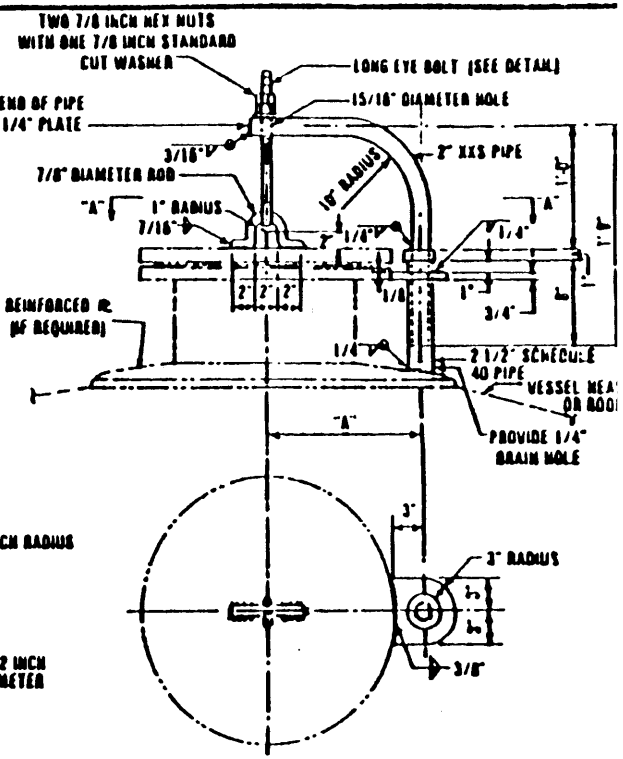
DAVIT ARM DETAIL



LUG DETAIL



EYE BOLT DETAIL



SECTION "A—A"

DAVIT DETAILS FOR HORIZONTAL MANHOLE COVERS

ARM DIMENSION "A"

(FOR HORIZONTAL MANHOLE COVERS)

MANHOLE SIZE	150 LB SERIES	300 LB SERIES
18"	1'-3 1/2"	1'-5"
20"	1'-4 3/4"	1'-6 1/4"
24"	1'-7"	1'-8"

NOTE: ALL MATERIAL SHALL BE CARBON STEEL UNLESS OTHERWISE SPECIFIED

Rust International Corporation

DAVIT DETAILS FOR MANHOLES

V-9

9-11

22-006A
8-4-83

Rust International Corporation
A Subsidiary of Ashland Rust Inc

PRESSURE VESSEL & STORAGE TANK DESIGN DATA SHEET

CONTRACT NO. 21-2519
SHEET NO. 200

REV	BY	DATE	
1	JWB	[illegible]	NOZ. LOC.
2	JWB	[illegible]	LEGS
3	JWB	[illegible]	LEGS.
4	JWB	[illegible]	ADDED G
5	JWB	[illegible]	[illegible]
6	JWB	[illegible]	DEX A

CUSTOMER : U.S. DEPT. OF ENERGY PADUCAH, KY.
DESCRIPTION : UNCONTAMINATED STORAGE TANK
CAPACITY : 5,000 GAL.
NO. REQUIRED : ONE (1)
ITEM: F-100
AREA: WBS-1.2.1

NOTES: (1) SCH. 40S - WITH LAP JOINT STUB ENDS.
(2) LAP JOINT FLANGES
(3) ACID PASSIVATE AFTER FABRICATION
(4) CARBON STL. ONLY - PER SEC. 11 OF SPEC.
(5) ANSI A58.1
(6) TEFLON OR EQUAL APPROVED BY CONTRACTOR

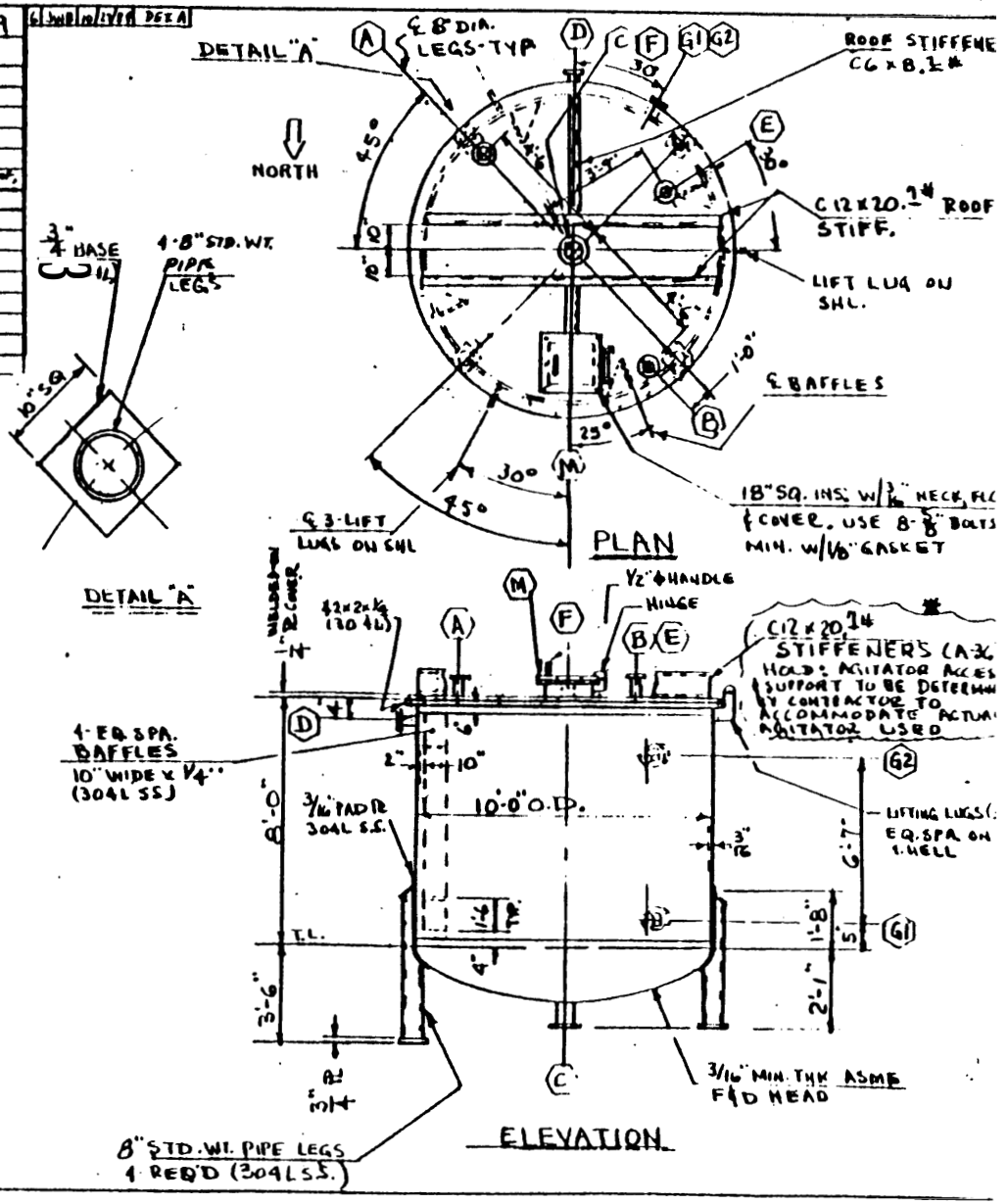
DESIGN CRITERIA

Oper. Press. psig	ATMOS	Oper. Temp °F	AMB
Design Press. psig	ATMOS	Design Temp °F	120
Sp. G. of Contents	1.0	Lethal	NO
Code	APT 650	Code Stamp	NO
Postweld HT	NO	Radiography	SPOT
Joint Eff. Shell	85%	Joint Eff. Heads	100%
Corr. Allow. Shell	0.0"	Corr. Allow. Heads	
Corr. Allow. Bott.	0.0"	Corr. Allow. Roof	—
Hydro. Test psig	FULL WATER	Air Test psig	NO
Wind Loading (5)	YES	Seismic Loading (5)	YES
Top Head - Roof	FLAT	Bott. Head - Bottom	F&D
Matls: Shell	A 240 304L	Matls: Heads	A 240 304L
Roof	A 240 304L	Bottom	—
Cone Sect.	—	Internal Hd.	—
(1) Nos. Necks	A 312 304L	(2) Nos. Flanges	A-105
Mbd. Necks	A 240 304L	Mbd. Flanges	A 240 304L
Mbd. Covers	A 240 304L	Nos. Blinds	—
Internal Pipe	—	Internal Pipe	—
Couplings	—	Handholes	—
HEX Bolts - Studs	304 S.S.	HEX Nuts	304 SS.
Gaskets	(6)	Structurals	A-36 (UN)
Mbd. Davits	NO	Mbd. Hinges	YES
Platforms		Platform Clips	NO
Ladder - Cage		Ladder Clips	
Stair		Stair Clips	
Insulation		Insulation Supports	
Fireproofing		Fireproofing Supports	
Trays		Tray Supports	
Stiffener Rings		Lining	
Vessel Support	4 - LEGS	Allow. Soil Bearing	—
Surface Prep. Ins.	(3)	Surface Prep. Outs.	(4)
Shop Paint Inside	NO	Shop Paint Outside	
Field Paint Inside		Field Paint Outside	NO

SCHEDULE OF APPURTENANCES

NOZZLES	RQD	SIZE	SER	TYPE	MK.	MISC. FITTINGS	RQD	SIZE	SER	TYPE	MK.
INLET	1	1"	150#	LJ	A	MANHOLE	1	18"	-	FLG	M
INLET	1	1½"	150	LJ	B						
OUTLET	1	3"	150	LJ	C						
O'FLOW	1	2"	150	LJ	D						
VENT	1	6"	150	LJ	E						
* AGITATOR	1	10"	150	SO	F						
LEVEL	2	4"	150	LJ	G						

DESIGNED BY: JWB DATE: 12/8/83 CHECKED BY: RFB DATE: 12/21/83



Rust International Corporation

PRESSURE VESSEL & STORAGE TANK DESIGN DATA SHEET

CONTRACT NO. 21-2519
SHEET NO. 201

REV	BY	DATE	
1	[illegible]	9/11/	APPLY & F
2	[illegible]	9/11/	[illegible]

CUSTOMER : U.S. DEPT. OF ENERGY PADUCAH, KY.
DESCRIPTION : SULFURIC ACID STORAGE TANK
CAPACITY : 15,000 GAL.
ITEM: F-110A
AREA: WBS-1.2.1
NO REQUIRED : ONE(1)

NOTES: (1) A-[illegible] NOZ. ACID; SCH 160 [illegible] RTV
(2) TEFLON OR EQUAL APPROVED BY CONTRACTOR
(3) SEE SEC. II OF SPECIFICATIONS
(4) PER RUST STD. V-9
(5) PER ANSI ASB.1

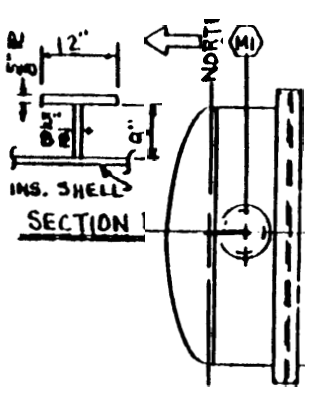
DESIGN CRITERIA

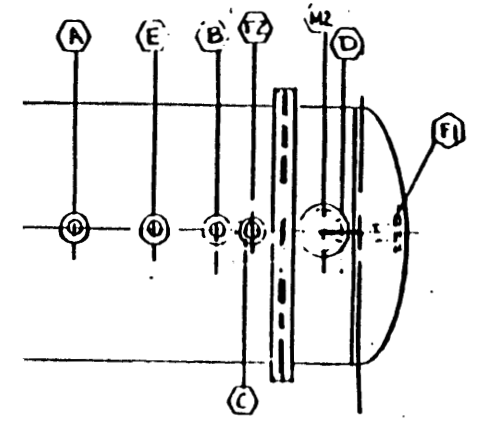
Oper. Press. psig	ATMOS	Oper. Temp. °F	AMB.
Design Press. psig	14	Design Temp. °F	120
No. of Courses	1.84	Lined	NO
Code	API 12F	Code Stamp	NO
Corrosion Allow.	1.0	Radiography	SPOT
Joint Eff. Shell	85 %	Joint Eff. Heads	100%
Corr. Allow. Shell	1/8"	Corr. Allow. Heads	3/16"
Corr. Allow. Bott.	—	Corr. Allow. Roof	—
Material Shell	SS	Air Test psig	NO
Wind Load per (5)	YES	Vacuum Condition (5)	YES
Top Handrail	FLD	Bott. Head Bottom	—
Material Shell	SA 285 C	Heads Heads	SA 285 C
Roof	—	Bottom	—
Corr. Allow.	—	Structural Mat.	—
1 Nozzles	SA 53 B	Shell Flanges	SA-105
Manways	SA 285 C	Head Flanges	SA-105
Misc. Connect.	SA 105	Man. Hatch	—
Internal Pipe	—	Internal Pipe	—
Supports	—	Handholes	—
Saddle Plates	SA 285 C	Plate	SA 307 B
Gaskets	—	Bolting	SA 36
Weld Metal (1)	YES	Weld Metal	NO
Radiography	NO	Platform Clips	
Ladder Cage		Ladder Clips	
Base		Shell Clips	
Insulation		Insulation supports	
Fireproofing		Reinforcing Plates	
Paint	V	Base Supports	
Nameplate & Data	SS SHROUD	Lining	—
Internal Supports	SHELL	Anchor Bolt Material	(3)
Bolting Flange Std.	ERNIE	Bolting Flange Grade	
Flange Face Finish	—	Flange Nozzle Outside	
Flange Nozzle Inside	—	Flange Manway Outside	NOTE

SCHEDULE OF APPURTENANCES

NOZZLES	NOD	SIZE	SER	TYPE	MK	MISC FITTINGS	NOD	SIZE	SER	TYPE	MK
[illegible]	1	[illegible]	150	WF	A	[illegible]	2	24	STD	HI	M
[illegible]	1	1	150	RF	B						
OUTLET	1	3	150	RF	C						
DRAIN	1	6	150	WF	D						
[illegible]	1	12	150	RF	E						
[illegible]	2	[illegible]	150	RF	F						

DESIGNED BY [illegible] DATE [illegible] CHECKED BY: RP DATE: 11/11/11





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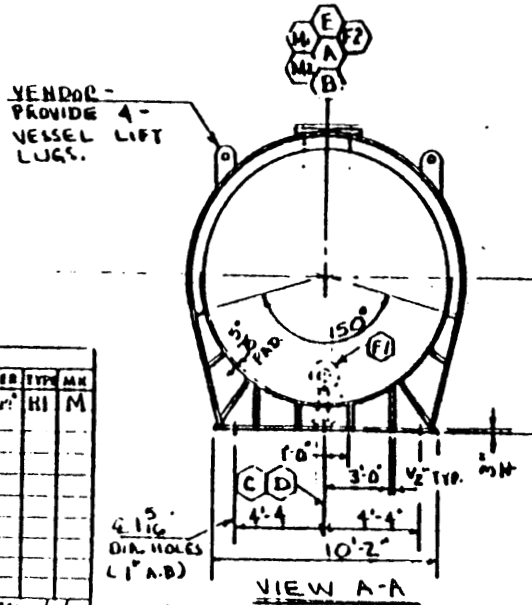
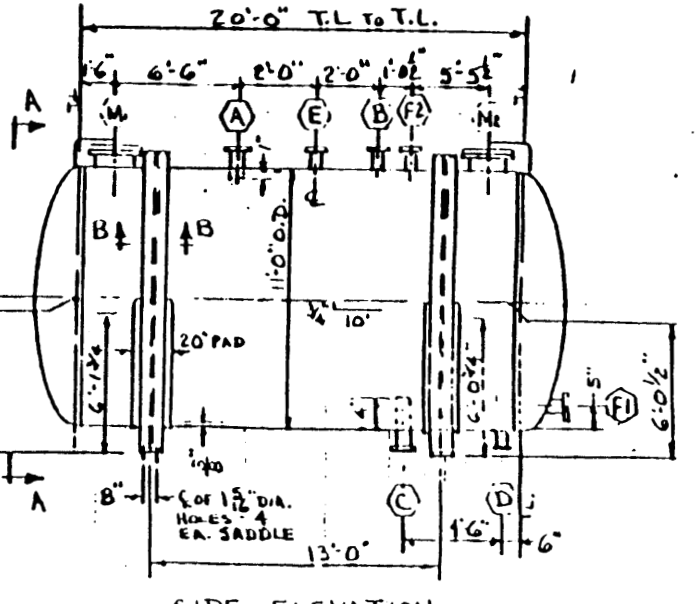


VIEW A-A



SIDE ELEVATION

Rust International Corporation

PRESSURE VESSEL & STORAGE TANK DESIGN DATA SHEET

CONTRACT NO. 21-2519
SHEET NO. 202

REV	BY	DATE	
1	JNB	10/5/81	ADDED ELEV
2	JNB	11/6/81	REVISED

CUSTOMER : U. S. DEPT. OF ENERGY PADUCAH, KY.
DESCRIPTION : SULFURIC ACID STORAGE TANK
CAPACITY : 15,000 GAL.
NO REQUIRED : ONE (1)
ITEM: F-130F
AREA: WBS-1.2.1

NOTES: (1) X-HVY. NOZ. ACID, SCH. 160 NOZ. EXCEPT AS NOTED
(2) TEFLON OR EQUAL APPROVED BY CONTRACTOR
(3) SEE SEC. II OF SPECIFICATIONS
(4) PER RUST STD V-9
(5) PER ANSI A58.1

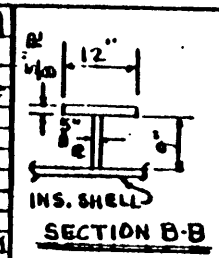
DESIGN CRITERIA

Design Press. PSIG	ATMOS.	Oper. Temp. °F	AMB.
Design Temp. °F	15	Pen. on Base °F	130
No. of Cycles	.54	Service	NO
Code	ASME	Corr. Resist. Lining	NO
Radiography	NO	Heat Treatment	SPOT
Joint Eff. Shell	85%	Joint Eff. Heads	100%
Corr. Allow. Shell	1/2"	Corr. Allow. Shell	1/16"
Corr. Allow. Bott.	—	Corr. Allow. Bott.	—
Cradle Pad	CS	Bot. Skirt	NO
Internal Loading (5)	TES	Internal Loading (2)	YES
Type Head - Shell	F.D.	Type Head - Bottom	
Plate, Shell	SA-285-C	Plate, Heads	SA-285-C
Bolt	—	Bolting	—
Cone Sect.	—	Lining	—
(1) Nozz. Flanges	SA-53-B	Nozz. Flanges	SA-105
Int. Pipe	SA-285-C	Int. Pipe Flanges	SA-105
Misc. Castings	SA-105	Nozz. Blinds	—
Internal Piping	—	Internal Pipe	—
Expansion Joints	—	Handholes	—
Bolting - Studs	SA-307-B	Plate	SA-307-B
Gaskets	2	Plate	SA-36
Wind Design (4)	YES	Wind Girders	NO
Platforms	NO	Platform Clips	
Ladder - Cages		Ladder Clips	
Stairs		Shell Clips	
Insulation		Insulation Supports	
Fireproofing		Refractories Anchors	
Supports		Base Reinforcing	
Nozzle Orient.	135° CW from N1	Lining	
Internal Support	2 SADDLES	Antiflotation Design	—
Bottom Plug Size	NONE	Bottom Plug Gasket	(3)
Insul. Thickness		Insul. Support Clips	
Paint Spec. Inside		Insul. Protection	NONE
Paint Spec. Outside		Paint Spec. Outside	

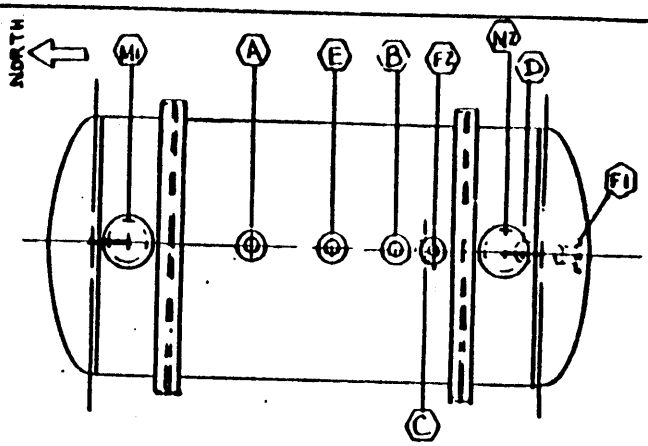
SCHEDULE OF APPURTENANCES

NOZZLES	NOZ	SIZE	SER	TYPE	MK	MISC. FITTINGS	NOZ	SIZE	SER	TYPE	MK
INLET	1	3	150	RF	A	LADDOLE	2	24	150	RF	M
AIR	1	1	150	R.F.	B						
OUTLET	1	3	150	R.F.	C						
DRAIN	1	6	150	RF	D						
P.V.	1	1½	150	RF	E						
LEVEL	2	4	150	RF	F						

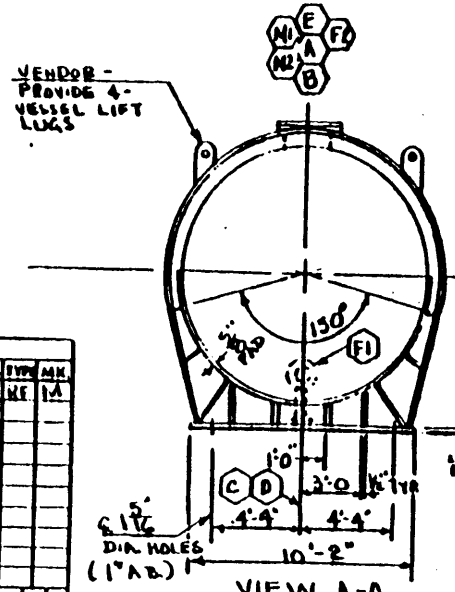
DESIGNED BY: JNB DATE: 10-18-81 CHECKED BY: AP DATE: 11/7/81



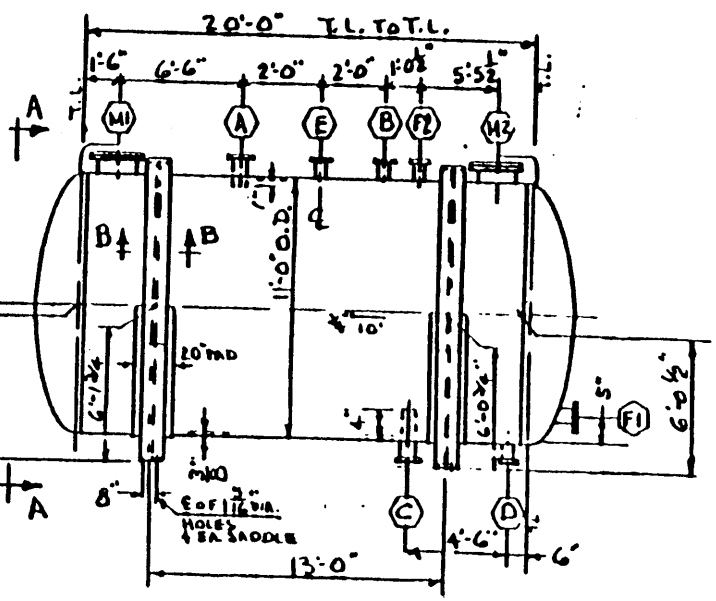
SECTION B-B



PLAN



VIEW A-A



SIDE ELEVATION

9-14

9.300 PUMPS AND MOTOR DRIVES

1.0 GENERAL

The attached data sheets prescribe the minimum requirements for the furnishing of pumps for this project.

**ALTERNATE VENDOR'S
1) Goulds, 2) Ingersol Rand, 3) Worthington

CENTRIFUGAL PUMP DATA SHEET

SPECIFICATION NO.	9.300
TITLE	Environmental Protection & Safety Modifications
B/M NO.	
APPLICATION	Uncontaminated Solution Disposal Pumps
DATA SHEET NO.	DS-CMD-16209-1
LOCATION	C-400 Building Paducah, KY .
WORK ORDER NO.	16209

NO. REQUIRED	SPARES IN TOTAL	BY	CHECKED	APPROVED	DATE
2	-				

EQUIPMENT NUMBERS	REV.	REVISION DESCRIPTION	BY	APPD.	DATE
J100A J100B					

OPERATING CONDITIONS

Normal Capacity CPM 35	Maximum Capacity CPM
Product Handled 55% Nitric Acid	Discharge Head 68'
Corrosion Due To Acidity	Total Static Head
Pumping Temp. °F 80° Vapor Press. PSIA	Suction Head
Sp. Gr. at Pumping Temp. 1.35	Total Differential Head
Viscosity Cps. 1.31 At 68 °F	NPSH Available NPSH Required Ft.

SPECIFICATIONS

Pump Shall be Furnished in Accordance with

Type Horizontal	Pump Eff. at Service Pt.%
Over-all Size 2 x 1-10/85	Motor HP 3
RPM 1750 No. Stages 1	Driver to be Furnished by
Rotation Rt. Handed	Pump Base yes
Suct. Size 2"	Driver Base yes
Disch. Size 1"	Coupling yes
Dia. of Impeller Furnished 8-5/8"	

MATERIALS AND DETAILS

Casing 316 SS	Radial Bearings
Bearing Enclosure	Thrust Bearings
Suct. & Disch. Conn. 316 SS	Packing or Seals
Shaft 316 SS	
Shaft Sleeves 316 SS	
Impeller Durcomet 100 (ACI Alloy CD-4MCu)	
Wearing Rings	Jacketing
	Protective Coating

GENERAL INFORMATION

Performance Curve No.	Witness Tests Required
General Assembly Dwg. No.	Hydrostatic Tests
Parts List	Performance Tests
Dimension Print No.	Inspection
Mfgr. Model No. Durco 2x1-10/85 **	Test Procedure & Calculations Per
Net Wt. of Pump & Base	

NOTE: Space marked with an asterisk (*) indicates bidder to furnish the information.

DATA SHEET

MOTOR

PROJECT: EPSM, Phase I WBS-1.2.1 Uncontaminated Solution Storage		DATA SHEET NO.: DS-CMD-16209-2	REV.: 0
		PAGE:	OF:
PLANT: PGDP	BUILDING: C400	PREPARED BY: RUST Intern'l	THIS SHEET PART OF: DS-CMD-16209-1
W.O. OR E.S.O.: 16209		APPROVAL:	DATE:
REQUISITION NO.:		PROCURED BY: FPSC	INSTALLED BY: FPSC

REVISIONS

REV.	APPROVAL	DATE

EQUIPMENT NUMBERS	NJ 100A NJ 100B			
SELECTION: Manufacturer	*			
Model No.	*			
TOTAL QUANTITY REQUIRED	2			
SPECIFICATIONS: Rated HP	3			
Volts / Phase / HZ	460/3/60			
	*			
Locked Rotor Current, Amps				
Temperature Rise, Degree C	85			
	*			
Full Load Torque, lb. ft.	*			
Rotation Facing Coupling End				
Energ Sq.				
Enclosure	TEFC			
Altitude	3300 Ft.			
Full Load Current, Amps	*			
Ambient Temp.. Degrees C	40			
NEMA Design Letter	*			
Starting Torque, lb. ft.	*			
Pull-out torque. lb. ft.	*			
Duty rating 1.15 S.F.	Continuous			
Sound level	NEMA			
Bearings	*			
Lubrication	*			
Insulation	F			
Couplings furnished by	Subcontractor			
Base furnished by	Subcontractor			
Non-standard mount or extensions	Subcontractor			
PERFORMANCE: Power Factor per cent	79.9 (1)(2)			
Efficiency per cent	84.6 (1)(2)			
GENERAL INFORMATION: Serial No.	*			
Frame No.	*			
Net Wight lbs.	*			
TYPE MOUNTING: Foot, Face or Flanged	*			
Ceiling, Floor or Wall	*			
Horizonal or Vertical	*			

REMARKS:
1) **Guaranteed Minimum**
Motors shall comply with applicable NEMA Standards.
2) Per NEMA MG1-12.53a IEEE 112, Method B, Form E

Furnish the following manufacturer's data in quantities indicated:	NUMBER Of COPIES W/Bids	Approval	Certified	TYPE OF DATA (CONTINUED)	NUMBER Of COPIES W/Bids	Approval	Certified
1. Outline dimensional drawings		6	10				
2. Performance data		6	10				
3. Weight of equipment		6	10				

** ALTERNATE VENDOR'S
I) Gurman Rupp, 2) Crane Chempump, 3) Ingersol Rand

DATA SHEET

VERTICAL SUMP PUMP

Equip. No, J105 No. Req'd.

PROJECT: Environmental Protection & Safety Mods., Phase I	DATA SHEET NO.: DS-CMD-16209-3 PAGE 1 OF 1	0	
PLANT: Paducah BUILDING: C-400	PREPARED BY: RUST International	THIS SHEET PART OF: 9.300	
W.O. OR E.S.O.: 16209	APPROVAL	DATE	
REQUISITION NO.	PROCURED BY: FPSC	INSTALLED BY: FPSC	

REVISIONS

REV.	APPROVAL	DATE

OPERATING CONDITIONS

LIQUID 55% HNO_3 at 80 °F PT VAP PR psia at 100°F
at PT: sp gr 1.35 vis Ssu 1.31 cps Vap Pr psia
NPSH: Avail Required at PT Liq Water
CORROSION OR EROSION DUE TO Acidity
CAPACITY, gpm: Normal 5 " Design 15

DISCH PRESS 12 psi
SUCTION PRESS psi
DIFF PRESS psi
DIFF HEAD 15 ft
SOLIDS 0 % Max Dia

PUMP SPECIFICATIONS

** MANUFACTURER Goulds
SIZE AND TYPE 1 x 1-1/2 - 6 3171 gp. st
DISCHARGE: Size 1" ASA Rating Facing Position
RPM 1750 HYDROSTATIC TEST PRESS 25 PSIG

GUAR EFF AT DESIGN %
BPH: At Design Max
RECOMMENDED DRIVER hp 1/2
PERFORMANCE CURVE
SECTIONAL DWG
OUTLINE DWG

MATERIALS	BRINELL HARDNESS
TANK	
PUMP CASE 316 SS	
STRAINER 316 SS	
IMPELLER 316 Ss	
IMPELLER WEAR RING 316 SS	
CASE WEAR RING 316 SS	
SHAFT 316 SS	
SHAFT COVER TUBE 316 SS	
GLAND	
CAGE RING	
STUFFING BOX	
THROAT BUSHING	
RADIAL BEARING	
GUIDE BEARING	
FOOT BEARING	
THRUST BEARING	
PACKING	
MECHANICAL SEAL	
COVER PLATE	
COUPLING	

CONSTRUCTION FEATURES

TANK DIMENSION By: Vendor Purch
STRAINER: Dia Opening
Distance Below Cover Plate
IMPELLER: Open X Closed Semi-enol
Design Dia 4-1/2" Max Min
WEAR RING: Clearance on Dia
SHAFT: Dia

GLAND Split: Yes No Quench: Yes No
CAGE RING In and Out Connection: Yes No
STUFFING BOX Water Jacket: Yes No
Bore in. Depth in.

GUIDE BEARING: How Many
LEVEL SWITCH: By Vendor By Purchaser
High Low Type
NEMA: Class Group Volts Amps
PACKING: Size No. of Rings Percent Spare
MECHANICAL SEAL Materials: Rotating Face
Stationary Face Gaskets
COVER PLATE: Dimensions
COUPLING: Type

TESTS REQUIRED Hydrostatic Witness: Yes No Running Witness: Yes No
NPSH TEST: Yes No Witness: Yes No
DISMANTLING AND INSPECTION AFTER RUNNING TEST: Yes No
INSPECTION: Yes No SPECIAL TESTS: Yes No
WEIGHT lb WEIGHT BASE lb TOTAL WEIGHT

DRIVER DATA

ELEC MOTOR: Make and Type Frame No. Weight lb
hp 1/2 rpm 1750 Phase 3 Cycle 60 Volts 460
BEARINGS: Ball X Sleeve LUBRICATION: Oil Grease

*Information to be supplied by equipment manufacturer.

UCN-2641-T

DATA SHEET

MOTOR

REVISIONS			

PROJECT: EPSM, Phase I		DATA SHEET NO.: DS-CMD-16209-4	REV.: 0
WBS-1.2.1 Uncontaminated Solution Storage		PAGE OF	
PLANT / BUILDING	PREPARED BY		THIS SHEET PART OF
W.O. 16209	APPROVAL		DATE
REQUISITION NO.	PROCURED BY: FPSC		INSTALLED BY: FPSC

EQUIPMENT NUMBERS	NJ 105
SELECTION: Manufacturer	*
Model No.	
TOTAL QUANTITY REQUIRED	1
SPECIFICATIONS: Rated HP	1/2
Volts/Phase/HZ	460/3/60 (or 120/240V, 1/60)
Full Load RPM	1800
Locked Rotor Current, Amps	*
Temperature Rise, Degree C	85
Locked Rotor KVA Code Letter	*
Full Load Torque, lb. ft.	*
Rotation Facing Coupling End	*
Energy	Sq. Cage Ind.
Enclosure	TEFC
Ambient Temp., Degrees C	40
NEMA Design Letter	*
Starting Torque, lb. ft.	*
Pull-out torque, lb. ft.	*
Duty rating 1.15 S.F.	Continuous
Sound level	NEMA
Bearings	*
Lubrication	*
Insulation	F
Couplings furnished by	subcontractor
Base furnished by	subcontractor
Non-standard mount or extensions	Subcontractor
PERFORMANCE: Power Factor per cent	(1)(2)
Efficiency per cent	(1)(2)
GENERAL INFORMATION: Serial No.	*
Frame No.	*

Furnish the following manufacturer's data in quantities indicated:	NUMBER Of COPIES W/Bids	Approval	Certified
1. Outline dimensional drawings		6	10
2. Performance data		6	10
3. Weight of equipment		6	10

TYPE OF DATA (CONTINUED)	NUMBER OF COPIES W/Bids	Approval	Certified

*Information to be supplied by equipment manufacturer.

** ALTERNATE VENDOR'S
1)Gurman-Rupp, 2) Crane Chempump, 3) Ingersol Rand

DATA SHEET

VERTICAL SUMP PUMP

Equip. No. J110 No. Req'd.

PROJECT: Environmental Protection & Safety Mods., Phase 1

DATA SHEET NO.: DS-CMD-16209-5 0

PAGE 1 OF 1

REVISIONS		
REV.	APPROVAL	DATE

PLANT	BUILDING	PREPARED BY	THIS SHEET PART OF
Paducah	C-407	RUST Inter'l	9.300
W.O. OR E.S.O.		APPROVAL	DATE
16209			
REQUISITION NO.		PROCURED BY	INSTALLED BY
		FPSC	FPSC

OPERATING CONDITIONS

LIQUID Rain Water at AMB °FPT VAP PR psia at 100°F

at PT: sp gr 1.0 vis Say 1.13 cps Vap Pr psia 0.43

NPSH: Avail Required at PT Liq Water

CORROSION OR EROSION DUE TO O_2 in H_2O + Dil HNO_3

CAPACITY, gpm: Normal 50 Design 75

DISCH PRESS 10 p

SUCTION PRESS p

DIFF PRESS

DIFF HEAD 20

SOLIDS 0 % Max Dia -

PUMP SPECIFICATIONS

** MANUFACTURER Goulds

SIZE AND TYPE 1-1/2 x 3-6 3171 GP, ST

DISCHARGE: Size 1-1/2" ASA Rating Facing Position

RPM 1750 HYDROSTATIC TEST PRESS 25 PSIG -

GUAR EFF AT DESIGN

BPH: At Design Max

RECOMMENDED DRIVER hp 1-1/2

PERFORMANCE CURVE

SECTIONAL DWG -

OUTLINE DWG

MATERIALS	BRINELL HARDNESS
TANK	
PUMP CASE 316 SS	
STRAINER 316 SS	
IMPELLER 316 SS	
IMPELLER WEAR RING 316 SS	
CASE WEAR RING 316 SS	
SHAFT 316 SS	
SHAFT COVER TUBE 316 SS	
GLAND	
CAGE RING	
STUFFING BOX	
THROAT BUSHING	
RADIAL BEARING	
GUIDE BEARING	
FOOT BEARING	
THRUST BEARING	
PACKING	
MECHANICAL SEAL	
COVER PLATE	
COUPLING	

CONSTRUCTION FEATURES

TANK DIMENSION By: Vendor Purch

STRAINER: Dia Opening

Distance Below Cover Plate

IMPELLER: Open Closed Semi-enol

Design Dia Max Min

WEAR RING: Clearance on Dia

SHAFT: Dia

GLAND Split: Yes No Quench: Yes No

CAGE RING In and Out Connection: Yes No

STUFFING BOX Water Jacket: Yes No

Bore in. Depth in.

GUIDE BEARING: How Many

LEVEL SWITCH: By Vendor By Purchaser

High Low Type

NEMA: Class Group Volts Amps

PACKING: Size No. of Rings Percent Spare

MECHANICAL SEAL Materials: Rotating Face

Stationary Face Gaskets

COVER PLATE: Dimensions

COUPLING: Type

TESTS REQUIRED Hydrostatic Witness: Yes No Running Witness: Yes No

NPSH TEST: Yes No Witness: Yes No

DISMANTLING AND INSPECTION AFTER RUNNING TEST: Yes No

INSPECTION: Yes No SPECIAL TESTS: Yes No

WEIGHT lb WEIGHT BASE lb TOTAL WEIGHT

DRIVER DATA

ELEC MOTOR: Make and Type Frame No. Weight

hp 1-1/2 rpm 1750 Phase 3 Cycle 60 Volts 460

BEARINGS: Ball X Sleeve LUBRICATION: Oil Grease

*Information to be supplied by equipment manufacturer.

UCN-2641-T

DATA SHEET

MOTOR

REVISIONS		
REV.	APPROVAL	DATE

PROJECT: EPSM, Phase I WBS-1.2.1 Uncontaminated Solution Storage		DATA SHEET NO.: DS-CMD-16209-6	REV.: 0
		PAGE OF	
PLANT: PGDP	BUILDING: C407	PREPARED BY: RUST Intern'l	THIS SHEET PART OF: DS-CMD-16209-5
		APPROVAL	DATE
REQUISITION NO.		PROCURED BY: FPSC	INSTALLED BY: FPSC

EQUIPMENT NUMBERS	NJ 110
SELECTION: Manufacturer	*
Model No.	
TOTAL QUANTITY REQUIRED	1
SPECIFICATIONS: Rated HP	1½
Volts/Phase/HZ	460/3/60
Full Load RPM	1800
Locked Rotor Current, Amps	*
Temperature Rise, Degree C	85
Locked Rotor KVA Code Letter	*
Full Load Torque, lb. ft.	*
Rotation Facing Coupling End	*
Electrical Type	Sq. Cage Ind.
Enclosure	TEFC
Altitude	3300 Ft.
Full Load Current, Amps	*
Ambient Temp., Degrees C	40
NEMA Design Letter	*
Starting Torque, lb. ft.	*
Pull-out torque, lb. ft.	*
Duty rating 1-15 S.F.	Continuous
Sound level	NEMA
Bearings	*
Lubrication	*
Insulation	*
Couplings furnished by	Subcontractor
Base furnished by	Subcontractor
Non-standard mount or extensions	Subcontractor
PERFORMANCE: Power Factor per cent	76.5 (1)(2)
Efficiency per cent	82.1 (1)(2)
GENERAL INFORMATION: Serial No.	*
Frame No.	*
Net Weight lbs.	*
TYPE MOUNTING: Foot, Face or Flanged	*
Ceiling, Floor or Wall	*
Horizonal or Vertical	*

REMARKS:
1) Guaranteed Minimum
Motors shall comply with applicable NEMA Standards.
2) Per NEMA MG1-12.53a IEEE 112, Method B, Form E

Furnish the following manufacturer's data in quantities indicated:	NUMBER Of COPIES W/Bids	Approval	Certified	TYPE Of DATA (CONTINUED)	NUMBER OF COPIES W/Bids	Approval	Certified
1. Outline dimensional drawings		6	10				
2. Performance data		6	10				
3. Weight of equipment		6	10				

b

** ALTERNATE VENDOR'S

1) Buffalo, 2) Pacific

CENTRIFUGAL PUMP DATA SHEET

SPECIFICATION NO.	9.300
TITLE	Environmental Protection & Safety Modifications
B/M NO.	
APPLICATION	Sulfuric Acid Transfer Pumps
DATA SHEET NO.	DS-CMD-16209-7
LOCATION	C-616 PGDP Paducah, KY
WORK ORDER NO.	16209

NO. REQUIRED	SPARES IN TOTAL	BY	CHECKED	APPROVED	DATE
2					

EQUIPMENT NUMBERS	REV.	REVISION DESCRIPTION	BY	APPD.	DATE
J120A J120B	0				

OPERATING CONDITIONS

Normal Capacity GPM 40	Maximum Capacity GPM
Product Handled 93% H_2SO_4	Discharge Head
Corrosion Due To Acidity	Total Static Head
Pumping Temp. °F AMB 40-80 Vapor Press. PSIA 0	Suction Head
Sp. Gr. at Pumping Temp. 1.8	Total Differential Head 40'
Viscosity Cps 25-40 At 70-40 °F	NPSH Available NPSH Required Ft.
Service Intermittent - Pump should not run below 40°F	NPSH Includes Ft. Static Head Lift

SPECIFICATIONS

Pump Shall be Furnished in Accordance with

Type Canned Chempump	Pump Eff. at Service Pt.%
RPM 3600 No. Stages -	Driver to be Furnished by Subcontractor
Rotation RT	Pump Bore Subcontractor
Disch. Size 1-1/2"	Coupling Subcontractor
Dia. of Impeller Furnished 3-3/4"	

MATERIALS AND DETAILS

Casing Carpenter 20 for all wetted parts	Rodiol Bearings
Bearing Enclosure	Thrust Bearings
Suct. & Disch. Conn.	Packing or Seals
Shaft	
Shaft Sleeves	
Impeller	
Wearing Rings	Jacketing
	Protective Coating

GENERAL INFORMATION

Performance Curve No.	Witness Tests Required
General Assembly Dwg. No.	Hydrostatic Tests
Parts List	Performance Tests
Dimension Print No.	Inspection
Mfgr. Model No. Crane GC1-1/2K-152-H1CICA20 **	Test Procedure & Calculations Per
Net Wt. of Pump & Base 100	

NOTE: Space marked with an asterisk (*) indicates bidder to furnish the information.

DATA SHEET

VERTICAL SUMP PUMP

Equip. No. J125 — No. Req'd. 1

REVISIONS		
REV.	APPROVAL	DATE

PROJECT: Environmental Protection & Safety Mods., Phase I		DATA SHEET NO.: DS-CMD-16209-8 PAGE 1 OF 1	REV.: 0
PLANT: Paducah BUILDING: C-616	PREPARED BY: RUST Inter'l.		THIS SHEET PART OF: 9-300
W.O. OR E.S.O.: 16209	APPROVAL: -		DATE:
REQUISITION NO.:	PROCURED BY: FPSC		INSTALLED BY: FPSC

OPERATING CONDITIONS

LIQUID Rain water at AMB °F PT VAP PR psia at 100°F

at PT: sp gr 1.0 vis Saa 1.13 CPS Vap Pr psia 0.43

NPSH: Avail ____ Required ____ at PT Liq ____ Water ____

CORROSION OR EROSION DUE TO O_2 in H_2O and dil H_2SO_4

CAPACITY, gpm: Normal 10 " Design 115

DISCH PRESS 10 psi

SUCTION PRESS ____ psi

DIFF PRESS ____ psi

DIFF HEAD 20 ft

SOLIDS ____ % Max Dia ____

PUMP SPECIFICATIONS

** MANUFACTURER Goulds

SIZE AND TYPE 1 x 1-1/2 x 6 NM4105

DISCHARGE. Size 1 ASA Rating ____ Facing ____ Position ____

RPM 1750 HYDROSTATIC TEST PRESS 25 PSIG ____

GUAR EFF AT DESIGN ____ %

BPH: At Design ____ Max ____

RECOMMENDED DRIVER hp 1

PERFORMANCE CURVE ____

SECTIONAL DWG ____

OUTLINE DWG ____

MATERIALS	BRINELL HARDNESS
TANK	
PUMP CASE Polyester	
STRAINER Valox	
IMPELLER Polyester	
IMPELLER WEAR RING	
CASE WEAR RING	
SHAFT C20	
SHAFT COVER TUBE Polyester	
GLAND	
CAGE RING	
STUFFING BOX	
THROAT BUSHING	
RADIAL BEARING	
GUIDE BEARING 1	
FOOT BEARING Teflon	
THRUST BEARING	
PACKING	
MECHANICAL SEAL	
COVER PLATE	
COUPLING Flexible T.B. Wods	

CONSTRUCTION FEATURES

TANK DIMENSION ____ By: Vendor ____ Purch ____

STRAINER: Dia ____ Opening ____

Distance Below Cover Plate ____

IMPELLER: Open ____ Closed Shrouded Semiopn ____

Design Dia 5-1/2" Max ____ Min ____

WEAR RING: Clearance on Dia ____

SHAFT: Dia ____

GLAND Split: Yes ____ No ____ Quench: Yes ____ No ____

CAGE RING In and Out Connection: Yes ____ No ____

STUFFING BOX Water Jacket: Yes ____ No ____

Bore ____ in. ____ Depth ____ in.

GUIDE BEARING: How Many ____

LEVEL SWITCH: By Vendor ____ By Purchaser ____

High ____ Low ____ Type ____

NEMA: Class ____ Group ____ Volts ____ Amps ____

PACKING: Size ____ No. of Rings ____ Percent Spare ____

MECHANICAL SEAL Materials: Rotating Face ____

Stationary Face ____ Gaskets ____

COVER PLATE: Dimensions ____

COUPLING: Type ____

TESTS REQUIRED Hydrostatic Witness: Yes ____ No ____ Running Witness: Yes ____ No ____

NPSH TEST: Yes ____ No ____ Witness: Yes ____ No ____

DISMANTLING AND INSPECTION AFTER RUNNING TEST: Yes ____ No ____

INSPECTION: Yes ____ No ____ SPECIAL TESTS. Yes ____ No ____

WEIGHT ____ lb WEIGHT BASE ____ lb TOTAL WEIGHT ____ lb

DRIVER DATA

ELEC MOTOR: Make and Type ____ Frame No. ____ Weight ____ lb

hp 1 rpm 1750 Phase 3 Cycle 60 Volts 460

BEARINGS: Ball X Sleeve ____ LUBRICATION: Oil ____ Grease ____

*Information to be supplied by equipment manufacturer.

UCN-7441-T

DATA SHEET

MOTOR

PROJECT: EPSM, Phase WBS-1.2.1 Acid Storage Area		DATA SHEET NO.: DS-CMD-16209-9	REV: C
		PAGE:	OF:
PLANT: PGDP	BUILDING: C-616	PREPARED BY: 'RUST Intern'l	THIS SHEET PART OF: DS-CMD-16209-8
W.O. OR E.S.O.: 16209		APPROVAL:	DATE:
REQUISITION NO.:		PROCURED BY: FPSC	INSTALLED BY: FPSC

REVISIONS

REV.	APPROVAL	DATE

EQUIPMENT NUMBERS	NJ125			
SELECTION: Manufacturer	*			
Model No,				
TOTAL QUANTITY REQUIRED	1			
SPECIFICATIONS: Rated HP	1			
Volts/Phase/HZ	460/3/60			
Full Load RPM	1800			
Locked Rotor Current, Amps	*			
Temperature Rise, Degree C	85			
Locked Rotor KVA Code Letter	*			
Full Load Torque, lb. ft.				
Electrical Type Energy Eff	Sq. Cage Ind.			
Enclosure	TEFC			
Altitude	3300 Ft.			
Full Load Current, Amps	*			
Ambient Temp., Degrees C	40			
NEMA Design Letter	*			
Starting Torque, lb. ft.	*			
Pull-out torque, lb. ft.				
Duty rating 1.15 S.F.	Continuous			
Sound level	NEMA			
Bearings	*			
Lubrication	*			
Couplings furnished by	Subcontractor			
Base furnished by	Subcontractor			
Non-standard mount or extensions	Subcontractor			
PERFORMANCE: Power Factor per cent	74.0 (1)(2)			
Efficiency per ctnt	81.5 (1)(2)			
GENERAL INFORMATION: Serial NO.	*			
Frame No.	*			
Net Weight lbs.	*			
TYPE MOUNTING: Foot. Face or flanged	*			
Ceiling, Floor or Wall	*			
Horizonal or Vertical	*			

REMARKS: 1) Guaranteed Minimum
Motors shall comply with applicable NEMA Standards.

Furnish the following manufacturer's data in quantities indicated:	NUMBER OF COPIES W/Bids	Approval	Certified
1 Outline dimensional drawings		6	10
2. Performance data		6	10
3. Weight of equipment		6	10

TYPE OF DATA (CONTINUED)	NUMBER OF COPIES W/Bids	Approval	Certified

*Information to be supplied by equipment manufacturer.

INDEX

SECTION	DESCRIPTION	PAGE
	SECTION 11 - PAINTING	
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11.430 - PAINTING - GENERAL SECTION

1. GENERAL

This specification covers the preparation of surfaces and the furnishing and application of paint and primers.

This specification is composed of a general section supplemented by sections which provide detailed specifications for preparation of surface and application for each type of paint to be applied. Only those sections applicable to the work are included.

2. MATERIALS

A. Paints and Primers

Shall be "Speedhide" (Pittsburgh Paints) as manufactured by PPG Industries, Inc. Equivalent painting systems as manufactured by Sherwin-Williams, Devoe Paint Division, Cleanese Coating Co., The Glidden Company, or an approved alternate, will satisfy this specification.

Specific materials required in the work shall be provided by the Subcontractor as specified in each individual specification section contained herein.

B. Approval

Before delivery of any material to the site, the Subcontractor shall. submit to the Contractor the name of the manufacturer, the brand, and quality of the materials he proposes to use. Only materials which have been approved by the contractor may be delivered to the site and used in the work.

C. Tests

In cases of dispute, test data shall be provided by the Subcontractor comparing alternate paint-primer systems to those specified. Tests shall compare paint composition, solids content by volume, coverage, film thickness, and total applied coats. Tests shall be made by a nationally recognized testing laboratory, and a written report giving results of the tests shall be furnished to the Contractor by the Subcontractor.

D. Sealed Packages

All materials shall be delivered to the site in the manufacturer's sealed packages and containers, with labels intact and seals unbroken. All materials shall be in covered containers with descriptive labels of the material contained therein. Materials shall *not* be opened until required for use or for sampling.

E. Storage

Paint matertals and equipment shall be stored only in such places as may be approved by the contractor. The Subcontractor shall maintain the storage area and leave it free from fire hazards due to improperly stored rags, waste, or other combustible materials.

F. Colors

Cofors shall be as specified in the Painting Schedule, Section 11.436.

3. METHODS AND WORKMANSHIP

The following specifications of methods and workmanship shall apply to all work. Additional requirements shall be as called for in the *various* sections.

A. Preparation of Surfaces

1) General

Painting on any surface shall not be started until all preparation of the 'surface is completed.

2) Minimum Preparation

As a minimum preparation, surfaces to be painted shall be brushed clean of all dust, dirt, or loose paint before paint is applied. Dull all glossy surfaces with sandpaper, steel wool, or liquid sanding aid. The surfaces shall be smooth, free of grease, scale, rust, welding spots, slag, or other adhering matter which would prevent a proper paint bond. Surfaces containing excessive alkalinity shall be primed with Pittsburgh Alkali-Resistant Primer 6-3. Galvanized steel shall be primed with Pittsburgh Galvanized Steel Primer 6-209. Bare steel shall be coated with Pittsburgh Zinc Chromate Primer 6-204 or approved equal. All manufacturer's recommendations shall be part of the requirements of this Specification.

B. Application

a. In general, all paint shall be applied as specified by the manufacturer and shall be done in a workmanlike manner, leaving the finished surfaces free from drops, ridges, waves, slips, laps, and

brush marks. Paint shall be applied under dry and dust-free conditions and shall not be applied when the ambient temperature is below that recommended by the manufacturer.

b. All primer and intermediate coats of paint shall be unscarred and completely integral at the time of application of each succeeding coat. Each coat of paint shall have a slight variation of color to distinguish it from the preceding coat, Sufficient time shall be allowed between coats to insure proper drying.

c. Spray or roller painting may be employed where practicable, if approved by the Contractor. Paints shall be thoroughly stirred and kept at a uniform consistency during application, and shall not be thinned in excess of the printed directions of the manufacturer. Solvents and thinners used shall be of the type recommended by the paint manufacturer,

C. Coating Thickness

A minimum of three coats (primer and two finish coats) shall be applied. Additional coats shall be applied to obtain complete coverage and in accordance with total thickness recommended by the manufacturer for the particular coating system. The finish coat of paint shall completely obscure the previous coat.

D. Protection

During painting operations the Subcontractor shall furnish and maintain, in place adequate protective covers and drop cloths. Sprayed application shall be in conformity with all safety regulations in effect at the work site and the Subcontractor shall be responsible for protecting all adjoining work from spray particles. Any paint spots or spillage which may occur shall be promptly removed. "WET PAINT" signs shall be posted to protect newly painted surfaces.

E Cleaning

During the work, or upon completion, the Subcontractor shall go over all areas and clean off misplaced paint from finished surfaces. Finishes of affected items shall be restored to their original condition.

F. Touch-up Painting

Where prime coats have been applied as a shop coat or in the field, as specified in other specifications, only spot priming and two finish coats shall be applied to provide the total protective finish required by this specification. A primer shall be applied to worn places and bare spots, skips of original painting and surfaces from which paint has to be removed by cleaning, peeling and scaling. A primer shall be applied to all field welded joints, bare spots, and surfaces damaged by new construction. These spot primed areas shall be covered with two finish coats to match existing finish.

G. Preparation of New Surfaces

Steel surfaces shall be prepared In accordance with Steel Structures Painting Council specification No. SP2-63.

11.434 - EXTERIOR - GLOSS ENAMEL

1. MATERIALS

Materials shall be Pittsburgh "Speedhide" modified alkyd resin paint and suitable primers for use on metal surfaces as specified in the Painting Schedule.

A. Prime Coat

Surfaces shall be primed in accordance with Section 11.430 Painting - General Section.

B, Finish Coats

As listed in the Painting Schedule.

C. Miscellaneous Materials

Turpentine, ASTM D 13.

2. METHODS AND WORKMANSHIP

A. prime and Finish Coat

Paint coverage shall consist of three coats on all unpainted surfaces called for in the Painting schedule, consisting of one primer and two finish coats.

11.436 - PAINT SCHEDULE (METAL ITEMS)

1. **GENERAL**

All bate pipes, pipe enclosures, pipe coverings, ducts, hangers, supports, anchors, wall sleeves, structural steel, and other ferrous metal surfaces shall, unless otherwise specified or required by virtue of material incompatibility, be finish-painted with the same color as on new or existing surfaces, whichever is more suitable. All bare metal surfaces shall receive one prime coat in accordance with Section 11.430. Color numbers refer to the chips of Federal Standard 595.

A. Prefinlshed items such as construction materials and equipment, instrument cabinets, Vendor supplied control panels, etc. shall not be painted unless specifically noted otherwise on the drawings.

B. All carbon steel and black iron outdoor uninsulated piping shall teceivc a prime coat of zinc chromate and (2) finish coats of gray, color chip No. 16307. Outdoor insulated piping shall not be painted.

C. In an area where bumper posts are required or piping offers a safety hazard such as tripping, possible head injury, or possible overhead interference with vehicular traffic, the pipe shall be primed in accordance with Specification 11.430, General Section, and striped with alternate yellow and black stripes three (3) inches wide, at an angle of 45° to the horizontal.

D. Painting Schedule (Metal Items)

Surface	Color	PPG Number
Metal items not against or integral with new surfaces	Match adjacent surface	
Structural Steel	Gray	97-4
Supporting Brackets & Members	Gray	97-4
Hand Rails	Gray	97-4
Guard Rails	Yellow	54-302
Grating	Gray	97-4
Bumper Posts	Yellow	54-302
	Black	6-253

11.437 - ACID RESISTANCE COATING

1. MATERIALS

Material shall be Poly-Plus 170-F by I.W. Industries (or approved equal) special polymer resins, inert fillers, and fiberglass reinforcement. The coating shall be suitable for use on concrete and steel.

A. Prime Coat

Poly-Plus 101 primer at 200 sq ft per gallon.

B. Base Coat

Poly-Plus 170-F basecoat resin, hardener No. 5. Mix into Poly-Plus base coat resin. Apply at approximately 1/16 inch thick.

C. Top Coat

Imbed fiberglass cloth into basecoat. Add Hardener No. 5 into Poly-Plus 170F topcoat resin. Apply at 1/16 inch thick. Apply Poly-Plus 170-F Sealer.

D. Surface Preparation

Cure concrete 28 days, then treat with 1:2 concentrated hydrochloric acid. If a membrane curing compound is used, sandblasting will be required.

Steel surfaces shall be abrasive blasted to a white metal SSPC-SP-5-63 with an anchor profile of 2-4 mils.

2. METHODS AND WORKMANSHIP

The base coat shall contain 10 oz. woven roving glass cloth as needed. The coating materials should be troweled on as per manufacturer's data sheets. See drawings for areas to be coated.

APPENDIX D

SPECIFICATIONS FOR ENVIRONMENTAL LABORATORY, C-409

(SEE ATTACHMENT II, APPENDIX C FOR REFERENCED DRAWINGS)

This is to certify that Gary R. Holland, a Registered Professional Engineer in the State of Kentucky, Registration No. 12230, inspected Tanks 1 through 6 listed in Table 0-10, C-409 Hazardous Waste Pilot Plant Tanks Dimensions and Thickness, and found them structurally sound, capable of withstanding normal operational stresses, and located in an area which is not subject to forklift traffic or movement of other operational' equipment which could inflict damage sufficient to cause a massive failure. In addition, all tanks are located within a diked area to contain inadvertent accidental spills.

Gary R. Holland
Feb. 24, 1987

NOTE: Original embossed by signer

SPECIFICATIONS FOR

ENVIRONMENTAL LABORATORY, C-409

AT

THE PADUCAH GASEOUS DIFFUSION PLANT

PAOUCAH, KENTUCKY

INVITATION NO. 8006

SUBCONTRACT SPECIFICATIONS 13614

UNION CARBIDE CORPORATON
NUCLEAR GIVISION

Post Office Box 1410

Paducah, Kentucky 42001

April 11, 1980

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Section 1

STRUCTURAL STEEL AND MISCELLANEOUS METALS

1-1. SCOPE.--This section of the specifications relates to the detailing, fabricating, furnishing, and erection of all structural steel, related items and miscellaneous metal, complete as shown on the drawings and as specified herein.

1-2. CODES AND STANDARDS.--Codes and standards which are called for or referred to herein are hereby made a part of this specification to the extent indicated by the reference thereto.

1-3. SHOP DRAWINGS.

1-3.1 Shop drawings shall be submitted for approval in accordance with SPECIAL CORDITIONS paragraph: SUBCONTRACTOR'S SUBMITTALS.

1-3.2 The Subcontractor shall submit completed and checked shop drawings for approval. The approval of shop drawings will be for size and arrangement of principal and auxiliary members and strength of connections only, and shall not relieve the Subcontractor of the responsibility for errors, omission, or the accuracy of his own dimensions.

1-4. MATERIALS.

1-4.1 General.--Except as otherwise specified herein, all material shall conform to the AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings. Material shall be new. Substitutions of materials, sizes or shapes shall not be made without prior approval of the Construction Engineer.

1-4.2 Structural Steel Shapes, Bars and Plates.--Structural steel shapes, bars and plates shall conform to ASTM A36.

1-4.3 Steel Pipe.--Steel pipe shall be used for handrails and shall conform to ASTM A501. Pipe for support columns shall confom to ASTM A501 or ASTM A53, Types E or S, Grade 8.

1-4.4 Fasteners.

1-4.4.1 Standard Threaded Fasteners.--Standard threaded fasteners shall be machine bolts and nuts of the unfinished type conforming to ASTM A307, Grade A. Plain washers shall conform to ANSI B27.2; beveled washers shall conform to ANSI 827.4.

1-4.4.2 High Strenqth Threaded fasteners.--High tensile bolts, nuts and washers shall conform to ASTM A325.

1-4.4.3 Filler Metal for Welding.--Welding electrodes for manual shielded metal-arc welding shall conform to AWS A5.1, E70 Series.

1-4.4.4 Self Tapping Sheet Metal Screws.--Sheet metal screws for attaching 18 gage metal deck at laps and to structural members shall be No. 14 cadmium plated steel, hex bead, gimlet point, self-tapping variety with cupped, galvanized or stainless steel washers with integral neoprene gaskets. All other screws and fasteners shall be galvanized steel unless otherwise indicated, and shall be size and type as indicated on the design drawings.

1-4.4.5 Sheet Metal Closures and Flashings.--All sheet metal closures and flashings shall be fabricated from galvanized sheet conforming to ASTM A446, Grade A. Gage thickness shall be as shown on the drawings. Galvanized finish shall conform to ASTM A525, Class G90.

1-4.5 Anchor Bolts.--Anchor bolts installed in existing concrete shall be of the double-wedge expansion type, made of cold dram steel having a minimum yield strength of 70,000 psi. Finish shall be a rust resistant zinc coating with a final clear acetate coating which exceeds ASTM B117. These anchors shall be set to the line and grade as detailed on the design drawings.

1-4.6 Checkered Plate.--Checkered plate shall be an "Inland 4-way", raised checkered pattern, 1/4" thick of commercial wade carbon steel as-manufactured by Inland Steel Company, 30 W. Monroe Street, Chicago, Illinois 60603, or approved equal.

1-4.7 Bar Grating.--Bar grating shall be all welded construction, 1 1/4" x 3/16" bearing bars spaced on 1 3/16" centers with 1/2" x 3/76" cross bars spaced 4" on centers. Bar grating shall be factory primed with red oxide.

1-4.8 Stair Treads.--Stair treads shall be electro-pressure welded steel, 36" x 10 15/16" with abrasive metal nosing as manufactured by the Reliance Steel Products Company or approved equal. Grating type shall be 1R4, 1 1/4" x 3/16" bearing bars on 1 3/16" centers and cross bars on 4" centers. Treads shall be factory primed with red oxide.

1-4.9 Grout.--Nonoshrink grout shall be "Embeco" No. 636 as manufactured by Masterbuilders, or approved equal.

1-5. DETAILING.

1-5.1 General.--All detailing by the fabricator shall be in accordance with the AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings, AWS, D1.1 Structural Welding Code, and ASTM A36.

1-5.2 Connections.

1-5.2.1 Strength.--In the absence of the specific design data concerning the stresses developed, the connections, either welded or bolted, shall be sufficiently strong to develop the full strength of the weakest member. Where connections are shown on the design drawings, however, the fabricator shall be governed accordingly.

1-5.2.2 Shop Connections.--Shop connections shall be welded or high strength bolted.

1-5.2.3 Field Connections.--field connections shall be made with minimum 5/8" diameter high tensile bolts except as otherwise shown on the drawings. These connections shall be considered the bearing type with threads not excluded from the shear plane.

1-6. FABRICATION.

1-6.1 General.--All structural steel shall be fabricated in accordance with the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

1-6.2 Bolting.--High strength bolts shall be tightened to a bolt tension not less than the proof load given in the ASTM Specification for the bolt. Tightening shall be done with properly calibrated wrenches or by turn-of-nut method.

1-6.3 Welding --All butt welding shall be of the full penetration type, either double welded or welded against a backing structure. Welds between abutting members at right angles to each other shall not be considered as butt welds.

1-7. SHOP FINISH.

1-7.1 General.--The shop painting system shall consist of surface preparation and shop application of prime paint.

1-7.2 Surface Preparation and Shop Primer.

1-7.2.1 Surface preparation of structural steel and miscellaneous metal shall be in accordance with the Steel Structure Painting Council Specification SSPC-SP-2-63, Hand Tool Cleaning.

1-7.2.2 All cleaned surfaces shall be primed before deterioration of cleaned surface has taken place with one shop coat of Pittsburgh "Speedhide" No. 6-204 zinc chromate or approved equal.

1-8. ERECTION.

1-8.1 General.--Unless otherwise specified herein, erection of structural steel shall conform with the applicable section of AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings, and the AISC Code of Standard Practice for Buildings and Bridges.

1-8.2 Temporary Bracing.--Temporary bracing shall be used whenever necessary to support all loads to which the structure may be subjected, including equipment and operation thereof, and piles of materials. Such bracing shall be left in place as long as may be required for safety.

1-8.3 Field Connections.--field connections shall be made by either bolting or welding in accordance with the design drawings.

1-8.3.1 Bolted Connections.--Bolted connections shall be tightened to a bolt tension not less than the proof load given in the ASTM Specification for the bolt. Tightening shall be done with properly calibrated wrenches or by the turn-of-nut method.

1-8.3.2 Welded Construction.--Welding of structural steel work shall be done by the shielded metal arc process in accordance with AWS 01.1; Structural Welding Code, except where directed otherwise. Qualification of the welding procedures and welders shall be in strict accordance with the requirements of this code.

The Construction Engineer will visually check any of the welding at his discretion and observe the weld area preparation and the technique and performance of each welder. The welds shall be visually examined for compliance with the stated code, and in particular, to assure that the welds are free of unacceptable defects, properly contoured and sized, and located as specified by the drawings. Where visual evidence so indicates, the Construction Engineer may require that welds be sectioned by chipping with a mechanical round-nosed chipping tool. If the quality of any welder's work is found to be unsatisfactory, a complete requalification of the welder may be required.

The Subcontractor shall repair, or correct as instructed by the Construction Engineer, all welds which do not comply with the provisions of the subcontract drawings and specifications at no additional cost to the Contractor.

1-9. STEEL DECKING.

1-9.1 General.--All steel decking shall be fabricated and erected in accordance with the Steel Deck Institute Code of Recommended Standard Practice, the design drawings and as specified herein.

1-9.2 Material.--Steel decking shall be Wheeling Narrow Rib deck, Type A18 as manufactured by Wheeling Corrugating Company, Wheeling, West Virginia, or approved equal. Basic steel shall conform to ASTM A446, Grade A for galvanized steel having a minimum yield strength of 33,000 psi. Type and finish shall be as Indicated on the drawings; or as otherwise specified herein.

1-9.3 Design.--Basic steel shall be flat rolled carbon sheets of structural quality. The maximum design stress shall not exceed 20,000 psi under a 'live load of 20 pounds per square foot. Properties shall conform to AISI "Specification for the Design of Cold Formed Steel Structural Members". Where possible, sheets shall extend the full height of the enclosure *from* ledge angle to top.

1-9.4 Shop Finish.--Steel decking shall be finished with a galvanized coating conforming to ASTM A525, Class G90. .

1-9.5 Erection.--The steel decking shall be erected in accordance with the design drawings. Each unit shall be placed on supporting steel framework and adjusted to final position before being permanently fastened. The unit shall be brought to proper bearing on the supporting girts. Siding shall be attached to supports using clips and welds as detailed on the design drawings and as recommended by the manufacturer. Side laps shall be fastened together at midspan using welds or screws. All joints 'and seams shall be caulked with General Electric No. 1300 Silicone compound or approved equal to make the laboratory air tight. No deviation from this erection procedure shall be accepted without prior approval of the Construction Engineer.

1-10. STAINLESS STEEL LINED ENCLOSURE.

1-10.1 General.--The materials and fabrication of the stainless steel lined enclosure shall be in accordance with this section of the specifications as applicable and as follows. The fabrication details as shown on the drawings shall be followed unless approved shop drawings show otherwise.

1-10.2 Stainless Steel Liner.--Stainless steel sheets shall be 18 gage, type 304L, cold-rolled, with No. 2B finish and shall conform to ASTM A240. The sheets shall be attached with *No.* 14 stainless steel self-tapping sheet metal screws with stainless steel washers, 12" on centers, maximum. All seams shall be seal welded using compatible stainless steel welding procedures.

1-10.3 Door and Hardware.--Door shall be "Ceco" or approved equal, 3' x 6'-8 x 1 3/4" thick, hollow metal, standard duty, flush type, constructed of 20 gage steel. Door shall be mortised and reinforced for hardware. Hardware shall consist of 1 1/2 pairs *of* "Ceco" or approved equal ball bearing hinges and one pull bar located on the outside. The inside of the door shall be lined with stainless steel sheet as specified above.

1-10.4 Paint.--All carbon steel shall be cleaned and primed in accordance with paragraph 1-7.2. Exposed carbon steel shall be finished in accordance with paragraph 4-5.3. Galvanized and stainless steel shall not be painted.

1-71. REJECTION.--All work or parts thereof and materials entering therein, indicating irremediable or injurious defects, improper fabrication, excessive repairs, or that is not in accordance with the requirements of this specification, shall be subject *to* rejections.

1-12. FIELD PAINTING.--Field painting shall be performed in accordance with Section 4 - PAINTING.

Section 2

MODULAR OFFICE

2-1. **SCOPE.--This** section of the specifications relates to the furnishing and erection of the modular office **and** related items, complete **as** shown on the **drawings and as specified** herein.'

2-2. **CODES** AND **STANDARDS.--Codes** and standards which are called for or referred to herein are hereby made a part of this specification to the extent indicated **by** the reference thereto.

2-3. **SHOP DRAWINGS.--Shop** drawings shall **be** submitted for approval in **accordance with SPECIAL CONDITIONS** paragraph: **SUBCONTRACTOR'S . SUBMITTALS.**

2-4. **MATERIALS.**

2-4.1 General.--The modular office shall **be a** standard model **"SPA-SAVER"**, specified **herein, as** manufactured **by** National Partitions, Inc., 340 **West 78th** Road, **Hialeah,** Florida 33014, or **approved** equal.

2-4.2 Walls.--Prefabricated panels **shall be 3" thick x 4'** nominal width, completely modular. Panels shall **be** fully fabricated, i.e., door panels shall **be prehung with all** hardware. Air conditioner panel **shall be** cut and **trimmed** for **dimensions as specified.** Panels shall **be** fire retardant. Sound deadening construction shall be **a** noncombustible expanded Kraft honeycomb core and shall **have a** 3/16" vinyl clad hardboard **(Class A** non-**combustible)** with facing on each **side.** Color shall be standard beige.

2-4.3 Posts.--Posts shall **be** substantial **aluminum extrusions** with anodized finish supporting loads to 3,500 lbs. **Posts** shall function as connectors for panels and as channeled raceways for telephone **and** electric lines. Posts **shall be trimmed** to match panels.

2-4.4 Base Channel.--Base channel shall **be** a continuous **substantial** anodized aluminum "U" channel attached to the checkered plate. The **base channel shall be** finished to match the **wall** panels.

2-4.5 Ceiling.--A complete fiberglass suspended ceiling shall **be** furnished including white enameled T-bar grid, vinyl faced fiberglass tile, clear primatic-luminous panels, hanger **tabs** and wire. **Ceiling** panels shall **be 2' x 4' acoustical panels.** Ceiling panels shall **be** laid in **design** to allow **use** of troffer lighting. Panels shall **be** guaranteed for dimensional stability and shall **be** rated Class **25,** noncombustible.

2-4.6 Door.--Door shall be solid core, 3'-0" x 6'-8" x 1 3/8" with a 20" x 30" window of 1/4" thick plexiglass. Frame shall be anodized aluminum. Door and frame shall be prehung at the factory and assembled in a pane? to insure proper fit. All hardware shall be installed and tested before packaging. Lock set shall be the only item packaged separately. Door shall be outfitted with key, lock and 3 1/2" x 3 1/2" butts of commercial grade. Finish shall harmonize with anodized aluminum trim. An extruded aluminum threshold shall be provided with a positive vinyl stop of 1/2" x 3".

2-4.7 Roof Deck.--Roof deck shall be prepainted 20-gage ribbed steel interlocking panels with rubber closures sealing each end. Fascia trim angle of anodized aluminum shall be assembled around perimeter of roof.

2-4.8 Electrical and Lighting.--A conduit run consisting of junction box with supports, rigid conduit of length to reach ceiling plenum, connector and pulling elbow shall be provided, preassembled in the interior post side to create a vertical electrical raceway for each switch, outlet, etc,, as listed below:

Item	No.
Fixtures, fluorescent, troffer type (with lamps), 2' x 4', 2 tubes, 110 volts, Fluorescent fixtures shall be equipped with UL and CBM approved Class P ballasts of the high power factor type, and shall be sound rated A, The ballasts shall be protected from overheatfng by an internal thermally actuated, automatic reclosing devfce to limit winding temperature. Ballasts shall be of the high efficiency full output type suitable for use with 35 watt and 40 watt lamps. Ballasts shall be Universa? ballasts "watt reducer", General Electric "low energy", or approved equal.	6
Outlet, air conditioner, 250 volts, 2 pole, 3 wire, 20 amp, Hubbell Cat. #5461, or approved equal	1
Outlets, convenience, 125 volts, 2 pole. 3 wire, 20 amp, specification grade, NEMA configuration 5-20R, Hubbell Cat. #5362, or approved equal	6
Switch, single pole, Hubbell Cat. #1221, or approved equal	1

Wire and ceiling conduit will not be provided by the office manufacturer.

2-5. MODULAR OFFICE ERECTION.

2-5.1 The modular office shall be sited and erected in the exact location shown on the drawings. The office shall be erected in strict accordance with the details shown on the design drawings and the manufacturer's shop drawings and installation instructions.

2-5.2 All labor, tools, equipment and expendable materials shall be supplied by the Subcontractor.

2-5.3 CAUTION!!--Workmen shall not, under any circumstances, stand on the roof deck of the office during or after erection. Scaffolds, temporary platforms or picks shall be used to provide access when required during all erection and installation operations.

2-6. AIR CONDITIONER.--The window type air conditioners shall be installed within the appropriate opening and in accordance with the drawings and manufacturer's instructions.

2-7. ELECTRICAL.--Electrical accessories shall be installed in accordance with the office manufacturer's erection instructions and appropriate references in Section 8 - ELECTRICAL.

2-8. CLEANUP.--Any damaged or marred parts of the office shall be replaced or repaired by the Subcontractor at no additional cost to the Contractor and to the satisfaction of the Construction Engineer.

Section 3

DOORS, FRAMES AND HARDWARE

3- . SCOPE.--This section of the specifications relates to the furnishing and installation of doors, frames and hardware complete as shown on the drawings and as specified herein.

3-2. SHOP DRAWINGS.--Shop drawings shall be submitted for approval in accordance with SPECIAL CONDITIONS paragraph: SUBCONTRACTOR'S SUBMITTALS.

3-3. MATERIALS,

3-3.1 General.--Doors and hardware shall be "Ceco" or approved equal. Doors, frames and hardware shall be installed in accordance with the manufacturer's recommendations and as shown on the design drawings.

3-3.2 Hollow Metal Doors.--Hollow metal doors shall be standard duty flush type door 1 3/4" thick, half glass and be constructed of 20 gage steel. Doors shall be mortised and reinforced for all hardware and accessories.

3-3.3 Frames,--Door frame for door A shall be "Ceco" standard 16 gage-steel frame with 2" face. Door frame for door B shall be fabricated from structural steel as detailed on the design drawings.

3-3.4 Hollow Metal Door Hardware.

3-3.4.1 Hinges.--Hinges for doors A and B shall be 1 1/2 pairs of two ball bearing steel, "Ceco" No. 2312, US 10 finish.

3-3.4.2 Latch Set.--Latch set for door A shall be heavy duty passage latch "Ceco" No. 5110, US 10 finish.

3-3.4.3 Antipanic Device.--Antipanic device for door B shall be mortise device "Ceco" No. F23, US 10 finish, cylinder will be furnished by the Contractor.

3-3.4.4 Closers.--Surface closers for doors A and B shall be hold-open type, "Ceco" No. 3032.

3-3.4.5 Threshold.--Threshold for door B shall be "Zero" No. 260, aluminum or approved equal. Threshold shall be installed in accordance with the manufacturer's recommendations and as shown on the design drawings.

3-3.3.5 Glazing.--Polished wire glass for doors shall be 1/4" thick reinforced with 0.02 wire in twisted hexagonal mesh 1 1/4" x 7/8" or welded diamond mesh with openings about 1 1/8" x 5/8". Putty for glazing shall be as recommended by the glass manufacturer.

3-4. INSTALLATION.

3-4.1 Installation of Frames.--The steel frames shall be plumbed, leveled and rigidly secured in place as detailed on the drawings.

3-4.2 Installation of Doors.--Doors shall be installed in the locations indicated on the drawings with the indicated mounting hardware in complete conformance with the manufacturer's directions.

Section 4

PAINTING

4-1. SCOPE.--This section of the specifications relates to furnishing the labor, equipment and materials needed to perform all operations required for painting and finishing complete as shown on the drawings and as described herein.

4-2. MATERIALS.

4-2.1 General.--Use ready-mixed paints suitable for the purpose for which they are to be used. Paint and fillers shall be equal to the best products of the Sherwin Williams Company; Glidden Company; Pittsburgh Plate Glass Company; or approved equal. Painting materials such as linseed oil, turpentine, etc., shall be of highest quality and have identifying labels on containers. for purposes of indicating quality required, Pittsburgh designations are used.

4-2.2 Paint shall he well ground, shall not settle badly, cake or thicken in the container, shall be readily broken up with a paddle to a smooth consistency and shall show easy brushing properties. The paint shall be suitable for spraying when thinned with not more than 12% volume of mineral spirits.

4-3. GENERAL REQUIREMENTS.

4-3.1 Scaffolding.--The Subcontractor shall provide and later remove all necessary scaffolding, ladders, etc., as required for the proper execution of the work.

4-3.2 Sequence.--Painting, other than priming, shall generally be performed after others have completed their work. Where this is *not* practical, work shall be done in such manner that painting will not interfere with the work of others.

4-3.3 Protection.--The Subcontractor shall protect all surfaces not being painted, whether interior or exterior, from damage from painting operation. Generally, proper protection by means of drop cloths, marking and wet paint signs shall be used. If any damage does result, *it* shall be restored to the satisfaction of the Contractor at no additional *cost.*

4-4. PREPARATION OF SURFACES, APPLICATION OF PAINT.

4-4.1 General.--All surfaces to be painted shall be clean, smooth, dry and free from dust, grit, grease, concrete and frost. All work shall be done in a workmanlike manner, leaving the finished surfaces free from drops, ridges, waves, laps and brush marks. Paint shall not be applied when the temperature is below 50°F nor when a temperature drop of 20°F or more is forecast, nor when the temperature is over 90°F. Paint shall be thoroughly stirred and kept at a uniform consistency during application and shall not be thinned in excess of the direction of the manufacturer. Paint containers shall not be opened until required for use. Paint may be applied by the spray method except during cold weather or when, in the opinion of the Contractor, spraying in any particular application would produce unsatisfactory results. Other work shall be properly protected by drop cloths or other coverings.

4-4.2 Metal Work.--Shop primed or galvanized metal work shall be kept clean and free from corrosion following installation. Abraded surfaces shall be retouched prior to finish painting, using the same type paint as the priming coat.

4-5. PAINTING SYSTEMS.

4-5.1 Prime Coat.--Unless otherwise specified carbon steel items shall be primed with Pittsburgh "Speedhide" No. 6-204 zinc chromate or approved equal. Any galvanized items which require painting shall be primed with Pittsburgh "Speedhide" No. 6-209 galvanized steel primer or approved equal.

4-5.2 Structural and Miscellaneous Carbon Steel, Doors and Frames, Safety Rails, Supports, Hangers, Etc.

Prime Coat:	See Section 4-5.1
Intermediate Coat:	PPG Semigloss Enamel, Vista Green, No. 23-76
Finish Coat:	Same as Intemediate Coat

4-5.3 Fire Protection.

Prime Coat:	See Section 4-5.1
Intermediate Coat:	PPG Gloss Enamel, Banner Red, No. 54-301
Finish Coat:	Same as Intermediate Coat

4-5.4 Electrical.

See Section 4-5.2

4-5.5 Piping.

See Section 5

NOTE: Galvanized ribbed decking and sheet metal wilt not require painting.

Section 5-1
General Piping

5-1-1. SCOPE.--This specification outlines the materials of construction, fabrication, and installation requirements necessary for installing piping systems. The specification is composed of a General Section 5-1, supplemented by Subsections 5-2 through 5-17.

5-1-2. MATERIALS.--Unless noted otherwise on the drawings, materials shall be provided as specified in each individual subsection included herein. All materials shall be in strict accordance with the required American National Standards Institute (ANSI), ASTM Standards or other approved standards and specifications. All valves shall be as specified in the various subsections.

5-1-3. FABRICATION AND INSTALLATION.--The following details of fabrication and installation apply to all subsections of this specification. Additional requirements, if any, will be detailed within the various subsections or on the drawings.

5-1-4. GENERAL.--Piping material, including valves and fittings, shall be delivered to the site in a clean and protected condition. End seals of pipe and valves and flange covers shall be maintained in place, being removed only as necessary for cleaning, fabrication, erection, or for inspection. Care shall be exercised in the handling and storage of all piping materials and prefabricated piping so that contamination by moisture, grease, dirt, or injurious foreign matter shall not occur.

5-1-4.1 Piping specified on the drawings shall follow the routing shown on the drawings. The pipe shall be cut accurately to measurements specified on the drawings and to suit field conditions and shall be carefully worked into place without forcing or springing.

5-1-4.2 Piping and tubing passing through floors, walls, and ceilings shall be provided with pipe sleeves of sufficient size to allow 1/4" annular clearance around the pipe or insulated pipe. Sleeves shall be sealed with caulk to allow for no air leakage.

5-1-4.3 Ceiling and wall plates shall be provided where specified on the drawings and shall be primed and painted to match.

5-1-4.4 The interior or exterior surfaces of all piping shall be kept clean at all times. Pipe shall be free of fins and burrs and shall be cleaned in accordance with cleaning procedures specified in Section 5-15.

5-1-4.5 Flanges, unions, and valves shall be installed as specified and located where they will be accessible after erection.

5-1-4.6 Valves shall be properly placed and made leak proof under the test pressure described.

5-1-4.7 Valves which are to be soldered, brazed, or welded shall be disassembled prior to heating. Allow valves to cool, clean if necessary, and reassemble.

5-1-5. CUTTING.--Pipe and tubing shall be cut accurately to measurements as specified on the drawings and to suit field conditions. Approved tube or pipe cutters, or other methods approved by the Company shall be used and all cuts shall be reamed to remove burrs. Any objectfonable defects shall be removed by machining, chipping, or grinding.

5-1-6. JOINING METHODS.--The following methods shall be used as applicable to the individual sections of this specification.

5-1-7. THREADING.—Threading of pipe shall preferably be done after any bending, forging, or heat treating operations, Where threading must be perfomed first, threads shall be protected during such operations in an acceptable manner. Threads shall conform to ANSI 82.1. Pipe dope shall be applied to *the* male threads only.

5-1-7.1 When threading chemically cleaned pipe, use trichlorethane (methyl chloroform) inhibited, as the cutting fluid.

5-1-7.2 Teflon ribbon, when used as thread dope, shall not be applied to the 'first *two-* threads on pipe.

5-1-8. WELDING.

5-1-8.1 General.--All welding, including the qualification of procedures and welders, shall be performed in strict compliance with ASME Boiler and Pressure Vessel Code, Section IX; AWS D10.9 Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing; applicable ANSI Code for Pressure Piping. All welding procedures and welder's qualifications shall be approved by the Company before work is started. Each welder shall be assigned an identification number, letter, or symbol which shall be used to identify his work when specified in applicable codes, standards, or specifications.

5-1-8.2 All welds are subject to inspection by the Company. The Company reserves *the* right to accept, reject, or demand removal of welds which are in violation or believed to be in violation of these specifications. Welders performing welds found to be unsound shall be subject to appropriate retest provisions of the ASME Boiler Code or other applicable standards.

5-1-8.3 Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 7/16" or more than 1/8".

5-1-8.4 Welded branch connections to headers shall be made by the use of welded outlet fittings, such as reducing tees, weldolets, sockolets, and threadolets, as shown on the drawings in compliance with the ANSI Code for Pressure Piping 831.1, paragraph 127.4.8.

5-1-8.5 Welded miter bends shall not be used unless so specified on the drawings.

5-1-8.6 Backup rings shall not be used unless specified on the drawings. When required, backup rings shall be of the size, type, and material specified.

5-1-9. WELDING RODS AND ELECTRODES.--All bundles, boxes, or kegs in which rods and electrodes are delivered shall be legibly marked with the following information:

Classification
Trade designation
Manufacturer's name
Standard size and length
Heat number

5-1-9.1 . All welding rods shall be identified with at least one imprint per rod showing the AWS classification number as per AWS A5.1 (15). In addition, welding rods 1/8" and over in diameter shall be marked or stamped with positive identification marks at intervals of not more than 18". Such marks shall be clearly distinguishable and shall include the classification number of the Gelding rod and the trade designation of the manufacturer.

5-1-9.2 Welding rods and electrodes shall be stored, handled, and identified at all times to assure the use of the proper welding rod in a welding process.

5-1-10. SOLDERING.--This is covered in the applicable piping sections.

5-1-11. FLANGING.—Where steel flanges mate with cast iron flanged fittings, valves, or equipment, they shall be provided with flat faces and full face gaskets. Provide full face gaskets between cast iron flanges. Flat ring type gaskets shall be used between steel flanges equipped with raised serrated faces.

5-1-11.1 Flanges shall be made up with meeting face in a plane that is exactly perpendicular to the axis of the pipe. Upon erection, flanges shall be so positioned in rotation that the bolt holes shall straddle the vertical flange centerline. All gaskets shall be evenly centered between the flange faces with ring gaskets engaging fully upon raised face flanges. The meeting flanges shall mate flush and true and the bolts shall be tightened uniformly to draw the flanges evenly and firmly upon the gasket. A17 bolt threads shall be coated with Crane antiseize compound prior to installation. When made up the bolts shall extend through nuts by at least one full thread.

5-1-12. **TOLERANCES.--The** tolerance on **overall dimensions** of a?l **shop fabricated** piping **shall not exceed ± 1/8".**

5-1-13. HANGERS **AND ANCHORS.--The** location **and design** of **pipe hangers will be shown on** the **drawings.**

5-1-13.1 **When supporting pipe subject to thermal expansion, hanger rods shall be set at a slight angle** so that **when pipe expands, rods will be plumb.**

5-1-13.2 The location and desfgn of **anchors shall be as shown on the drawings.**

5-1-13.3 The location and spacing of **hangers shall be such** that the **piping is held in position** without **swaying, vibrating, or sagging excessively.**

Section 5-2
EQUIPMENT

5-2-1. SHOP DRAWINGS AND VENDOR DATA.--Shop drawings and vendor data shall be submitted for contractor approval in accordance with the Special Conditions prior to installation on the following equipment:

(1) Pumps
(2) Water heater
(3) Safety shower
(4) Water still
(5) Valves
  (a) Pressure reducing
  (b) Safety relief

5-2-2. EQUIPMENT.

5-2-3. WATER HEATER.--Electric, shall conform to the following specifications:

(1) Have glass-lined heavy steel tank with magnesium anode protection.
(2) 8e insulated with a minimum of 2" of fiberglass insulation.
(3) Be enclosed in a steel jacket having a high grade baked white enamel finish.
(4) Be equipped with immersion type heating elements.
(5) 120 volt controls and magnetic contactors.
(6) Be tested to 300 psi hydrostatic pressure and guaranteed to 150 psi working pressure.
(7) Be equipped with a high temperature cutoff in accordance with NEC in addition to an automatic heating element control thermostat. The high temperature cutoff shall disconnect all ungrounded conductors. The high temperature cutoff shall *be* installed to sense maximum water temperature and shall be trip free with manual reset.
(8) 8e equipped with a pressure and temperature relief valve as required by code and bearing the National Board stamps. It shall be combined AGA to temperature water rated and ASME pressure steam rated. Automatic resetting with lifting lever and extension temperature element. Temperature relief shall be 210°F and pressure setting 125 pounds. Minimum valve inlet shall be 3/4".
(9) Be guaranteed for 3 years and UL listed.

(10) Submit manufacturer's information for approval and supply spare parts information with heaters.
(11) Have the storage capacity, recovery rate, and electrical characteristics shown below:

Approved manufacturers are A. O. Smith, Ruud, Rheem, or approved equal.

30 gallon, 208 volt, 60 hertz, single phase, 6KW, 25 gph recovery 100° rise, commercial unit

5-2-4. SAFETY SHOWERS.

5-2-4.1 Free standing, complete with deluge shower head and stay open valve with rigid pull rod and ring; Stanchion floor flange and interconnecting fittings, Speakman Model SE-253 or equal. Quantity as shown on drawing.

5-2-4.2 Ceiling Mounted.--Complete with deluge shower head and self-closing valve with chain and pull ring, Speakman Model SE-206 or equal, Quantity as shown on drawings.

5-2-4.3 Hand Held.--Complete with 6' of hose with 1/2" connector; chrome plated deck mounting bracket for countertop up to 2 1/2" thick, Speakman Model SE-921 or approved equal.

5-2-5. ACID WASTE PUMP UNIT.--Pumping unit shall be in accordance with Ryan-Herco, size .020 acid waste pumping station. Unit shall automatically collect and transfer nitric acid waste.

5-2-5.1 Pump.--Shall be vertical centrifugal with chlorinated-polyvinyl chloride wetted parts. Wetted portions of float and float columns shall be polypropylene. Pump shall deliver minimum of 10 gpm at 20' of head. Motor shall be 1/3 horsepower, 3450 rpm, 120 volt, TEFC, single phase.

5-2-5.2 Chemical Waste Holding Tank.--Shall be molded of high density heavy gauge polyethylene or polypropylene. Tank size to be approximately 24" by 18" by 18" high with openings to accommodate sump pump controls.

5-2-6. WATER STILL.

5-2-6.1 General.--The still shall be rated at 5 gallon per hour and shall consist of an evaporator with its heat supply, a condenser, and devices to control the water level and salt concentration in the evaporator. Unit shall be wall hung.

5-2-6.2 Evaporator.--The evaporator shall be the vertical, cylindrical double wall type. The evaporator shell shall be polished stainless steel. The inner shell shall be copper. All surfaces that contact the vapor and distillate shall be coated with pure tin. A water level sight glass shall be provided. The still shall be equipped with a constant bleeder device to continuously deconcentrate impurities from the evaporator, a constant level device for water level control.

5-2-6.3 Electric Heaters shall be 115 volt, 1 phase, immersion type.

5-2-6.4 Condenser shall be the horizontal type, atmospherically vented. The condenser shall be copper and brass and finished in polished nickel. Surfaces that contact the vapor and distillate shall be coated with pure tin.

5-2-6.5 Automatic controls include all devices and fittings so that when connected to a storage vessel the still will start automatically when water in the vessel drops to a preset level and stop automatically when the vessel is filled to a preset level. Automatic controls shall operate on 115 volt ac, 60 hertz, and include an automatic cooling water shut-off valve, a manual cooling water throttling valve, a low water *cutoff* to protect the electric heaters against burn out. Approved manufacturer - Barnstead Model XG301.

5-2-7. STORAGE TANK - DISTILLED WATER.

5-2-7.1 Storage capacity shall be 25 gallons as specified.

5-2-7.2 Equipment.--The vertical cylindrical storage tank shall be fabricated of copper and be tinned by hand wiping inside. The tank shall be furnished with a movable cover, sight gauge, and a tinned draw-off faucet with serrated hose nipple. Tank shall be furnished with floor stand.

5-2-7.3 Vent.--Vent shall be equipped with air filter to protect distilled water against airborne impurities down to 0.2 microns.

5-3-1. SERVICE RATING.

Pressure range	0 to 150 psig
Maximum temperature	480°F

5-3-2. MATERIALS AND EQUIPMENT.--The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those required for the work shall be selected from this listing unless otherwise shown on the drawings.

5-3-3. CODES.—Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI "Code for Pressure Piping, B31.1.0, Power Piping."

5-3-4. MATERIALS.

Item	Size (incl.)	Specifications
Pipe*	To 1 1/2"	Steel, seamless, Schedule 40, ASTM A106, Grade B
Fittings	To 1 1/2"	Steel, 3000-lb, ASTM A105 or A181, Grade 2, socket weld, ANSI B16.11
	2" to 24"	Steel, seamless, ASTM A234, WPA or WPB, butt weld ends, ANSI B16.9, tdmatch pipe
Flanges	1/2" and 3/4"	Steel, ASTM A105 or A181, Grade 1, 150-lb, socket weld type, ANSI B16.5
	1" to 24"	Steel, ASTM A105 or A181, Grade 1, 150-lb, slip-on or welding neck type, ANSI B16.5
Unions	To 2"	Steel, 3000-lb, ASTM A105 or A181, Grade 2, with integral steel seats and socket weld ends, dimensions per manufacturer's standard
Valve Stem Packing for repacking only	All	Johns-Manville No. C-14
Dope		Threads - Crane high temperature thread compound
		Gaskets - Graphite and oil

*Where threaded connections are required, Schedule 80 pipe shall be used.

Item	Size (incl.)	Specifications
Strainers	To 2"	Cast steel, ASTM A216, Grade WC8, screwed ends, Y pattern, Monel screen with 1/64" perforations, Leslie Co. 7200 with 600-lb steam rating at 800°F
Traps		All steam traps shall be of the type and size specified on the drawings

5-3-4.1 Valves.

Service	Size (incl.)	Make and Figure Number	Materials Body	Materials Trim	Type of Ends
Shut-Off					
Gate	All	Vogt Series SW13111	CS	11 1/2 to 13% CR SS	SW
Globe	All	Vogt Series SQ12141	FS	11 1/2 to 13% CR SS	SW

Note: The following gate valves shall be used on condensate lines downstream of steam traps.

Gate	All	Crane 431UB	Brs	Brs	Scrd
Check					
Swing	All	Lunk 554	Brz	Brz	Scrd

5-3-4.2 Pressure Reducing Valves.--Pressure reducing valves shall be of the type and size specified on the drawings.

5-3-4.3 Safety Valves.--Safety valves shall be of the type, size, and setting specified on the drawings. All safety valves shall be National Board stamped and shall have lever operators (packed for indoor service when specified). Safety valves shall be turned over to the Company for pressure setting prior to installation.

5-3-5. PIPING FABRICATION AND INSTALLATION.

5-3-5.1 General.--All steam and condensate piping shall be pitched down 1/4" per 10' in the direction of flow unless otherwise shown on the drawings. Cold springing of pipe shall be done where indicated on the drawings. Only steel fittings shall be used on expansion loops. All other details of fabrication shall be as specified in Section 5-1.

5-3-5.2 Cleaning.--Piping shall be cleaned by flushing with water for five minutes after erection and testing.

5-3-5.3 Testing and Inspection.--Testing and inspection shall be as specified in Section 5-16, Class 8.

5-3-5.4 Insulation (Thenal).--Insulation of steam and condensate shall be as specified in Section 5-12 using expanded perlite insulation as specified in Section 5-14. Condensate lines located at elevations of 7' above floor or less shall be insulated with fibrous insulation specified in Section 5-13 for personnel protection.

5-3-5.5 Identification of Piping and Color Code.--Identification of piping and color code shall be as specified in Section 5-17.

5-3-5.6 Painting.--Painting shall be as specified in Section 5-17.

Section 5-4
Steam and Condensate

5-4-1. SERVICE RATING.

Pressure range	151 to 250 psig
Maximum temperature	500°F

5-4-2. MATERIALS AND EQUIPMENT.--The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those required for the work shall be selected from this listing unless otherwise shown on the drawings.

5-4-3. CODES.--Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI "Code for Pressure Piping, 831.1.0, Power Piping."

5-4-4. MATERIALS.

Item	Size (incl.)	Specifications
Pipe	To 2"	Steel, seamless, Schedule 80, ASTM A106, Grade B
Fittings	To 2"	Steel, 3000-lb, ASTM A105 or A181, Grade 2, socket weld ends, ANSI 816.11
Flanges	To 2"	Steel, ASTM A105 or A181, Grade 1, 300-lb, welding neck (bored to match pipe) or slip-on welding type, ANSI 816.5
Unions	To 2"	Steel, 3000-lb, ASTM A105 or A181, Grade 2, with integral steel seats and socket weld ends, dimensions per manufacturer's standard
Dope		Crane high temperature thread compound
Gaskets	All	"Flexitallic" Type CG with 1/8" thick carbon steel ring and Type 304 SS and Canadian asbestos filler
Valve Stern Packing (for repacking only)	All	Johns-Manville C-14
Bolts and Nuts		Steel bolt studs, ASTM A193, Grade B7 and semifinished heavy hex nuts, ASTM A194, Grade 2 or 2H

Item	Size (incl.)	Specifications
Strainers	To 2"	Cast steel, ASTM A216, Grade WC8, screwed ends, Y pattern, Monel screen with 1/64" perforations, Leslfe Co. 7200 with 600-lb steam rating at 800°F
Traps		All traps shall. be of the size and type specified on the drawings

5-4-4.1 Valves.

Service	Size (incl.)	Make and Figure Number	Material Body	Material Trim	Type of Ends
Shut-Off					
Gate	1/2 to 2"	Vogt Series SW13111	CS	11 1/2 to 13% CR SS	SW
Globe	1/2 to 2"	Vogt Series SW12141	FS	11 1/2 to 13% CR SS	SW
Check					
Piston	1/2 to 2"	Vogt Series SW6083	FS'	11 1/2 to 13% CR SS	SW

5-4-4.2 Pressure Reducing Valves.--Pressure reducing valves shall be of the type and size specified on the drawings.

5-4-4.3 Safety Valves.--Safety valves shall be of the type, size, and setting specified on the drawings. All safety valves shall be National Board. stamped and shall have lever operators (packed for indoor service when specified). Safety valves shall be turned over to the Company for pressure setting prior to installation.

5-4-5. PIPING FABRICATION AND INSTALLATION.

5-4-5.1 General.--All steam and condensate piping shall be pitched down 1/4" per 10' in the direction of flow unless otherwise shown on the drawings. Cold springing of pipe shall be done where indicated on the drawings. Only steel fittings shall be used on expansion loops. All other details of fabrication shall be as specified in Section 5-1.

5-4-5.2 Cleaning.--Cleaning of steam and condensate piping shall be accomplished by flushing for five minutes with water after erection and testing.

5-4-5.3 Testing and Inspection.--Testing and inspection shall be as specified in Section 5-16, Class 8.

5-4-5.4 Insulation (Thermal).--Insulation of 250 psig steam and condensate lines shall be as specified in Section 5-14 expanded perlit

5-4-5.5 Identification of Piping and Color Code.--Identification of piping and color code shall be as specified in Section 5-17.

5-4-5.6 Painting.- See Section 5-17.

Section S-5
Aboveground Potable Water (Sanitary Water)

5-s-1. SERVICE RATING.

Maximum pressure	125 psi
Maximum temperature	140°F

5-5-2. MATERIALS AND EQUIPMENT.—The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those required for the work shall be selected from this listing unless otherwise shown on the drawings.

5-5-3. CODES.--Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of "National Plumbing Code," ANSI A40.8.

5-5-4. MATERIALS.

Item	Size (incl.)	Specifications
Pipe	To 2"	Steel, butt welded, galvanized, Schedule 40 ASTM A120
Fittings	To 2"	M.I., galvanized, 150-lb, ASTM A197, screwed ends, ANSI 816.3
Unions	To 2"	M.I., galvanized, 150-lb, ASTM A197, screwed ends, brass-to-iron seats, dimensions per manufacturer's standard
Caps	To 2"	M.I., galvanized, 150-lb, ASTM A197, screwed ends, ANSI 816.3
Dope		Red lead
Valve Stem Packing	1/16" to 3/16" round	Garlock 1178
(for repacking only)	1/4" and up square	Garlock 233

5-5-4.1 Valves.

Service	Size (incl.)	Make and Figure Number	Material Body	Material Trim	Type of Ends
Shut-Off					
Gate	1/4" to 2"	Lunk 2125	Brz	Brz	Scrd

5-5-5. PIPING FABRICATION AND INSTALLATION.

5-5-5.1 General.--Adequate provisions shall be made to prevent water hammer, rattling of the pipe, chattering of valves and faucets, and other objectionable noises in the system. Full size air chambers, 2' to 3' vertical length, shall be provided at the top of all risers, at the end of all branches, and at fndividual fixtures where necessary. Whenever it is necessary to have a submerged potable water supply to a fixture, tank or other equipment, a vacuum breaker shall be installed in the supply line at an elevation above the overflow line of the fixture. Valves shall be installed in all branches at the takeoff from the main, at all risers, before all connections to equipment, and as shown on the drawings. A11 other details of fabrication and installation shall be as specified in Section 5-1.

5-5-5.2 Cleaning and Sterilization.--Cleaning of potable water systems shall be by flushing with water for five minutes and sterilization shall be as specified in Section 5-15.

5-5-5.3 Testing and Inspection.--Testing and inspection shall be as specified in Section 5-16, Class 8.

5-5-5.4 Insulation (Thermal).--Insulation of hot and cold water lines shall be as specified in Section 5-12 using fibrous glass as specified in Section 5-13.

5-5-5.5 Identification of Piping and Color Code.--Identification of piping and color code shall be as specified in Section 5-17.

5-5-5.6 Painting.--Painting shall be as specified in Section 5-17.

Section 5-6
Distilled Water (Stainless Steel)

5-6-1. SERVICE RATING.

Maximum pressure	150 psig for demineralized and distilled water
Maximum temperature	400°F for demineralized and distilled water

5-6-2. MATERIALS AND EQUIPMENT.--The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those required for the work shall be selected from this listing unless otherwise shown on the drawings.

5-6-3. CODES.—Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable requirements of ANSI "Code for Pressure Piping, 831.3, Petroleum Refinery Piping."

5-6-4. MATERIALS.--All stainless steel material shall have a maximum carbon content of 0.030 percent ladle analysis and shall be capable of passing the Huey Nitric Acid Test, ASTM A262 with a maximum average corrosion rate of 0.0020" penetration per month.

Item	Size (incl.)	Specifications
Pipe	To 1/2"	Stainless steel, Type 304L, Schedule 10S, welded, ASTM A312, per Y-MS-107
Fittings	To 1/2"	Stainless steel, Type 304L, 3000-lb, ASTM A403, forged socket weld ends
Unions	To 1/2"	Stainless steel, Type 304L, 3000-7b, ASTM A182, socket weld, ground joint
Gaskets	Water Service	Red rubber sheet, 1/16" thick, full face, ASTM 02000, No. 2AA705A13L14, Sepco Corp. 20
Dope		Teflon, ribbon thread sealant, Permacel or Scotch brand
Valve Stem Packing (for repacking only)	All	Teflon, Chevron type
Valve Bonnet Gaskets (for replacement)		Teflon

5-6-4.1 Valves.

Service	Size (incl.)	Make and Figure Number	Material Body	Material Trim	Type of Ends
Shut-Off					
Globe	3/8"	Hoke Mdl. 3212G6Y	18-8S	18-8S	Swagelok
Ball	1/4 to 2"	Worcester 455T	SS-303 & 304L	Teflon Seat	SW
Control					
Globe	1/2 to 1"	Hancock Fig. 400	78-8SMo	8-8SMo	Scrd
Globe	1/4 to 2"	Aloyco 314	SS-304L	8-8SMo	SW

5-6-5. PIPING FABRSCATION AND INSTALLATION.--Piping fabrication and installation shall be as specified in Section 5-1.

5-6-6. CLEANING.--Cleaning shall be as specified in Section 5-15.

5-6-7. TESTING AND INSPECTION.--Testing and inspection shall be as specified in Section 5-16, Class B for distilled water.

5-6-8. SOENTIFICATION OF PIPING AND COLOR COO€.--Identification of piping and color code shall be as specified in Section 5-17.

Section 5-7
Drain Piping

5-7-1. DRAIN PIPING.

5-7-2. All drain piping from laboratory sinks and service fixtures shall be PVC pipe. Installation of drainage piping shall be as shown on design drawings. Where details of fabrication are not shown on drawings or specified in this or other specifications, fabrication and installation shall be in accordance with National Plumbing Codes.

5-7-3. MATERIALS.

Item	Size (incl.)	Specifications
Pipe	To 4"	Polyvinyl chloride, ASTM 01785, Type 1, Grade 1, Schedule 80, normal impact
Fittings	To 4"	Polyvinyl chloride, ASTM 02467, socket type, Schedule 80 (pipe and fittings shall be purchased from same manufacturer)
Gaskets	1	Teflon
Solvent Cement		As supplied by manufacturer of pipe and fittings
Drum Traps		PVC or polyethylene, Hamilton Industries 34L235, size 1 1/2"
Cup Sinks		PVC or polyethylene, Hamilton 34L143 with strainer

5-7-4. CLEANING, INSPECTION, AND TESTING.--To be in accordance with Section 11 of this specification,

Note: Chemical waste discharge piping from sump pump to waste holding tank shall be PVC. Connection of pipe to waste holding tank will be flanged with a swing away piece to allow for removal of tank for dumping,

Section 5-8
Nitrogen

5-8-1. **SERVICE RATING.**

Pressure range	0 **psig** to 125 psig
Temperature range	**Minus 20°F** to 150°F

5-8-2. MATERIALS AND **EQUIPMENT.--The** material list of **this** specification is comprehensive in **nature.** It is not **intended** that all materials listed will necessarily **be** required, but that those required for the **work** shall be selected from this listing **unless** otherwise shown on the **drawings.**

5-8-3. CODES.--Where **'details** of fabrication are not **shown** on the drawings **or** specified in this or **other** specifications, fabrication shall **be** in accordance with the applicable fabrication requirements *of* **ANSI**, "Code for **Pressure** Piping, **B31.3,** Petroleum Refinery Piping."

5-8-4. **MATERIALS.**

Item	Size' (Incl.)	Specifications
Pi**pe***	To 1/2"	**Steel, welded, Schedule** 40, **ASTM A106,** Gra'de B
Fittings	To 1/2"	**Steel, 3000-lb, ASTM** A105 or A181, Grade 2 **socket** weld **ends,** ANSI 816.11
Unions	To 1/2"	Steel, 3000-lb, ASTM A105 or A181, Grade 2 with integral steel **seats** and **socket weld end**
Valve Stem Packing **(for repacking only)**	1/16" to 3/16" **round**	Garlock Company 117B
	1/4" and up square	**Garlock** Company **233**
Dope		**Red** Glyptal or letharge and glycerine

*Where threaded connections **aye required,** Schedule 80 pipe shall **be used.**

5-8-4.1 Valves.

~~Service~~	~~*Size* (incl.)~~	**Make and** Figure **Number**	**Material** ~~Body~~	Trim	Type of Ends
Shut-Oif					
Globe	1/8" to 1/2"	Kerotest R42A01P thru R42A04P	Brs	Nylon	**Scrd**

Item	Size (incl.)	Make and Figure Number	Body Material	Trim	Type of Ends
Globe	1/4" and 2"	Rego 2500 Series	Brz SN		Scrd

5-8-5. PIPING FABRICATION AND INSTALLATION.--Piping fabrication and installation shall be as specified in Section 5-1.

5-8-6. CLEANING.--Cleaning shall be as specified in Section 5-15.

5-8-7. TESTING AND INSPECTION.--Testing and inspection shall be as specified in Section 5-76, Class A.

5-8-8. IDENTIFICATION OF PIPING AND COLOR CODE.--Identification of piping and color *code* shall be as specified in Section 5-17.

5-8-9. PAINTING.--Painting shall be as specified in Section 5-17.

Section 5-9
Oxygen

5-9-1. SERVICE RATING.

Pressure range 0 psig to 150 psig
Temperature range **Minus 20°F** to 250°F

5-9-2. MATERIALS AND EQUIPMENT.--The material list *of* this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those required for the **work** shall **be** selected from this listing **unless** otherwise **shown** on the drawings.

5-9-3. COOK--Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of **ANSI**, "Code **for Pressure** Piping, 831.3, Petroleum Refinery Piping," and NFPA Pamphlet No. 51, "**Gas** Systems for Welding **and** Cutting."

5-9-4. MATERIALS.

Item	Size (incl.)	Specifications
Pipe*	To 1/2"	Steel, seamless, Schedule 40, **ASTM** A106, Grade B
Pipe Fittings	To 1/2"	Steel, 3000-lb, **ASTM** A105 or A181, Grade 2, socket weld **ends**, ANSI 816.11
Unions	To 1/2"	Steel, 3000-lb, ASTM A105 or A131, Grade 2, with integral steel seats **and** socket **weld ends**
Dope		**Red** Glyptal or litharge and glycerine
Valve Stem Packing	All	Braided teflon, multifilament yarn, Style C-1045 by Crane Packing Company

*Where threaded **pipe** connections are required, 'Schedule 80 pipe shall **be used.**

5-3-4.1 Valves.

Service	Size (incl.)	**Make** and Figure Number	Material Body	Material Trim	Type *of* Ends
Shut-Off					
Globe	1/8" to 1/2"	**Kerotest R42A01P**	Brs	Nylon	Scrd

5-9-5. PIPING FABRICATION AND INSTALLATION.--A mixture of leak detection detergent and water shall be used as a lubricant when cutting threads. No oil is permitted. Detergent shall be similar to American Gas and Chemical Company, Formula 372. All other details of fabrication and installation shall be as specified in Section 5-1.

5-9-6. CLEANING.--Cleaning shall be as specified in Section 5-15.

5-9-7. TESTING AND INSPECTION.--Testing and inspection shall be as specified in Section 5-16, Class A.

5-9-8. IDENTIFICATION OF PIPING AND COLOR CODE.--Identification of piping and color code shall be as specified in Section 5-17.

5-9-9. PAINTING.--Painting shall be as specified in Section 5-17.

Section 5-10
Acetylene

5-10-1. SERVICE RATING.

Pressure range	0 psig to 15 psig
Temperature range	Minus 20°F to 125°F

5-10-2. MATERIALS AND EQUIPMENT.--The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those required for the work shall be selected from this listing unless otherwise shown on the drawings.

5-10-3. CODES.--Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI, "Code for Pressure Piping, 831.2, Fuel Gas Piping," and NFPA Pamphlet No. 51, "Gas Systems for Welding and Cutting."

5-10-4. MATERIALS.

Item	*Size* (incl.)	Specifications
Pipe	To 2"	Steel, seamless, Schedule 40, ASTM A106, Grade B
Fittings	To 2"	Steel, 3000-lb, ASTM A105 or A181, Grade 2, socket weld ends, ANSI 616.11
Unions	All	Use flanges
Flanges	1/2" to 3/4"	Steel, ASTM A105 or A181, Grade 1, 150-lb, socket weld type, ANSI 816.5
	1" to 2"	Steel, ASTM A105 or A181, Grade 1, 150-lb, slip-on or welding neck type, ANSI 816.5
Gaskets	All	"Flexitallic" style CG, 3/32" thick, carbon steel ring and Type 304 stainless steel and Canadian asbestos filler
Plugs		Steel, screwed ends, square head, solid, ANSI 816.14
Dope		Glyptal or litharge and glycerine
Bolts and Nuts		Steel, heavy hex or square head machine bolts with semifinished heavy hex nuts, ASTM A307, Grade 8

5-10-5. VALVES.

Service	Sire (incl.)	Make and Figure Number	Material Body	Material Trim	Type of Ends
Shut-Off and Control					
Globe	1/4"	Rego 2553AC	F Brs	Syn Rub	scrd
Globe	3/8"	Rego 2553AAC	F Brs	Syn Rub	Scrd
Globe	1/2"	Rego 2554AC	C Brz Tin Pltd	Syn Rub	scrd
Globe	3/4"	Rego 2554AAC	C Brz Tin Pltd	Syn Rub	Scrd
Globe	1"	Rego 2507AC	C Brz Tin Pltd	Syn Rub	Scrd
Globe	1 1/2"	Rego 2511AC	C Brz Tin Pltd	Syn Rub	scrd
Globe	2"	Rego 2513AC	C Brz Tin Pltd	Syn Rub	scrd
Check	1/4" to 2"	Nupro C4-1/3	SS	Buna N	Scrd

5-10-6. HYDRAULIC FLASHBACK ARRESTER.--Shall be in accordance with Rexarc 3-01-71, for acetylene gas, sized for 300 cfm. The complete unit shall be Factory Mutual approved, and installed in the acetylene pipfng system as shown on drawing MSE-13614-G. Installation shall comply with National Fire Protection Association Pamphlet No. 51.

5-10-7. PIPING FABRICATION AND INSTALLATION.

5-10-7.1 General.--Pipe joints for carbon steel piping shall be socket welded.

5-10-7.2 All other details of fabrication and installation not covered in this Subsection shall be as specified in Sectfon 5-1.

5-10-8. CLEANING.--Cleaning of acetylene piping shall be accomplished by flushing with dry air for .five minutes.

5-10-9. TESTING AND INSPECTION.--Testing and inspection shall be as specified in Section 5-16, Class A.

5-10-10. IDENTIFICATION OF PIPING AND COLOR CODE,--Identification of piping and color code shall be as specified in Section 5-16.

5-10-11. PAINTING.--Painting shall be as specified in Section 5-17.

Section 5-11
Plant Air Piping
(Compressed Air)

5-11-1. SERVICE RATING.

Maximum Pressure	150 psig
Maximum Temperature	150°F

5-11-2. MATERIALS AND EQUIPMENT.--The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but that those required for the work shall be selected from this listing unless otherwise shown on the drawings.

5-11-3. CODES.--Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be done in accordance with the applicable fabrication requirements of ANSI, "Code for Pressure Piping, 831.3, Petroleum Refinery Piping."

5-11-4. MATERIALS.

Item	Size (incl.)	Specifications
Pipe*	1/2" and under	Steel, welded, Schedule 40, ASTM A106, Grade B
Fittings	1/2" and under	Steel, 3000-lb, ASTM A105 or A181, Grade 2, socket weld ends, ANSI B16.11
Unions	1/2" and under	Steel, 3000-lb, ASTM A105 or A181, Grade 2, with integral steel seats and socket weld ends
Valve Stem Packing (for repacking only)	1/16" to 3/16" round	Garlock 1178
	1/4" and up square	Garlock 233
Dope		Red lead

*Where threaded pipe connections are required, Schedule 80 pipe must be used.

5-11-4.1 Valves.

Service	Size (incl.)	Make and Figure Number	Material Body	Material Trim	Type of Ends
Shut-Off					
Gate	A71	Lunk 2125	Brz	Brz	Scrd

5-11-5. PRESSURE REDUCING VALVES.--Reducing valves shall be of the type, size, and setting specified on the drawings.

5-11-6. SAFETY VALVES AND RELIEF VALVES.--Safety and relief valves shall be of the type, size, and setting specified on the drawings. Safety valves shall be National Board stamped and shall be turned over to the Company for pressure setting prior to installation.

5-11-7. PIPING FABRICATION AND INSTALLATION.--Piping fabrication and installation shall be as specified in Section 5-1.

5-11-8. CLEANING.--Cleaning shall be as specified in Section 5-15.

5-11-9. TESTING AND INSPECTION.--Testing and inspection shall be as specified in Section 5-16, Class A *for* plant air.

5-11-10. IOEMIFICATION OF PIPING AND COLOR CODE.--Identification of piping and color code shall be as specified in Section 5-17.

5-11-11. PAINTING.--Painting shall be as specified in Section 5-17.

Section 5-12
Thermal Insulation for Piping
General

5-12-1. SCOPE.--This specification describes the general requirements relating to materials and the application of thermal insulation to piping and equipment.

Supplementary sections provide specifications for specific types of insulation.

The drawings will give insulation thickness and the section to use for various services.

5-12-2. DEFINITIONS.--The following terms, when used in this specification, shall be interpreted as defined:

Caluking Mastic and Sealer	A mastic used for forming fillets and seals.
Curved Segment	A block insulation of uniform thickness, formed to fit curved surfaces, with straight edges. beveled radially.
Fabricating Adhesive	An adhesive used in cementing insulation to insulation, such as in the fabrication of fitting covers.
Fillet	A suitable radius made with caulking mastic at the inside corners formed by intersecting surfaces of insulation.
Fitting Covers	Block and pipe insulation fabricated into convenient matching sections to cover flanges, valves, and fittings.
Flash Paint	The lowest temperature of a volatile material at which it gives off vapor sufficient *to* form an ignitable mixture with the air near the surface *of* the material.
PVA Mastic	A vinyl based emulsion which, when dry, forms a tough, flexible, fire resistant, water-proofing coating.
Reinforcing Cloth	An open weave glass cloth used *to* reinforce mastic coating.

Seal	A waterproof closure made by applying caulking mastic in the corner formed by the intersection of insulation and a metallic surface.
Sectional Pipe Insulation	Two semicylinders of pipe insulation combined to form a complete circumference.
Segmental Pipe Insulation	Curved segments of pipe insulation of less than 1/2 circumference which, when grouped and combined with an odd width, where necessary, forms a complete circumference.
Staggered and Broken Joints	Pipe insulation will be in a staggered position when, upon application, the end joint between two abutting half sections is lapped by 1/3 to 1/2 the length of the half section placed on the opposite side of the pipe.
	Block (curved segments and lagging) insulation will be in a staggered position when the abutting end joints between two blocks occurs, upon application, at least 1/3 the length of a section from similar joints of adjacent blocks.
	Multilayer insulation (pipe and block) will be considered broken joint when applied so that no two joints in adjacent layers coincide except in crossing at right angles.
Vapor Barrier	A mastic coating of jacketing material which has a low water vapor permeability and will prevent the transmission of water vapor from the atmosphere to insulation.
Waterproofing	A mastic coating or jacket applied to the outside of insulation for moisture and weather protection or as a surface finish.

5-12-3. MATERIALS.--Insulation and accessories shall be as specified in other sections. All insulation materials shall be delivered to the job in their original cartons or containers, which shall be labeled as to the manufacturer's name and type of material contained.

Insulation shall be stored in such a manner as to remain dry.

Bands customarily furnished with pipe insulation will not be required.

5-12-4. APPLICATION.--It is not intended that all details outlined under this heading apply to all insulation on the job, but that they shall apply only as required in the individual subsections. Additional requirements are specified in other sections. Special details when required, and which are not given, will be shown on the drawings. Manufacturer's instructions shall be followed when they are available with a material.

5-12-4.1 Insulation.--Insulation shall be dry when applied. The surfaces to which it is applied shall also be dry and clean.

5-12-4.2 Flash Points.--The flash points of volatile materials are given in the subsections. When these flash points are equal to or less than the temperature of the surrounding atmosphere, adequate ventilation shall be provided to eliminate fire hazards.

5-12-4.3 Protection Against Wetting.--When circumstances prevent the immediate application of a mastic or jacket waterproof coating, the insulation shall be temporarily protected against wetting.

5-12-4.4 Mastic Coating.--Apply PVA and other mastic coatings by palming, troweling, or spraying. Reinforce with glass fiber cloth embedded in the mastic so that when dry the weave of the cloth is not visible. Lap the joints of the cloth at least 2" and apply so that there is a smooth, unbroken surface. The finished dried thickness of mastic and cloth shall not be less than 1/16".

When spraying, mask or otherwise protect all adjacent areas which are not to be coated. Obtain approval from the Company before spraying inside.

Apply a heavy fillet of caulking mastic at inside corners of insulation and at junctions of insulation and metal before applying mastic coating.

Round outside corners of insulation and use a double layer of reinforcing cloth in the mastic.

5-12-4.5 Application to Piping.--Install insulation in single layer up to 3" thickness. Above 3" thickness use multilayers. All other application details are covered in the subsections.

Section 5-13
Thermal Insulation - Fibrous Glass

5-13-1. SCOPE.--This specification describes the materials required and the application of fibrous glass insulation for piping operating at temperatures of 50°F to 350°F.

Technical Specification Section 5-12, General, is an integral part of this specification.

5-13-2. MATERIALS.--All material items listed are not necessarily needed for a particular job, but those required shall be selected from this listing.

5-13-2.1 Insulation.--Insulation shall be composed of fibrous glass wool with a rosin binder, formed into semicylindrical sections for pipe insulation and 24" by 48" semirigid boards for equipment insulation. Pipe insulation shall have a flame retardant self-sealing lap jacket of a laminate of aluminum foil and a special embossed white kraft paper with a flame retardant snuffer type adhesive and shall be reinforced with glass fibers. Insulation shall have the following properties:

Density - 6-lb per cu ft for pipe insulation
4.2-lb per cu ft for equipment insulation

Thermal Conductivity - Shall not exceed the following values:

Mean Temp °F	Btu/hr/sq ft/°F/in thk
50	0.24
100	0.27
200	0.33

The following insulation is acceptable: Owens-Corning Fiberglass Corporation heavy density sectional pipe insulation with white flame retardant jacket and self-sealing lap and Type 7-4 rigid equipment insulation.

5-13-2.2 Accessory Materials.--Accessory materials shall be as follows:

Tape	1" wide acetate back glass reinforced, Nashua Corporation 402
Wire	Stainless steel, Type 304, 18 gauge (0.0475"), cold drawn, bright annealed
Fabricating Adhesive	Benjamin Foster 85-20 (flash point - none)
Insulation Cement	Hydraulic setting, Johns-Manville No. 375, or Eable-Picher One-Coat or Forty-Eight Quick-Set

Caulking Mastic	Benjamin Foster 30-45 Foamseal or Insul-Coustic IC-405 (flash point - 100°F)
Joint Sealing Strips	3" wide, self-sealing, same material as jacket
Vapor Barrier Mastic	Insul-Coustic Hypalon IC-570, color - white
PVA Mastic	Vimasco WC-1 or Insul-Coustic IC-551, color - gray to match Chip No. 36440, Federal Standard 595
Reinforcing Cloth	White open weave glass cloth, 10 by 10, weaveset mesh, with nonasphaltic binder, Benjamin Foster Mast-A-Fab

5-13-3. APPLICATION.

5-13-3.1 Pipe.--Apply insulation to pipe with joints tightly butted, Seal longitudinal lap of jacket and cover all circumferential joints with sealing strips. On cold water piping, at 21' intervals, seal the joints with heavy coating of vapor barrier mastic. Apply to butt edges and inside surface of insulation 2" on either side of the joint. Press in place while the vapor barrier is wet. Seal at each hanger and support in a similar manner. Insulation for cold water piping shall be vapor proof throughout. No additional coating or finish is required on the surface of the factory applied flame retardant jacket.

5-13-3.2 Fittings, Flanges, and Valves.--Fabricate covers from insulation of the same thickness as that on adjacent pipe. Factory-molded covers are acceptable. Valves and fittings 2" ips and smaller may be insulated with insulating cement. Adhere the two halves of the cover with fabricating adhesive and secure in place with tape or wire. Coat the exterior surfaces of fitting covers with a 1/8" wet film thickness of vapor barrier mastic. When Cry, cever the joints between the cover and adjacent pipe insulation with sealing strips. Allow insulating cement to thoroughly dry before applying vapor barrier mastic. Reinsulate any cracks due to shrinkage of cement.

Section 5-14
Thermal Insulation - Expanded Perlite

5-14-1. SCOPE.--This specification describes the materials required and the application of expanded perlite insulation for piping operating at temperatures of 212°F *to* 1600°F.

5-14-2. MATERIALS,--Not all material items listed are necessarily needed for a particular job, but those required shall be selected from this listing.

5-14-2.1 Insulation.--Pipe and block insulation shall be composed of expanded perlite with reinforced mineral fibers in suitable proportion and with outer binding fibers added to provide proper structural strength. The insulation shall conform to ASTM C610 (asbestos free).

The following insulation is acceptable: Celotex Corp., "Celotemp 1500" and Pamrod, Inc., "Careytemp 1500" molded.

5-14-2.2 Accessory Materials.

Wire	Stainless steel, Type 304, 18 gauge (0.0475"), cold drawn, brfght annealed
Caulking Mastic	Benjamin Foster 30-45 Foamseal or Insul-Coustic IC-405 (flash point 100°F)
Insulating Cement	Careytamp MW-One Cement (asbestos free)
Reinforcing Cloth	White, open weave, glass cloth, 10 by 10 weaveset mesh, with nonasphaltic binder, Benjamin Foster Mast-A-Fab
Fabricating Adhesive	Careytemp adhesive
PVA Mastic	Vimasco WC-1 or Insul-Coustic IC-551, color - gray *to* match Chip No. 36440, Federal Standard 595
Lagging Adhesive	Benjamin Foster 81-42W Lag-Fas (red stripe) or Insul-Coustic IC-102 Sure-tag, color white

5-14-3. APPLICATION.

5-14-3.1 Pipe.--Install single layer insulation in staggered position and multilayers with broken joints. Use 18 gauge (0.0475") stainless steel wire to secure insulation up to 11" OD and all liner layers of multilayer insulation. Use 3/8" by 0.015" straps for insulation more than 11" OD. Space wire and straps on 9" centers and not more than 4 1/2" from end joint. Point up all cracks and small depressions with insulating cement. Allow to dry before applying PVA mastic. Do not allow insulating cement to come in contact with stainless steel surfaces.

5-14-3.2 Fittings, Flanges, and Valves.--Insulate with covers fabricated from the same material and thickness as that specified for adjacent pipe. Fabricate the covers in accordance wtih ASTM C450. Join the pieces with fabricating cement and make ail covers in two halves secured in place with wire or straps. Factory-molded covers are acceptable.

5-14-3.3 Supports.--Install welded clips or a clamp ring support near the bottom of vertical runs in excess of 21' on insulated pipe 4" ips and larger. Add another support every 21'. A flanged joint is considered a support.

5-74-3.4 Surface Finish for Piping.--Cover piping and fitting insulation with 8-ounce canvas, adhered and completely sized with lagging adhesive applied at the rate of one gallon per 85 square feet.

Section S-15
Cleaning, Conditioning, and Sterilization of Piping System

5-15-1. **SCOPE.--This section** of the specification describes the cleaning requirements for piping systems listed under Piping **Section** S and includes the **sterilization requirements** for piping **Systems** conveying **potable** water.

5-15-2. GENERAL.--The contractor will furnish **the water,** nitrogen, and plant **or** compressed oil-free **dry air, as** required, for cleaning pipe or piping systems. The subcontractor shall furnish **all ffttfngs, hoses, piping,** and **accessories** to connect the **system** being cleaned to the contractor's **system.**

Block control valves **in the open position; remove** orifice plates, traps, and strainers **prior** to **or during** the **process** of cleaning. **Introduce** the **flushing medium at** the **remote** end of **the** piping **system. Flush** from the upstream side of check valves. Alternately **open** each **extremity** of **the lfne so** that the ***entire system*** is flushed.

The following **piping** systems **(after** chemically **cleaning)' must be kept absolutely free** of **oil, grease, dirt,** paint, and other foreign materials **before and after erection.**

Section	Services
S-a	Nitrogen
5-9	**Oxygen**
5-11	Plant Air

Tools for **assembling** the piping **must** be degreased.

5-15-3. PIPING WHICH **REQUIRES** CHEMICAL CLEANING BEFORE **ERECTION.--Pi pe,** valves, **and** fittings for the following services **shall be chemically** cleaned:

Section	Services
5-6	Oistilled Water (SS)
5-8	**Nitrogen**
5-9	Oxygen
5-10	Acetylene
5-11	Plant Air

The contractor will do all chemical cleaning and cap **or** seal off all **ends** of pipe, valves, **or** fittings. Piping shall **be** cleaned in **the** largest practical assemblies, **but** dimensions shall not exceed 20' **by 4' by 4'** nor contain **more** than **two** fittings **and** shall not contain any **valves.** Pipe **2" and** larger shall **be** provided **with** lifting **lugs.**

The subcontractor shall deliver materials to be cle to the C-400 Building cleaning facility. After cleaning, the subcont shall pick up the materials from C-400 and keep them as clean as rece

The subcontractor shall pay for recleaning if requi because of his negligence in handling and storage.

5-15-4. PIPING WHICH DOES NOT REQUIRE CHEMICAL CLEANING BEF ERECTION.--All pipe, valves, and fittings used in fabricating piping under this classification for conveying services other than those lis paragraph 5-15-3 will not require chemical cleaning. However, each c of any piping system will not require chemical cleaning. However, ea component of any piping system under this classification shall be cle inspected before erection as follows:

Inspect all pipe, valves, and fittings for physical and replace broken, chipped, cracked, or defective items with new.

Remove all loose scale, rust, dirt, mud, and other materials from interior surfaces by wire brushing, scrubbing, or flus with air or water.

Remove excess dirt, rust, grease, and oil from exte surfaces.

Provide caps or protective covers over ends of pipe and fittings until ready to install.

5-15-5. PIPING STERILIZATION.--The hot and cold sanitary wa systems shall be sterilized after erection and testing.

Prior to a sterilization, the system shall be flush potable water for five minutes at a velocity of at least 2.5' per sec Drain system and then sterilize.

5-15-6. STERILIZATION MATERIALS AND METHODS.

5-15-6.1 Materials.--Use a disinfecting solution which conta minimum of 50 ppm of chlorine by weight of water. Commercial high-te hypochlorite, known as HTH, with not less than 65 percent available c shall be used to prepare this solution.

Commercial laundry bleach with a minimum content of percent available chlorine may be substituted for HTH in preparing th fecting solution in lines 1 1/2" and smaller. Use 1/2 pint of laundr to each gallon of water in the system.

5-15-6.2 Method.--Make a slurry in a suitable container using the proper amount of HTH. Add the slurry or laundry bleach, a little at a time, to the line as it is being filled with water. A uniform concentration throughout the system is required. Let the line stand full for at least 24 hours. At the end of this time the chlorine content of the water shall not be less than 10 ppm. Flush the line until the chlorine content of the water is less than 1 ppm, then connect to the existing system,

Section 5-16
Testing and Inspection of Piping Systems

5-16-1. SCOPE.--This specification covers the testing and inspection of piping system. The subcontractor shall furnish all labor, material equipment, tools, and services necessary for testing except fur work, materials, and/or equipment to be furnished by the contractor. Three classe of tests are included:

Class A - Pneumatic Test.
Class 8 - Hydrostatic Test
Class C - Water Test, Drainage Systems

The class of test to be applied is specified in the applic ble piping sections.

5-16-2. DEFINITION FOR MAXIMUM WORKING PRESSURE OF A SYSTEM.--The maximum working pressure of a system is defined as the predetermined value a which the piping system's safety relieving devices are set to prevent over-pressurizing the system. Either the set pressure of the relieving devices o the maximum operating pressure of the piping system shall be specified on th drawings.

5-16-3. GENERAL TESTING REQUIREMENTS.--General requirements for te to be performed on installed piping systems under this specification shall b as follows:

5-16-3.1 Blank off or replace with spool pieces items of equipnent (e.g., instruments, controls, safety, and relief valves) rated for pressures below the test pressure. Before performing final operating pressure test on system, remove test blanks and Spool pieces, and reconnect protected instruments and equipment.

5-16-3.2 Inspect all parts of the system for leaks, especially at valves, flanges, welds, threaded connections, and packed joints. All leaks shall be repaired and the repaired joints retested.

5-16-3.3 Check that safety and relief valves have been inspected and set by the contractor at the required set pressure.

5-16-3.4 Soap solution for soap testing shall be a soapless lather, leak detector solution as manufactured by Industrial Colloids and Chemical, or approved equal.

5-16-3.5 Use adequate precautions during pneumatic pressure testing. Clear the installation area of personnel not engaged in testing operations. Visually inspect the system installation for compliance with the design drawi and specifications.

5-16-3.6 The test medium for testing piping systems shall be as shown in Table I (this specification).

5-16-4. WORK, MATERIALS, AND/OR EQUIPMENT FURNISHED BY THE CONTRACTOR.

5-16-4.1 The contractor will furnish the test gauges and testing media required to conduct Class A, Class B, and Class C tests.

5-16-5. CLASS A TESTING (PNEUMATIC PRESSURE TEST).--Class A testing consists of pneumatically pressure testing piping systems or isolated sections of piping systems with compressed air or nitrogen as specified in Table I. Test pressures and test procedures shall be as follows:

5-16-5.1 Test Pressure.--Test pressure for pneumatically pressure testing pipe sizes 6" and under shall be 1.5 times the maximum working pressure, but in no case less than 50 psig.

5-16-5.2 Test Procedure (when test pressure is 50 psig).--With equipment items protected and safety precautions taken in accordance with paragraphs 5-16-3.1 and 5-16-3.5, pressure system to 50 psig. Soap test all welds, joints, and connections. Repair leaks and retest repaired joints.

After instruments and equipment have been reconnected, these connections shall be pressurized and soap tested at maximum operating pressure. Repair leaks and retest repaired joints,

5-16-5.3 Test Procedure (when test pressure exceeds 50 psig).--With equipment items protected and safety Precautions taken in accordance with paragraphs 5-16-3.1 and 5-16-3.5, gradually Pressurize system to 50 percent of the test pressure. Thereafter, the test pressure shall be increased in steps of approximately 1/10 of the test pressure until the required test pressure is reached. Then reduce pressure to 75 percent of the test pressure. Soap test all welds, joints, and connections. Repair leaks and retest required joints.

After instruments and equipment have been reconnected, these connections shall be pressurized and soap tested at maximum operating pressure. Repair leaks and retest repaired joints.

5-16-6. CUSS B TESTING (hydrostatic test).--Class B testing consists of hydrostatically pressure testing piping systems or isolate4 sections of piping systems with water or another liquid as specified in Table I. Test pressures and test procedures shall be as follows:

5-16-6.1 Test Pressure.--Test pressure shall be 1.5 times the maximum working pressure, unless specified otherwise on the drawings, but not less than 50 psig.

5-16-6.2 Test Procedure.--With equipment items protected in accordance with paragraphs 5-16-3.1 and 5-16-3.5, pressurize system to test pressure. Hold pressure while visually inspecting all welds, joints, and connections for leaks. Repair leaks and retest repaired joints.

Orain system and after instruments and equipment are reconnected, refill with service medium and apply maximum operating pressure. Hold pressure while visually inspecting these joints and connections for leaks. Repair leaks and retest repaired joints.

5-16-7. CLASS C TESTING (water test, drainage systems).

5-16-7.1 Class C testing consists of testing building drains and building sewers with a 10' head of water as follows:

5-16-7.2 Test building drain and vent system in accordance with the National Plumbing Code, ANSI A40.8, paragraph 14.9, Water Test. Final test may be either smoke or peppermint test.

5-16-7.3 Test building sewer in accordance with the National Plumbing Code, ANSI A40.8, paragraph 14.10.

TABLE I
TEST MEDIA FOR PIPING SYSTEMS

Piping Section	Service	Test Medium		
		Class A Test	Class B Test	Class C Test
5-3	Steam and Condensate 0-50 pounds		Water	
5-4	Steam and Condensate 151-250 pounds		Water	
5-5	Aboveground Potable Water		Water	
5-6	Distilled Water (SS)		Water	
5-7	Chemical Drains			Water
5-8	Nitrogen	Nitrogen/ Dry Air		
5-9	*Oxygen*	Nitrogen		
5-10	Acetylene	Nitrogen		
5-11	Plant Air	Plant Air	Water	

Section 5-17
Identification of Piping and Color Code

5-17-1. **SCOPE.--This** specification outlines **details** of identifying valves and the identification and color coding of exposed piping after erection, insulation, and painting are completed. Exposed piping **is** defined in all piping which is visible in **the** open or **may** be **exposed by** the removal of panels.

5-17-2. DESCRIPTION OF MARKERS.--Identification markers **shall be** self-adhesive labels as manufactured by the W. H. Brady Company, **Milwaukee,** Wisconsin. The labels shall be of suitable background color, upon which are printed. in black lettering the name of the flowing **medium,** followed by pressure in psig. The direction of **flow** in each pipe shall **be** indicated **by** a black arrow on **a** label adjacent to **the** identification label and of the **same** background color **as** the identification label. Piping identification colors shall be as **shown** in Section 5-17-6.

Letter heights for **use** in titles are governed **by** the outside diameter of **the** pipeline, including insulation. The letter heights are to be 5/8".

5-17-3. **LOCATION OF** MARKERS.

5-17-3.1 **Straight sections** of pipelines, inside buildings, shall bear identification **markers at maximum** intervals of 20'. Straight sections, of pipelines, **outside** buildings, **shall bear** identification **markers at maximum** intervals of 20'.

5-17-3.2 Branch lines shall be identified with a marker located not more than 5' from the main line.

5-17-3.3 Lines passing through walls or floors shall be identified on each side by a marker located not **more** than 5' from the wall or *floor.*

5-17-3.4 Markers on **banks** of piping shall be placed in **a** row, side-by-side, for **ease** *of* reference.

5-17-4. METHOD **OF APPLYING** LABELS.

5-17-4.1 **Surface** to which labels **are** adhered **must be** *free of* scale, dirt, **dust,** grease, and moisture. Press the **label** firmly in place, rubbing thoroughly, particularly along the edges, until the adhesive **makes** a good **bond.**

5-17-4.2 Overcoat the entire label, including 1/2" overlap at the edges with a heavy coat *of* Glidden Clear **Silk** Screen Acrylic Y-7135.

5-17.4.3 Mastic coatings on insulated lines such as Vimasco's WC-1, Insul-Coustic's IC-551, **and** Benjamin **Foster's** 60-60 **must** be completely **dry** before applying labels.

5-17-5. **IDENTIFICATION** OF VALVES.--All valves identified on the drawings and specification with V-numbers shall be permanently identified with stainless steel tags embossed with the applicable V-numbers. Tags shall be attached to valves with a stainless steel wire. They shall not be attached to handwheels or levers or other parts of valves which would interfere with operation.

5-17-6. PIPING SERVICE AND LABEL WORDING	LABEL BACKGROUND COLOR
Compressed afr - psig	Blue
Steam condensate	Orange
Steam - psig	Orange
Nitrogen	Blue
Oxygen - psfg	Yellow
Acetylene - psig	Yellow
Sanitary water - HOT	Green
Sanitary water - COLD	Green

5-17-7. PIPE PAINTING.

5-17-7.1 All carbon steel and black iron indoor piping both insulated and uninsulated shall be painted except piping or valves enclosed in housings or above suspended ceilings. Exposed surfaces in insulation on insulated pipe shall be primed with a coat of flat white undercoat and topcoated with two coats of enamel as hereafter described.. Uninsulated pipe both indoor and outdoor shall be primed and topcoated with two coats of enamel as hereafter described.

5-17-7.2 Paint for prime coating shall be a zinc chromate equivalent to "Speedhide No. 6-204" as manufactured by Pittsburgh Paint Company. Paint for topcoating shall be "Speedhide Interior-Exterior Gloss Enamel" as manufactured by Pittsburgh Paint Company. The final color shall be as shown below; the initial topcoat shall be tinted to provide a lighter color than the final required color.

Surface	Color	Chip Number
Compressed air	White	23-83
Nitrogen	Blue	23-77
Steam and condensate	Gray	23-75
Water	Gray	23-75
Oxygen	Green	3-20
Acetylene	Orange	23-8t

Section 6

ENVIRONMENTAL CONTROL SYSTEMS INSTALLATION AND EQUIPMENT

6-1. **GENERAL.--In** general, the work will consist of furnishing and installing **fume hood** exhaust fans, roof exhaust fans, heat pump, **supply grilles,** return air **grilles,** sidewall **exhaust** fan, supports and **associated** duct-work **as** shown on the **drawings and specified** herein.

6-2. **SHOP DRAWINGS** AND **MANUFACTURER'S DATA.--The** subcontractor shall submit for approval vendor data and **shop drawings** as specified **herein** and in the Special Conditions on the following equipment:

Description	MSE-13614-A Drawing Item Number
Sidewall Exhaust Fan	Item A
Canopy Number **Exhaust Fan**	Item B
Fume Hood **Exhaust Fan**	Item C
Fume Hood Exhaust Fan	Item D
Duct Fan, Canopy Number **2 and** Enclosure Exhaust	Item E
Roof **Exhaust Fan**	Item F
Heat Pump	Item G
Fan Coil Unit	Item H
Ceiling Diffuser	Item J
Ceiling Diffuser	Item K
Ceiling Diffuser	Item L
Return Air Grill	Item M
Return Air Grill	Item N
Louver	Item P

6-3. **SIDEWALL EXHAUST FAN.--The sidewall** exhaust fan shall **be as** specified on data **sheet** DS-M-13614-A. Fan shall be installed **as** shown on the design drawings **and in** accordance with manufacturers installation instructions.

6-4. CENTRIFUGAL **EXHAUST FAN.--The** centrifugal exhaust **fans shall be** as specified on data sheets DS-M-13614-B, C **and** D. The **fans** shall **be** mounted on vibration isolation **pads and as** per manufacturers recommendations in locations **shown** on **mechanical drawing MSE-13614-A.**

6-5. FIBER GLASS DUCT FANS.--The fiber glass duct mounted fans shall **be as** specified **on** data sheet DS-M-13614-E and shall be installed as shown on drawing MSE-13614-A and in accordance with manufacturers installation instruct;

6-6. **VAPOR** COMPRESSION HEAT PUMP.--Heat pump shall **be a** split syste **with** matching indoor **and** outdoor unit coil **volumes plus expansion valves** for both systems. **Outdoor** unit shall **be** equipped with compressor crankcase heater, suction line accumulator, discharge high temperature cutout, high pressure switch and defr controls. Units are to operate on 208 volts, 60 cycle, single-phase power. Indoo unit shall contain 5 kW backup heat controlling **by** the **second** stage of **the** indoor

6-6. VAPOR COMPRESSION HEAT PUMP.--Continued

thermostat. The combined efficiencies of the matched system shall be 7.8 EER, high temperature COP 2.7, and low temperature COP of 1.9. Unit shall be Lennox HP10-211V and C8P13-480FF or approved equal, complete with thermostat.

6-7. DUCTWORK AND EQUIPMENT.--All ductwork whall be fabricated and installed in accordance with details on the drawings and the recommendations of the SMACNA LVDCS. Ductwork accessories such as fasteners, bolts, nuts, sheet metal screws, etc., shall be zinc coated steel.

6-7.1 Ceiling Grilles and Diffusers.--All ceiling grilles and diffusers shall be as specified on drawing M5E-13614-A.

6-7.2 Turning Vanes.--All square elbows shall have airfoil type turning vanes installed, except where noted.

6-7.3 Stainless Steel Duct.--All stainless steel duct shall be continuous welded except where connections are made to fans which shall be flanged and gasketed with neoprene rubber.

6-8. PIPING FABRICATION AND INSTALLATION.--The following details of fabrication and installation apply to refrigerant and drain piping as shown on drawing MSE-13614-A.

6-8.1 Refrigerant Piping.

6-8.1.1 Furnish and install all refrigerant piping complete with pipe fittings and supports, as required or indicated. Sizes shall be recommended by unit manufacturer.

6-8.1.2 All tubing shall be new, straight, uniformly round, free from all blisters, flats or dents, and all ends shall be reamed tc full inside diameter before erecting. Tubing shall be so installed as to be capable of relieving strain from expansion and contraction.

6-8.1.3 As few fittings as possible shall be used to make connections, but this shall not be taken to mean that the connections shall not be made as neat and inconspicuous as possible.

6-8.2 Condensate Drain Piping.

6-8.2.1 Furnish and install all condensate drain piping complete with pipe fittings, supports, etc.; as required or indicated. Piping shall be 3/4" copper as shown on MSE-13614-A and 8.

6-8.2.2 All tubing shall be new, straight, uniformly round, free from all blisters, flats or dents, and all ends shall be reamed to full inside diameter before erecting. Tubing shall be installed as to be capable of relieving strain from expansion and contraction.

6-8.2.3 As few fittings as possible shall be used to make connections, but this shall not be taken to mean that the connections shall not be made as neat and inconspicuous as possible.

6-9. PIPING MATERIALS.

6-9.1 Refrigerant Piping.--The compressor shall be piped to the DX coil according to information supplied by manufacturer. Materials required for refrigerant piping shall be selected from the following lists:

Item	Site (Incl.)	Specifications
Tubing	1/4" to 1"	Copper, seamless water tube, hard drawn, Type L, in straight lengths, ASTM B88.
Fittings (solder type)	1/4" to 1"	Copper, wrought, seamless, ANSI 816.22 or. cast brass, 485-5-5-5), ANSI 816.18, tinned: elbows for wrought copper shall be long radius type.
Fittings (flared)	1/4" to 3/4" nominal	Use only to mate with. valves or equipment; forged brass or drawn brass rod, ANSI 870.1.

6-10. PIPING TESTING.

6-10.1 Refrigerant Piping.--Before any insulation is applied, the system shall be tested by charging to approximately 10 psig with Refrigerant 12, and then adding nitrogen or helium to increase system pressure to 300 psig, and held for 12 hours. without loss of pressure. A refrigerant leak detector shall be used to check the entire system for leaks at 300 psig pressure, Affected sections of the system shall be retested after any repairs are made. The system shall then be evacuated and charged by the subcontractor. The subcontractor shall then. insulate refrigerant piping.

6-10.2 Condensate Drains.--Testing consists of testing the condensate drain piping with 10' head of water. The drain test shall be in accordance with National Plumbing Code, ANSI A40.8, paragraph 14.9, Water Test. Repair leaks and retest.

6-11. INSULATION MATERIALS.

6-11.1 Refrigerant Piping.--Insulation shall be composed of 3/8" thic cellular foam pipe insulation. Insulation shall be Armstrong "Armaflex" or approv equal. All joints shall be sealed with Armstrong adhesive or approved equal.

6-11.2 Supply and Return Ouct Insulation (Internal).

6-11.2.1 Insulation duct liner shall be composed of inorganic fibrous glass 1" thickness, unless otherwise specified on drawings, with a resin binder performed into semirigid panels and covered on one side with a neoprene coating conforming tc the requirements of NFPA 90A. Thermal conductivity shall not exceed 0.25 Btu/h/sq ft/°F/in. thick at a mean temperature of 75°F.

6-11.2.2 The following is acceptable: Certain-Teed/Saint Gobain Insulation Corporation, "Ultra-Liner" insulation board with NFPA coating or approved equal.

6-11.2.3 Accessory Materials.

Item	Specifications
Fasteners	Grahm Isul-Pins and Clips of same material as duct or approved equal.
Adhesive	Fire resistant, Benjamin Foster 85-10 "Spark-Fas," Insu1-Coustic/8irma Corporation "Sure Stick," or approved equal.

6-11.3 Supply and Return Ouct Insulation (External).

6-11.3.1 Insulation shall be composed of an inorganic fibrous glass with a resin binder performed into a blanket obtainable in rolls. One side shall be covered with an aluminum foil, scrim, and flame resistant kraft paper facing.

Density	3/4 pound per cubic foot.
Thermal Conductivity	Shall not exceed 0.28 8tu/h/sq ft/°F/in. thick at a mean temperature of 75°F.

6-11.3.2 The following is acceptable: Owens-Corning flexible vapor seal insulation, Type PF-335F with FRK facing. Thickness shall be 1" unless otherwise specified on the drawings.

6-12.1 Ductwork shall be supported fn accordance with Ffgures 5-1 thru 5-5 with strap per SMACNA Low Pressure Duct Construction Standards.

6-12.2 After ductwork systems have been installed, a simple physical leak test inspection shall be conducted. All afr leaks shall be sealed as approved by the Construction Engineer.

6-13. BALANCING.—Air balancing *of* supply and exhaust systems shall be performed by the subcontractor. Fan speeds and diffusers shall be adjusted to provide air flow as stated on drawing M5E-13614-A.

6-14. START-UP.--The HVAC units shall be started up and tested in the presence of a representative of the Contractor. Arrangements shall be made prior *to* start-up so that a representative can be present. HVAC units shall operate for 24 hours without malfunction before approval of system. Before final approval of *system,* all filters shall be removed, cleaned with water, air dried, and replaced.

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
OAK RIDGE, TENNESSEE 37830

DATA SHEET

ROOF OR WALL VENTILATOR

PROJECT	DATA SHEET NO.
Environmental Laboratory C-409 Building	DS-M-13614-A
	PAGE OF

REVISIONS			PLANT	BUILDING	PREPARED BY	THIS SHEET PART
REV.	APPROVAL	DATE	PGOP	C-409	M. W. Ihnen	T.S. Sect.
			W.O. OR E.S.O.		APPROVAL	DATE
			REQUISITION NO.		PROCURED BY	INSTALLED BY
					FPSC	FPSC

EQUIPMENT NUMBERS	Item A EF-1		
SELECTION - Manufacturer	Green Heck		
Model	SW-22-f		
Size	22		
TOTAL QUANTITY REQUIRED	1 each		
FAN SPECIFICATIONS & PERFORMANCE			
Airflow, CFH	2945		
Static pressure, "W.G.	0		
RPM, max	580		
Brake HP. Max	1/4		
Type of wheel	Centrifugal		
Material of construction	Aluminum		
Finish	Spun aluminum		
Roof or Wall mounting	Wall mounting		
MOTOR SPECIFICATIONS			
Electrical type	Ind.		
Enclosure	Total encl.		
Duty rating	Cont.		
Bearings	Ball		
Lubrication	Seal		
Frame Number	*		
Rated HP	1/4		
Volts, phase. Hz	115/1/60		
ACCESSORIES-			
V-Belt drive	Direct drive		
Fixed	-		
Adjustable	-		
Backdraft damper	yes		
Inlet grille			
Belt guard	-		
Bird screen	Yes PVC coated		
Acoustical roof cub	No		

REMARKS:

Fan wheel shall be statically and dynamically balanced

Furnish the following manufacturer's data in quantities indicated:	NUMBER OF COPIES W/Bids	Approval	Certified	TYPE OF DATA (CONTINUED)	NUMBER OF COPIES W/Bids	Approval	Cer
1. Outline dimension drawings		6	6	5. Descriptive literature		6	6
2. Weight of equipment		6	6				
3. Performance curves or tables		6	6				
4. Installation instructions		6	6				

UNION CARBIDE CORPORATION
NUCLEAR DIVISION
OAK RIDGE, TENNESSEE 37830

DATA SHEET

CENTRIFUGAL FAN

PROJECT: Environmental Laboratory C-409 Building
DATA SHEET NO: DS-M-13614-B
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REV.	APPROVAL	DATE

PLANT	BUILDING	PREPARED BY	THIS SHEET PAR. OF
PGDP	C-409	M. W. Ihnen	T.S. Sect. 6

W.O. OR E.S.O.	APPROVAL	DATE

REQUISITION NO.	PROCURED BY	INSTALLED BY
	FPSC	FPSC

EQUIPMENT NUMBERS: Item B

SELECTION: Manufacturer	Barry
Model No.	BVD 105
Size	10 1/2
TOTAL QUANTITY REQUIRED	1 each
PERFORMANCE - Volume CFM	930
Static pressure, in. W.G.	1.0
Service-Supply, Exhaust, etc.	Exhaust
Flowing medium	Air-fumes
Temperature at inlet °F	70
Barom. press. at inlet, "Hg.	29.92
Outlet velocity, FPM max.	1476
Wheel diameter, in.	10.5
Fan speed, RPM max.	1949
Brake HP max.	.27
ARRANGEMENT - AMCA Arrangement No.	10
SISW or DIDW	SISW
Rotation	CW
AMCA discharge position	UB
AMCA motor position	Arr 10
Housing: Fixed, 45° Adjustable	Fixed
Inlet connection type	Flanged
Outlet connection type	Flanged
CONSTRUCTION - AMCA Class	
AMCA sparkproof class	
Housing material	316 SS
Housing seams	Continuous Welded
Housing design: Full or Split	Full
Shaft material	316 SS
Bearings: Roller or Ball? (All bearings shall be self-aligning external grease lube type. Roller bearings shall be taper-lock spherical type).	Ball

CONSTR(cont) - Wheel type	Nonoverloading BI
Wheel material	316 SS
Wheel construction	
MOTOR - Equipment Number	
Horsepower	1/2
Volts, phase, Hz	115/1/60
Electrical type	Induct
Enclosure	TEFC
Adjustable base required	Yes
Service factor	1.15
Full load RPM	1750
NEMA design letter	*
NEMA Frame No.	*
DRIVE - Type	V-belt
HP rating	.75
Motor sheave Fixed, Vari-pitch	Vari-pitch
ACCESSORIES - Belt guard	Yes
Variable inlet vanes	No
Opposed blade disch. damper	No
Inlet screens	No
Access door: Flush or Raised	Raised
Access door position	3 o'clock
Drain connx size, in. IPS	1
Weatherproof drive cover	No
Bearing cooling type	-
vibration base common to fan & motor sized for 10% transmissibility	Rubber in shear or fiberglass
PAINTING - Manufacturer's standard	*
Special (describe)	
COATINGS - (Describe)	

Furnish the following manufacturer's data in quantities indicated:	NUMBER Of COPIES W/Bids	Approval	Certific
1. Performance curves or tables indicating actual fan speed, outlet velocity, and brake HP for specified conditions.		4	10
2. Outline dimensional drawings by		4	10

TYPE OF DATA (CONTINUED)	NUMBER Of COPIES W/Bids	Approval	Certif
3. Weight of equipment		4	
4. Installation instructions		-	
5. AMCA round ratings		6	

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UNION CARBIDE CORPORATION
NUCLEAR DIVISION
OAK RIDGE, TENNESSEE 37830

DATA SHEET

CENTRIFUGAL FAN

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PLANT	BUILDING	PREPARED BY	THIS SHEET PART
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REQUISITION NO.	PROCURED BY	INSTALLED BY
	FPSC	FPSC

EQUIPMENT NUMBERS: Item C

SELECTION: Manufacturer	Barry	MOTOR - Equipment Number	
Model No.	BVD 105	Horsepower	1/4
Size	10 1/2	Volts, phase, Hz	5/1/
TOTAL QUANTITY REQUIRED	1 each	Electrical type	Induct
PERFORMANCE - Volume CFM	1000	Enclosure	TEFC
Static pressure, In. W.G.	.75	Adjustable base required	Yes
Service-Supply, Exhaust, etc.	Exhaust	Service factor	1.15
Flowing medium	Air fumes	Full load RPM	7?
Temperature at inlet °F	70	NEMA design letter	*
Barom. press. at inlet, "Hg.	29.92	NEMA frame No.	*
Outlet velocity, FPM max.	1588	DRIVE - Type	- t
Wheel diameter, in.	10.5"	HP rating	.75
Fan speed, RPM max.	1887	Motor sheave fixed. Vari-pitch	ari-p
Brake HP max.	.24	ACCESSORIES - Belt guard	Yes
ARRANGEMENT - AMCA Arrangement No.	10	Variable inlet vanes	-
SISW or DIDW	SISW	Opposed blade disch. damper	
Rotation	CCW	Inlet screens	-
AMCA discharge position	UB	Access door: Flush or Raised	aised
Inlet connection type	Flanged	Weatherproof drive cover	No
Outlet connection type	Flanged	Bearing cooling type	No
CONSTRUCTION - AMCA Class	I	vibration base common to fan & motor sized for 10% transmissibility	Rubber snear fibers
AMCA spark proof class			
Housing material	376 SS	PAINTING - Manufacturer's standard	*
Housing seams	Continuous Welded	Special (describe)	
Housing design: Full or Split	Full		
Shaft material	316 SS		
Bearings: Roller or Ball? (All bearings shall be self-aligning external grease lube type. Roller bearings shall be taper-lock spherical type).	Ball	COATINGS - (Describe)	
		Wheel type	Nonoverloading RI
		Wheel material	316 SS
		Wheel construction	

REMARKS: Fan snail be AMCA rated and tested. Fan unit shall be both statically and dynamically balanced.
Fan shall bear AMCA seal.

Furnish the following manufacturer's data in quantities indicated:	NUMBER OF COPIES W/Bids	Approval	Certified	TYPE OF DATA (CONTINUED)	NUMBER OF COPI W. Bids	Approval	Ce
1. Performance curves or tables indicating actual fan speed, outlet velocity, and brake HP for specified conditions.		4	10	3. Weight of equipment		0	-
2. Outline dimensional drawings		6	6	4. Installation Instructions		-	)
				5. AMCA sound ratings		6	-

*Information to be supplied by equipment manufacturer.

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OAK RIDGE, TENNESSEE 37830

DATA SHEET

CENTRIFUGAL FAN

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REQUISITION NO. | PROCURED BY: FPSC | INSTALLED BY: FPSC

EQUIPMENT NUMBERS: Drawing M5E-13614-A Item D

SELECTION: Manufacturer	Barry	MOTOR - Equipment Number	
Model No.	BVD 105	Horsepower	?/4
Size	10 1/2	Volts, phase, Hz	5/1/60
TOTAL QUANTITY REQUIRED	1 each	Electrical type	Induct
PERFORMANCE - Volume CFM	750	Enclosure	TEFC
Static pressure, In. W.G.	3f4	Adjustable base required	Yes
Service-Supply, Exhaust, etc.	Exhaust	Service factor	1 15
Flowing medium	Air fumes	Full load RPM	50
Temperature at inlet °F	70	NEMA design letter	*
Barom. press. at inlet. "Hg.	29.92	NEMA Frame No.	*
Outlet velocity, FPM max.	1191	DRIVE - Type	V-belt
Wheal diameter, In.	10.5	HP rating	75
Fan wed. RPM max.	1626	Motor sheave Fixed, Vari-pitch	Vari-pitch
Brake HP max.	.15	ACCESSORIES - Belt guard	Yes
ARRANGEMENT- AMCA Arrangement No.	10	Variable inlet vanes	-
SISW or DIDW	SISW	Opposed blade disch. damper	-
Rotation	CCW	Inlet screens	-
		CONSTR (cont) - Wheel type	Nonoverloading BI
		Wheel material	316 SS
		Wheel construction	

Inlet connection type	Flanged	Weatherproof drive c a w	-
Outlet connection type	Flanged	Bearing cooling type	-
CONSTRUCTION - AMCA Class	1	Spring type vibration base common to fan & motor sized for 10% transmissibility	Rubber in snear or fiberglass
AMCA sparkproof class			
Housing material	316 SS		
Housing design: Full or Split	Full	Special (describe)	
Shaft material	316 SS		
Bearings: Roller or Ball? (All bearings shall be self-aligning external grease lube type. Roller bearings shall be taper-lock spherical type).	Ball	COATINGS - (Describe)	

Furnish the following manufacturer's data in quantities indicated:	NUMBER Of COPIES W/Bids	Approval	Certified
I. Performance curves or tables indicating actual fan speed, outlet velocity, and brake HP for specified conditions.		4	10

TYPE OF DATA (CONTINUED)	NUMBER OF COPIES W/Bids	Approval	Certified
3. Weight ot equipment		b	-
4. Installation instructions		-	6
5. AMCA sound ratings		b	

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NUCLEAR DIVISION
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DATA SHEET

AXIAL FLOW FAN

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PLANT	BUILDING	PREPARED BY	THIS SHEET PR
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W.O. OR E.S.J.		APPROVAL	DATE
REQUISITION NO.		PROCURED BY	INSTALLED BY
		FPSC	FPSC

EQUIPMENT NUMBERS: Drawing M5E-13614-A Item E

SELECTION: Manufacturer	Hartzell	CONSTR. (cont) - Shaft material	Monel
		MOTOR - Equipment Number	-
Size		Horsepower	.75
TOTAL QUANTITY REQUIRED	2 each	Volts, phase, Hz	208/1/6
		Enclosure	TEFC
Static pressure, In. W.G.	.75	Adjustable base required	Yes
Service-Supply, Exhaust, etc.	Exhaust	Full load RPM	1750
Flowing medium	Air fumes	NEMA design letter	*
Temperature at inlet °F	70	NEMA Frame No.	*
Barom. press at inlet, "Hg.	29.92	DRIVE - Type	V-belt
Outlet velocity, FPM max.		HP rating	1.0
Rotor diameter, In.	16	ACCESSORIES - Streamline inlet (no duct)	-
Brake HP mrx,	.75	Outlet cone	-
AMCA Arrangement No,	-	Belt guard (external)	Yes
Horiz. or Vert. mounting	Vert	Tunnel belt enclosure	Yes
Diameter of basic fan, In,	16	Inlet screen	-
Dia. of connecting duct, In.	16	Access door position	-
Motor location looking in air-flow direction	Motor mounted to fan	Weatherproof motor cover	-
Base for Floor, Wall or Ceiling		Weatherproof drive cover	-
		Spring type vibration base sized	

Bearings: Roller or Ball? (All bearings shall be self-aligning external grease lube type. Roller bearings shall be taperlock spherical type)	Ball

COATING - (Describe): All internal surfaces sh be resin coated after assembly, all bolts shal oe monel

REMARKS: fan snarl be AMCA rated ma tested. Fan unit shall be both statically and dynamically balanced.

Furnish the following manufacturer's data in quantities indicated:	NUMBER OF COPIES W/Bids	Approval	Certified	TYPE OF DATA (CONTINUED)	NUMBER OF COPI W Bids	Approval	Ce
1. Performance curves or tables indicating actual fan speed, outlet velocity and brake HP for specified conditions.		4	10	3. Weight of equipment		6	-
				4. Installation instructions		-	6
				5. AMCA sound ratings.		6	-
2. Outline dimensional drawings		6	6				

*Information to be supplied by equipment manufacturer.

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DATA SHEET

REVISIONS		
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PLANT	BUILDING	PREPARED BY	THIS SHEET PART OF
PGOP	C-409	M. W. Ihnen	T.S. Sect. 6

APPROVAL	DATE

REQUISITION NO.	PROCURED BY	INSTALLED BY
	FPSC	FPSC

EQUIPMENT NUMBERS	
Drawing M5E-13614-A	
SELECTION- Manufacturer	Hartzell
Model	61-32NH4
Size	32
TOTAL QUANTITY REQUIRED	2 each
FAN SPECIFICATIONS & PERFORMANCE	
Airflow, CFM	10,000
Static pressure." W.G.	0
RPM, max	1160
Brake HP, Max	.a2
Type of wheel	Cast Alum. Air foil
Material of construction	Galv. St.
Finish	Galv.
Root or Wall mounting	Roof
MOTOR SPECIFICATIONS	
Electrical type	fnduct
Enclosure	TEAO
Duty rating	Continuous - 1.15 S.F.
Bearings	Ball
Lubrication	External grease 1ube
Frame Numoer	•
Rated HP	1.0
Volts, phase, Hz	208/3/60
ACCESSORIES-	
	Direct drive
Fixed	-
Adjustable	-
Backdratt damper	Yes
Inlet grille	Inlet screen!
Belt guard	-
Galv. St. Wind Band	Yes

Furnish the following manufacturer's data in quantities indicated:	NUMBER OF COPIES W/Bids	Approval	Certified
1. Outline dimension drawings		4	10
2. Weight of equipment		4	
3. Performance curves or tables		4	10
4. Installation instructions		4	10

TYPE OF DATA (CONTINUED)	NUMBER OF COPIES W/Bids	Approval	Certified
5. Descriptive literature		4	10

*Information to be supplied by equipment manufacturer.

UCN-28410
(2 3-71)

SPECIFICATIONS FOR

LIQUID CHEMICAL LABORATORY, C-409

AT

THE PAOUCAH GASEOUS DIFFUSION PLANT

PAOUCAH, KENTUCKY

INVITATION NO. 8115

SUBCONTRACT SPECIFICATIONS 13817

UNION CARBIDE CORPORATION
NUCLEAR DIVISION

Post Office Box 1410

Paducah, Kentucky 42001

December 16, 1983

TECHNICAL SPECIFICATIONS

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SECTION 4 - ARCHITECTURAL

4.100 - SPECIALTY WORK: DEMOLITION

1. GENERAL

The work to be performed under this section of the specifications consists of completing the demoliton as required by the design drawings and as specified herein. The work consists of removing an abandoned spray booth. Drawings detailing the work are Included in the subcontract package.

2. SALVAGE MATERIALS

Salvageable materials, not otherwise Indicated for reuse shall be transported and stored in the salvage area as specified in the SPECIAL CONDITIONS.

3. WASTE MATERIALS

Waste, debris, and/or other spoil material shall be disposed of as specified in the SPECIAL CONDITIONS.

SECTION 4 - ARCHITECTURAL

4.620 - HOLLOW METAL DOOR AND FRAME

1. GENERAL

This specification covers furnishing, fabrication,' shop painting, and erection of hollow metal door and frame.

2. SHOP DRAWINGS

Shop drawings shall be submitted for approval In accordance with SPECIAL CONDITIONS paragraph: SUBCONTRACTOR'S SUBMITTALS.

The Subcontractor shall submit completed and checked shop drawings for approval. The approval of shop drawings will be for door and frame types, sizes, styles, astragals, hardware reinforcing, and swing only, and shall not relieve the Subcontractor of the responsibility of error, omissions, or the accuracy of his own dimensions.

3. MATERIALS

A. Steel Frame

Frame shall be formed from cold-rolled, .16 gage steel. Frame shall be knocked-down mitered corners and shall have reinforcements with integral tabs. See drawings for size and location of door frame.

B. Hollow Metal Door

Door shall be flush, heavy duty, 18 gage 1 3/4" thick with urethane core. Door shall be mortised and reinforced for all hardware and related door accessories indicated on the drawings and as specified herein. Door shall be thoroughly cleaned, pretreated with a bonderizing or phosphatizing treatment to provide a strong bond between metal and paint and shop primed with a rust-inhibiting metal primer paint standard with the manufacturer.

C. Hardware

Hardware shall consist of 1 1/2 pairs of ball bearing hinges; a heavy duty antipanic device with provision for a mortise cylinder; as manufactured by Medico Security Lock, Inc., P. 0. Box 1075, Salem, Virginia 24153; a hold-open type closer, and an aluminum threshold.

4. INSTALLATION

A. Frame

Steel frame shall be plumbed, leveled, and rigidly secured in place by clips and/or bolts to fit design drawings.

8. ooor

Door and hardware shall be installed as indicated on the drawings. Door shall fit the frame square and true to 3/32" at jambs and head and 1/8" at bottom and threshold.

C. General

Door shall be protected from damage after installation. If damage does occur, door, frame, or accessories shall be replaced. Ooor shall be clean and shall operate properly in all functions at the final inspection.

5. PAINTING

Door and hardware shall be finish painted as specified in Section 11.430 - PAINTING.

4.623 - ROLL-UP DOOR

1. GENERAL

This specification covers furnishing, fabrication, shop painting, and erection of the door.

2. SHOP DRAWINGS

Shop drawings shall be submitted for approval in accordance with SPECIAL CONDITIONS paragraph: SUBCONTRACTOR'S SUBMITTALS.

The Subcontractor shall submit completed and checked shop drawings for approval, The approval of shop drawings will be for the door in general and shall not relieve the Subcontractor of the responsibility of error, omissions, or the accuracy of his own dimensions. Included with the shop drawings shall be installation procedures, general maintenance instructions, and parts manuals.

3. MATERIALS

A. General

Roll-up steel door shall be standard steel type construction with weather-tight features. Door shall be as manufactured by any of the following or Contractor. approved equal :

"Extr-Tite," Kinnear Corporation, Columbus, Ohio 43216
"Weatherlock," "Weatherguard," Walter Balfour & Company, Brooklyn, New York 11222
"Model A-1090," 3. C. Wilson Corporation, Norfolk, Virginia 23501
"Air-Bar," North American Door Company, Inc., Lindenhurst, New York 11757

8. Door

Door shall be manual operated, spring counterbalanced, overhead coiling type, and shall be designed for use on the type of openings indicated on the drawfngs. Ooor shall be complete with all guides, hardware, fasteners, operating mechanisms, and accessories. Guides at jambs shall be set back a sufficient distance to provide a clear opening when door is in the open position.

C. Curtain

Curtain shall be formed of interlocking galvanized steel slats of No, 20 gage minimum thickness. Slats shall be the manufacturer's standard. The curtain shall be designed to resist a wind pressure of 20 lbs per square foot without damage. The curtain shall roll up on a drum supported at the head of the opening on brackets and be balanced by helical springs.

D. Endlocks and Windlocks

The ends of each slat shall have malleable iron endlocks of the manufacturer's standard design. The door shall have windlocks of manufacturer's standard design at the ends of each slat, Windlocks shall prevent curtain from leaving the guide ds a result of deflection from wind pressure or other forces.

E. Bottom Rail

The curtain shall have a rolled-steel bottom bar consisting of two angles of equal weight, one on each side, fastened to the bottom of the curtain and shall have a compressible and replaceable rubber, neoprene, or vinyl weather seal attached to the bottom rail,

F. Guides

The guides shall consist of steel shapes not less than 2 1/2" deep and not less than 3/16" thick and shall form a channel pocket of sufficient depth to retain the curtain in place under the wind pressure specified. Provisions for removal of the door shall be included in the design. Guides shall be securely attached to adjoining construction with 3/8" diameter bolts spaced near each end and not over 24" apart. Door shall have guides weatherstripped.

G. Roller Shaft

The roller shaft shall be constructed of steel pipe or commercial welded steel tubing of proper diameter and thickness for the size of the curtain, Deflection shall not exceed 0.03" per foot of span. Ends of roller shall be closed with cast iron plugs, machined to fit the pipe. An oil-tempered, helical, counter-balancing steel spring, capable of producing sufficient torque installed within the roller. Spring shall be easily adjustable.

H. Brackets

Brackets shall be fabricated of heavy cast iron or steel, designed to close the ends of roller shaft housing and to form a supporting ring for hood. The bracket hubs or shaft plugs shall be equipped with prelubricated ball bearing, shielded, or sealed.

I. Hood

Hood shall be constructed of steel not lighter than No. 24 gage, formed to fit the contour of end brackets and reinforced with steel rods, or rolled beads at top and bottom edges. A weather baffle shall be provided at the lintel.

J. Gears

Gears shall be of the best grade gray iron, cast iron teeth machine molded from machine cut patterns.

4. FINISH

A. Galvanizing

Curtain and bottom rail shall be hot dipped galvanized with a zinc coating not less than 1.25 oz total per square foot of flat metal, coating class 1.25 in accordance with ASTM A525-81. Hood shall have either class 1.25 galvanizing as described above or be fabricated from electrolytic zinc-coated sheets conforming to ASTM A591-81, at Subcontractor's option.

8. Pretreatments

All zinc coated surfaces shall be given a phosphate coating prior to applications of prime paint.

C. Shop Applied Prime Paint

All ferrous surfaces including galvanized curtain, hood, and slats but excluding wearing surfaces shall be given one shop applied prime coat of the manufacturer's standard primer. Primer shall not contain lead. Nongalvanized surfaces shall be wire brushed to bare metal prior to primer application.

5. INSTALLATION

Door shall be installed in accordance with approved shop drawings and manufacturer's data. Anchors and inserts for brackets, tracks, hardware, and other accessories shall be located accurately. Upon completion, door shall be weather-tight and shall be lubricated and adjusted to operate freely.

6. PAINTING

Door shall be finish painted as specified in Section 11.430 - PAINTING.

SECTION 4 - ARCHITECTURAL

4.710 - FABRICATION AND ERECTION OF STRUCTURAL STEEL AND MISCELLANEOUS METAL

1. GENERAL

This specification covers furnishing, fabricating, shop painting, and erection of structural steel and miscellaneous metal.

2. CODES AND STANDARDS

Codes and standards which are called for or referred to herein are hereby made a part of these specifications to the extent indicated by the reference thereto.

A. American Institute of Steel Construction (AISC)

"Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," Eighth Edition

"Code of Standard Practice for Steel Building and Bridges," Eighth Edition

B. American Society for Testing and Materials (ASM)

A36-81a	Specification for Structural Steel
A325-83	Specification for High Strength Bolts for Structural Steel Joints, Including Suitable Nuts and Plain Hardened Washers
A167-82	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet,, and Strip

C. American Welding Society (AWS)

AWS D1.1-80	Structural Welding Code - Steel
AWS Chapter 65 Welding Handbook	Austenitic Chromium-Nickel Stainless Steel

D. Steel Structures Painting Council

SSPC-PA 1-82	Shop, Field, and Maintenance Painting
SSPC-SP 3-82	Power Tool Cleaning

E. Occupational Safety and Health Act (OSHA)

Standard 1910.23

3. MATERIALS

A. Structural Steel

Structural steel shapes, bars, and plates shall conform to ASTM A36-81a.

B. Checkered Plate

Checkered plate shall be 1/4" thick standard raised checkered pattern.

C. Bar Grating

Bar grating shall be 1 1/2" x 3/16" hot-rolled carbon steel, welded. Openings between bars shall be 1" with cross bars spaced 4" on center. Bearing bars shall run the length of the grating.

D. Welding Electrodes

Normal arc welding electrodes and submerged arc welding electrodes and granular flux for welding of weldable steel shall be in accordance with AWS D1.1-80.

E. Bolts

All high tensile bolts, nuts, and washers shall be in accordance with ASTM A325-83.

F. Stainless Steel

1) General

All stainless steel shall conform to ASTM A167-82. Material shall be new. Substitutions of materials, sizes, or shapes shall not be made without prior approval of the Construction Engineer.

2) Stainless Steel

All stainless steel shall be type 304L.

3) Welding Electrodes

Welding electrodes shall be the type specified for type 304L stainless steel by AWS Chapter 65 of Welding Handbook.

G. Ladder Safety Swing Gates

Safety swing gates shall meet OSHA Standard 1910.23: Gate shall open inward and close automatically after each passage. Gate shall guard the entire ladder opening.

4. CESIGN

A. General

All designing and detailing by the fabricator shall be in accordance with the AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings," AWS 01.1-80, and ASTM A36-81a.

B. Connections

1) Design and detail all parts of all connections for maximum strength of members compatible with their sections, lengths, and the types of stress to which they are subject. However; where loadings, reactions, stresses, or connections are shown on the design drawings, the fabricator shall be governed accordingly.

2) Shop connections shall be welded. The fabricator shall submit his welding standards for approval in accordance with SPECIAL CONDITIONS paragraph: SUBCONTRACTOR'S SUBMITTALS,

3) Field connections shall be made by welding or bolting in accordance with the design drawings.

5. FABRICATION

A. General

1) Except as modified herein, all structural steel shall be fabricated in accordance with the AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings."

2) Structures shall be shop fabricated so as to *form* assemblies of the largest practicable sizes economically suitable for transportation, and possible to be handled and erected.

B. Bolting

High strength bolts shall be tightened to a bolt tension not less than the proof load given in the ASTM Specification *for* the bolt. Tightening shall be done with properly calibrated wrenches or by turn-of-nut method.

C. Welded Construction Structural Steel

Welding of structural steel work shall be done by the electric arc process in accordance with AWS 01.1-80. Qualification of welders and duration of qualification period shall be in accordance with the requirements of this code. Certification shall be furnished by the Subcontractor when requested by the Construction Engineer.

D. Welded Construction Stainless Steel

Welding of stainless steel shall be In strict accordance with AWS Chapter 65. Welding shall be by one or more of the Arc Welding processes covered in AUS Chapter 65. Qualification of welders and duration of qualification shall be in accordance with the requirements of AWS 01.1-80. Certification shall be furnished by the Subcontractor when requested by the Construction Engineer.

6. SHOP FINISH

A. General

Except as otherwise indicated or specified, all structural steel, miscellaneous metal, and collateral material provided under this section shall be shop painted. Shop painting system shall consist of surface preparation, pretreatment where specified, and shop application of prime paint. Contact surfaces to be welded shall not be coated within 3" of the weld, prior to welding. All operations required for shop painting shall be in accordance SSPC-PA 1-82 and Section 11.430 of this specification.

8. Shop Primer

1) Surface preparation of structural steel and miscellaneous metal for normal painting shall be in accordance with SSPC-SP 3-82.

2) All cleaned surfaces shall be primed, before deterioration of cleaned surface has taken place, with one shop coat of Pittsburgh No. 6-204 zinc chromate or approved equal.

7. MARKING AND SHIPPING

All structural steel shall be prominently paint marked for identification in assembly with piece marks applied right side up on the end corresponding to the left end of the members shown in horizontal or inclined position, and at the lower end of the members in a vertical position. The markings shall be placed in protected areas, such as the web of beams, to avoid their obliteration. All metal shall be properly protected and so loaded as to prevent damage in transit.

8. ERECTION

A. General

Unless otherwise specified herein, erection of structural steel shall conform with the applicable sections of the AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," and the AISC "Code of Standard Practice for Steel Buildings and Bridges."

8. Temporary Bracing

Temporary bracing shall be used whenever necessary to support all loads to which the structure may be subjected, including equipment and operation thereof, and piles of materials. Such bracing shall be left in place as long as may be required for safety.

C. Field Connections

Field connections shall be made by welding or bolting in accordance with the shop drawings and Paragraph 9 - FABRICATION of this specification.

9. REJECTION

All work or parts thereof and materials entering therein, indicating irremediable or injurious defects, improper fabrication, excessive repairs, or that is not in accordance with the requirements of this specification shall be subject to rejection.

10. FIELD PAINTING

Structural steel and miscellaneous metals shall be field painted where required in accordance with Section 11.430 - PAINTING.

4.730 - FABRICATION AND ERECTION OF STEEL DECKING

1. GENERAL

This specification covers furnishing, fabricating, and erection of steel decking.

2. CODES AND STANDARDS

Codes and standards which are called for or referred to herein are hereby made a part of these specifications to the extent fndfcated by the reference thereto.

A. Steel Oeck Instftute (SDI)

"Design Manual for Composite Decks, Form Decks, and Roof Decks"

B. American Society for Testing and Materials (ASTM)

A446-76	Specification for Steel Sheet, 'Zinc-Coated (Galvanized) by the Hot-Dipped Process, Structural (Physfcal) Quality
A525-81	Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanired) by the Hot-Dip Process

3. MATERIALS

A, Steel Decking

Steel decking shall be 1 1/2" x 6", Wheeling narrow rib decking, Type A18, as manufactured by Wheeling Corrugating Company, Wheeling, West Virginia, or approved equal. Basic steel shall conform to ASTM A446-76, Grade A for galvanized steel having a minimum yield strength of 33,000 psi. Decking shall be finished with a galvanized coating conforming to ASTM A525-81, Class G 90.

B. Sheet Metal Closures and Flashing

Sheet metal closures and flashings shall be fabricated from galvanized sheets conforming to ASTM A446-76, Grade A. Gage thickness shall be 16 or as shown on the drawings. Galvanized finish shall conform to ASTM A525-81, Class G 90.

C. **Fasteners**

Sheet metal screws for attaching 18 gage metal deck at laps and to structural members shall be No. 14 cadmium plated steel, hex head, gimlet point, self-tapping variety with cupped, glavanized or stainless steel washers with integral neoprene gaskets. All other screws and fasteners shall be galvanized steel unless otherwise indicated, and shall be size and type as indicated on the design drawings.

4. FABRICATION AND ERECTION

A. General

All decking shall be fabricated and erected in accordance with the SDI "Design Manual for Composite Decks, Form Decks, and Roof Decks;" the design drawings; and as specified herein. Where possible, sheets shall extend the full height of the enclosure.

B. Erection

The decking shall be erected in accordance with the shop drawings. Each sheet shall be placed on the supporting steel framework and adjusted to final position before being permanently fastened. Decking shall be attached to supports using clips and screws as detailed on the shop drawings. Side laps shall be fastened together at midspan using screws,

C. Caulking

All joints and seams shall be caulked with General Electric No. 1300 Silicone compound or approved equal to make the walls air tight. No deviation from this erection procedure shall be accepted without prior approval of the Construction Engineer.

5. REJECTION

All work or parts thereof and materials entering therein indicating irremediable or injurious defect, improper fabrication, excessive repairs, or that is not in accordance with the requirements of this specification shall be subject to rejection,

6. PAINTING

Galvanized steel decking shall not be painted.

4.860 - LABORATORY FURNISHINGS

1. GENERAL

This specification covers the furnishing and installing of all laboratory equipment and accessories and related work as shown on the drawings and as specified herein.

2. SHOP DRAWINGS

Shop drawings shall be submitted for approval in accordance with SPECIAL CONDITIONS Paragraph: SUBCONTRACTOR'S SUBMITTALS.

The Subcontractor shall submit completed and checked shop drawings for approval. The approval of the shop drawings will be for laboratory equipment, accessories, work tops, details, and assemblies and shall not relieve the Subcontractor of the responsibility for errors, omissions, or accuracy of his details.

3. MATERIALS

A. General

All laboratory equipment shall be manufactured by Kewanee Scientific Equipment Corp., or approved equal.

The Subcontractor shall provide the following:

1) All laboratory equipment as shown on APPENOIX A - LABORATORY EQUIPMENT SCHEDULE and accessories, trim parts, such as scribes, filler panels, base mouldings, and corner clips.
2) Adequate supporting devices required for complete installation.
3) All hardware required for installation such as screws, nuts and bolts, clips, anchors, shims, inserts, etc.
4) Black plastic moulding, 4" high, shalt be installed around all exposed cabinet bases.
5) All drawers shalt be equipped with 2 1/2" x 1 1/8" (card size) aluminum label holders.

8. taboratory Equipment.

A17 laboratory equipment shall be assembled in accordance with the shop drawings and engineering standards for maximum stability and strength, while allowing maximum compatibility within all cabinet configurations.

C. Work Top

Work top shall be "Kemresin" as manufactured by Kewaunee Scientific Equipment Corporation, or approved equal.

The "Kemresin" work top shall be made from modified epoxy resins especially designed for laboratory counterwork surfaces. Tops shall be 1" thick and all exposed edges and vertical corners shall be radiused 1/4". Top shall be moulded in one section. Rear cube shall be 4" high.

D. Sink

Sink shall be 16 gage, 304-L stainless steel as specified and shall be mechanically fastened.

E. Fixtures

All equipment shall be furnished complete with faucets, drains and tail pieces, and utility and electric outlets as shown on the design drawing or as shown on APPENDIX A - LABORATORY EQUIPMENT SCHEDULE.

F. End Filler

End filler shall be furnished as shown on the design drawings or as shown on APPENDIX A - LABORATORY EQUIPMENT SCHEDULE..

G. Color Selection

Color for all base unit shells, drawer bodies, and trim parts shall be "Kem-Ponent" standard color number 20, sand tan.

Accent color used on drawer fronts, doors, and top front panels shall be "Kem-Ponent" standard color number 22, burnt orange.

4. INSTALLATION

A. General

All laboratory equipment shall be protected from soiling and damage during handling and installation. Laboratory equipment shall be installed in strict accordance with the shop drawings and as specified herein.

B. Positioning

Laboratory equipment shall be positioned plumb, level true, and straight with no distortions. Laboratory equipment shall be shimmed as required using concealed shims.

C. Adjustments

Laboratory equipment and hardware shall be adjusted so that all doors and drawers operate smoothly without warp or bind. All operating hardware shall be lubricated with appropriate lubrication.

0. Cleaning

All laboratory equipment and accessorfes shall be thoroughly cleaned and polished upon completion of the installatfon.

5. AREA HOUSEKEEPING

The area shall be thoroughly cleaned of all trash, debris, and other refuse after completion of the work. All such materials shall be removed from the work areas in accordance with the SPECIAL CONDITIONS,

APPENDIX A

Laboratory Equipment Schedule

ITEM NO.	DESCRIPTION OF EQUIPMENT	SIZE	QUANTITY	CATALOG MODEL NO.
1a.	Sink Base Unit	48"L x 35 3/4"H x 22"W	1 ea.	KG-2008
b.	Stainless Steel Tub Sink	28"L x 16"W x 12"H	1 ea.	1089
c.	Sink Service Fittings:			
	1) Hot and cold water mixing faucet	---	1 ea.	T-318
	2) Distilled water gooseneck	---	1 ea.	T-368
	3) Eye wash, hand-held table-top mounted, Speakman Safety Equipment Company	---	1 ea.	SE-921
	4) Stainless steel crumb cup strainer	1 1/2" Outlet	1 ea.	995
	5) Trap and sink outlet. assembly, polypropylene	1 1/2"	1 ea.	464
2a.	Base Unit	48"L x 35 3/4"H x 22"W	2 ea.	KD-2378
b.	Air fitting	---	1 ea.	T-260
c.	Nitrogen gas fitting	---	1 ea.	T-260
3.	Work Top	145"L x 31"W x 1"T	1 ea.	---
4.	Peg Board	20"L x 29"H x 3/4"T	1 ea	K7-1901
5.	Wall Storage Case	48"L x 30"H x 16"W	2 ea.	KW-1628
6.	End Filter Panel	---	1 ea.	KL-323-1A

SECTION 5 - PIPING

5.100 - PIPING INSTALLATION - GENERAL SECTION

1. GENERAL

This specification outlines the materials of construction, fabrication, and installation requirements necessary for installing piping systems. The specification is composed of a general section supplemented by sub-sections.

Unless otherwise noted on the drawings, materials shall be provided as specified in each section of this specification. All valves shall be as specified and each shall be individually tagged and identified with its respective ID number.

2. CODES AND STANDARDS

Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the reference thereto.

A. American Society for Testing and Materials (ASTM)

A53-82	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A105-82	Specification for Forgings, Carbon Steel for Piping Components
A106-82	Specification for Seamless Carbon Steel Pipe for High-Temperature Service
A181-81	Specification for Forgings, Carbon Steel for General-Purpose Piping
A182-82	Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
A197-79	Specification for Cupola Malleable Iron
A262-81	Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
A269-82	Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

A307-83	Specification for Carbon Steel Externally Threaded Standard Fasteners
A312-82	Speciffcation for Seamless and Welded Austenitic Stainless Steel Pipe
A403-82	Specification for Wrought Austenitic Stainless Steel Piping Fittings
B32-76	Specification for Solder Metal
B61-82	Speciffcation for Steam or Valve Bronze Castings
B68-80	Specification for Seamless Copper Tube, Bright Annealed
B75-81	Specification for Seamless Copper Tube
B88-83	Specification for Seamless Copper Water Tube
C533-80	Speciffcation for Calcium Silicate Block and Pipe Thermal Insulation
D1785-83	Specificatton for Polyvinyl Chloride (PVC) Plastic Pipe Schedules 40, 80 and 120
02000-80	Classification System for Rubber Products in Automotive Applications
D2467-76	Specification for Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40
F104-83	Classification System for Nonmetallic Gasket Materials

8. American National Standard Institute (ANSI)

A13.1-81	Scheme for the. Identification of Piping systems
B2.1-68	Pipe Threads (Except Dryseal) Specifications, Dimensions, and Gaging for Taper and Straight Pipe Threads Including Certain Special Applications
B16.3-77	Malleable Iron Threaded Fittings Class 150 and 300

B16.5-81	Pipe Flanges and Flanged Fittings
816.9-78	Factory-Made Wrought Steel Buttwelding Fittings
B16.11 -80	Forged Steel Fittings, Socket-Wetding and Threaded
B16.14-77	Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads
B16.22-80	Wrought Copper and Copper A7loy Solder Joint Pressure Fittings
B31.1-80	Power Piping
B31.3-80	Chemical Plant and Petroleum Refinery Piping

C. American Welding Society (AWS)

A5.1-81	Specification for Covered Carbon Steel Arc Welding Electrodes
D10.9-80	Specification for Qualifications of Welding Procedures and Welders for Piping and Tubing

0. American Society of Mechanical Engineers (ASME)

Soiler and Pressure Vessel Code, Section IX, 1983

E. Pipe Fabrication Institute

Stancard ES3

3. FABRICATION AND INSTALLATION

A. General

Piping materials including valves and fittings furnished by the Subcontractor shall be new and shall be delivered to the site in a clean and protected conditionl End seals of pipe, valves, and flange covers shall be maintained in place and shall be removed only as necessary for cleaning, fabrication, erection, or for inspection. Care shall be exercised in the handling and storage of all piping materials and prefabricated piping so that contamination'by moisture, grease, dirt, or injurious foreign matter shall not occur.

Piping specified on the drawings shall follow *the* routing shown on the drawings. The pipe shall be cut accurately to measurements specified on the drawings and to suit field conditions and shall be carefully worked into place without forcing or springing.

The interior or exterior surfaces of all piping shall be kept clean at all times. Pipe shall be free of fins and burrs and shall be cleaned in accordance with cleaning procedures specified in Section 5.310.

Flanges, unions, and valves shall be installed as specified and shall be located for easy accessibility after erection.

Valves shall be properly packed and made leak proof under the test pressure described. Valves to be soldered, brazed, or welded shall be disassembled prior to heating. Allow valves to cool, clean if necessary, and reassemble.

8. Cutting

Pipe and tubing shall be cut accurately to measurements as specified on the drawings and to suit field conditions. Approved tube or pipe cutters, or other methods approved by the Contractor shall be used. All cuts shall be reamed to remove burrs. Any objectionable defects shall be removed by machining, chipping, or grinding.

C. Bending

Changes of direction should be made by bending wherever possible in steel, aluminum, copper, alloy pipe, or tube unless specifically disallowed in subsections of this specification.

Bending radii shall in no case be less than the minimum radii recommended in the "Pipe Fabrication Institute Standard ES3."

D. Joining Methods

The following methods shall be used as applicable to the individual subsections of this specification:

1) Threading

Threading of pipe shall be done preferably after any bending, forging, or heat treating operations. Where threading must be performed first, threads shall be protected during such operations. Threads shall conform to ANSX 82.1. Pipe dope shall be applied to the male threads only. When threading chemically-cleaned pipe, use the trichloroethane (methyl chloroform) inhibited, as the cutting fluid.

Teflon ribbon, when used as thread dope, shall not be applied to the first two threads of pipe.

2) Welding

a) General

All welding, qualification procedures, and qualification of welders shall be in strict compliance with ASME Boiler and Pressure Vessel Code, Section IX and AWS 010.9.

All welds are subject to inspection by the Contractor. The Contractor reserves the right to accept, reject, or demand removal of welds which are in violation or believed to be in violation of these specifications. Welders performing welds found to be unsound shall be subject to appropriate *retest* provisions of the ASME Boiler Code or other applicable standards,

Socket weld joints shall be assembled so that space between the end of the pipe and the bottom of the socket is no less than 1/16" or more than 1/8".

Welded branch connections to headers shall be made by the use of welded outlet fittings, such as reducing tees, weldolets, sockolets, and 'threadolets as shown on the drawings in compliance with ANSI 831.1, Paragraph 127.4.8.

b. Welding Rods and Electrodes

All bundles, boxes, or kegs in which rods and electrodes are delivered shall be legibly marked with the following information:'

Classification
Trade Designation
Manufacturer's Name
Standard Size and Length
Heat Number

All welding rods shall be identified with at least one imprint per rod showing the AWS classification number in accordance with AWS A5.1(15). In addition, welding rods 1/8" and over in diameter shall be marked or stamped with positive identification at intervals of not more than 18". Such marks shall be clearly distinguishable and shall include the classification number of the welding rod and the trade designation of the manufacturer.

Welding rods and electrodes shall be stored, handled, and identified at all times to assure the use of the proper welding rod in a welding process,

c. Carbon Steel Piping

The following welding procedures shall apply to all services:

For vee butt welds on pipe and fittings 1 1/2" and smaller and fillet welds on socket weld- fittings 3/8" and smaller, use oxyacetylene welding of steel pipe' or gas tungsten-arc welding of carbon steel materials welding procedures.

For vee butt welds on, pipe and fittings 2" and larger, fillet welds on socket weld fittings 3/4" and larger, and fillet welds on all sizes of slip-on flanges, weldolets, sockolets, and threadolets use shielded metal-arc welding of carbon steel materials, shielded metal-arc welding of steel with combination 6010 and low hydrogen electrodes or gas tungsten-arc welding of carbon steel materials welding procedures. A minimum of two passes shall be used on all fillet welds. A 1/8" electrode must be used for all passes on 3/4" socket weld fittings.

c. Stainless Steel Piping

For all stainless steel piping welding use welding procedures for arc welding of chromium nickel stainless steel materials. Use filler metal type ER-308L.

3) Flanging

Where flanges mate with cast iron flanged fittings, valves, or equipment, they shall be provided with flat faces and full face gaskets. Provide full face gaskets between cast iron flanges. Flat ring type gaskets shall be used between steel flanges equipped with raised serrated faces.

Flanges shall be made up with meeting face in a plane that is exactly perpendicular to the axis of the pipe. Upon erection, flanges shall be so positioned in rotation that the bolt holes shall straddle the vertical flange centerline. All gaskets shall be evenly centered between the flange faces with ring gaskets engaging fully upon raised face flanges. The meeting flanges shall mate flush and true and the bolts shall be tightened uniformly to draw the flanges evenly and firmly upon the gasket. All bolt threads shall be coated with Crane high temperature compound prior to installation. When made up, the bolts shall extend through nuts by at least one full thread.

E. Hangers and Anchors

In genera?, the location and design of pipe hangers will be shown on the drawings. In some cases for pipe 2" and smaller, hangers may not be shown. The Subcontractor shall then provide suitable hangers selected from or patterned after those shown on the drawings.

The location and design of anchors shall be as shown on the drawings. The location and spacing of hangers shall be such that the piping is held in position without swaying, vibrating, or sagging excessively. Spacing shall not exceed maximum spans as follows:

Tubing	
Size	Span
1/2"	6'-0"
3/4"	6'-0"
1"	6'-0"
1 1/4"	7'-0"
1 1/2"	8'-0"
2"	9'-0"

Piping	
Size	Span
1/2"	8'-0"
3/4"	10'-0"
1"	12'-0"
1 1/4"	13'-0"
1 1/2"	15'-0"
2"	16'-0"
3"	20'-0"
4"	23'-0"

When supporting pipe which is subject to thermal expansion, hanger rods shall be set at slight angle so that when pipe expands the rods will be plumb.

4. MATERIAL SERVICE LISTING AND SPECIFICATIONS

Service symbol and material section numbers as listed hereinafter conform to service designations as shown on the drawings:

Symbol	Service	Conditions Maximum PSIG	Conditions Maximum °F	Material Section	Remarks
S SC	Steam & Steam condensate	150	480	101	C.S. screwed & butt welded
DW	Distilled water	150	400	107	S.S. screwed & butt weld
D	Drain	-0-	160	111	PVC & socket
N	Nitrogen	125	150	117	C.S. socketweld & copper brazed
O	Oxygen	150	250	119	C.S. socketweld
CW	Cold water (Sanitary)	125	130	124	Copper soldered & screwed
HW	Hot water (Sanitary)	125	130	124	Copper soldered & screwed
WS	Waste solution	150	150	128	S.S. butt weld
CA	Compressed Air	150	200	136	C.S. socketweld & copper brazed

5.101 - STEAM (S) & STEAM CONDENSATE (SC)

1. **SERVICE RATING (Low Pressure)**

Pressure Range: 0 to 150 psig
Maximum Temperature: 480°F

2. **MATERIALS AND EQUIPMENT**

The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but those required for the work shall be selected from this listing unless otherwise Indicated on the drawings.

A. Codes and Standards

Where details of fabrication are not shown on the drawings or specified herein, fabrication shall be in accordance with the applicable fabrication requirements of ANSI 831.1.

B. Materials

Item	Size (Incl.)	Specifications
Pipe	to 1 1/2"	Steel, seamless, Schedule 40, ASTM A106 Grade B
Fittings	to 1 1/2"	Steel, 2000 lb, ASTM A105 or A181 Grade 2, screwed ends, ANSI 816.11, EXCEPT use 3000 lb rating on couplings, half-couplings, reducers, and caps
Unions	to 2"	Steel, 3000 lbs, ASTM A105 or A181 Grade 2, with integral steel seats and screwed ends, dimensions per manufacturer's standard.
Plugs	All	Steel, solid type, square head screwed, ANSI B16.14
Valve Stem Packing (for repacking only)	All	Johns-Manville No. C-14

Item	Size (Incl.)	Specifications
Dope		Threads: Crane high temperature thread compound Gaskets: Graphite and oil
Strainers		Cast steel, screwed, Y-pattern, 600 lb @ 800°F, Leslie 7200, or Armstrong BXSC Series

C. Valves

See Section 5.610 for additional description.

Service	Size (Incl.)	Contractor's V No.
Gate	1/2" to 2"	V-6177
Check	1/2"	V-210
Globe	1/2"	V-1132

3. PIPING FABRICATION AND INSTAUATION

All steam and condensate piping shall be pitched down 1/4" per 10' in the direction of flow unless otherwise indicated on the drawings.

4. CLEANING

Cleaning shall be as specified in Section 5.310.

5. TESTING AND INSPECTION

Testing and inspection shall be as specified in Section 5.410.

6. INSULATION (Thermal)

Insulation of steam and condensate lines shall be as specified in Sections 5.210, 5.211, and 5.212.

7. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Section 5.510.

a. PAINTING

Painting shall be as specified in Section 11.430.

5.107 - DISTILLED WATER (DW)

1. SERVICE RATING

Maximum pressure: 150 psig
Maximum temperature: 400°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature.. It is not intended that all materials listed will necessarily be required, but those required for the work shall be selected from this listing unless otherwise shown on the drawings.

A. Codes and Standards

Where details of fabrication are not shown on the drawings or specified in this specification, fabrication shall be in accordance with the applicable requirements of ANSI B31.3, "Code for Pressure Piping, Petroleum Refinery Piping."

B. Materials

All stainless steel material shall have a maximum carbon content of 0.030% ladle analysis and shall be capable of passing the Huey Nitric Acid Test (ASTM A262) with a maximum average corrosion rate of 0.0020" penetration per month.

Item	Size (Incl.)	Specifications
Pipe	to 1"	Stainless steel, Type 304L, Schedule 10S, welded, ASTM A312
Fittings	to 1"	Stainless steel, Schedule 10S, ASTM A403, Grade WP-304L, butt weld ends, ANSI 816.9
Unions	to 1"	Use flanges
Flanges	to 1"	Stainless steel, Type 304L, corrosion weight, slip-on, ASTM A182, drilling and O.D. to match ANSI 816.5, 150# standard
Dope		Teflon, ribbon thread sealant, Permacel or Scotch brand
Valve Stem Packing (for repacking only)	All	Teflon, Chevron type
Valve Bonnet Gaskets (for replacement)		Teflon

C. Valves

See Section 5.610 for additional description.

Service	Size (Incl.)	Contractor's V. No.
Ball	1/4" to 2"	V-6194

3. PIPING FABRICATION AND INSTALLATION

Piping fabrication and installation shall be as specified in Section 5.700.

4. CLEANING

Cleaning shall be as specified in Section 5.310.

5. TESTING AND INSPECTION

Testing and inspection shall be as specified in Section 5.410, Class 8 for distilled water.

6. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Section 5.510.

5.111 - ORAIN PIPING (D)

1. GENERAL

All drain piping from laboratory sinks and service fixtures shall be PVC pipe. Installation of drainage piping shall be as shown on design drawings. Where details of fabrication are not shown on drawings or specified in this section or other sections of this specification, fabrication and installation shall be in accordance with Natfonal Plumbing Codes.

2. MATERIALS

Item	Size (Incl.)	Specifications
Pipe	to 4"	Polyvinyl chloride, ASTM 01785, Type 1, Grade 1, Schedule 80, normal impact
Fittings	to 4"	Polyvinyl chloride, ASTM *02467*, socket type, Schedule 80 (pipe and fittings shall be purchased from same manufacturer)
Gaskets	All	Teflon
Solvent cement	All	As supplied by manufacturer of pipe and fttings
Drum traps	1 1/2"	PVC or polyethylene, Hamilton Industries 34L235
Cup sinks	All	PVC or polyethylene, Hamilton 34L143 with strainer

3. CLEANING

Prior to erection, the inside of all pipe and fittings shall be cleaned of all dirt and foreign materials. After installation, all drain piping shall be cleaned free of foreign deposits.

4. TEST AND INSPECTION

Test and inspection shall be as specified in Section 5.410.

5.117 - NITROGEN (N)

1. SERVICE RATING

Pressure range: 0 psig to 125 psig
Temperature range: -20°F to 150°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but those required for the work shall be selected from this listing unless otherwise shown on the drawings.

A. Codes and Standards

Where details of fabrication are not shown on the drawings or specified in this specification, fabrication shall be in accordance with the applicable fabrication requirements of ANSI 831.3, "Code for Pressure Piping, Petroleum Refinery Piping."

B. Materials

Item	Size (Incl.)	Specifications
Pipe*	to 1/2"	Steel, welded, Schedule 40 ASTM A53, Grade 8
Fittings	to 1/2"	Steel, 3000 lb, ASTM A105 or A181, Grade 2, socket weld ends, ANSI 816.11
Unions	to 1/2"	Use flanges
Flanges	to 1/2"	Steel, ASTM A105 or A181, Grade 1, 150 lb, slip on or welding neck, ANSI 816.5
Gaskets	All	Compressed asbestos, 1/16" thick, ring type, ASTM F104, Grade P1161A, Sepco Corp. No. 200
Bolts and Nuts	All	Steel, heavy hex or square head machine bolts, with semifinished heavy hex nuts, ASTM A307, Grade 8

*Where threaded connections are required, Schedule 80 pipe shall be used.

Item	Size (Incl.)	Specifications
Valve Stem Pack?ng (for repacking only)	1/16" to 3/16" round	Garlock Company 1178
	1/4" and up square	Garlock Company 233
Dope		Red Glyptal or letharge and glycerine

C. Valves

See Section 5.610 for addittonal description.

Service	Size (Incl.)	Contractor's V No.
Globe	1/4" to 2"	V-6409

3. PIPING FABRICATION AND INSTALLATION

Piping fabrication and fnstallation shall be as specified in Section 5.100.

4. CLEANING

Cleaning shall be as speciffed in Section 5.310.

5. TESTING AND INSPECTION

Testing and inspection shall be as speciffed in Section 5.410, Class A.

6. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Section 5.510.

7. PAINTING

Painting shall be as specified in Section 11.430.

5.119 - OXYGEN

1. SERVICE RATING

Pressure range: 0 psig to 150 psig
Temperature range: -20°F to 250°F

2. MATERIALS

Item	Size (Incl.)	Specifications
Pipe	to 1 1/2"	Steel, seamless, Schedule 40, ASTM A106, Grade B
Pipe Fittings	to 1 1/2"	Steel, 3000 lb, ASTM A105 or A181, Grade 2, socket weld ends, ANSI 616.11

3. CLEANING

Cleaning shall be as specified in Section 5.310.

4. TESTING AND INSPECTION

Testing and inspection shall be as specified in Section 5.410,

5. IDENTIFICATION OF PIPING

Identification of piping and color code shall be as specified in Section 5.510.

6. PAINTING

Painting shall be as specified in Section 11.430.

5.124 - HOT AND COLD SANITARY WATER (HSW & CSW)

1. SERVICE RATING

Maximum pressure: 125 psi
Maximum temperature: 140°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials will necessarily be required, but those required for the work shall be selected from this listing unless otherwise shown on the drawings.

A. Codes and Standards

Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI A40.8, "National Plumbing Code."

B. Materials

Item	Size (Incl.)	Specifications
Pipe	to 2"	Copper, seamless water tube, hard drawn, ASTM 888, Type L in 20' straight lengths
Fittings	to 2"	Wrought copper solder joint, ASTM 875, in accordance with ANSI 816.22
Unions+	to 2"	Wrought copper, solder joint, ANSI 816.22
Dope		Teflon tape
Valve Stein Packing (for repacking only)	1/16' to 3/16' round	Garlock Company 1178
	1/4" and up square	Garlock Company 233
Copper "Solder" Joints		Silver Braze Handy and Harmon Braze Technique (72% Ag, 28% Cu) RTSN per UCN-W-703

*When connecting copper to steel use dielectric unions with nonmetallic gasket suitable for connecting dissimilar metals to prevent corrosion.

C. Valves

See Section 5.610 for additional description.

Service	Size (Incl.)	Contractor's V No.
Gate	1/4" to 2"	V-6134

D. Backflow Preventer

Backflow preventer shall be 1 1/2" N.P.S. with valves, Beeco Aergap Mode7 FRP-II. DO NOT SUBSTITUTE.

E. Safety Shower Assembly

Safety shower assembly shall have 8" head, stay-open ball valve with pull chains, rings, and interconnecting fittings, Speakman No. SE-226, or approved equal.

3. PIPING FABRICATION AND INSTALLATION

Adequate provisions shall be made to prevent water hammer, rattling of the pipe, chattering of valves and faucets, and other objectionable noises in the system. Full size air chambers, 2' to 3' vertical length, shall be provided at the top of all risers, at the end of all branches, and at Individual fixtures where necessary, Whenever it is necessary to have a submerged sanitary water supply to a fixture, tank, or other equipment, a vacuum breaker shall be installed in the supply line at an elevation above the cverflow line of the fixture. Valves shall be installed in all branches at the take-off from the main, at all risers before all connections to equipment, and as shown on the drawings. All other details of fabrication and installation shall be as specified in Section 5.100.

4. CLEANING

Cleaning of sanitary water systems shall be as specified in Section 5.310.

5. TESTING AND INSPECTION

Testing and inspection shall be as specified in Section 5.410.

6. INSULATION (Thermal)

Insulation shall be as specified in Section 5.218.

7. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Section 5.510.

a. PAINTING

Painting shall be as specified in Section 11.430.

5.128 - WASTE SOLUTION (WS)

1. SERVICE RATING

Maximum pressure: 150 psi
Maximum temperature: 32°F to 150°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials will necessarily be required, but those required for the work shall be selected from this listing unless otherwise shown on the drawings.

See SPECIAL CONDITIONS, APPENDIX II for contractor-furnished material applicable to the section.

A. Codes and Standards

Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI 831.3.

B. Materials

All stainless steel pipe and fittings shall be solution annealed, have a maximum carbon content of 0.030% ladle analysis, and shall be capable of passing the Huey nitric acid test (ASTM A262) with a maximum average corrosion rate of 0.0020" penetration per month.

Item	Size (Incl.)	Specifications
Pipe	1/2" to 4"	Stainless steel, type 304L, Schedule 10, welded; ASTM A312 (modified maximum carbon content of 0.034,)
Fittings	1/2" to 4"	Stainless steel, type 304L, Schedule 10, ASTM A403, Grade WP 304L, butt weld ends, per ANSI 816.9
Unions	All	Use flanges
Flanges	1/2" to 4"	Stainless steel, type 304L, corrosion weight welding neck or slfp on (bored for Schedule 10 pipe), ASTM A182; drilling and 00 to match ANSI 816.5, 150 lb standard

Item	Size (Incl.)	Specifications
Gaskets		Teflon, 1/8" thick, ring type
Dope		Teflon ribbon thread sealant, Permacel or Scotch brand
Valve Stem Packing (for repacking only)	1/8" and up	Teflon, chevron type
Valve Bonnet Gaskets (for replacement)		Teflon
Bolts and Nuts		Steel, heavy *hex* or square head machine bolts with semifinished heavy hex nuts, ASTM A307, Grade B
Liquid Level Sight Cages		Valve material 316 stainless steel, for nitric acid service, high pressure Pyrex glass, Teflon gaskets, with ball check, Jacoby-Tarbox style T/HP

Tank	Center to Center
Solution Holding (2)	40"
Solution Treatment (2)	42"

Liquid Level Switch		Type 316 stainless steel, sensor, standard model, Sensall No. 502, National Sonics (Division of Xertex Corp.) DO NOT SUBSTITUTE

C. **Valves**

See Section 5.610 for additional description.

Service	Size (Incl.)	Contractor's V No.
Plug	1/2" *to* 6"	V.-6245

Service	Size (Incl.)	Contractor's V No.
Check		
Swing	1/4" to 10"	V-1100

3. PIPING FABRICATION AND INSTALLATION

Pfping fabrication and installation shall be as speciffed in Section 5.100.

4. CLEANING

All waste solution piping shall be cleaned, ends sealed, and delivered to the construction site by the contractor.

5. TESTING AND INSPECTION

Testing and inspection shall be as specified fn Sectfon 5.410.

6. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of pfping and color code shall be as speciffed in Section 5.510.

SECTION 5 - PIPING

5.136 - DRY COMPRESSED AIR (CA)

1. **SERVICE RATING**

Maximum pressure: 150 psi
Maximum temperature: 200°F

2. **MATERIALS AND EQUIPMENT**

The material list of this specification is comprehensive in nature. It is not intended that all materials will necessarily be required, but those required for the work shall be selected from this listing unless otherwise shown on the drawings.

A. Codes and Standards

Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI 831.3.

8. Materials

Item	Size (Incl.)	Specifications
Pipe	to 1 1/2"	Steel, seamless, Schedule 40, ASTM A106, Grade B
Fittings	to 1 1/2"	Steel, 3000 lb, ASTM A105 or A181, grade socket weld ends, ANSI 816.11
Plugs	All	Steel, square head, solid type, screwed, per ANSI 616.14
Strainers	1 1/2" and under	Cast steel, 125 lb, Y-pattern, socket weld ends, 40 mesh stainless steel screen

C. Valves

See Section 5.610 for additional description.

Service	Size (Incl.)	Contractor's V No.
Gate	1/4" to 2"	V-1

3. CLEANING

Cleaning shall be as specified in Section 5.310.

4. TESTING AND INSPECTION

Testing and inspection shall be as speciffed in Section 5.410.

5. IDENTIFICATION OF PIPING

Identification of piping and color code shall be as speciffed in Section 5.510.

6. PAINTING

Painting shall be as speciffed in Section 11.430.

SECTION 5 - PIPING

5.210 - THERMAL INSULATION FOR PIPING AND EQUIPMENT

1. GENERAL

This section of the specification describes the general requirements relating to materials and the application of thermal insulation for piping. Specifications for specific types of insulation appear in the following sections. .Refer to Paragraph 4 - THERMAL INSULATION SCHEDULE for Insulation thickness for use In various services.

2. MATERIALS

Insulation and accessories shall be as specifled in the following sections of this specification. All insulation materials shall be delivered to the job in their original cartons or containers which shall be labeled with the manufacturer's name and type of material contained. Insulation shall be stored in such a manner as to remain dry.

3. APPLICATION

It is not intended that all details outlined in this paragraph shall apply to all insulation on the job, but shall apply only as required in the individual sections. Additional requirements are also specified in the sections. Special details when required and not given will be indicated on the drawings. Manufacturer's instructions shall be followed when available with the material.

A. Insulation

Insulation shall be dry when applied to clean and dry surfaces,

B. Application to Piping

Install insulation in single layers of up to 3" thickness.

4. THERMAL INSULATION SCHEDULE

A. Piping

1 All steam lines 0 to 150 psig shall be insulated with 1 1/2" thick calcium silicate in accordance with Section 5.211.

2 All condensate lines shall be insulated with 1" thick calcium silicate up to an elevation of 7' above floor.

3 All hot and cold sanitary water (HSW and CSW) lines shall be insulated with 1/2" thick flexible elastomer in accordance with Section 5.278.

5. PAINTING

Painting shall be as specified in Section 11.430.

5.211 - THERMAL INSULATION - CALCIUM SILICATE

1. GENERAL

This section of the specification describes the materials required and the application of calcium silicate insulation for piping operating at temperatures of 212°F to 1200°F. Section 5.210 is an fntegral part of this section.

2. MATERIALS

All materials listed are not necessarily required, but those required shall be selected from this listing:

A. Insulation

Pipe insulation shall be composed of hydrous calcium silicate blended with reinforcing mineral fibers in a suitable proportion, with or without inorganic filler added, conforming to ASTM C533 and shall be asbestos free.

The following insulations are acceptable: Johns-Manville, "Thermo 12;" Owens-Corning, "Kaylo 10AF;" Calsilite Corporation, "Calsilite AF;" and Fiberboard Corporation Pabco Division, Caltemp NA."

6. Accessory Materials

Item	Specifications
Wire	Stainless steel, type 304, 18 gauge (0.0475"), cold-drawn, bright annealed
Straps	Stainless steel, type 304, 3/8" x 0.015"
Seals	Stainless steel, type 304, 3/8" double-pronged, A. 3. Gerrard
Caulking Mastic	Benjamin Foster 30-45 Foamseal or Insul-Coustic IC-405 (flash point: 100°F)
Insulating Cement	Hydraulic setting, Johns-Manville No. 375, or Eagle-Picher One-Coat or Forty-Eight Quick-Set

Item	Specifications
Fabricating Cement	Benjamin Foster 81-93 or Refractory and Insulation Corporation's Block Stick
Lagging Adhesive	Benjamin Foster 81-42W Las Fas (red stripe) or Insul-Coustic IC-102 Sure-Lag, color - white

3. APPLICATION

A. Pipe

Install single layer insulation in a staggered position. Use 18 gauge (0.0457") stainless steel wire to secure insulation up to 11" O.D. Use 3/8" x 0.015" straps for insulation more than 11" O.D. Space wire and straps on 9" centers and not more than 4 1/2" from end joints. Point up all cracks and small depressions with insulating cement.

B. Fittings, Flanges, and Valves

Insulate with covers fabricated from the same materials and thickness as that specified for adjacent pipe. Fabricate the covers in accordance with ASTM C450. Join the pieces with fabricating cement and make the covers in two halves. Secure in place with wire or straps. Insulate fittings and valves 2" and smaller with insulating cement to a thickness equal to that specified for the pipe.

C. Exceptions

All flanges and valves shall be insulated with the proper thickness unless otherwise specified on the drawings. Terminate the insulation at uninsulated flanges. Do not insulate traps, unions, and control valves.

D. Supports

Install welded clips or a clamp ring support near the bottom of vertical runs in excess of 21' on Insulated pipe 4" and larger. Add another support every 21'. A flanged joint is considered a support.

E. Surface Finish

Cover piping and fitting insulation with 8 oz canvas, adhered, and completely sized with Tagging adhesive applied at the rate of one gallon per 85 square feet. Apply a 40 lb rosin sized paper under-layment on outside of piping insulation before covering with canvas.

5.218 - THERMAL INSULATION - ELASTOMERIC - PIPE

1. GENERAL

This section of the specification describes the materials required and the application of elastomeric flexible insulation for piping operating at temperatures of 50°F to 220°F.

2. MATERIALS

A. Insulation

Insulation shall be composed of a flexible elastomer similar to Armstrong F/R Armaflex or Owens-Corning 0-C flexible tubing, 1/2" thick.

B. Adhesive

Adhesive shall be Armstrong 520 or Owens-Corning OC 500.

3. APPLICATION

Application procedures shall be in accordance with manufacturer's instructions.

SECTION 5 - PIPING

5.310 - CLEANING AND CONDITIONING OF PIPING SYSTEMS

1. SCOPE

This section of the specification describes the cleaning requirements for piping systems listed in Section 5.100.

2. GENERAL

A. The Contractor will furnish the water, nitrogen, and plant or compressed oil-free dry air, as required, for cleaning pipe or piping systems.

B. Block control valves in the open position, remove orifice plates, traps, and strainers prior to or during the process of cleaning. Introduce the flushing medium at the remote end of the piping system. Flush from the upstream side of check valves. Alternately open each extremity of the line so that the entire system is flushed.

C. The following piping systems (after chemical cleaning) must be kept absolutely free of oil, grease, dirt, paint, and other foreign materials before and after erection:

Subsection	Service
117	Nitrogen
119	Oxygen
136	Dry compressed air

Tools for assembling the piping must be degreased.

3. PIPING REQUIRING CHEMICAL CLEANING BEFORE ERECTION

A. Pipe, valves, and fittings for the following services shall be chemically cleaned:

Subsection	Service
107	Distilled water
117	Nitrogen
119	Oxygen
136	Dry compressed air

B. The Contractor will furnish all cleaning materials, perform all chemical cleaning, and cap or seal off all ends of pipe, valves, or fittings at no cost to the Subcontractor. Piping shall be cleaned in the largest practical assemblies, but dimensions shall not exceed 20' x 4' x 4' or contain

more than two fittings and Shall not contain any valves. Weld two each lifting lugs, minimum 2" hole diameter, to each pipe or piping assembly to be cleaned by the Contractor. Lugs shall be spaced to provide for a balanced lift. They shall be removed after cleaning and before installation of the piping. Lifting lugs shall be provided when the following conditions exist:

1) Straight length of pipe 4" diameter or larger and 6' in length or longer

2) Any assembly of pipe and fittings regardless of pipe diameter, number of fittings or length.

C. The Subcontractor shall notify the Contractor at least three working days prior to furnishing materials to be cleaned. The Subcontractor shall provide all labor to load, unload, and transport materials to and from Building C-400. The Subcontractor shall pay for any recleaning required because of his negligence in handling and storage.

4. PIPING NOT REQUIRING CHEMICAL CLEANING BEFORE ERECTION

All pipe, valves, and fittings used in fabricating piping systems under this classification for conveying services other than those listed in Paragraph 3 will not require chemical cleaning. However, each component of any piping system under this classification shall be cleaned and inspected before erection as follows:

Inspect all pipe, valves, and fittings for physical defects; and replace broken, chipped, cracked, or defective items with new.

Remove all loose scale, rust, dirt, mud, and other foreign materials from interior surfaces by wire-brushing, scrubbing, or flushing with air or water.

Remove excess dirt, rust, grease, and oil from exterior surfaces.

Provide caps or protective covers over ends of pipe, valves, and fittings until ready to install.

5. PIPING SYSTEMS REQUIRING CLEANING AFTER ERECTION AND TESTING

A. By Flushing with Initial Test Medium

Piping systems conveying the following services shall be cleaned after erection and testing by flushing with initial test medium for five minutes:

Subsection	Services	Test Medium
5-101	Steam (0-150 psig)	Water
5-107	Distilled water	Water
5-124	Hot & cold sanitary water	Water

B. By Purging

Piping systems conveying the following services shall be cleaned after erection and testing by purgfng until the specified dew point is reached and held for 30 minutes:

Subsection	Service	Purge Gas	Dew Point
117	Nitrogen	Nitrogen	0°F
119	Oxygen	Nitrogen	0°F
136	Dry compressed air	Dry compressed air	-40°F

6. PIPING SYSTEMS NOT REQUIRING CLEANING AFTER ERECTION AND TESTING

Subsection	Service
111	Drain

7. PIPING SYSTEMS REQUIRING STERILIZATION

A. The following piping systems conveying sanitary water shall be sterilized after erection and testing:

Subsection	Service
'124	Sanitary water (copper tubing)

B. Prior to a sterilization, the system shall be flushed with sanitary water for five minutes at a velocity of at least 2.5' per second. Drain system and then sterilize.

8. STERILIZATION MATERIALS AND METHODS

A. Materials

Use a disinfecting solution which contains a minimum of 50 ppm of chlorine by weight of water. Commerical high-test' hypochlorite, known as HTH, with not less than 65% available chlorine, shall, be used to prepare this solution.

Commercial laundry bleach with a minimum content of 5.25% available chlorine may be substftuted for HTH in preparing the disinfecting solution in lines 1 1/2" and smaller. Use one-half pint of laundry bleach to each gallon of water in the system.

8. Quantities

The following table may be used as a guide for quantities required:

HYPOCHLORITE TABLE

Diameter of Pipe	12-foot Lengths	16-foot Lengths	40-foot Lengths	50-foot Lengths
6" and smaller	0.5 oz.	0.5 oz	0.5 oz	0.5 oz

C. Method

Make a slurry in a suitable container using the proper amount of HTH. Add the slurry or laundry bleach, a little at a time, to the line as it is being filled with water. A uniform concentration throughout the system is required. Let the line stand full for at least 24 hours. At the end of this time, the chlorine content of the water shall not be less than 10 ppm. Flush the line until the chlorine content of the water is less than one ppm, then connect to the existing system.

0. Alternate Method

Where sterilizing by the above method is impractical (such as tfe-ins up to first shutoff valve), the following alternate method, with the approval of the Contractor, may be used:

Before erection, thoroughly scrub pipe, valves, and fittings with a disinfecting solution made with one-half pint of laundry bleach to a gallon of water. Wash thoroughly with clean sanitary water and do not contaminate before installing.

E. Witness of Sterilization

Sterilizing shall be performed in the presence of an authorized representative of the Contractor. The Contractor will check chlorine content of the water after completion of the sterilizing process.

SECTION 5 - PIPING

5.410 - TESTING AND INSPECTION OF PIPING SYSTEMS

1. GENERAL

This section of the specification covers the testing and inspection of piping systems. The Seller shall furnish all labor, materials, equipment, tools, and services necessary for testing except for work, materials, and/or equipment to be furnished by the Company. Two classes of tests are included:

Class A - Pneumatic test
Class 8 - Hydrostatic test

The class of test to be applied is specified In the applicable sections.

2. DEFINITION FOR MAXIMUM WORKING PRESSURE OF A SYSTEM

The maximum working pressure of a system is defined as the predetermined value at which the piping system's safety relieving devices are set to prevent overpressurizing the system. Either the set pressure of the relieving devices or the maximum operating pressure of the piping system shall be specified on the drawings.

3. GENERAL TESTING REQUIREMENTS

General requirements for *tests* to be performed on installed piping systems under this specification shall be as follows:

A. Blank off or replace with spool pieces items of equipment (e.g., vessels, pumps, instruments, controls, safety, and relief valves) rated for pressures below the test pressure. Before performing final operating pressure test on a system, remove test blanks and spool pieces and reconnect protected instruments and equipment.

8. Inspect all parts of the system for leaks, especially at valves, flanges, welds, threaded connections, and packed joints. All leaks shall be repaired and the repaired joints retested.

C. Check that safety and relief valves have been inspected and set by the Company at the required set pressure.

0. 'Soap solution or soap testing shall be a soapless lather, leak detector solution, as manufactured by Industrial Colloids & Chemical, Inc., Knoxville, Tennessee, or Company-approved equal.

E. Use adequate precautions during pneumatic pressure testing. Clear the installation area of personnel not engaged in testing operations. Visually inspect the system installation for compliance with the design drawings and specifications.

F. The test shall be performed in the presence of an authorized representative of the Company.

7. WORK, MATERIALS, AND/OR EQUIPMENT FURNISHED BY COMPANY

The Company will furnish the test gauges and testing media required to conduct Class A and Class B tests.

8. CLASS A TESTING (PNEUMATIC PRESSURE TEST)

Class A testing consists of pneumatically pressure testing piping systems or isolated sections of piping systems with compressed air or nitrogen as specified in Table 1. Test pressures and test procedures shall be as follows:

A. Test Pressure

Test pressure for pneumatically testing pipe sizes 6" and under shall be 1.5 times the maximum working pressure but in no case less than 50 psig.

B. Test Procedure (When Test Pressure is 50 psig)

With equipment items protected and safety precautions taken in accordance with Paragraphs 3.A. and 3.E., pressurize system to 50 psig. Soap test all welds, joints, and connections. Repair leaks and retest repaired joints.

After instruments and equipment have been reconnected, these connections shall be pressurized and soap-tested at maximum operating pressure. Repair leaks and retest repaired joints.

C. Test Procedures (When Test Pressure Exceeds 50 psig)

With equipment items protected and safety precautions taken in accordance with Paragraphs 3.A. and 3.E., gradually pressurize system to 50% of the test pressure. Thereafter, the test pressure shall be increased in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Then reduce pressure to 75% of the test pressure. Soap test all welds, joints, and connections. Repair leaks and retest repaired joints.

After instruments and equipment have been reconnected, these connections shall be pressurized and soap-tested at maximum operating pressure. Repair leaks and retest repaired joints.

9. CUSS 8 TESTING (HYDROSTATIC TEST)

Class 8 testing consists of hydrostatically pressure testfng piping systems or isolated sections of piping systems with water or another liquid as specified in Table 1. Test pressures and test procedures shall be as follows:

A. Test Pressure

Test pressure shall be 1.5 times the maximum working pressure unless otherwise specified on the drawings, but not less than 50 psig.

8. Test Procedures

With equipment items protected in accordance with Paragraphs 3.A. and 3.E., pressurize system to test pressure. Hold pressure while visually inspecting all welds, joints, and connections for leaks. Repair leaks and retest repaired joints.

Drain system and after instruments and equipment are reconnected, refill with service medium and apply maximum operating pressure. Hold pressure while visually inspecting these joints and connections for leaks. Repair leaks and retest repaired joints.

Table 1
(Showing Test Media for Pipfng Systems)

Subsection	Service	Class A fest	Class 8 Test	Test Pressure (psig)
101	Steam & condensate		Water	55
107	Distilled water		Water	50
111	Drains		(Service test with water)	
117	Nitrogen	Dry air or nitrogen	---	50
119	Oxygen	Nitorgen	---	50
124	Sanitary water	---	(Service. test with water)	
128	Waste solution	---	Water	50
136	Compressed air	Dry air	---	50

SECTION 5 - PIPING

5.510 - IDENTIFICATION OF PIPE AND VALVES

1. GENERAL

This section of the specifications outlines details of identifying valves and exposed piping after erection, insulation, and painting are completed. Exposed piping is defined as all piping which is visible in the open or may be exposed by the removal of covers or panels designed to provide access for inspection or maintenance.

2. DESCRIPTION OF MARKERS

Identification markers shall be vinyl cloth having a self-adhesive backing that is resistant to moisture, oils, and most solvents and that will hold tight within a temperature range of -40 to 250°F. Label shall be weather and fade resistant and similar to those manufactured by W. H. Brady Company, Milwaukee, Wisconsin.

The labels shall be of specified background color upon which is printed the name of the flowing medium with specified letter color. The direction of flow in each pipe shall be Indicated by any arrow on a label adjacent to the identification label and of the same color as the identification label

Where additional information Is required, a separate label shall be applied adjacent to the service Identification label. Background color, letter color, and letter height shall be the same as service identification.

Services listed below require addition of line operating pressure information which will consist of individual numeral labels indicating normal line operating pressure plus a label containing the letters PSIG:

STEAM
DRY COMPRESSED AIR
NITROGEN

Labels shall conform to ANSI A13.1, "Scheme for the Identification of Piping Systems."

These labels and acrylic overcoating shall be furnished and installed by the Subcontractor.

Letter heights for use in titles are governed by the outside diameter of the pipeline including insulation. The minimum letter heights to be used are:

Outside Diameter	Letter Heights
1/2 - 3" included	5/8"
3 1/2" and up	1 1/4"

3. EXPLANATION OF COLOR CODE

The type of hazard of the flowing medium is indicated by the colors listed below:

Background Color	Flowing Medium	Letter Color
Yellow	Dangerous Materials	Black
Green	Generally Safe Liquids	Black
Blue	Generally Safe Gases	White

4. LOCATION OF MARKERS

Straight sections of pipelines shall bear identification markers at maximum intervals of 40'.

Branch lines shall be identified with a marker located not more than 5' from the main line.

Lines passing through walls or floors shall be identified on each side by a marker located *not* more than 5' from the wall or floor.

Markers on banks of piping shall be placed In a row, side by side, for ease of reference.

5. METHOD OF APPLYING LABLES

Surface to which labels are adhered must be free of scale, dirt, dust, grease, and moisture. Press the label firmly in place, rubbing thoroughly, particularly along the edges, until the adhesive makes a good bond.

Overcoat the entire label fncluding 1/2" overlap at the edges with a heavy coat of Glidden Clear Silk Screen Acrylic Y7135.

Mastic coatings on insulated lines, such a Vimasco's WC-1, Insul-Coustic's IC-551, and Benjamin Foster's 60-60, must be completely dry before applying label.

Service and Label Wordfnp	Section Number	Label Background Ground
Steam	101	Yellow
Distilled Water	107	Green
Nitrogen	117	Blue
Oxygen	119	Yellow
Sanitary Water	124	Green
Waste Solution	128	Yellow
Compressed Air	136	Blue

6. IDENTTFICATION OF VALVES

All valves identified on the drawings and speciffcations with V-numbers shall be permanently identified with stainless steel tags embossed with the applicable V-numbers. Tags shall not be attached to handwheels or levers or other parts of valves which would interfere with operation. Tags and wire will be furnished by the Contractor. The Subcontractor shall submit a list of the required V-numbers to the Contractor.

5.610 - VALVE INDEX AND ACCEPTANCE MANUFACTURERS

1. GENERAL

The following information is given in the valve tabulatfon for each valve number included:

a. Valve number
b. Body material
c. Type of end connections
d. Type of valve
e. Specification section number in which valve is specified
f. List of acceptable valves giving manufacturer's name and model number

Valve Number	Body Material	Ends	Type	Section Number	Manufacturer Model No.
V-1	Brass or Bronze	Scr'd	Gate	5.136	Lunkenheimer 2125 Crane 428 Jenkins 62U
V-6134	Bronze	Solder	Gate	5.124	Nibco-Scott S-111 Powell 1812 Stockham B-109
V-6771	Cast or Forged Carbon Steel	Scr'd	Gate	5.101	Crane 3607XU Lunkenheimer 1311-W Vogt 13111
V-6194	Stainless Steel 304L	Socket-weld	Ball	5.107	Worcester 445T Powell 4206-T-SWE Hills-McCann S-303
V-6409	Bronze	Scr'd	Globe	5.117	Rego 2500-Series
V-1132	Forged Carbon Steel	Scr'd	Globe	5.101	Lunkenheimer 1711W Vogt 12141 Pacific 3661-2
V-210	Bronze	Scr'd	Check	5.101	Nibco-Scott T-453-B Crane 36 Walworth 420

Valve Number	Body Material	Ends	Type	Section Number	Manufacturer Model No.
V-1100	Stainless Steel 316	Scr'd	Check	5.128	Powell 2341 Jenkins 1330 Pacific 1001
V-6245	Stainless Steel 316	Scr'd*	Plug	5.128	Durco G432 Unichem V1S Xomox 066
		Flg'd*			Ourco 6411 Unichem V1F Xomox 067V

*1/2" thru 1 1/2" sizes use scr'd valves
2" and 3" sizes use flanged valves

SECTION 7 - ELECTRICAL

7.110 - ELECTRICAL CONSTRUCTION

1. GENERAL

A. scope

This section of the specification relates to the furnishing of all labor, equipment, material, and performance of all work necessary for or incidental to the complete installation of electrical equipment and services in accordance with the drawings and as hereinafter specified.

B. Subcontractor's Responsibility

1) The Subcontractor shall provide complete electrical work, unless otherwise indicated, for all automatic and/or manual devices connected with or required for the control of electrical equipment associated with all equipment and systems covered under other sections of this specification.

2) The Subcontractor shall coordinate the requirements of all electrical equipment, perform tests, make adjustments wherever necessary to insure proper performance of the equipment, and fdentify equipment in accordance with the drawfngs and specifications.

C. Installation

1) The Subcontractor shall install work to conform to recommendations contained in the most recent issue of the National Electrical Code (NEC), the National Electrical Safety Code, and to the applicable rules of national standards and codes hereinafter referred to. In the event of conflict between the requirements of the specifications and any standards or code, the specifications shall govern.

2) All work required for the installation of electrical work shall be performed by craftsmen skilled in the electrical trade.

2. APPLICABLE CODES AND STANDARDS

A17 materials, equipment and work performed shall be in accordance with the appropriate sections of the latest issue of the following documents:

National Electrical Code
National Electrical Manufacturers Association
American National Standards Institute
Underwriters' Laboratories, Inc.

Federal Specifications
Institute of Electrical and Electronic Engineers
National Electrical Safety Code
Illuminating Engineering Society Lighting Handbook
Insulated Power Cable Engineers Association
American Society for Testing and Materials
Edison Electric Institute Specifications

3. DESCRIPTION OF WORK

The work shall include the installation of electrical feeders from existing motor control center "A" to a new 45 kVA transformer and from the transformer to a new lighting panel located on the ground floor of the C-409 building. The lighting panel will serve as power source for the C-409 liquid lab area. The lab area work shall include the installation of electrical receptacles, lighting, lab equipment wiring, and lab liquid containment system as shown on the drawings.

4. MATERIALS AND EQUIPMENT

A. General

All materials and equipment furnished, unless otherwise noted, shall be new and shall bear the label of the Underwriters' Laboratories, Inc., (UL), whenever standards have been established and label service is regularly furnished by that agency.

B. Substitutions

1) The use of brand names, catalog numbers or names of manufacturers is solely for the purpose of indicating the type and quality that will be acceptable. Unless otherwise specifically indicated by the words "no substitute", substitutes will be permitted as approved by the Contractor.

2) Vendor drawings shall be submitted to the Contractor for approval in accordance with Special Conditions, paragraph SC-11.

C. Lighting Fixtures

Lighting fixtures shall be of the type, size, and kind specified in the fixture schedule or legend on the drawings. Fluorescent fixtures shall be equipped with class P ballasts that shall be UL and CMB approved and of the high power factor type. They shall be sound rated A. The ballasts shall be protected from overheating by an internal thermally actuated, automatic reclosing device to limit winding temperature. Ballasts shall be of the high efficiency full output type suitable for use with both 35 watt and 40 watt lamps. Ballasts shall be Universal ballast "watt reducer", General Electric "low energy", or equal.

D. Lamps

All lamps shall be furnished and installed by the Subcontractor, Incandescent lamps for connection to 120 volt circuits shall be specifically rated for 125 volts unless otherwise specified. Fluorescent lamps shall be cool white type.

E. Lighting Panelboards

1) Lighting and low voltage panelboards, for operation on 208 or 240 volts, shall be of the dead front safety type complete with main circuit breaker, when specifled on the drawings, rated for 240 volt ac. Panelboards shall be provided with the type, number and size of branch circuit breaker units as indicated on the drawings. Panelboards shall bear the UL label. Panelboards shall have fully. rated isolated neutral buses and shall also be equipped with an equipment ground bus. Panelboards shall be comparable to Square-D Company type NQOB with QOB-GFl frame bolt-in branch circuit breakers unless otherwise noted on the drawings.

2) The main circuit breaker shall be installed in the panelboard such that the breaker is closed when the operating handle is moved upward (for vertically mounted breaker) or to the right (for horizontally mounted breaker). The main and branch breakers shall have "off-on" markings to clearly indicate the handle position.

3) Cabinet boxes shall be constructed of zinc coated steel and shall conform to the requirements of the UL standard for cabinets and boxes. Panelboard fronts shall be door-indoor type. Trims shall be *fitted* with hinged doors having latches only. A directory holder shall be mounted on the Inside of each door. A neatly typed directory properly identifying each circuit shall be mounted therein. Cabinets shall be supplied with standard side gutter wiring space and shall be for surface mounting as indicated on the drawings.

F. Receptacles

Duplex, 120 volts, 20 ampere, and single, 208 volts, 20 ampere type receptacles shall be as specified on the drawings,

G. Transformer - 45 kVA

1) The transformer shall be standard repetitive manufactured product of a reputable manufacturer and shall comply with NEMA standards and specifications.

2) The transformer shall be of the ratings and capacities, three-phase, as noted on the drawings, with all terminal surfaces either tin or silver plated. Unless specifically noted otherwise, the transformer shall be of the dry type for general light and power service. The transformer shall be suitable for indoor use 'for wall bracket or floor mounting as required by the drawings. Unless noted otherwise, the transformer shall have a minimum number of 2-1/2 percent fully rated kVA taps, 2 FCAN and 4 FC8N.

H. Manual Starters - Full Voltage

Manual starters for 120 volt motors shall be a toggle operated switch with trip free overload protection in suitable enclosure unless otherwise noted on the drawings. .Overload relay heater elements shall be sized in accordance with the motor nameplate full load current.

I. Safety Switches

Safety switches shall be heavy duty type single throw, with visible blades in NEMA 3R enclosure for all switches located outdoors and NEMA 1 enclosures for all switches located indoors. Switches shall have quick-make, quick-break mechanism, front cover interlock and indicator handle. Switches shall be of the ampere and voltage ratings, number of poles, nonfusible, etc., as indicated on the drawings.

5. MISCELLANEOUS INSTALLATION METHODS

A. Fastenings

Fastenings to wood shalt be by means of wood screws or bolts; to masonry by means of threaded metal inserts, metal expansion screws, metal expansion .shields or toggle bolts; and to steel by means of machine screws, bolts or by welding. No wood or fiber plugs will be permitted. Fastenings to concrete may be accomplished with Ramset Tow powered gun fasteners, toggle bolts or expansion anchors.

B. Hangers and Supports

1) Hangers and supports shall be furnished and installed as shown on the drawings and as specified herein.

2) Equipment supports shall be Unistrut or structural steel, welded or bolted, rigid and workmanlike in appearance. Hex head machine bolts with spring lock washers shall be used.

3) Hangers shall be galvanized steel with, approved conduit clamps and/or straps.

4) All angle iron, channel iron, Unistrut, rods, hangers and supports required to install and mount the electrical equipment shall be furnished and installed by the Subcontractor. Angle and channel iron members shall. be cleaned of rust and scale and painted with one coat of metal primer after fabrication and then if not concealed, shall be painted in accordance with Section 11.

6. CONDUIT, FITTINGS AND ACCESSORIES

A. Heavy Wall Rigid Steel

1) Heavy wall rigid steel conduit shall be hot-dipped galvanized or electro-galvanized, inside and outside, in conformity with Federal Specifications WW-C-581A. Conduit couplings, elbows, nipples and

fittings fabricated from steel tubing shall conform in all respects to the same specifications. Conduit shall be National Electric Sherarduct, Youngstown Buckeye, or Triangle.

2) Aluminum fittings, boxes, condulets, etc., shall not be used with steel conduit except where specifically shown on the drawings.

B. Liquidtight Flexible Metal Conduit

1) Liquidtight flexible metal conduit shall be fabricated of galvanized steel flexible tubing with a synthetic jacket extruded over the tubing, similar to "Sealtite EF" manufactured by American Metal Hose Division of the American Brass Company.

2) All flexible conduit exposed to weather, water or other liquids shall be liquidtight with connectors approved for this use.

3) Liquidtight conduit assemblies shall include on each end an insulated straight or 90 degree angle connector equal to Thomas & Betts Series No. 5300. This shall be the conduit assembly intended wherever a liquidtight assembly is called for on the drawings or in the specifications.

4) Liquidtight conduit assemblies shall be used between motor terminal boxes or other equipment subject to vibration and/or mechanical adjustment and the rigid conduit systems or elsewhere as shown on the drawings. Liquidtight conduit used to connect to motor terminal boxes for housing motor conductors shall not be less than 12 times the trade size in length but in no case less than 12 in.

C. Conduit Fittings

1) Cast malleable iron or steel conduit fittings shall be thoroughly coated with metallic zinc or cadmium inside and outside after all machine work is completed and, insofar as it applies, fittings shall conform to Federal Specifications W-F-406.

2) Nonmetallic insulating type bushings used on rigid conduit shall be O.Z. type A, Thomas & Betts 200 series', Efcor Type P8, or Appleton type BBU.

D. Boxes: Junction, Terminal, Pull

1) All junction and pull boxes shall be furnished and sized in accordance with the NEC where not sized on the drawings.

2) Junction and pull boxes located indoors in nonhazardous areas shall be code gauge galvanized sheet steel, welded construction, with conduit knockouts or raceway openings and hinged covers.

E. Installation

1) All wiring shall be Installed in galvanized or sherardized rigid steel conduit,

2) Conduit shall be delivered to the job site in 10-foot lengths, each length bearing the UL label and the name of the manufacturer. Conduit whether concealed or exposed, shall be adequately supported in accordance with NEC requirements and good practice. Supports shall be spaced not more than 7 ft. apart for one inch and smaller conduit or more than 10 ft. apart for conduit larger than one inch.

3) Conduit shall be secured to walls, building framing, etc., by the use of malleable iron galvanized "U" bolts, beam clamps, conduit straps, or Unistrut fittings when Unistrut racks or supports are used. Conduit shall be securely fastened to all outlet boxes, pull boxes, cabinets and switch boxes by double locknuts and insulating bushings unless boxes with conduit hubs are provided.

4) Conduit shall In no case be secured directly to other piping. Conduit parallel to or crossing uninsulated hot water or steam pipes must be separated from them by 12 in. if parallel or 6 in. if crossing. Where these lines are insulated, conduit parallel to or crossing them must clear the insulation surface by 2 in. Conduit shall not be run directly under cold water lines and shall be separated *from* them in other directions by at least 3 in,

5) Conduit shall be cut square and threaded with an approved conduit cutter and threader. The ends shall be reamed of burrs, and all metal shavings and cutting lubrtcants shall be removed before the conduit is connected to the conduit system.

6) Bends, offsets and bevels shall be avoided if practical; but if they are necessary, they shall be made with an approved bending device. Conduit crushed or deformed in bending will be rejected. The use of heat in bending conduit will not be permitted. Where a number of conduits are run together, the radii of any required bends shall be such that *the* installation will be neat in appearance.

7) All connections in rigid conduit shall be made with appropriate fittings and be securely tightened. Improperly made connections or terminations, as well as any which have not been adequately tightened, will be rejected. All conduit shall be installed by craftsmen skilled in the trade.

8) The exact locations and routing of conduit, when not shown in detail on the drawings, shall be determined by the Subcontractor subject to approval of the Construction Engineer.

9) Conduit which is run exposed shall be run at right angles to or parallel to building structural members wherever possible and shall be adequately supported by brackets, clamps, or braces wherever required. Diagonal runs shall not be made except in special cases or concealed in concrete slab.

10) In no case shall any electrical conduit be bent or any fabricated elbow be applied to less than the allowable bending radius of any installed conductor.

7. WIRE, CABLE AND CONNECTORS

A. Conductors

1) All conductors shall be stranded copper except lighting and receptacle circuit conductors may be solid. The minimum size conductor to be used for power and lighting circuits shall be No. 12 AWG.

2) All conductor sizes as specified on drawings are given in American Wire Gauge.

B. 600-Volt Insulation

1) Wire and cable with a 600-volt insulation rating shall be furnished and installed for all power feeders, motor leads, lighting and control circuits that are designed for operating voltages up to and including 550 volts. All conductors shall be listed by UL for the applications specified on the drawings.

2) All conductors shall have NEMA type XHHW insulation rated at 90°C.

3) Computer cable shall be 51 pair #22 AWG solid conductors, tinned copper, vinyl insulated with Beldfoil aluminum-polyester shield overall, 22 AWG 7x30 stranded drain wire with chrome vinyl jacket. Color coded from Belden Chart "C". Belden Catalog No. 8751 or equal.

C. Copper Conductor Connectors 300 Volts or Less

1) Splices, taps and terminations of stranded conductors No. 10 AWG and smaller shall be made with pressure connectors, Thomas & Betts "Sta-Kon" or equal. Splices and taps in solid No. 10 AWG and smaller shall be made with split-bolt connectors or with insulated wire nuts, Thomas & Betts "Piggy" or equal. Terminations of solid conductors No. 10 AWG and smaller may be made by forming the wire to fit under a screw head, thus requiring no connector.

2) Splices and taps in copper conductors No. 8 AWG through No. 1 AWG and terninations of these sizes of conductors other than in equipment lugs (i.e., molded case circuit breakers) shall be made with either copper mechanical connectors or with wrought copper compression connectors.

Type of Connection	Type of Connector	Thomas & Betts Series No.
Splice	Mechanical - Split-Bolt	2T thru 8T
Tap	Mechanical - Split-Bolt	2T thru 8T
Termination	Mechanical - One-Hole Lug	#31000
Splice	Compression - Two-Way Connector	#54500
Tap	Compression - "C" Tap	#54700
Termination	Compression - One-Hole Lug	#54100

3) Splices and taps in copper conductors No. 1/0 AWG through No. 4/0 AWG and terminations of these sizes of conductors other than in equipment lugs (i.e., molded case circuit breakers] shall be made with wrought copper compression connectors.

Type of Connection	Type of Connector	Thomas & Betts Series No.
Splice	Two-Way Connector	#54500
Tap	"C" Tap	*154700.*
Termination	Two-Hole Lug	#54200

D. Copper Conductor Connectors over 300 Volts

All connectors specified for use with copper conductors carrying 300 volts or less are applicable for use with conductors carrying up to 600 volts, except insulated wire nuts shall not be used. Splices in conductors No. 10 and smaller shall be made with split-bolt connectors.

E. Wire Connections

1) Splices and taps shall be made in junction boxes or wiring gutters only.

2) Wire shall be thoroughly cleaned before connectors are applied.

F. Insulation of Splices and Taps 600 Volts

1) Splices and taps in thermoplastic (THW and XHHW) and rubber conductors shall first be Insulated with rubber tape, Okonite Company "Okonite" type No. 10. Connection shall then be wrapped with all weather vinyl plastic tape, 3M Company "Scotch" No. 88. Connections not housed in a junction box or other metal enclosure shall have an additional protective wrapping of friction tape, Okonite Company "Manson" type No. 5, to protect the connection from abrasions.

2) All outdoor splices and taps in type THW and XHHW insulated conductors, such as splices at service entrances and any connections which are subjected to high humidity, shall be insulated as specified above, then wrapped with linen cloth tape and painted with two brushed-on coats of General Electric Company "Glyptal".

3) On all splices and taps, the tape applied directly over the connector shall be wrapped as tight as possible in a manner so as to pad the sharp edges and fill the indents of the connector. The outer tape shall be applied until the total area of the initial taping is covered with a minimum of four layers. The total thickness of the combination of tapes shall be at least equal to the thickness of the conductor insulation. Tape of an appropriate width shall be used.

a. IDENTIFICATION

A. Equipment

1) Safety switches, circuit breakers, motor starters, lighting panels, power panelboards and other similar electrical equipment shall be identified.

2) Light switches, receptacles and other similar electrical devices shall be identified as to voltage, phase and source of power. For example, a lighting switch on circuit 15 from panel 8 would be marked "120 Volt, 1Ø, LP8-15".

3) The means of identification shall be subject to approval of the Construction Engineer but in general shall be as follows:

4) Exterior surfaces of lighting switches and receptacles shall be identified by means of raised 1/4-inch high characters on 1/2-inch wide aluminum strips. Identification tags shall be securely fastened to the equipment with noncorrosive rivets.

5) Safety switches, circuit breakers, motor starters, lighting panels, power panelboards and other similar electrical equipment shall be identified as per Sketch A-E-14469-A, Rev. 1 attached to this section of the specification.

6) Identification shall be in accordance with the one line diagram and shall include the following:

Maximum voltage
Equipment designation
Source of supply "Fed from...."
Equipment supplied

The "maximum voltage" and "source of supply" may be omitted on branch breakers in unit substations or panelboards where such is obvious. The "equipment supplied" notation may also be omitted where such is obvious.

Example: (1) 480 volts AC
(2) Power Dist panel "POP"
(3) Fed from Sub 9A1
Compt 5A

7) Lighting and Distribution Panelboards

The panel directories in lighting panelboards shall be neatly filled out, showing for each circuit the equipment served, floor and column location and room number where applicable. Spare circuits shall be identified on the schedule.

8. Conductors

1) All single conductor power and control wiring shall be identified in all readily accessible junction boxes in the wiring system as well as at *a37* terminations. Conductors need not be identifled in pull boxes where no taps or splices are made. Identificatfon shall be by means of taped on numbers or letters attached to each conductor.

2) All three-phase power feeder conductors shall be identified by phase designation, e.g., ØA, Ø8, ØC.

9. GROUNDING

A. General

1) The grounding shall be in accordance with the drawings and the NEC.

2) All ground connections required by the NEC and any other additional grounding as shown on the drawings or as specified herein shall be furnished and Installed. All enclosures for safety snitches, circuit breakers, control devices, motor frames, cabinets, panelboards, etc., shall be grounded to the building common ground network with bare copper wire of the sizes as shown on the drawings or in accordance with the NEC. In general, grounding shall conform with the applicable requirements of the NEC except as amended herein.

3) Equipment and circuits shall be grounded by a continuous grounding conductor. The groundfng conductor shall be run in the same conduit with the power conductors. The use of conduit as sole means of grounding will not be acceptable. Grounding or bonding of equipment to building steel as a sole means of grounding will not be acceptable.

4) All ground wires shall be copper. Aluminum ground wires are not permitted and will not be accepted. Ground wires NO. 8 AWG and larger shall be stranded.

5) Connections to ground buses and connections of ground conductors to switch boxes, panel boxes, cabinets, etc., shall be made with compression connectors. Splices and taps in ground conductors need not be insulated.

6) All contact surfaces shall be thoroughly clean and bright before connections are made to insure making good electrical contact.

B. Lighting Fixture Enclosure Grounding

A continuous ground conductor, preferably a solid, bare wire sized in accordance with the drawings, shall be run in the same conduit as the circuit conductors and attached to the metal enclosure of each lighting fixture and related local switch box.

C. Receptacle Grounding

All receptacles, 120 and 208 volt, shall be provided with a grounding pole, which shall be attached to a continuous ground conductor sized in accordance with the drawings. The ground conductor shall be permanently grounded to the building grounding system.

D. Transformer Neutral Grounding

The secondary neutrals of all 208Y/120 volt, three-phase lighting transformer shall be grounded in accordance with Section 250-26 of the NEC.

10. FIELD TESTING

A. General

Test all wire, cable and electrical equipment furnished, installed or connected to assure proper installation, connection and function in accordance with the drawings, specifications and manufacturer's recommendations. Include all tests recommended by the equipment manufacturer whether specified or not, unless specifically waived by the Contractor. Include any additional tests issued by the Contractor that he deems necessary because of field conditions to determine that equipment, material and systems meet requirements of the specifications. Furnish qualified personnel and testing equipment as required to perform all tests. Maintain a complete and accurate written record of all tests showing date, personnel making test, equipment or material tested, tests performed, and results with copies furnished to the Contractor. The Subcontractor shall be responsible for any damage to equipment or material due to improper test procedures or test apparatus handling, and shall replace or restore to original condition any damaged equipment or material at no cost to the Contractor. Provide safety devices such as rubber gloves and blankets, protective screens and barriers, danger signs, etc., to adequately protect and warn all personnel in the vicinity of the tests.

B. Molded Case Circuit Breaker Tests

Check all connections, visually inspect each breaker and operate manually. Check for proper current rating for circuit to which connected. Megger each pole for freedom from grounds.

C. Phasing and Polarity Tests

Check all motors for proper rotation and determine that both phasing and phase rotation are correct for all circuits. Change all wiring where phasing or polarity is not correct and repeat tests.

D. 600 Volt Wire and Cable Tests

1) This section of the specification covers the electrical testing of all 600 volt insulated single and multiconductor wire and cable.

2) *Test* No. 1 - Continuity.

a. Make test for continuity and correctness of wiring and identification on all conductors of lighting and receptacle branch circuit, power and control circuits and motor leads.

b. Test shall be made with a dc test device such as a bell, a buzzer or a light.

3) Test No. 2 - Insulation Resistance

a. All 600 volt power cables No. 4 AWG and larger shall be given an 'Insulation Resistance Test" using a 1000 volt motor driven "Megger".

b. The test shall be made with the conductors disconnected at the equipment. .Test shall be made between one conductor and ground with the other conductors grounded. Each conductor shall be tested in the same manner. The voltage shall be applied for a minimum of three minutes and until the reading reaches a nearly constant value.

c. Acceptable minimum resistance readings shall be 25 megohms. If megger readings indicate damaged insulation, the conductor shalt be rejected and shall be replaced by the Subcontractor. The replacement conductor must pass the required megger test.

d. More than one conductor may be listed on the same cable test report provided all conductors 'listed are tested and accepted on the same date. Reports shall include complete identification of the feeder, megger readings vs. time data, ambient temperature and weather conditions.

E. Lighting Fixtures

Give all lighting fixtures an dperational test. All fixtures must operate, all lenses must be clean and all local switches must function properly.

F. 120 Volt Receptacles

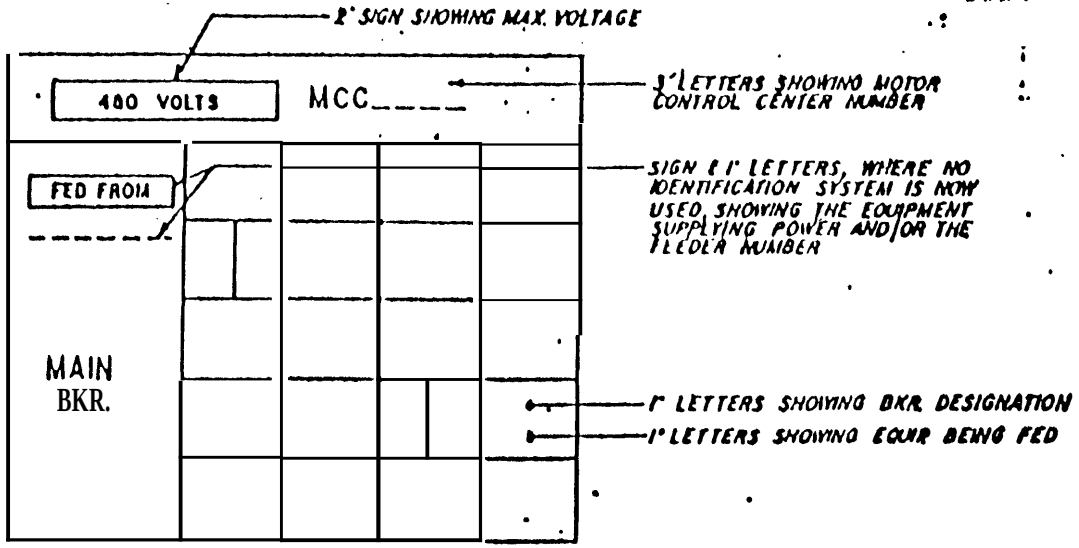
1) A random check of receptacles shall be made to insure that neutral and ground wires are connected properly.

2) After installation, all 120 volt receptacles shall be checked for correct wiring by the use of a Daniel Woodhead Model No. 1750 tester.

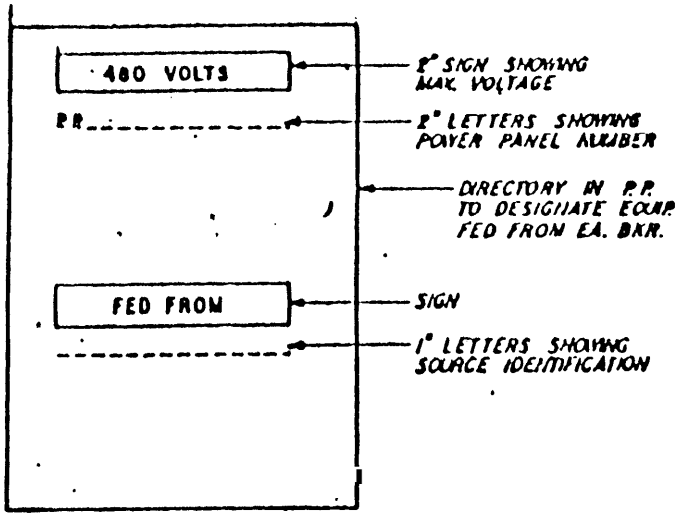
3) After completion of wiring. test. in Section 7-10.F.2, all 120 and 208 volt receptacles shall be given an equipment ground impedance test. The test shall be performed using a Daniel Woodhead Model No. 7040 "Ground Loop Impedance Tester". The maximum allowable impedance shall be 1.0 ohms.

CAUTION: This test shall be performed at each receptacle with no loads plugged into other receptacles sharing the same equfpment ground conductor.

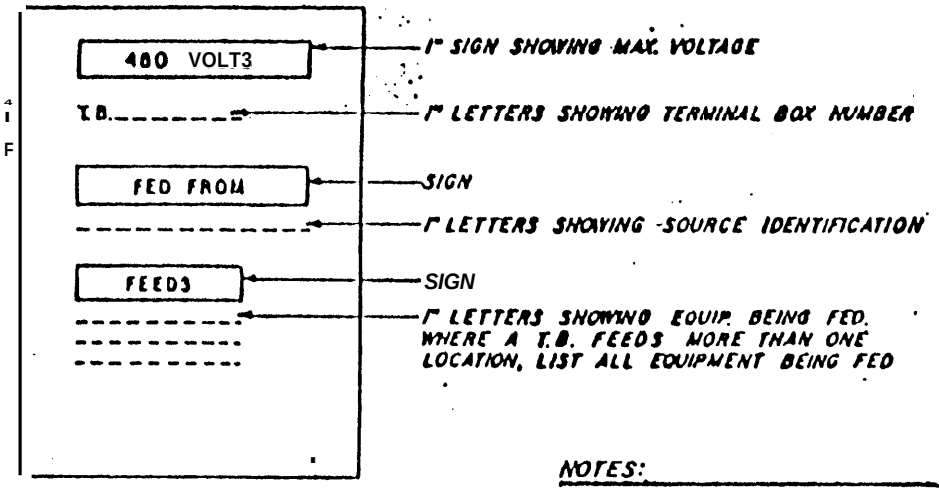
4) All receptacle checks shall be made by the Subcontractor using test equipment furnished by the Subcontractor and in the presence of the Construction Engineer. Any receptacles not passing the requfred tests shall be corrected by the Subcontractor and then verified by the Constructfon Engineer as being acceptable.



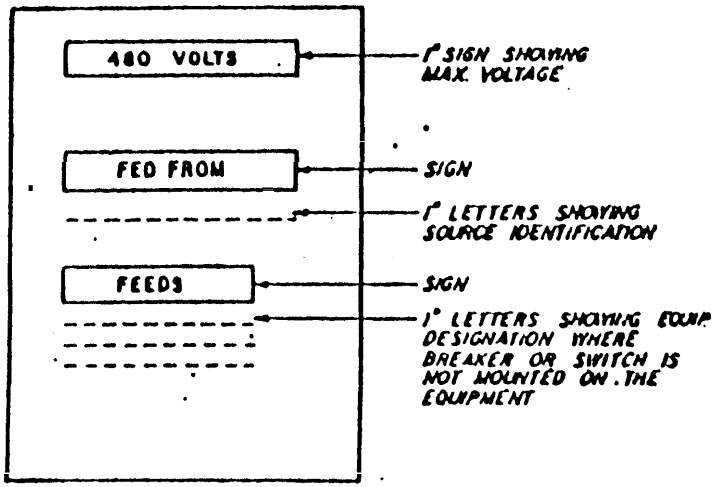
MOTOR CONTROL CENTER



POWER PANEL



TERMINAL BOX



DISCONNECT SWITCH
CIRCUIT BREAKER OR
MOTOR STARTER

NOTES:

1. ALL LETTERING IS OF YELLOW VINYL ADHESIVE BACKED LETTERS.
2. ALL SIGNS ARE VINYL ADHESIVE BACKED STRIPS WITH BLACK LETTERS ON A YELLOW BACKGROUND.
3. ALL EQUIP. SIGNS ARE TO BE SIZED TO SUIT THE EQUIPMENT. MATERIAL TO BE PHENOLIC ADHESIVE BACKED OR FIBER, DISC AS APPROPRIATE.
4. BEFORE THE APPLICATION OF PRESS ON SIGNS AND LETTERING THE SURFACE SHALL BE CLEANED W/SOLVENT SUCH AS VARSOL. AFTER APPLICATION SPRAY THE SIGNS & LETTERING WITH "KRYLON" LACQUE
5. VINYL ADHESIVE BACKED LETTE[illegible] LL BE BRADY QAV QUIK-ALIGN LETTERS VINYL C[illegible] HESIVE BACKED STRIP SIGNS SHALL BE BRADY VO[illegible] MARKERS AND BRADY CUSTOM CONDUIT AND VOLT[illegible] ERS
6. ALL STRIP SIGNS MAY BE REPLACED WITH EQUAL SIZE BRADY QAV QUIK-ALIGN LETTERS.

EQUIPMENT DESIGNATION

F[illegible]ENT SIGNS
(SEE NOTE 3)

DESIGN BY D.A.B.	DATE 1973	UNION CARBIDE CORPORATION NUCLEAR DIVISION — [illegible] PLANT
DRAWN BY JENKINS	5-10-1973	
CHECKED BY J.R.B.	5-10-1973	ELECTRICAL SYS[illegible]
[illegible]	5-19-73	IDENTIFICATION SC[illegible]
[illegible]	5-11-73	

SECTION 11 - PAINTING

11,430 - PAINTING

1. GENERAL

This specification covers the preparation of surfaces and the furnishing and application of paint and primers.

2. MATERIALS

A. Paints and Primers

Paints and primers specified are manufactured by PPG Industries, Inc.. Equivalent painting systems as manufactured by Sherwin-Williams; Devoe and Reynolds Co., Inc.; The Glidden Canpany; Mobil; or an approved equal are acceptable.

B. Submittals

Any paint/primers other than that speciffed shall be submitted by the Subcontractor for approval by the Construction Engineer.

C. Sealed Packages

All materials shall be delivered to the site in the manufacturer's sealed packages and containers, with labels intact and seals unbroken. All materials shall be in covered containers with the descriptive labels of the material contained therein. Materials shall not be opened until required for use or for sampling.

D. Storage

Paint materials and equipment shall be stored only in such places as may be approved by the Construction Engineer. The Subcontractor shall maintain the storage area and leave it free from fire hazards due to improperly stored rags, waste, or other combustible materials.

3. METHODS OF WORKMANSHIP

A. Preparation of Surfaces

Painting on any surface shall. not be started until all preparation of the surface is completed. As a minimum preparation, all other new or existing painted surfaces to be painted shall be brushed clean of all dust, dirt, or loose paint before paint is applied. Dull all glossy surfaces with sandpaper, steel wool, or liquid sanding aid. The surfaces shall be smooth, free of grease,' scale, rust, welding spots and slag or other adhering matter which would prevent a proper paint bond.

8. Application

In general, all paint shall be applied as specified and shall be done in a workmanlike manner, leaving the finished surfaces free from drops, ridges, waves, laps, and brush marks. Paint shall be applied under dry dust-free conditions.

All primer and intermediate coats of paint shall be unscarred at the time of application of each succeeding coat. Each coat of paint shall have a slight variation of color to distinguish it from the preceding coat. Sufficient time shall be allowed between coats to Insure proper drying.

Spray or roller painting may be employed where practicable if approved by the Construction Engineer.

Paints shall be thoroughly stirred and kept at a uniform consistency during application and shall not be thinned In excess of the printed directions on the'container. Solvents and thinners used shall be of the type compatible with the paint used.

C. Protection

During painting operations, the Subcontractor shall furnish and maintain In place adequate protective covers and drop cloths. Sprayed application shall be in conformity with all safety regulations In effect at the work sfte and the Subcontractor shall be responsible for protecting all adjoin ing work from spray particles. Sprinkler heads, heat and smoke detectors, etc., shall be covered with plastic or paper bags before painting operations, and all covers shall be removed after painting is completed. Area shall be well ventilated during painting. Any paint spots or spillage which may occur shall be promptly removed. "WET PAINT" signs shall *be* posted to protect newly painted surfaces.

0. Cleaning

During the work, or upon completion, the Subcontractor shall go over all areas and clean off misplaced paint from finished surfaces. Finishes of affected items shalt be restored to their original condition.

E. Touch-up Painting

A primer shall be applied to all field welded joints, bare spots, and surfaces damaged by new construction. These spot primed areas shall be covered with one finish coat to match existing finish.

4. PAINTING SCHEDULE

A. General

Paint coverage shall consist of three coats on all new surfaces consisting of a primer, intermediate, and finish coat unless noted otherwise. All paints/No's. specified are manufactured by PPG Industries, Inc. Paint thickness is listed In minimum wet film thfckness, in mils (MWF).

B. Coating System

1) Structural and miscellaneous steel, doors and frames, supports, hangers, etc.:

Shop/Field Prime: 6-204; Zinc chromate; 3.1 MWF
Intermediate Coat: 23-76; Vista Green; 3.1 MWF
Finish Coat: 23-76; Vista Green; 3.1 MWF

2) Floor checked plate, bar gratfng, and nosing angles:

Shop/Field Prime: 6-204; Zinc chromate; 3.1 MWF
Intermediate Coat: 23-49; Gray; 3.1 MWF
Finish Coat: 23-49; Gray; 3.1 MWF

3) Galvanized ribbed decking and sheet metal and stainless steel sheet metal will not be painted.

5. PIPE PAINTING

A. General

All uninsulated carbon steel and black iron indoor piping shall be painted, except piping or valves enclosed in housings or above suspended ceilings. Exposed surfaces of insulation on insulated pipe shall be primed with coat of flat white undercoat and topcoated with one coat of enamel as hereafter described. Uninsulated pipe shall be primed and topcoated with one coat of enamel as hereafter described.

B. **Colors**

Paint for prime coating shall be a zinc-chromate equivalent to No. 6-204 as manufactured by Pittsburgh Paint Company. Paint for topcoating shall be "Speedhide Interior-Exterior Gloss Enamel" as manufactured by Pittsburgh Paint Company. The final color shall be as shown below:

Surface	Color	Chip Number
Compressed air	White	23-83
Nitrogen	Blue	23-77
Water	Gray	23-75
Oxygen	Green	3-20
Steam & condensate	Gray	23-75

Painting not required on bare copper tubing or stainless steel.

SECTION 7

Fire Protection System

7-1. GENERAL.

7-1.1 This section of the specification relates to the design, furnishing, and installation of an extension to an existing wet-pipe sprinkler system for areas indicated on the design drawfngs,, New piping provided shall be extended from existing piping as indicated on the drawings.

7-1.2 Work under this specification shall be performed by a recognized sprinkler subcontractor fully qualified under the laws of the state of Kentucky for the installation of automatic sprinkler systems. The subcontractor shall submit satisfactory evidence to the contractor in writing of comparable experience.

7-1.3 Sprinkler system design shall be based on a maximum sprinkler head spacing of 130 square feet. Piping shall be ordinary hazard pipe sizing, as per NFPA Pamphlet No. 13, paragraph 3-6.

7-2. CODES AND STANDARDS.--Codes and standards which are called for or referred to herein are hereby made part of this specification to the extent indicated by the reference thereto. The latest editions shall apply. In the event of discrepancies between this specification and the codes or standards, this specification shall govern.

The following codes and standards shall constitute a part of this specification:

American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
National Fire Protection Association (NFPA)
Factory Mutual System

7-3. SHOP DRAWINGS AND MANUFACTURER'S DATA.

7-3.1 Shop drawings shall be submitted for approval: in accordance with the Special Conditions.

7-3.2 The subcontractor shall furnish a listing of make and model numbers of sprinkler heads, h'angers, etc., for approval, if these items are different from those indicated on the drawings and in this specification.

7-4. PIPING SUPPORTS AND HANGERS.--All supports and hangers shall be in accordance with NFPA Pamphlet No. 13 and as shown on the drawings. Earthquake protection shall be provided by the use of sway bracing designed and installed in accordance with NFPA Pamphlet No. 13. All other details of fabrication and installation which are not covered by the NFPA Pamphlet No. 13 shall be in accordance with this specification.

7-5. MATERIALS AND EQUIPMENT.

7-5.1 The material list of this specification is ccmprehensive in nature. It is not intended that all materials listed will necessarily be required but that those required for the work be selected from this listing.

7-5.2 Approval of materials will be based on the manufacturer's published' ratings, which must carry the approval of the National Fire Protection Association and be listed in the Underwriters Laboratories, Inc., "List of Inspected Fire Protection Equipment and Materials," or approved "Equipment for Industrial Fire Protection" as published by tie Factory Mutual System.

7-5.3 Codes.--Where detail of design, fabrication, and erection are not shown on the drawings or specified in this or other specifications, the omitted details shall be in accordance with the requirements of the National Fire Protection Association Pamphlet No. 13.

7-5.4 Materials.--The sprinkler system shall be nongalvanized of the material and specifications listed:

Specification No. 104A

Item	Size (Incl.)	Specifications
Pipe	A71	Steel, Schedule 40, ASTM A120, Grade 8, butt weld
Fittings	All	150-pound, malleable, screwed, ASTM A197, ANSI B16.3
Unions	All	150-pound, malleable iron, screwed, brass-to-iron seats
Plugs	All	Cast iron, square head
Dope	-	Red lead or teflon tape
Bolts and Nuts	-	ANSI heavy hex or regular square head steel machine bolts with semifinished heavy hex steel nuts, ASTM A307, Grade B

Item	Size (Incl.)	Specifications
Thteadolets	All	Steel, 2000-pound, ASTM A105
Sprinkler Heads	-	Underwriters approved, 165°F, brass upright or chrome pendant heads, as required, shall be used unless specified otherwise on drawings
Hangers and Sway Bracing	-	Hangers and sway bracing shall be installed in accordance with NFPA Pamphlet No. 13 and as shown on drawings. Earthquake protection shall be designed for Seismic Zone 3

Substitutes

The use of brand names, catalog numbers, or name of manufacturers is solely for the purpose of indicating the type and quality that will be acceptable. Substitutions may be permitted as described in the Special Conditions.

7-6. 308 INSTALLATION REQUIREMENTS.

7-6.1 General, .

7-6.1.1 Piping material including valves and fittings shall be delivered to the site in a clean and protected condition. End seals of pipe, valves, and flange covers shall be maintained in place, being removed only as necessary for cleaning, fabrication, erection, or for inspection by the Construction Engineer. Care shall be exercised in the handling and storage of all piping materials and prefabricated piping so that contamination by moisture, grease, dirt, or injurious foreign matter shall not occur.

7-6.1.2 The pipe shall be cut accurately to measurements shown on the drawings and to suit field conditions, and shall be carefully worked into place without forcing or springing.

7-6.1.3 All pipe passing through ceilings shall be provided with adjustable deep chrome sprinkler ceiling escutcheons.

7-6.1.4 The interior and exterior surfaces of all piping shall be kept clean at all times. Pipe shall be free of fins and burrs and shall be cleaned in accordance with cleaning procedures, specified herein.

7-6.1.5 No flanges or unions shall be placed in locations which will be inaccessible after erection.

7-6.2 Cutting.--Pipe and tubing shall be cut accurately to measurements as shown on the drawings and to suit field conditions. Approved pipe cutters or other methods approved by the Construction Engineer shall be used and all cuts shall be reamed to remove burrs. Any objectionable defects shall be removed by machining, chipping, or grinding.

7-6.3 Threading.--Threads shall be concentric with the outside of the pipe and shall conform to ANSI 82.1. Pipe dope shall be applied lightly but sufficiently to cover the male threads only. Threads shall be drawn full tight but shall not be overtightened. Cross threaded joints shall be rethreaded and remade.

7-7. CLEANING.

7-7.1 Prior to erection all pipe and fittings shall be cleaned as follows:

7-7.1.1 The inside of all pipe and fittings shall be free of foreign matter prior to erection. The inside of the pipe and fittings shall be blown out *with* compressed air.

7-7.2 After erection and prior to testing, valves and plugs at low points in all *systems* shall be opened and the system shall be thoroughly flushed with water.

7-8. TESTING.--Testing of the sprinkler system shall be as prescribed by NFPA Pamphlet No. 13, but in no event will the test pressure be less than 200 psig maintained for two hours. For short sections of piping, as approved by the Construction Engineer, only an operational test is required. Each test shall be in the presence of the Construction Engineer. These representatives shall sign the certificate *of* inspection as a witness of a successful test. The Construction Engineer shall be notified at least 24 hours in advance of all testing.

7-9. PROCEDURE FOR PLACING SYSTEMS IN SERVICE.--Under the supervision *of* the Construction Engineer, the contractor and subcontractor shall jointly place the various systems in service with the operating mediums. The subcontractor shall furnish all labor and tools required.

7-10. JOB INSTRUCTIONS.

7-10.1 All fabricatfon and installation work shall conform to the applicable portions of the NFPA Pamphlet No. 13.

7-10.2 When a system is connected to an existing system, the shutdown period shall be limited to regular working hours and the system shall be restored to service at the end of the regular working day. The Construction Engineer shall be notified 24 hours in advance *of* the shutdown of a sprinkler system.

7-11. PIPE PAINTING AND IDENTIFICATION.--See Section 4.

Section 8

ELECTRICAL

8-1. GENERAL.

8-1.1 Scope.--This section of the specification relates to the furnishing of all labor, equipment, material, and performance of all work necessary for or incidental to the complete installation of electrical equipment and services in accordance with the drawings and as hereinafter specified.

8-1.2 Subcontractor's Responsibility.--The Subcontractor shall provide complete electrical work, unless otherwise indicated, for all automatic and/or manual devices connected with or required for the control of electrical equipment associated with all equipment and systems covered under other sections of this specification.

The Subcontractor shall coordinate the requirements of all electrical equipment, perform tests, make adjustments wherever necessary to insure proper performance of the equipment, and identify equipment in accordance with the drawings and specifications.

8-1.3 Installation.--The Subcontractor shall install work to conform to recommendations contained in the most recent issue of the National Electrical Code (NEC), the National Electrical Safety Code, and to the applicable rules of national standards and codes hereinafter referred to. In the event of conflict between the requirements of the specifications and any standards or code, the specifications shall govern.

All work required for the installation of electrical work shall be performed by craftsmen skilled in the electrical trade.

8-2. APPLICABLE CODES AND STANDARDS.--All materials, equipment and work performed shall be in accordance with the appropriate sections of the latest issue of the following documents:

(1) National Electrical Code
(2) National Electrical Manufacturers Association
(3) American National Standards Institute
(4) Underwriters' Laboratories, Inc.
(5) Federal Specifications
(6) Institute of Electrical and Electronic Engineers
(7) National Electrical Safety Code
(8) Illuminating Engineering Society Lighting Handbook
(9) Insulated Power Cable Engineers Association
(10) American Society for Testing and Materials
(11) Edison Electric Institute Specifications

8-3. **DESCRIPTION OF WORK.--The** work **shall** include the installatio of electrical feeders from existing motor control center "A" to three 45 kVA transformers and from the three transformers to three **new** lighting panels located on the mezzanine floor *of* the C-409 building. The **lighting panels** will **serve as** power source for the **C-409** lab **area.** The lab area **work** shall include the installation of electrical receptacles, supplemental lighting, lab equipment wiring, prefabricated office wiring, and **HVAC** system as shown on the drawings.

8-4. MATERIALS **AND EQUIPMENT.**

8-4.1 **General.--All** materials **and** equipment furnished, unless otherwise **noted,** shall be new and shall bear the label **of** the Underwriters' Laboratories, Inc., (Ut), whenever standards have been established and label service is regularly furnished **by** that agency.

8-4.2 Substitutions.

8-4.2.1 The **use** of brand names, catalog numbers or names *of* manufacturers **is solely** for the purpose of indicating the type and **quality** that will **be** acceptable. Unless otherwise specifically indicated **by** the words "no substitute," substitutes will be permitted **as** approved **by** the Contractor,

8-4.2.2 Vendor drawings shall be **submitted** to the Contractor for approval **in** accordance **with Special Conditions, paragraph SC-11.**

8-4.3 Lighting Fixtures--Lighting **fixtures** shall **be** of the type, size, and kind **specified** in the **fixture** schedule or legend on the drawings. **Fluorescent fixtures** shall **be equipped** with class **P ballasts** that shall be UL **and** CM8 approved and of the high power factor **type. They** shall be sound rated A. The ballasts shall be protected from overheating **by** an internal thermally actuated, automatic reclosing device to limit winding temperature. Ballasts **shall** be of the high efficiency full output type suitable for use with both 35 watt and 40 watt lamps. Ballasts shall be Universal ballast "watt reducer," General Electric "low energy," or equal.

8-4.4 Lamps.--All lamps shall **be** furnished and installed **by** the Subcontractor. Incandescent lamps for connection to 120 volt circuits shall be specifically rated for 125 **volts** unless otherwise specified. Fluorescent **iamps** shall be cool **white** type.

8-4.5 Liqhting Panelboards.

8-4.5.1 Lighting and low voltage panelboards, for operation on 208 or 240 volts, shall **be** of the dead front safety type complete with main circuit breaker, when specified on the drawings, rated for 240 volt **ac.** Panelboards shall be provided with the **type,** number and size of branch circuit breaker units **as** indicated on the drawings. Panelboards shall bear the UL label. Panelboards shall **have** fully rated **isolated** neutral **buses** and shall also **be** equipped with an equipment ground bus. Panelboards shall be comparable to Square-D Company type NQ08 with Q08-GF1 frame bolt-in branch circuit breakers unless othemise noted on the drawings.

8-4.5.2 The main circuit breaker shall be installed in the panelboard such that the breaker is closed when the operating handle is moved upward (for vertically mounted breaker) or to the right (for horizontally mounted breaker). The main and branch breakers shall have "off-on" markings to clearly indicate the handle position.

8-4.5.3 Cabinet boxes shall be constructed of zinc coated steel and shall conform to the requirements of the UL standard for cabinets and boxes. Panelboards fronts shall be door-in-door type. Trims shall be fitted with hinged doors having latches only. A directory holder shall be mounted on the inside of each door. A neatly typed directory properly identifying each circuit shall be mounted therein. Cabinets shall be supplied with standard side gutter wiring space and shall be for surface mounting as indicated on the drawings.

8-4.6 Receptacles.

8-4.6.1 Ouplex, 120 volts, 20 ampere, and single, 208 volts, 20 ampere type receptacles shall be as specified on the drawings.

8-4.7 Transformer - 45 kVA.

8-4.7.1 Transformers, wherever possible, shall be standard repetitive manufactured products of one reputable manufacturer and shall comply with NEMA standards and specifications.

8-4.7.2 All transformers shall be of the ratings and capacities, three-phase, as noted on the drawings, with all terminal surfaces either tin or silver plated. Unless specifically noted otherwise, all transformers shall be of the dry type for general light and power service. Transformers shall be suitable for indoor use for wall bracket or floor mounting as required by the drawings. Unless noted otherwise, all transformers shall have a minimum number of 2-1/2 percent fully rated kVA taps below and above rated primary voltage in accordance with the following:

3 phase, 30 kVA and larger: 2 FCAN and 4 FC8N

8-4.8 Magnetic Starters - Full Voltage.

a-4.8.1 Magnetic motor starters shall be size 1, rated for 600 volts, with start-stop pushbutton mounted in front cover of a NEMA 1 enclosure.

8-4.8.2 Magnetic starters for three-phase motors shall be equipped with three thermal overload relays for overload protection. Overload relay heater elements shall be sited and installed by the Subcontractor in accordance with motor nameplate full load current.

a-4.8.3 Operating coils shall be 208 volts, 60 Hz.

8-4.8.4 Enclosure shall be NEMA type 1 except where otherwise noted on the drawings.

8-4.8.5 Starters shall be Allen-Bradley Bulletin 709 with push-button kit Bulletin No. 1481 or approved equal.

8-4.9 Manual Starters - Full Voltage.--Manual starters for 120 volt motors shall be a toggle operated switch with trip free overload protection in suitable enclosure unless otherwise noted on the drawings. Overload relay heater elements shall be sized in accordance with the motor nameplate full load current.

8-4.10 Safety Switches.--Safety switches shall be heavy duty type single throw, with visible blades in NEMA 3R enclosure for all switches located outdoors and NEMA 1 enclosures for all switches located indoors. Switches shall have quick-make, quick-break mechanism, front cover interlock and indicator handle. Switches shall be of the ampere and voltage ratings, number of poles, nonfusible, etc., as indicated on the drawings.

8-5. MISCELLANEOUS INSTALLATION METHODS.

8-5.1 Fastenings.--Fastenings to wood shall be by means of wood screws or bolts; to masonry by means of threaded metal inserts, metal expansion screws, metal expansion shields or toggle bolts; and to steel by means of machine screws, bolts or by welding. No wood or fiber plugs will be permitted. Fastenings to concrete may be accomplished with Ramset low powered gun fasteners, toggle bolts or expansion anchors.

8-5.2 Hangers and Supports.

8-5.2.1 Hangers and supports shall be furnished and installed as shown on the drawings and as specified herein.

8-5.2.2 Equipment supports shall be Unistrut or structural steel, welded or bolted, rigid and workmanlike in appearance. Hex head machine bolts with spring lock washers shall be used.

8-5.2.3 Hangers shall be galvanized steel with approved conduit clamps and/or straps.

8-5.2.4 All angle iron, channel iron, Unistrut, rods, hangers and supports required to install and mount the electrical equipment shall be furnished and installed by the Subcontractor. Angle and channel iron members shall be cleaned of rust and scale and painted with one coat of metal primer after fabrfcation and then if not concealed, shall be painted in accordance with Section 4.

8-6. CONDUIT, FITTINGS AND ACCESSORIES.

8-6.1 Heavy Wall Rigid Steel.

8-6.1.1 Heavy wall rigid **steel** conduit shall be hot-dipped galvanized or electro-galvanized, inside and outside, in conformity with Federal Specifications WW-C-581A. Conduit couplings, elbows, nipples and fittings fabricated from steel tubing shall conform in all respects to the same specifications. Conduit shall **be** National Electric Sherarduct, Youngstown Buckeye, or **Triangle.**

8-6.1.2 Aluminum fittings, **boxes,** condulets, etc., shall not **be used** with steel conduit **except** where specifically shown on the drawings.

8-6.2 Liquidtight **Flexible Metal** Conduit.

8-6.2.1 Liquidtight flexible **metal** conduit shall **be** fabricated of galvanized **steel** flexible tubing with a synthetic jacket **extruded over** the tubing, similar to "Sealtite EF" manufactured **by** American **Metal Hose** Division *of* the American **Brass** Company.

8-6.2.2 All flexible conduit exposed to weather, **water** or other liquids **shall be** liquidtight with connectors **approved** for **this use.**

8-6.2.3 Liquidtight conduit **assemblies** shall include on each **end an** insulated **straight** or 90 degree **angle** connector **equal** to Thomas & Betts Series **No. 5300.** This shall **be the** conduit assembly intended'wherever **a** liquidtight **assembly** is **called** for **on the drawings** or **in the specffications.**

8-6.2.4 Liquidtight conduit **assemblies shall be used** between motor terminal boxes **or** other equipment **subject** to vibration and/or mechanical **adjustment and the** rigid conduit **systems** or elsewhere as shown on the drawings. Liquidtight conduit used to connect to motor terminal boxes for housing **motor** conductors shall not **be less** than 12 ***times*** the trade size in length but in **no case less** than 12 **in.**

8-6.3 Conduit Fittings.

8-6.3.1 **Cast malleable** iron **or steel** conduit fittings shall **be** thoroughly coated with metallic zinc or **cadmium** inside and **outside** after all machine work is completed **and,** insofar **as it applies,** fittings **shall** conform to Federal Specifications **W-F-406.**

8-6.3.2 Nonmetallic insulating type bushing **used** on rigid conduit shall **be** O. Z. type A, **Thomas & Betts** 200 series, Efcor Type 98, or Appleton **type** 88U.

8-6.4 **Boxes:** Junction, Terminal, Pull.

8-6.4.1 All junction and pull **boxes** shall **be** furnished and **sized** in accordance with **the** the NEC where **not** sized on the **drawings.**

8-6.4.2 Junction **and** pull **boxes** located indoors in nonhazardous areas **shall** be code gauge galvanized sheet steel, welded construction, with conduit knockouts or raceway openings **and** hinged covers.

8-6.5 Installation.

8-6.5.1 All wiring shall be installed in galvanized or sherardized rigid steel conduit.

8-6.5.2 Conduit shall be delivered to the job site in 10-foot lengths, each length bearing the UL label and the name of the manufacturer. Conduit, whether concealed or exposed, shall be adequately supported in accordance with NEC requirements and good practice. Supports shall be spaced not more than 7 ft. apart for one inch and smaller conduit or more than 10 ft. apart for conduit larger than one inch.

8-6.5.3 Conduit shall be secured to walls, building framing, etc., by the use of malleable iron galvanized "U" bolts, beam clamps, conduit straps, or Unistrut fittings when Unistrut racks or supports are used. Conduit shall be securely fastened to all outlet boxes, pull boxes, cabinets and switch boxes by double locknuts and insulating bushings unless boxes with conduit hubs are provided.

8-6.5.4 Conduit shall in no case be secured directly to other piping. Conduit parallel to or crossing uninsulated hot water or steam pipes must be separated from them by 12 in. if parallel or 6 in. if crossing. Where these lines are insulated, conduit parallel to or crossing them must clear the insulation surface by 2 in. Conduit shall not be run directly under cold water lines and shall be separated from them in other directions by at least 3 in.

8-6.5.5 Conduit shall be cut square and threaded with an approved conduit cutter and threader. The ends shall be reamed of burrs, and all metal shavings and cutting lubricants shall be removed before the conduit is connected to the conduit system.

8-6.5.6 Bends, offsets and bevels shall be avoided if practical; but if they are necessary, they shall be made with an approved bending device. Conduit crushed or deformed in bending will be rejected. The use of heat in bending conduit will not be permitted. Where a number of conduits are run together, the radii of any required bends shall be such that the installation will be neat in appearance.

8-6.5.7 All connections in rigit conduit shall be made with appropriate fittings and be securely tightened. Improperly made connections or terminations, as well as any which have not been adequately tightened, will be rejected. All conduit shall be installed by craftsmen skilled in the trade.

8-6.5.8 The exact locations and routing of conduit, when not shown in detail on the drawings, shall be determined by the Subcontractor subject to approval of the Construction Engineer.

8-6.5.9 Conduit which is run exposed shall be run at right angles to or parallel to building structural members wherever possible and shall be adequately supported by brackets, clamps, or braces wherever required, Diagonal runs shall not be made except in special cases or concealed in concrete slab.

8-6.5.10 In no case shall any electrical conduit be bent or any fabricated elbow be applied to less than the allowable bending radius of any installed conductor.

8-7. WIRE, CABLE AND CONNECTORS.

8-7.1 Conductors.

8-7.1.1 All conductors shall be stranded copper **except** lighting and receptacle circuit conductors **may be** solid. The minimum size conductor to **be used** for power and lighting circuits shall be No, 12 AWG.

a-7.1.2 **All** conductor sizes as specified on drawings are given in American Wire Gauge.

8-7.2 600-Volt Insulation.

8-7.2.1 Wire and **cable** with a 600-volt insulation rating shall **be** furnished **and** installed for all power feeders, motor leads, lighting and control **circuits that** are designed for operating voltages **up** to and including **550 volts. All conductors shall be listed by UL** for the applications specified on **the drawings.**

8-7.2.2 All conductors shall **have** NEMA type **XHHW** insulation rated at **90°C.**

8-7.3 Copper Conductor Connectors 300 Volts or **Less.**

8-7.3.1 Spl*ices*, taps and terminations of stranded conductors No. 10 AWG and smaller shall **be made** with **pressure** connectors, Thomas & Betts "Sta-Kon" or **equal.** Splices and **taps** in solid No. 10 AWG and smaller **shall** be **made** with split-bolt connectors or with insulated wire nuts, Thomas & Betts "Piggy" or **equal.** Terminations of solid conductors No. 10 **AWG** and **smaller** may **be** made **by** forming **the wire** to fit under a **screw** head, thus requiring no connector.

8-7.3.2 **Splices** and taps in copper conductors No. 8 **AWG** through No. 1 **AWG** and terminations of these sizes of conductors other than in equipment lugs (i.e., molded **case** circuit breakers) shall **be** made with either copper mechanical connectors or with wrought copper compression connectors.

Type of Connection	Type of Connector	Thomas & Betts Series No.
Splice	Mechanical - Split-Bolt	2T thru 8T
Tap	Mechanical - Split-Bolt	2T thru 8T
Termination	Mechanical - One-Hole Lug	131000
Splice	Compression - Two-Way Connector	#54500
Tap	Compression - "C" Tap	#54700
Termination	Compression - One-Hole Lug	#54100

8-7.3.3 Splices and taps in copper conductors No. 1/0 AWG through No. 4/0 AWG and terminations of these sizes of conductors other than in equipment lugs (i.e., molded case circuit breakers) shall be made with wrought copper compression connectors.

Type of Connection	Type of Connector	Thomas & Betts Series No.
Splice	Two-Way Connector	#54500
Tap	"C" Tap	#54700
Termination	Two-Hole Lug	8154200

8-7.4 Copper Conductor Connectors over 300 Volts.

8-7.4.1 All connectors specffied for use with copper conductors carrying 300 volts or less are applicable for use with conductors carrying up to 600 volts, except insulated wire nuts shall not be used. Splices in conductors No. 10 and smaller shall be made with split-bolt connectors.

8-7.5 Wire Connections.

8-7.5.1 Splices and taps shall be made in junction boxes or wiring gutters only.

8-7.5.2 Wire shall be thoroughly cleaned before connectors are applied.

8-7.6 Insulation of Splices and Taps 600 Volts.

a-7.6.1 Splices and taps in thermoplastic (THW and XHHW) and rubber conductors shall first be insulated with rubber tape, Okonite Company "Okonite" type No. 10. Connection shall then be wrapped with all weather vinyl plastic tape, 3M Company "Scotch" No. 88. Connections not housed in a junction box or other metal enclosure shall have an additional protective wrapping of friction tape, Okonite Company "Manson" type No. 5, to protect the connection *from* abrasions.

8-7.6.2 All outdoor splices and taps in type THW and XHHW insulated conductors, such as splices at service entrances and any connections which are subjected to high humidity, shall be insulated as specified above, then wrapped with linen cloth tape and painted with two brushed-on coats of General Electric Company "Glyptal."

8-7.6.3 On all splices and taps, the tape applied directly over the connector shall be wrapped as tight as possible in a manner so as to pad the sharp edges and fill the indents of the connector. The outer tape shall be applied until the total area of the initial taping is covered with a minimum of four layers. The total thickness of the combination of tapes shall be at least equal to the thickness of the conductor insulation. Tape of an appropriate width shall be used.

8-8. IDENTIFICATION.

8-8.1 Equipment.

8-8.1.1 Safety switches, circuit breakers, motor starters, lighting panels, power panelboards and other similar electrical equipment shall be identified.

8-8.1.2 Light switches, receptacles and other similar electrical devices shall be identified as to voltage, phase and source of power. For example, a lighting switch on circuit 15 from panel 8 would be marked "120 Volt, 10, LPB-15."

8-8.1.3 The means of identification shall be subject to approval of the Construction Engineer but in general shall be as follows:

8-8.1.4 Exterior surfaces of lighting switches and receptacles shall be identified by means of raised 1/4-inch high characters on 1/2-inch wide aluminum strips. Identification tags shall be securely fastened to the equipment with noncorrosive rivets.

8-8.1.5 Safety switches, circuit breakers, motor starters, lighting panels, power panelboards and other similar electrical equipment shall be identified as per Sketch A-E-14469-A, Rev. 1 attached to this section of the specification.

8-8.1.6 Identification shall be in accordance with the one line diagram and shall include the following:

(1) Maximum voltage
(2) Equipment designation
(3) Source of supply "Fed from..."
(4) Equipment supplied

The "maximum voltage" and "source of supply" may be omitte on branch breakers in unit substations or panelboards where such is obvious. The "equipment supplied" notation may also be omitted where such is obvious.

Example: (1) 480 volts AC
(2) Power Dist panel
(3) Fed from Sub 9A1
Compt 5A

8-8.1.7 Lighting and Distribution Panelboards.--The panel directories in lighting panelboards shall be neatly filled out, showing for each circuit the equipment served, floor and column location and room number where applicable. Spare circuits shall be identified on the schedule.

8-8.2 Conductors.

8-8.2.1 All single conductor power and control wiring shall be identified in all readily accessible junction boxes in the wiring system as well as at all terminations. Conductors need not be identified in pull boxes where no taps or splices are made. Identification shall be by means of taped on numbers or letters attached to each conductor.

8-8.2.2 All three-phase power feeder conductors shall be identified by phase designation, e.g., ØA, ØB, ØC.

8-9. GROUNDING.

8-9.1 General.

8-9.1.1 The grounding shall be in accordance with the drawings and the NEC.

8-9.1.2 All ground connections required by the NEC and any other additional grounding as shown on the drawings or as specified herein shall be furnished and installed. All enclosures for safety witches, circuit breakers, control devices, motor frames, cabinets, panelboards, etc., shall be grounded to the building common ground network with bare copper wire of the sizes as shown on the drawings or in accordance with the NEC. In general, grounding shall conform with the applicable requirements of the NEC except as amended herein.

8-9.1.3 Equipment and circuits shall be grounded by a continuous grounding conductor. The grounding conductor shall be run in the same conduit with the power conductors. The use of conduit as sole means of grounding will not be acceptable. Grounding or bonding of equipment to building steel as a sole means of grounding will .not be acceptable.

8-9.1.4 All ground wires shall be copper. Aluminum ground wires are not permitted and will not be accepted. Ground wires No. 8 AWG and larger shall be stranded.

8-9.1.5 Connections to ground buses and connections of ground conductors to switch boxes, panel boxes, cabinets, etc., shall be made with compression connectors. Splices and taps in ground conductors need not be insulated.

8-9.1.6 All contact surfaces shall be thoroughly clean and bright before connections are made to insure making good electrical contact.

8-9.2 Lighting Fixture Enclosure Grounding.--A continuous ground conductor, preferably a solid, bare wire sited in accordance with the drawings, shall be run in the same conduit as the circuit conductors and attached to the metal .enclosure of each lighting fixture and related local switch box.

8-9.3 Receptacle Grounding.--All receptacles, 120 and 208 volt, shall be provided with a grounding pole, which shall be attached to a continuous ground conductor sized in accordance with the drawings. The ground conductor shall be permanently grounded to the building grounding system.

8-9.4 Transformer Neutral Grounding.--The secondary neutrals of all 208Y/120 volt, three-phase lighting transformer shall be grounded in accordance with Section 250-26 of the NEC.

8-10. FIELD TESTING.

8-10.7 General.--Test all wire, cable and electrical equipment furnished, installed or connected to assure proper installation, connection and function in acccrdance with the drawings, specifications and manufacturer's recommendations. Include all tests recommended by the equipment manufacturer whether specified or not, unless specifically waived by the Contractor. Include any additional tests issued by the Contractor that he deems necessary because of field conditions to determine that equipment, material and systems meet requirements of the specifications. Furnish qualified personnel and testing equipment as required to perform all tests. Maintain a complete and accurate written record of all tests showing date, personnel making test, equipment or material tested, tests performed, and results with copies furnished to the Contractor. The Subcontractor shall be responsible for any damage to equipment or material due to improper test procedures or test apparatus handling, and shall replace or restore to original condition any damaged equipment or material at no cost to the Contractor. Provide safety devices such as rubber gloves and blankets, protective screens and barriers, danger signs, etc., to adequately protect and warn all personnel in the vicinity of the tests.

8-10.2 Molded Case Circuit Breaker Tests.--Check all connections, visually inspect each breaker and operate manually. Check for proper current rating for circuit to which connected. Megger each pole for freedom from grounds.

8-10.3 Phasing and Polarity Tests.--Check all motors for proper rotation and determine that both phasing and phase rotation are correct for all circuits. Change all wiring where phasing or polarity is not correct and repeat tests.

8-10.4 600 Volt Wire and Cable Tests.

8-10.4.1 This section of the specification covers the electrical testing of all 600 volt insulated single and multiconductor wire and cable.

8-10.4.2 Test No. 1 - Continuity.

8-10.4.2.1 Make test for continuity and correctness of wiring and identification on all conductors of lighting and receptacle branch circuit, power and control circuits and motor leads.

8-10.4.2.2 Test shall be made with a dc test device such as a bell, a buzzer or a light.

8-10.4.3 Test No. 2 - Insulation Resistance.

8-10.4.3.1 All 600 volt power cables no. 4 AWG and larger shall be given an "Insulation Resistance Test" using a 1000 volt motor driven "Megger."

8-10.4.3.2 The test shall be made with the conductors dfsconnected at the equipment. Test shall be made between one conductor and ground with the other conductors grounded. Each conductor shall be tested in the same manner, The voltage shall be applied for a minimum of three minutes and until the reading reaches a nearly constant value,

8-10.4.3.3 Acceptable minimum resistance readings shall be 25 megohms. If megger readings indicate damaged insulation, the conductor shall be reject. and shall be replaced by the Subcontractor. The replacement conductor must p the required megger test.

8-10.4.3.4 More than one conductor may be listed on the same cable test report provided all conductors listed are tested and accepted on the same date. Reports shall include complete identification of the feeder, megger readings vs. time data, ambient temperature and weather conditions.

8-10.5 Lighting Fixtures.--Give all lighting fixtures an operational test. All fixtures must operate, all lenses must be clean and all local switches must function properly.

8-10.6 120 Volt Receptacles.

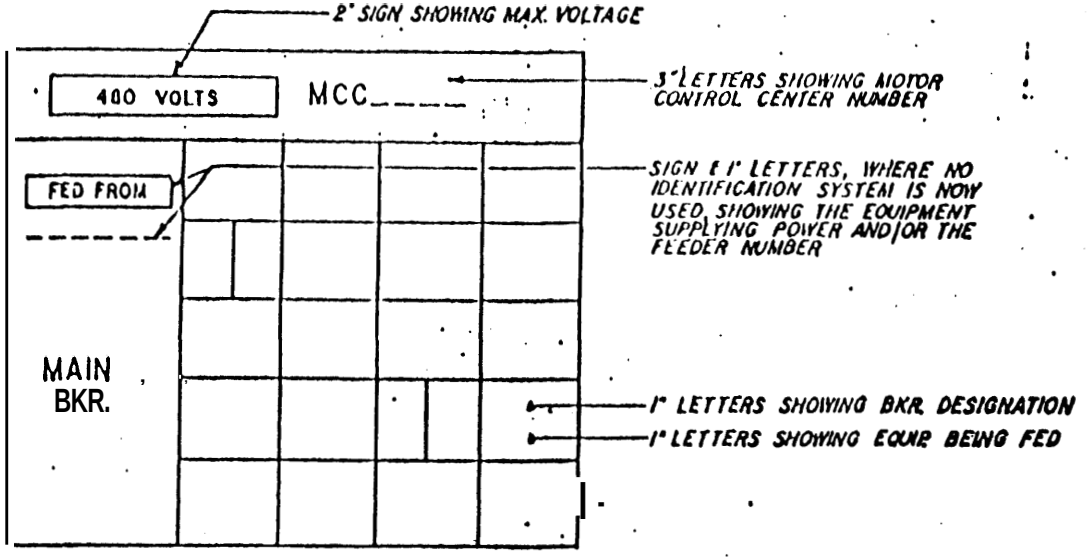
8-10.6.1 A random check of receptacles shall be made to insure that neutral and ground wires are connected properly,

8-10.6.2 After installation, all 120 volt receptacles shall be checked for correct wiring by the use of a Daniel Woodhead Model No. 1750 tester.

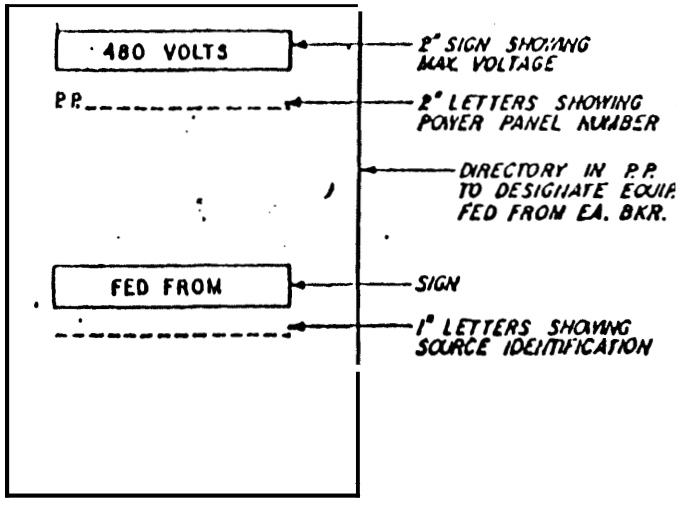
8-10.6.3 After completion of wiring test in section 8-10.6.2, all 120 & 20 volt receptacles shall be given an equipment ground impedance test. The test shall be performed using a Daniel Woodhead Model No. 7040 "Ground Loop Impedance Tester." The maximum allowable impedance shall be 1.0 ohms.

CAUTION: This test shall be performed at each receptacle with no loads plugged into other receptacles sharing the same equipment ground conductor,

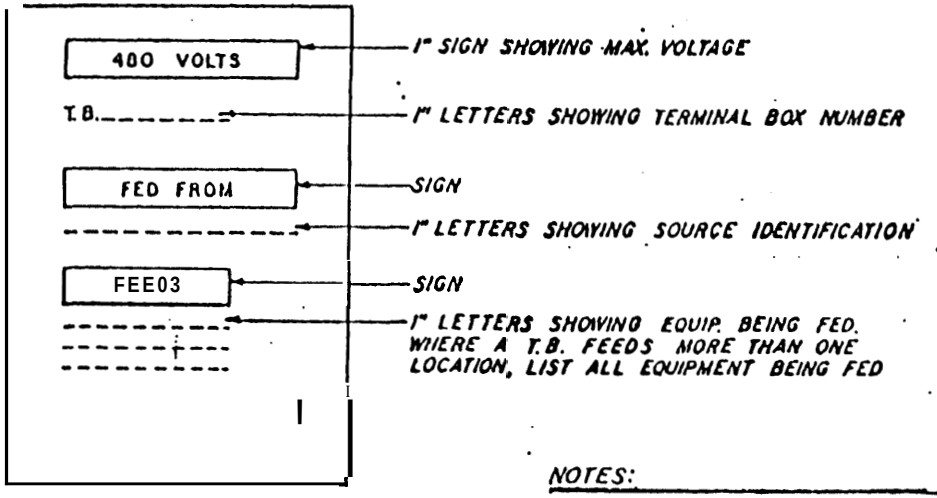
8-10.6.4 All receptacles checks shall be made by the Subcontractor using test equipment furnished by the Subcontractor and in the presence of the Construction Engineer. Any receptacles not passing the required tests shall be corrected by the Subcontractor and then verified by the Construction Engineer as being acceptable.



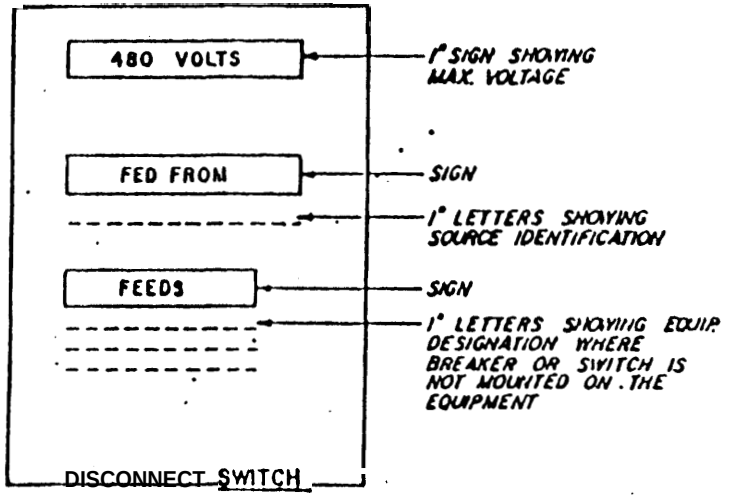
MOTOR CONTROL CENTER



POWER PANEL



TERMINAL BOX



DISCONNECT SWITCH

CIRCUIT BREAKER OR MOTOR STARTER

NOTES:

1. ALL LETTERING IS OF YELLOW VINYL ADHESIVE BACKED LETTERS.
2. ALL SIGNS ARE VINYL ADHESIVE BACKED STRIPS WITH BLACK LETTERS ON A YELLOW BACKGROUND.
3. ALL EQUIP. SIGNS ARE TO BE SIZED TO SUIT THE EQUIPMENT. MATERIAL TO BE PHENOLIC ADHESIVE BACKED OR FIBER, DISC AS APPROPRIATE.
4. BEFORE THE APPLICATION OF PRESS ON SIGNS AND LETTERING THE SURFACE SHALL BE CLEANED W/SOLVENT SUCH AS VANSOL. AFTER APPLICATION [illegible] THE SIGNS & LETTERING WITH "KRYLON" LACQU
5. VINYL ADHESIVE BACKED LETTE[illegible] BE BRADY QAV QUIK-ALIGN LETTERS. VINYL CLO[illegible] ADHESIVE BACKED SIGN SIGNS SHALL BE BRADY VOLTA[illegible]
6. ALL STRIP SIGNS MAY BE REPLACED WITH EQUAL SIZE BRADY QAV QUIK-ALIGN LETTERS.

. EQUIPMENT DESIGNATION

EQU[illegible]NT SIGNS

DESIGN BY B.A.S.	DATE 1973
DRAWN BY JENKINS	3-16-1973
CHECKED BY A.R.O.	3-19-1973
[illegible]	3-19-73

UNION CARBIDE CORPORATION
NUCLEAR DIVISION — [illegible] PLANT

ELECTRICAL SYSTE[illegible]

Section 9

LABORATORY EQUIPMENT

9-1. **SCOPE.--This** section of the specifications relates to furnishing and installing of all laboratory equipment and accessories as shown on the design drawings, or as specified herein. Refer to other sections of these specifications for the mechanical and electrical services.

9-2. **SHOP DRAWINGS.--Shop** drawings shall be submitted for approval in accordance with **SPECIAL** CONDITIONS paragraph: **SUBCONTRACTOR'S** SUBMITTALS.

9-3. GENERAL REQUIREMENTS.

9-3.1 **The** Subcontractor shall provide all laboratory equipment and accessories required and shall provide adequate **supporting** devices required for complete installation.

9-3.2 **The** Subcontractor shall provide all hardware required for installation **such** as **screws,** nuts and bolts, clips, anchors, shims, inserts, **etc.**

9-4. MATERIALS.

9-4.1 General.--The laboratory equipment shall **'be** manufactured **by** Kewanee Scientific Equipment Corp. **, or** approved equal **unless** otherwise specified. **Equipment shall be in** accordance with **APPENDIX A,** LABORATORY EQUIPMENT **SCHEDULE,** and as shown on the design drawings. Service fittings shall **be** in accordance with **APPENDIX** B, LABORATORY **SERVICE** FITTINGS, and as shown on the **design** drawings.

9-4.2 Laboratory Equipment---All laboratory equipment **shall** be assembled in accordance with the manufacturer's instruction and engineering **standards** for maximum stability and strength, while allowing maximum compatibility within all cabinet configurations.

9-4.3 Work Tops.--Work tops shall **be** "Kemresin" as manufactured **by Kewanee** or approved equal, or stainless steel. "Kemresin" tops shall **be** made from modified **epoxy** 'resins specially designed for laboratory counterwork surfaces. Stainless steel tops shall **be** fabricated from Type 316 stainless. Seams shall **be** welded, water tight, ground flush and polished. All corners shall be **covered** and rounded.

9-4.4 Sinks.--Sinks shall **be** sloped to the outlet and **shall** be furnished with outlets, including **back** nut and strainer.

9-4.5 Plumbing Fixtures.--All equipnent shall be furnished complete with faucets, drains and tail pieces, and utility and electric outlets as shown on the LABORATORY EQUIPMENT SCHEDULE, APPENDIX A.

9-4.6 Fume Hood.--Refer to the mechanical drawings for exhaust blower required for fume hood.

9-4.7 Color Selection.

9-4.7.1 Color for all base unit shells, drawer bodfes and trim parts shall be "Kem-Ponent" standard color number 20, sand trim.

9-4.7.2 Accent color used on drawer fronts, doors and top front panels shall be "Kem-Ponent" standard color number 49, tangerine.

9-5. INSTALLATION.

9-5.1 General.--All laboratory equipment shall be protected from soiling and damage Curing handling and installation. Laboratory equip ment shall be [redacted] in strict accordance with the manufacturer's instructions.

9-5.2 Positioning.--Laboratory equipment shall be positioned plumb, level true, and straight with no distortions. Shim as required, using concealed shims.

9-5.3 Adjustment.--Adjust laboratory equipment and hardware s that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

9-6. CLEANING.--Remove all packing and/or protection and thoroughly clean and polish all surfaces.

APPENDIX A

LABORATORY EQUIPMENT SCHEDULE

Environmental Laboratory, C-409

ITEM NO.	DESCRIPTION OF EQUIPMENT	SIZE	QUANTITY	CATALOG MODEL NO.
1	Utility Table	8'L x 31"H x 24"W	1 ea.	K7-6353
2	Wall Storage Case	48"L x 30"H x 12"D	9 ea.	KW-1258
3a.	Wall Table Assembly	15'-2"L x 41"H x 31"W	3 ea.	K7-2105
b.	Sink	25" x 15" x 10"D	1 ea.	1005
c.	Sink service fittings:			
	1) Distilled water gooseneck faucet	---	1 ea.	T-368
	2) Hot and cold water mixing valve	---	1 ea.	T-340
	3) Acetylene gas fitting	---	1 ea.	T-260
	4) Oxygen gas fitting	---	1 ea.	T-260
	5) Air fitting	---	1 ea.	T-260
	6) Nitrogen gas fitting	---	1 ea.	T-250
	7) Eye [illegible] s hand-held table-top mounted, Speakman Safety Equipment Company	---	1 ea.	SE-921
	8) "P" Drum trap, Polyethelene 1 1/2", Hamilton Industries	---		341231
	9) Kemresin Sink Outlet	1 1/2"	1 ea.	482
d.	Electrical outlet, 120-volt, AC, two-duplex single faced pedestal (NEMA 5-20R)	---	2 ea.	581-7
4	Wall Storage Cabinet	36"L x 30"H x 16"D	5 ea.	KW-1616

ITEM NO.	DESCRIPTION OF EQUIPMENT	SIZE	QUANTITY	CATALOG MODEL NO.
5	Fume Hood	5'L x 37"W x 7'-1 1/4"H	1 ea.	KH-1005-MS
	Accessories include: a) Four remote controlled service fittings; air, Acetylene, Nitrogen, cold water	---	---	---
	b) 250-volt single AC outlet (NEMA 6-20R)	---	2 ea.	---
	c) 120-volt duplex AC outlet (NEMA 5-20R)	---	2 ea.	---
	d) Two-tube, fluorescent light fixture with switch	---	1 ea.	---
	e) Cup drain, stainless steel	5" dia.	1 ea.	---
6a.	Wall Table	10'-2"L x 41"H x 31"W	1 ea.	K7-2065
b.	Sink	16" x 12" x 8"D	1 ea.	1008
c.	Sink service fittings: 1) Eye wash, hand-held table-top mounted, Speakman Safety Equipment Company	---	1 ea.	SE-921
	2) Hot and cold water mixing valve	---	1 ea.	T-340
	3) "P" Drum trap, Polyethelene 1 1/2", Hamilton Industries	---	1 ea.	34L231
	4) Kemresin Sink Outlet	7 1/2"	1 ea.	482
	5) Distilled water gooseneck faucet	---	1 ea.	T-368

ITEM NO.	DESCRIPTION OF EQUIPMENT	SIZE	QUANTITY	CATALOG MODEL NO.
6d.	Peg board	20"L x 29"H x 1 1/4"T	1 ea.	K7-1901
7	Fume Hood	4'L x 37"W x 7'-1 1/4"H	1 ea.	KH-1004-MS
	Accessories include:			
	a) Four remote controlled service fittings, air, Oxygen, Nitrogen, cold water	---	---	---
	b) 250-volt single AC outlet (NEMA 6-20R)	---	2 ea.	---
	c). 120-volt duplex AC outlet (NEMA 5-20R)	---	2 ea.	---
	d) Two-tube, fluorescent light fixture, with switch	---	1 ea.	---
	e) Cup drain, stainless steel	5" dia.	1 ea.	---
a	Preparation Wall Table	7'-9 1/2"L x 38"H x 31"W	7 ea.	FAB-485 (KTS-485)

APPENDIX B

LABORATORY SERVICE FITTINGS

Environmental Laboratory C-409

DESCRIPTION OF SERVICE FITTINGS	MODEL NO.
1) Hot and cold water mixing, 1/2" gooseneck sink faucet	T-354
2) Right hand distilled, 1/2" water gooseneck faucet	T-367
3) Acetylene straight stop, 3/8"	T-323
4) Oxygen straight stop, 3/8"	T-323-3
5) Nitrogen straight stop, 3/8"	T-323
6) Air straight stop, 3/8"	T-323
7) Stainless steel cup sink, 5" diameter x 4" deep	950-F
8) "P" Drum trap, Polyethelene, 1 1/2", Hamilton Industries	34L231

Section 10

EXCAVATION AND BACKFILL

10-1. **SCOPE.--This** section of the specifications relates to the excavating, filling, backfilling, grading and related **work as** shown on the drawings and **as** specified herein.

10-2. **GENERAL REQUIREMENTS.**

10-2.1 Existing Utilities, Lines and Structures.--The Subcontractor shall familiarize himself with all existing utilities prior to any excavation. He shall protect all utilities, lines and structures encountered in the prosecution of the work, **and** follow the procedures prescribed in the **. SPEC**IAL CONDITIONS.

10-2.2 **Pumping.--Sufficient** pumping **equipment** of the required capacity **and** *of* an approved design **shall be** provided, maintained and operated to **keep** excavation free of water during construction. If soft spots occur in excavated areas **as a result** of improper maintenance **by** the Subcontractor, the Subcontractor shall remove the unsuftable material and shall backfill . the area **as** specified **at** no additional **cost** to the Contractor.

10-2.3 **Disposal** of Waste Material.--Waste materials shall be disposed of as specified **in the SPECIAL CONDITIONS.**

10-2.4 Sheeting and Shoring.--Sheeting **and** shoring shall be furnished and placed **for support** of **earth banks bordering** excavations where the banks **are** at **a** sharper slope than the angle of **repose** of the earth. The size and arrangement of **members** shall **be** such that the banks are **retained** in place so that **no** earth **movement** can occur that would **damage** adjacent structures or underground utilities. **As** backfilling progresses, the sheeting and shoring shall **be** gradually withdrawn **so** that deposited fill is **placed against** the original earth of the bank.

10-2.5 Drainage.--Grading in the vicinity of the **work** area **shall be controlled so as to** prevent water from running into the excavated area.

10-2.6 Protectton.--Newly graded areas shall be protected from the action of **the** elements, **and any** settlement or washing that **may** occur from **any** cause, prior to **acceptance** of the **work, shall be** repaired and graded to the required elevations and slopes **at** no additional cost to the Contractor.

10-3. DEFINITION OF TERMS.

10-3.1 Fill.--Fill shall be material as specified, used to bring the existing grade to proposed grade.

10-3.2 Backfill.--Backfill shall be dry earth, or other approved material, used to replace earth removed during construction.

10-4. UNAUTHORIZED EXCAVATION.--Unauthorized excavation below the elevations or beyond other required limits indicated on the drawings or in these specifications shall be restored at the Subcontractor's expense in accordance with the procedure hereinafter specified for fill and backfill.

10-5. EXCAVATION.

10-5.1 General.

10-5.1.1 Excavation within the work area shall be performed to the lines and grades indicated on the drawings and as specified.

10-5.1.2 All excavated materials which are acceptable and are required as backfill shall be stored within the limits of the work area. Material not acceptable or not required for backfill shall be disposed of as waste material.

10-5.2 Earth Excavation.--Earth excavations shall conform to the dimensions and elevations indicated on the drawings. Final grade shall not be made until just before concrete is to be placed, and care shall be taken not to disturb the bottom of the excavation. Excavations carried below indicated depths will not be permitted except to remove unsatisfactory material.

10-5.3 Trench Excavation.--Trench excavation shall be of the necessary width for proper laying of pipe. The width of the trench shall not be greater than that necessary to adequately install the pipe in accordance with applicable sections of the specifications, except where indicated otherwise on the drawings. The bottom of the trench shall be accurately graded to provide uniform bearing and support for the pipe either on undisturbed soil or properly compacted material throughout its entire length except where it is necessary to excavate for coupling holes and for the proper sealing of pipe joints. Coupling holes shall be excavated after the trench bottom has been fine graded.

10-5.4 Concrete Excavation.--Existing concrete shall be removed in sufficient width to permit excavation of a pipe trench in accordance with Section 10-5.3, above. All excavated concrete shall be disposed of as waste materials.

10-5.5 Compaction.

10-S.5.1 When subgrades are less than the density as described below, the ground surfaces shall be broken up to a minimum depth of 6", pulverized and compacted to the specified density.

10-5.5.2 Compact soil to a density of at least 95% maximum at optimum moisture as determined in accordance with the AASHO Method T-99. Density shall be determined by T-191, T-205, of by Nuclear Density Meter.

10-6. FSLLING AND BACKFILLING.

10-6.1 Fill Material.--Materials for earth fill shall be dry earth, free from clods, boulders, broken rock or concrete exceeding 3" in the larger dimension, organic and vegetable matter, rubbish and other unsuitable material.

10-6.2 Backfill Material.--Materials for earth backfill shall be dry earth, free from clods, boulders, broken rock or concrete exceeding 3" inches in the larger dimension, organic and vegetable matter, rubbfsh and other unsuitable material. When approved by the Construction Engineer, "bank run gravel", as defined by ASTM D-2487, which is a natural gravel with 100% passing the 2-inch sieve, not less than 70% retained on the No. 8 sieve and not more than 5% passing the 200 mesh sieve, may be used for backfill material to within 1' of final grade.

10-6.3 Granular Fill Material.--Compacted granular fill shall consist of clean, tough, durable fragments of crushed limestone meeting the gradation requirements for Dense Graded Aggregate, as defined by the Kentucky Highway Department's "Standard Specification for Road and Bridge Construction", Section 805.

10-6.4 Sand Fill Material.--Sand fill material shall be natural sand as defined by the Kentucky Highway Department's "Standard Specification for Road and Bridge Construction", Section 804.

10-6.5 Placement.

10-6.5.1 Fill and backfill material shall be successively placed in horizontal layers not exceeding 8" in loose depth and at the proper water content for compaction. Fill and backfill shall be compacted to a density of at ?east 95% maximum at optimum moisture as determined in accordance with AASHO Methods T-99 and T-180, or Nuclear Density Meter.

10-6.5.2 No fill or backfill shall be placed when weather conditions or the conditions of the material preclude obtaining the required compaction.

10-7. GRADING.--All surfaces shall be graded back to the original elevation and sloped to drain, unless otherwise noted on the drawings. Seeding will not be required.

10-8. CONCRETE.--Concrete used for the repair of existing concrete shall have a minimum compressive strength of 1950 psi at 7 days and 3000 psi at 28 days, unless otherwise indicated on the drawings or specified. Finishes shall match existing adjacent finishes. All concrete shall. be cured in accordance with ACI Specifications.

10-9. TESTING.--When determined necessary by the Contractor, tests will be performed by the Contractor to determine the degree of compaction of fill and backfill in accordance with the provisions of AASHO Methods T-99 and T-180, or Nuclear Density Meter. The Subcontractor shall furnish the tabor and facilities required for taking samples of material to be tested.

10-10. CLEANING.--The entire area of the construction site shall be raked clean, free of all trash, debris, wood fonns, or other refuse after completion of the work, and all such materials shall be removed from the site.

Section 11

SANITARY SEWER PIPING

11-1. **SCOPE.--This section** of the specifications relates to sanitary sewer piping and related work **as** shown on the **design** drawings and **as specified** herein.

11-2. **MATERIALS.**

11-2.1 Polyvinyl Chloride Pipe (PVC).

11-2.1.1 PVC **Pipe** and Fittings.--PVC **pipe** and fittings shall be **in** accordance with **ASTM** 03034 (type **PSM** PVC **pipe)** with a Standard Dimensional Ratio (SDR) *of* 35. Available net laying lengths shall **be** 12.5 **or** 20' ± 1". Pipe **and** fittings shall have an integral bell with elastomeric seal joints.

11-2.1.2 PVC Pipe and Fitting Compound.--PVC pipe and fitting **compound** shall **be** rigid poly compounds and chlorinated poly compounds, **white in** color **with physical** properties **and** chemical resistance of cell classifications for **pipe** of **12454-B** and cell classifications for fittings of **12454-B, 12454-C, or 13344-C conforming with ASTM 01784.** Different cell classifications having **one** or **more superior** properties **and clean** reworked material generated **by** the manufacturer's own production shall **be** acceptable.

11-2.1.3 PVC **Pipe** Joints.--PVC **pipe** joints shall **be in** accordance with **ASTM** D3212. Joint **design** shall **be** tested and certified to result in no leakage under prescribed laboratory **test conditions** of joint alignment, load conditions, pressure and **vacuum,** and deflection.

11-2.1.4 Gaskets for PVC Pipe Joints.--Gaskets shall **be** manufactured **from a** high grade, **properly** vulcanized elastomeric compound consisting **of** either basic natural or synthetic rubber in conformance with **ASTM** F477. **Gasket** manufacturing tolerances shall comply with Rubber Manufacturer's Association tolerances for gaskets.

11-2.1.5 **Lubricant** for PVC **Pipe** Joints.--Lubricant shall be suitable for lubricating the joint components. It shall **have** no deteriorating effect **on** the gasket or pipe material.

11-3. **INSTALLATION.**

11-3.1 Install materials in accordance with requirements of specified codes and standards, written **or** published instructions **and** best practice recommendations of the manufacturer, and as supplemented in these specifications.

11-3.2 Trenches.--Trenches shall conform to the requirements as described in Section 10. Before starting to lay pipe, trenches shall be examined and approved by the Construction Engineer.

11-3.3 Grade and Alignment.--Pipe shall be installed in accordance with the lines and control elevations established on the drawings.

11-3.4 Pipe Embedment.--Pipe embedment for PVC pipe shall confon to the requirements as detailed on the design drawings and as described in Section 10.

11-3.5 Cleaning Pipe.--The inside of all pipe, including bells and spigots, shall be cleaned by thoroughly flushing out of a71 dirt, dust and other sediment, as well as any other foreign material, before being placed in the trench.

11-3.6 Inspection of Pipe on Installation.--Before lowering into trench and while suspended, the pipe shall be inspected for defects and cracks. Any defective, damaged or unsound pipe shall be rejected.

11-3.7 Temporary Plugs, Etc.--After placing pipe in trench, it shall be kept clean. All branches and other openings shall be stopped up by wood plugs or heads until connected or capped. Open ends of pipe at end of day's work shall be closed by wood plugs or heads.

11-3.8 Pipe Laying Procedure.--Installation of PVC sewer pipe and fitting shall be in accordance with UNI-Bell Standard UNI-B-5 (recommend practice for installation of PVC sewer pipe). All pipe shall be laid on 4" of sand fill material so as to obtain solid bearing throughout the installation, with the bell ends upgrade and the laying commenced at the downgrade end. Where the excavation has been carried below the plan subgrade, an approved bedding material of granular fill shall be placed, spread in layers not more than 4" thick, and tamped thoroughly to form a firn and uniform bearing for sand fill material. The pipe shall be laid true to line and grade without humps, depression, or offsets in the flow line. A variation of 1/4" from this flow line will be deemed sufficient reason to order removal of sections of pipe showing such variation and relaying of same to the true flow line. The longest laying lengths of standard pipe shall be used to the fullest extent to minimize the number of joints. Before joining the pipe in the trench, the bell and spigot surfaces shall be wiped free of dirt or other foreign matter. A lubricant as recommended by the pipe manufacturer shall be applied to the bell and spigot mating surfaces just before they are jointed together. The spigot end shall be positioned into the bell end of the pipe previously laid and shall then be shoved home to compress the joint and to assure a tight fit between the interfaces.

11-4. CLEANING, TESTING AND INSPECTION.--Before backfilling, flush the drainage system with clean potable water. Lamping tests shall be made between all manholes in the presence of the Construction Engineer. All pipe, fittings and joints shall be carefully examined, any damaged or defective materials discovered shall be removed and replaced. After replacements and repairs have been made, the above procedures shall be repeated until work is satisfactory and approved by the Construction Engineer.

SPECIFICATIONS FOR

LIQUID CHEMICAL LABORATORY, C-409

AT

THE PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH, KENTUCKY

INVITATION NO. 8115

SUBCONTRACT SPECIFICATIONS 13817

UNION CARBIDE CORPORATION
NUCLEAR DIVISION

Post Office Box 1410

Paducah, Kentucky 42001

December 16, 1983

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12 Not Required----------

C. Curtain

Curtain shall be formed of interlocking galvanized steel slats of No. 20 gage minimum thickness. Slats shall be the manufacturer's standard. The curtain shall be designed to resist a wind pressure of 20 lbs per square foot without damage. The curtain shall roll up on a drum supported at the head of the opening on brackets and be balanced by helical springs.

D. Endlocks and Windlocks

The ends of each slat shall have malleable iron endlocks of the manufacturer's standard design. The door shall have windlocks of manufacturer's standard design at the ends of each slat. Windlocks shall prevent curtain from leaving the guide as a result of deflection from wind pressure or other forces.

E. Bottom Rail

The curtain shall have a rolled-steel bottom bar consisting of two angles of equal weight, one on each side, fastened to the bottom of the curtain and shall have a compressible and replaceable rubber, neoprene, or vinyl weather seal attached to the bottom rail.

F. Guides

The guides shall consist of steel shapes not less than 2 1/2" deep and not less than 3/16" thick and shall form a channel pocket of sufficient depth to retain the curtain in place under the wind pressure specified. Provisions for removal of the door shall be included in the design. Guides shall be securely attached to adjoining construction with 3/8" diameter bolts spaced near each end and not over 24" apart. Door shall have guides weatherstripped.

G. Roller Shaft

The roller shaft shall be constructed of steel pipe or commercial welded steel tubing of proper diameter and thickness for the size of the curtain. Deflection shall not exceed 0.03" per foot of span. Ends of roller shall be closed with cast iron plugs, machined to fit the pipe. An oil-tempered, helical, counter-balancing steel spring, capable of producing sufficient torque installed within the roller. Spring shall be easily adjustable.

H. Brackets

Brackets shall be fabricated of heavy cast iron or steel, designed to close the ends of roller shaft housing and to form a supporting ring for hood. The bracket hubs or shaft plugs shall be equipped with prelubricated ball bearing, shielded, or sealed.

1. **Hood**

Hood shall be constructed of steel not lighter than No. 24 gage, formed to fit the contour of end brackets and reinforced with steel rods, or rolled beads at top and bottom edges. A weather baffle shall be provided at the lintel.

J. Gears

Gears shall be of the best grade gray iron, cast iron teeth machine molded from machine cut patterns.

4. **FINISH**

A. Galvanizing

Curtain and bottom rail shall be hot dipped galvanized with a zinc coating not less than 1.25 oz total per square foot of flat metal, coating class 1.25 in accordance with ASTM A525-81. Hood shall have either class 1.25 galvanizing as described above or be fabricated from electrolytic zinc-coated sheets conforming to ASTM A591-81, at Subcontractor's option.

B. **Pre**treatments

All zinc coated surfaces **shall** be given a phosphate coating prior to applications of prime paint.

C. Shop Applied Prime Paint

All ferrous surfaces including galvanized curtain, hood, and slats but excluding wearing surfaces shall be given one shop applied prime coat of the manufacturer's standard primer. Primer shall not contain lead. Nongalvanized surfaces shall be wire brushed to bare metal prior to primer application.

5. **INSTALLATION**

Door shall be installed in accordance with approved shop drawings and manufacturer's data. Anchors and inserts for brackets, tracks, hardware, and other accessories shall be located accurately. Upon completion, door shall **be** weather-tight and shall be lubricated and adjusted to operate freely.

6. **PAINTING**

Door shall **be** finish painted as specified in Section 11.430 - **PAINTING.**

4.710 - FABRICATION AND ERECTION OF STRUCTURAL STEEL AND MISCELLANEOUS METAL

GENERAL

This specification covers furnishing, fabricating, shop painting, and erection of structural steel and miscellaneous metal.

CODES AND STANDARDS

Codes and standards which are called for or referred to herein are hereby made a part of these specifications to the extent indicated by the reference thereto.

American Institute of Steel Construction (AISC)

"Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," Eighth Edition

"Code of Standard Practice for Steel Building and Bridges," Eighth Edition

B. American Society for Testing and Materials (ASTM)

A36-81a	Specification for Structural Steel
A325-83	Specification for High Strength Bolts for Structural Steel Joints, Including Suitable Nuts and Plain Hardened Washers
A167-82	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

C. American Welding Society (AWS)

AWS 01-1-80	Structural Welding Code - Steel
AWS Chapter 65 Welding Handbook	Austenitic Chromium-Nickel Stainless Steel

D. Steel Structures Painting Council

SSPC-PA 1-82	Shop, Field, and Maintenance Painting
SSPC-SP 3-82	Power Tool Cleaning

E. Occupational Safety and Health Act (OSHA)

Standard 1910.23

SPECIFICATIONS FOR

ENVIRONMENTAL LAB SPILL CONTAINMENT
C-409

AT

THE PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH, KENTUCKY

INVITATION NO. 8162

SUBCONTRACT SPECIFICATIONS **16417**

MARTIN MARIETTA ENERGY SYSTEMS, INC.

Post Office Box 1410

Paducah, Kentucky 42001

May 30, 1986

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APPENDIX I

Environmental. Lab Spill Containment, C-409

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C5E-16417-A	0	Liquid Chemical & Environmental Lab Containment

APPENDIX IX

Environmental Lab Spill Containment, C-409

MATERIALS TO BE SUBMITTED FOR APPROVAL

"A" designates shop drawings and pertinent performance data are required,

"B" designates catalog data and pertinent data are required.

"C" designates samples *are* required.

"D" designates material certification is required.

GENERAL CONSTRUCTION ITEMS

Concrete Mix Design	B
Coal Tar Epoxy Coating	B
Caulking	B

TECHNICAL SPECIFICATIONS

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SECTION 12	-	Not Required	-

4.890 - CONTAINMENT

1. SCOPE

This section relates to the tubing, caulking, coating, concrete, etc., including all related work necessary to complete the containments as shown on the drawing and as specified herein.

2. TUBING

Tubing shall be 1 1/4" x 1 1/4" x .18" thick steel in accordance with ASTM A501-84. Tubing shall be wire brushed cleaned and coated with two coats of black *coal* tar epoxy; TNEMEC Series 46-H-413, High-Build Tnem-Tar; or approved equal, applied in accordance with the manufacturer's written instructions. Tubing shall be anchored with 5/16" x 2" long anchor bolts.

3. CAULKING

All caulking shall be General Electric Silicone rubber, RTV 102 white or approved equal, applied in strict accordance with manufacturer's written instructions,

4. COATING

Areas noted on the drawing to be coated shall be coated with two coats of black *coal* tar epoxy; TNEMEC Series 46-H-413, High-Build Tnem-Tar; or approved equal, applied in accordance with manufacturer's instructions.

5, CONCRETE FOR THRESHOLDS AND RAMPS

A. Concrete Mix

Concrete for construction of the thresholds and ramp shall be 5000 psi at 28-day mixture utilizing a one-half inch maximum size coarse aggregate. This mix shall be equivalent to Kentucky D.O.T. Specification, Section No. 601 for class "D-Modified" concrete.

B. Placement

Prior to placing the concrete, the contact surfaces between the existing and new concrete shall be brush coated with a neat *slurry* mixture of portland cement paste. Placement of the 5000 psi concrete shall commence within one hour after the brush coat *is* applied.

C. Finish

Concrete ramp finish shall be steel trowelled to match existing adjacent surface.

6. DUSTING PREVENTION AND CLEAN UP

All wncrete saw cutting, concrete excavation, etc., shall be accomplished without creating dusting inside the building. The work areas shall be kept wet to eliminate dusting. The entire construction site area shall be clean, free of all excavated concrete, trash, debris and other refuse after completion of the work and all such material shall be removed fran the site.

3. MATERIALS

A. Structural Steel

Structural steel shapes, bars, and plates shall conform to ASTM A36-81a.

B. Checkered Plate

Checkered plate shall be 1/4" thick standard raised checkered pattern.

C. Bar Grating

Bar grating shall be 1 1/2" x 3/16" hot-rolled carbon steel, welded. Openings between bars shall be 1" with cross bars spaced 4" on center. Bearing bars shall run the length of the grating.

D. Welding Electrodes

Normal arc welding electrodes and submerged arc welding electrodes and granular flux for welding of weldable steel shall be in accordance with AWS D1.1-80.

E. Bolts

All high tensile bolts, nuts, and washers shall be in accordance with ASTM A325-83.

F. Stainless Steel

1) General

Ail stainless steel shall conform to ASTM A167-82. Material shall be new. Substitutions of materials, sizes, or shapes shall not be made without prior approval of the Construction Engineer.

2) Stainless Steel

All sttinless steel shall be type 3041.

3) Welding Electrodes

Welding electrodes shall be the type specified for type 304L stainless steel by AWS Chapter 65 *of* Welding Handbook.

G. Ladder Safety Swing Gates

Safety swing gates shall meet OSHA Standard 1910.23. Gate shall open inward and close automatically after each passage. Gate shall guard the entire 7adder opening.

4. DESIGN

A. General

All designing and detailing by the fabricator shall be in accordance with the AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings," AWS D1.1-80, and ASTM A36-81a.

B. Connections

1) Design and detail all parts of all connections for maximum strength of members compatible with their sections, lengths, and the types of stress to which they are subject. However; where loadings, reactions, stresses, or connections are shown on the design drawings, the fabricator shall be governed accordingly.

2) Shop connections shall be welded. The fabricator shall submit his welding standards for approval in accordance with SPECIAL CONDITIONS paragraph: SUBCONTRACTOR'S SUBMITTALS.

3) Field connections shall be made by welding or bolting in accordance with the design drawings.

5. FABRICATION

A. General

1) Except as modified herein, all structural steel shall be fabricated in accordance with the AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings."

2) Structures shall be shop fabricated so as to form assemblies of the largest practicable sizes economically suitable for transportation, and possible to be handled and erected.

B. Bolting

High strength bolts shall be tightened to a bolt tension not less than the proof load given in the ASTM Specification for the bolt. Tightening shall be done with properly calibrated wrenches or by turn-of-nut method.

C. Welded Construction Structural Steel

Welding of structural steel work shall be done by the electric arc process in accordance with AWS D1.1-80. Qualification of welders and duration of qualification period shall be in accordance with the requirements of this code. Certification shall be furnished by the Subcontractor when requested by the Construction Engineer.

D. Welded Construction Stainless Steel

Welding of stainless steel shall be in strict accordance with AWS Chapter 65. Welding shall be by one or more of the Arc Welding processes covered in AWS Chapter 65. Qualification of welders and duration of qualification shall be in accordance with the requirements of AWS D1.1-80. Certification shall be furnished by the Subcontractor when requested by the Construction Engineer.

6. SHOP FINISH

A. General

Except as otherwise indicated or specified, all structural steel, miscellaneous metal, and collateral material provided under this section shall be shop painted. Shop painting system shall consist of surface preparation, pretreatment where specified, and shop application of prime paint. Contact surfaces to be welded shall not be coated within 3" of the weld, prior to welding. All operations required for shop painting shall be in accordance SSPC-PA 1-82 and Section 11.430 of this specification.

B. Shop Primer

1) Surface preparation of structural steel and miscellaneous metal for normal painting shall be in accordance with SSPC-SP 3-82.

2) All cleaned surfaces shall be primed, before deterioration of cleaned surface has taken place, with one shop coat of Pittsburgh No. 6-204 zinc chromate or approved equal.

7. MARKING AND SHIPPING

All structural steel shall be prominently paint marked for identification in assembly with piece marks applied right side up on the end corresponding to the left end of the members shown in horizontal or inclined position, and at the lower end of the members in a vertical position. The markings shall be placed in protected areas, such as the web of beams, to avoid their obliteration. All metal shall be properly protected and so loaded as to prevent damage in transit.

8. ERECTION

A. General

Unless otherwise specified herein, erection of structural steel shall conform with the applicable sections of the AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," and the AISC "Code of Standard Practice for Steel Buildings and Bridges."

B. Temporary Bracing

Temporary bracing sha'll be used whenever necessary to support all loads to which the structure may be subjected, including equipment and operation thereof, and piles of materials. Such bracing shall be left in place as long as may be required for safety.

C. Field Connections

Field connections shall be made by welding or bolting in accordance with the shop drawings and Paragraph 5 - FABRICATION *of* this specification.

9. REJECTION

All work or parts thereof and materials entering therein, indicating irremediable or injurious defects, improper fabrication, excessive repairs, or that is not in accordance with the requirements of this specification shall be subject to rejection.

10. FIELD PAINTING

Structural steel and miscellaneous metals shall be field painted where required in accordance with Section 11.430 - PAINTING.

4.730 - FABRICATION AND ERECTION OF STEEL DECKING

1. GENERAL

This specification covers furnishing, fabricating, and erection of steel decking.

2. CODES AND STANDARDS

Codes and standards which are called for or referred to herein are hereby made a part of these specifications to the extent indicated by the reference thereto.

A. Steel Deck Institute (SDI)

"Design Manual for Composite Decks, Form Decks, and Roof Decks"

B. American Society for Testing and Materials (ASTM)

A446-76	Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dipped Process, Structural (Physical) Quality
A525-81	Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

3. MATERIALS

A. Steel Decking

Steel decking shall be 1 1/2" x 6", Wheeling narrow rib decking, Type A18, as manufactured by Wheeling Corrugating Company, Wheeling, West Virginia, or approved equal. Basic steel shall conform to ASTM A446-76, Grade A for galvanized steel having a minimum yield strength of 33,000 psi. Decking shall be finished with a galvanized coating conforming to ASTM A525-81, Class G 90.

B. Sheet Metal Closures and Flashing

Sheet metal closures and flashings shall be fabricated from galvanized sheets conforming to ASTM A446-76, Grade A. Gage thickness shall be 16 or as shown on the drawings. Galvanized finish shall conform to ASTM A525-81, Class G 90.

C. Fasteners

Sheet metal screws for attaching 18 gage metal deck at laps and to structural members shall be No. 14 cadmium plated steel, hex head, gimlet point, self-tapping variety with cupped, glavanized or stainless steel washers with integral neoprene gaskets. All other screws and fasteners shall be galvanized steel unless otherwise indicated, and shall be size and type as indicated on the design drawings.

4. FABRICATION AND ERECTION

A. General

All decking shall be fabricated and erected in accordance with the SDI "Design Manual for Composite Decks, Form Decks, and Roof Decks;" the design drawings; and as specified herein. Where possible, sheets shall extend the full height of the enclosure.

B. Erection

The decking shall be erected in accordance with the shop drawings. Each sheet shall be placed on the supporting steel framework and adjusted to final position before being permanently fastened. Decking shall be attached to supports using clips and screws as detailed on the shop drawings. Side laps shall be fastened together at midspan using screws.

C. Caulking

All joints and seams shall be caulked with General Electric No. 1300 Silicone compound or approved equal to make the walls air tight. No deviation from this erection procedure shall be accepted without prior approval of the Construction Engineer.

5. REJECTION

All work or parts thereof and materials entering therein indicating irremediable or injurious defect, improper fabrication, excessive repairs, or that is not in accordance with the requirements of this specification shall be subject to rejection.

6. PAINTING

Galvanized steel decking shall not be painted.

SECTION 4 - ARCHITECTURAL

4.860 - LABORATORY FURNISHINGS

1. GENERAL

This specification covers the furnishing and installing of all laboratory equipment and accessories and related work as shown on the drawings and as specified herein.

2. SHOP DRAWINGS

Shop drawings shall be submitted for approval in accordance with SPECIAL CONDITIONS Paragraph: SUBCONTRACTOR'S SUBMITTALS.

The Subcontractor shall submit completed and checked shop drawings for approval. The approval of the shop drawings will be for laboratory equipment, accessories, work tops, details, and assemblies and shall not relieve the Subcontractor of the responsibility for errors, omissions, or accuracy of his details.

3. MATERIALS

A. General

All laboratory equipment shall be manufactured by Kewanee Scientific Equipment Corp., or approved equal.

The Subcontractor shall provide the following:

1) All laboratory equipment as shown on APPENDIX A - LABORATORY EQUIPMENT SCHEDULE and accessories, trim parts, such as scribes, filler panels, base mouldings, and corner clips.
2) Adequate supporting devices required for complete installation.
3) All hardware required for installation such as screws, nuts and bolts, clips, anchors, shims, inserts, etc.
4) Slack plastic moulding, 4" high, shall be installed around all exposed cabinet bases.
5) All drawers shall be equipped with 2 1/2" x 1 1/8" (card size) aluminum label holders.

8. Laboratory Equipment

All laboratory equipment shall be assembled in accordance with the shop drawings and engineering standards for maximum stability and strength, while allowing maximum compatibility within all cabinet configurations.

C. Work Top

Work top shall be "Kemresin" as manufactured by Kewaunee Scientific Equipment Corporation, or approved equal.

The "Kemresin" work top shall be made from modified epoxy resins especially designed for laboratory counterwork surfaces. Tops shall be 1" thick and all exposed edges and vertical corners shall be radiused 1/4". Top shall be moulded in one section. Rear cube shall be 4" high.

D. Sink

Sink shall be 16 gage, 304-L stainless steel as specified and shall be mechanically fastened.

E. Fixtures

All equipment shall be furnished complete with faucets, drains and tail pieces, and utility and electric outlets as shown on the design drawing or as shown on APPENDIX A - LABORATORY EQUIPMENT SCHEDULE.

F. End Filler

End filler shall be furnished as shown on the design drawings or as shown on APPENDIX A - LABORATORY EQUIPMENT SCHEDULE.

G. Color Selection

Color for all base unit shells, drawer bodies, and trim parts shall be "Kem-Ponent" standard color number 20, sand tan.

Accent color used on drawer fronts, doors, and top front panels shall be "Kem-Ponent" standard color number 22, burnt orange.

4. INSTALLATION

A. General

All laboratory equipment shall be protected from soiling and damage during handling and installation. Laboratory equipment shall be installed in strict accordance with the shop drawings and as specified herein.

B. Positioning

Laboratory equipment shall be positioned plumb, level true, and straight with no distortions. Laboratory equipment shall be shimmed as required using concealed shims.

C. Adjustments

Laboratory equipment and hardware shall be adjusted so that all doors and drawers operate smoothly without warp or bind. All operating hardware shall be lubricated with appropriate lubrication.

D. Cleaning

All laboratory equipment and accessories shall be thoroughly cleaned and polished upon completion of the installation.

5. AREA HOUSEKEEPING

The area shall be thoroughly cleaned of all trash, debris, and other refuse after completion of the work. All such materials shall be removed from the work areas in accordance with the SPECIAL CONDITIONS.

APPENDIX I

LIQUID CHEMICAL LABORATORY C-409

TABLE OF DRAWINGS

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General		
C5E-13817-A	0	Locating and Routing Plan
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A5E-13817-B	0	Plan and Wall Elevations
A5E-13817-C	0	Wall Elevations and Details
A5E-13817-D	0	Laboratory Equipment
Electrical Drawings		
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E5E-13817-B	0	Receptacle & Equipment Plan
E5E-13817-C	0	Wiring Diagram and Details
E5E-13614-B	1	Receptacle Plans
E5E-13614-E	1	Panelboard Schedules
E-E-13235-B	3	Electrical Plan and Details
E-E-13235-C	4	Wiring Diagram and Details
E-E-13235-D	3	Control Panel Wiring and Fabricatic
E-16015	10C	Wiring Diagram Sheet #1
E-16018	4c	480 V. Single Line Diagram
Mechanical Drawings		
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M5E-13817-B	0	Piping Plan
M5E-13817-C	0	Sections
M5E-13817-D	0	Sections and Details
M5E-13817-E	0	Sections and Details

Item	Quantity	Description	Equipment Location	Available Date
8.	1 Each	Tank system, feeder solution, Wallace-Tiernan Series 35-150, Weight approximtely 1,400 lbs., Estimated cost $8,550. Item #2 Dwg. M5E-13817-B		
9.	1 Each	Filter, Backwash, stainless steel, 2-inch inlet, 2-inch outlet, 150 lb., flanges, Item #14, Dwg. M5E-13817-B Estimated Cost $2,200.		

APPENDIX II

LIQUID CHEMICAL LABORATORY, C-409

CONTRACTOR FURNISHED MATERIAL

The items listed below will be furnished by the Contractor to the Subcontractor.

Item	Quantity	Description	Equipment Location	Available Date
		(FROM SALVAGE)	*	*
1.	2 Each	Tank, solution holding, 500 gal., stainless steel, (modified by Contractor) Item #10, Dwg. M5E-13817-B		
2.	1 Each	Filter unit, stainless steel, OURCO Item #13, Dwg. M5E-13817-B		
3.	1 Each	Pump, unloading, stainless steel, Item #7, Dwg. M5E-13817-B		
4.	4 Each	Valve, 3" size, plug, 316 stainless steel, 150 lb., flanged, manually operated, Reference Dwg. M5E-13817-A		
		(NEW ITEMS)		
5.	2 Each	Tank, solution treatment, 250 gal., to be modified by Subcontractor as shown on Dwg. M5E-13817-E, Estimated *Cost* $1,100 each, Item #4, Dwg. M5E-13817-B		
6.	2 Each	Pump, Warren-Rupp SA1-A Sandpiper, Estimated *Cost* $750. each, Items 3 & 5 Dwg. M5E-13817-B		
7.	1 Each	Filter, rotary drum pre-coat vacuum, Alair Model #220, weight approximately 1,800 lbs., Estimated Cost $23,000. Item #6, Dwg. M5E-13817-B		

* All items listed above will be available inside the C-409 Building prior to start of construction **by** the Subcontractor.

Drawina No.	Rev. No.	Title
Architectural Demolition Drawinas		
A5E-13817-SK-1	0	Steel Demolition
A5E-13817-SK-2	0	Sections and Details
A5E-13817-SK-3	0	Rail and Drain Cover Demolition
A5E-13817-SK-4	0	Drain Cover and Door Sill Demolition
A5E-13817-SK-5	0	Pipe Support Demolition
A5E-13817-SK-6	0	Ladder, Platform and Tank Support Demolition
A5E-13817-SK-7	0	Misc. Demolition Details

APPENDIX IX

LIQUID CHEMICAL LABORATORY, C-409

MATERIALS TO BE SUBMITTED FOR APPROVAL

"A" designates shop drawings and pertinent performance data are required.

"B" designates catalog data and pertinent data are required.

"C" designates samples are required.

"D" designates material certification is required.

GENERAL CONSTRUCTION ITEMS

Metal Decking	B
Laboratory Furniture	B

ELECTRICAL ITEMS

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Transformer	A, B
Lighting Fixture	A, B
Receptacles	A, B
Wire and Cable	B, C

TECHNICAL SPECIFICATIONS

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SECTION 4 - ARCHITECTURAL

4.100 - SPECIALTY WORK: DEMOLITION

1. GENERAL

The work to be performed under this section of the specifications consists of completing the demoliton as required by the design drawings and as specified herein. The work consists of removing an abandoned spray booth. Drawings detailing the work are included in the subcontract package.

2. SALVAGE MATERIALS

Salvageable materials, not otherwise indicated for reuse shall be transported and stored in the salvage area as specified in the SPECIAL CONDITIONS.

3. WASTE MATERIALS

Waste, debris, and/or other spoil material shall be disposed of as specified in the SPECIAL CONDITIONS.

SECTION 4 - ARCHITECTURAL

4.620 - HOLLOW METAL DOOR AND FRAME

GENERAL

This specification covers furnishing, fabrication, shop painting, and erection of hollow metal door and frame.

2. SHOP DRAWINGS

Shop drawings shall be submitted for approval in accordance with SPECIAL CONDITIONS paragraph: **SUBCONTRACTOR'S** SUBMITTALS.

The Subcontractor shall submit completed and checked shop drawings for approval. The approval of shop drawings will be for door and frame types, sizes, styles, astragals, hardware reinforcing, and swing only, and shall not relieve the Subcontractor of the responsibility of error, omissions, or the accuracy of his own dimensions.

3. MATERIALS

A. Steel Frame

Frame shall be formed from cold-rolled, 76 gage steel. Frame shall be knocked-down mitered corners and shall have reinforcements with integral. tabs. See drawings for size and location of door frame.

B. Hollow Metal Door

Door shall be flush, heavy duty, 18 gage 1 3/4" thick with urethane core. Door shall be mortised and reinforced for all hardware and related door accessories indicated on the drawings and as specified herein. Door shall be thoroughly cleaned, pretreated with a bonderizing or phosphatizing treatment to provide a strong bond between metal and paint and shop primed with a rust-inhibiting metal primer paint standard with the manufacturer.

C. Hardware

Hardware shall consist of 1 1/2 pairs of ball bearing hinges; a heavy duty antipanic device with provision for a mortise cylinder; as manufactured by Medico Security Lock, Inc., P. 0. Box 1075, Salem, Virginia 24753; a hold-open type closer, and an aluminum threshold.

4. INSTALLATION

A. Frame

Steel frame shall be plumbed, leveled, and rigidly secured in place by clips and/or bolts to fit design drawings.

B. Door

Door and hardware shall be installed as indicated on the drawings. Door shall fit the frame square and true to 3/32" at jambs and head and 1/8" at bottom and threshold.

C. General

Door shall be protected from damage after installation. If damage does occur, door, frame, or accessories shall be replaced. Door shall be clean and shall operate properly in all functions at the final inspection.

5. PAINTING

Door and hardware shall be finish painted as specified in Section 11.430 - **PAINTING.**

4.623 - ROLL-UP DOOR

1. GENERAL

This specification covers furnishing, fabrication, shop painting, and erection of the door.

2. SHOP DRAWINGS

Shop drawings shall be submitted for approval in accordance with SPECIAL CONDITIONS paragraph: SUBCONTRACTOR'S SUBMITTALS.

The Subcontractor shall submit completed and checked shop drawings for approval. The approval of shop drawings will be for the door in general and shall not relieve the Subcontractor of the responsibility of error, omissions, or the accuracy of his own dimensions. Included with the shop drawings shall be installation procedures, general maintenance instructions, and parts manuals.

3. MATERIALS

A. General

Roll-up steel door shall be standard steel type construction with weather-tight features. Door shall be as manufactured by any of the following or Contractor approved equal:

"Extr-Tite," Kinnear Corporation, Columbus, Ohio 43216
"Weatherlock," "Weatherguard," Walter Balfour & Company, Brooklyn, New York 11222
"Model A-1090," J. C. Wilson Corporation, Norfolk, Virginia 23501
"Air-Bar," North American Door Company, Inc., Lindenhurst, New York 11757

8. Door

Door shall be manual operated, spring counterbalanced, overhead coiling type, and shall be designed for use on the type of openings indicated on the drawings. Door shall be complete with all guides, hardware, fasteners, operating mechanisms, and accessories. Guides at jambs shall be set back a sufficient distance to provide a clear opening when door is in the open position.

4.860 - LABORATORY FURNISHINGS

1. GENERAL

This specification covers the furnishing and installing of all laboratory equipment and accessories and related work as shown on the drawings and as specified herein.

2. SHOP DRAWINGS

Shop drawings shall be submitted for approval in accordance with SPECIAL CONDITIONS Paragraph: SUBCONTRACTOR'S SUBMITTALS.

The Subcontractor shall submit completed and checked shop drawings for approval. The approval of the shop drawings will be for laboratory equipment, accessories, work tops, details, and assemblies and shall not relieve the Subcontractor of the responsibility for errors, omissions, or accuracy of his details.

3. MATERIALS

A. General

All laboratory equipment shall be manufactured by Kewanee Scientific Equipment Corp., or approved equal.

The Subcontractor shall provide the following:

1) All laboratory equipment as shown on APPENDIX A - LABORATORY EQUIPMENT SCHEDULE and accessories, trim parts, such as scribes, filler panels, base mouldings, and corner clips.
2) Adequate supporting devices required for complete installation.
3) All hardware required for installation such as screws, nuts and bolts, clips, anchors, shims, inserts, etc.
4) Black plastic moulding, 4" high, shall be installed around all exposed cabinet bases.
5) All drawers shall be equipped with 2 1/2" x 1 1/8" (card size) aluminum label holders.

B. Laboratory Equipment

All laboratory equipment shall be assembled in accordance with the shop drawings and engineering standards for maximum stability and strength, while allowing maximum compatibility within all cabinet configurations.

C. Work Top

Work top shall be "Kernresin" as manufactured by Kewaunee Scientific Equipment Corporation, or approved equal.

The "Kemresin" work top shall be made from modified epoxy resins especially designed for laboratory counterwork surfaces. Tops shall be 1" thick and all exposed edges and vertical corners shall be radiused 1/4". Top shall be moulded in one section. Rear cube shall be 4" high.

D. Sink

Sink shall be 16 gage, 304-L stainless steel as specified and shall be mechanically fastened.

E. Fixtures

All equipment shall be furnished complete with faucets, drains and tail pieces, and utility and electric outlets as shown on the design drawing or as shown on APPENDIX A - LABORATORY EQUIPMENT SCHEDULE.

F. End Filler

End filler shall be furnished as shown on the design drawings or as shown on APPENDIX A - LABORATORY EQUIPMENT SCHEDULE.

G. Color Selection

Color for all base unit shells, drawer bodies, and trim parts shall be "Kem-Ponent" standard color number 20, sand tan.

Accent color used on drawer fronts, doors, and top front panels shall be "Kern-Ponent" standard color number 22, burnt orange.

4. INSTALLATION

A. General

All laboratory equipment shall be protected from soiling and damage during handling and installation. Laboratory equipment shall be installed in strict accordance with the shop drawings and as specified herein.

B. Positioning

Laboratory equipment shall be positioned plumb, level true, and straight with no distortions. Laboratory equipment shall be shimmed as required using concealed shims.

C. Adjustments

Laboratory equipment and hardware shall be adjusted so that all doors and drawers operate smoothly without warp or bind. All operating hardware shall be lubricated with appropriate lubrication.

D. Cleaning

All laboratory equipment and accessories shall be thoroughly cleaned and polished upon completion of the installation.

5. AREA HOUSEKEEPING

The area shall be thoroughly cleaned of all trash, debris, and'other refuse after completion of the work. Ail such materials shall be removed from the work areas in accordance with the **SPECIAL** CONDITIONS.

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APPENDIX A

Laboratory Equipment Schedule

ITEM NO.	DESCRIPTION OF EQUIPMENT	SIZE	QUANTITY	CATALOG MODEL NO.
1a.	Sink Base Unit	48"L x 35 3/4"H x 22"W	1 ea.	KG-2008
b.	Stainless Steel Tub Sink	28"L x 16"W x 12"H	1 ea.	1089
c.	Sink Service Fittings:			
	1) Hot and cold water mixing faucet	---	1 ea.	T-318
	2) Distilled water gooseneck	---	1 ea.	T-368
	3) Eye wash, hand-held table-top mounted, Speakman Safety Equipment Company	---	1 ea.	SE-921
	4) Stainless steel crumb cup strainer	1 1/2" Outlet	1 ea.	995
	5) Trap and sink outlet assembly, polypropylene	1 1/2"	1 ea.	464
2a.	Base Unit	48"L x 35 3/4"H x 22"W	2 ea.	KD-2378
b.	Air fitting	---	1 ea.	T-260
c.	Nitrogen gas fitting	---	1 ea.	T-260
3.	Work Top	145"L x 31"W x 1"T	1 ea.	---
4.	Peg Board	20"L x 29"H x 3/4"T	1 ea	K7-1901
5.	Wall Storage Case	48"L x 30"H x 16"W	2 ea.	KW-7628
6.	End Filler Panel	---	1 ea.	KL-323-1A

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APPENDIX A

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	2) Distilled water gooseneck	---	1 ea.	T-368
	3) Eye wash, hand-held table-top mounted, Speakman Safety Equipment Company	---	1 ea.	SE-921
	4) Stainless steel crumb cup strainer	1 1/2" Outlet	1 ea.	995
	5) Trap and sink outlet assembly, polypropylene	1 1/2"	1 ea.	464
2a.	Base Unit	48"L x 35 3/4"H x 22"W	2 ea.	KD-2378
b.	Air fitting	---	1 ea.	T-260
c.	Nitrogen gas fitting	---	1 ea.	T-260
3.	Work Top	145"L x 31"W x 1"T	1 ea.	---
4.	Peg Board	20"L x 29"H x 3/4"T	1 ea	K7-1901
5.	Wall Storage Case	48"L x 30"H x 16"W	2 ea.	KW-1628
6.	End Filler Panel	---	1 ea.	KL-323-1A

5.100 - PIPING INSTALLATION - GENERAL SECTION

1. GENERAL

This specification outlines the materials of construction, fabrication, and installation requirements necessary for installing piping systems. The specification is composed of a general section supplemented by subsections.

Unless otherwise noted on the drawings, materials shall be provided as specified in each section of this specification. All valves shall be as specified and each shall be individually tagged and identified with its respective ID number.

2. CODES AND STANDARDS

Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the reference thereto.

A. American Society for Testing and Materials (ASTM)

A53-82	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A105-82	Specification for Forgings, Carbon Steel for Piping Components
A106-82	Specification for Seamless Carbon Steel Pipe for High-Temperature Service
A181-81	Specification for Forgings,–Carbon Steel for General-Purpose Piping
A182-82	Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
A197-79	Specification for Cupola Malleable Iron
A262-81	Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
A269-82	Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

A307-83	Specification for Carbon Steel Externally Threaded Standard Fasteners
A312-82	Specification for Seamless and Welded Austenitic Stainless Steel Pipe
A403-82	Specification for Wrought Austenitic Stainless Steel Piping Fittings
B32-76	Specification for Solder Metal
B61-82	Specification for Steam or Valve Bronze Castings
B68-80	Specification for Seamless Copper Tube, Bright Annealed
B75-81	Specification for Seamless Copper Tube
B88-83	Specification for Seamless Copper Water Tube
C533-80	Specification for Calcium Silicate Block and Pipe Thermal Insulation
D1785-83	Specification for Polyvinyl Chloride (PVC) Plastic Pipe Schedules 40, 80 and 120
02000-80	Classification System for Rubber Products in Automotive Applications
02467-76	Specification for Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40
F104-83	Classification System for Nonmetallic Gasket Materials

B. American National Standard Institute (ANSI)

A13.1-81	Scheme for the Identification of Piping Systems
B2.1-68	Pipe Threads (Except Dryseal) Specifications, Dimensions, and Gaging for Taper and Straight Pipe Threads Including Certain Special Applications
B16.3-77	Malleable Iron Threaded Fittings Class 150 and 300

B16.5-81	Pipe Flanges and Flanged Fittings
B16.9-78	Factory-Made Wrought Steel Buttwelding Fittings
B16.11-80	Forged Steel Fittings, Socket-Welding and Threaded
B16.14-77	Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads
B16.22-80	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B31.1-80	Power Piping
B31.3-80	Chemical Plant and Petroleum Refinery Piping

C. American Welding Society (AWS)

A5.1-81	Specification for Covered Carbon Steel Arc Welding Electrodes
D10.9-80	Specification for Qualifications of Welding Procedures and Welders for Piping and Tubing

D. American Society of Mechanical Engineers (ASME)

Boiler and Pressure Vessel Code, Section IX, 1983

E. Pipe Fabrication Institute

Standard ES3

3. FABRICATION AND INSTALLATION

A. General

Piping materials including valves and fittings furnished by the Subcontractor shall be new and shall be delivered to the site in a clean and protected condition. End seals of pipe, valves, and flange covers shall be maintained in place and shall be removed only as necessary for cleaning, fabrication, erection, or for inspection. Care shall be exercised in the handling and storage of all piping materials and prefabricated piping so that contamination by moisture, grease, dirt, or injurious foreign matter shall not occur.

Piping specified on the drawings shall follow the routing shown on the drawings. The pipe shall be cut accurately to measurements specified on the drawings and to suit field conditions and shall be carefully worked into place without forcing or springing.

The interior or exterior surfaces of all piping shall be kept clean at all times. Pipe shall be free of fins and burrs and shall be cleaned in accordance with cleaning procedures specified in Section 5.310.

Flanges, unions, and valves shall be installed as specified and shall be located for easy accessibility after erection.

Valves shall be properly packed and made leak proof under the test pressure described. Valves to be soldered, brazed, or welded shall be disassembled prior to heating. Allow valves to cool, clean if necessary, and reassemble.

B. Cutting

Pipe and tubing shall be cut accurately to measurements as specified on the drawings and to suit field conditions. Approved tube or pipe cutters, or other methods approved by the Contractor shall be used. All cuts shall be reamed to remove burrs. Any objectionable defects shall be removed by machining, chipping, or grinding.

C. Bending

Changes of direction should be made by bending wherever possible in steel, aluminum, copper, alloy pipe, or tube unless specifically disallowed in subsections of this specification.

Bending radii shall in no case be less than the minimum radii recommended in the "Pipe Fabrication Institute Standard ES3."

D. Joining Methods

The following methods shall be used as applicable to the individual subsections of this specification:

1) Threading

Threading of pipe shall be done preferably after any bending., forging, or heat treating operations. Where threading must be performed first, threads shall be protected during such operations. Threads shall conform to ANSI B2.1. Pipe dope shall be applied to the male threads only. When threading chemically-cleaned pipe, use the trichloroethane (methyl chloroform) inhibited, as the cutting fluid.

Teflon ribbon, when used as thread dope, shall not be applied to the first two threads of pipe.

2) Welding

a) General

All welding, qualification procedures, and qualification of welders shall be in strict compliance with ASME Boiler and Pressure Vessel Code, Section IX and AWS D10.9.

All welds are subject to inspection by the Contractor. The Contractor reserves the right to accept, reject, or demand removal of welds which are in violation or believed to be in violation *of* these specifications. Welders performing welds found to **be** unsound shall be subject to appropriate retest provisions of the ASME Boiler Code or other applicable standards.

Socket weld joints shall be assembled so that space between the end of the pipe and the bottom of the socket is no less than 1/16" or more than 1/8".

Welded branch connections to headers shall be made **by** the use of welded outlet fittings, such as reducing tees, weldolets, sockolets, and threadolets as shown on the drawings in compliance with ANSI B31.1 , Paragraph 127.4.8.

b. Welding Rods and Electrodes

All bundles, boxes, or **kegs** in which rods and electrodes are delivered shall be legibly marked with the following information:

Classification
Trade Designation
Manufacturer's Name
Standard Size and Length
Heat Number

All welding rods shall be identified with at least one imprint per rod showing the AWS classification number in accordance with AWS A5.1(15). In addition, welding rods 1/8" and over in diameter shall be marked or stamped with positive identification at intervals of not more than 18". Such marks shall be clearly distinguishable and shall include the classification number of the welding rod and the trade designation of the manufacturer.

Welding rods and electrodes shall **be** stored, handled, and identified at all times to assure the use of the proper welding rod in a welding process.

c. Carbon Steel Piping

The following welding procedures shall apply to all services:

For vee butt welds on pipe and fittings 1 1/2" and smaller and fillet welds on socket weld fittings 3/8" and smaller, use oxyacetylene welding of steel pipe or gas tungsten-arc welding of carbon steel materials welding procedures.

For vee butt welds on pipe and fittings 2" and larger, fillet welds on socket weld fittings 3/4" and larger, and fillet welds on all sizes of slip-on flanges, weldolets, sockolets, **and** threadolets use shielded metal-arc welding of carbon steel materials, shielded metal-arc welding of steel with combination 6010 and low hydrogen electrodes or gas tungsten-arc welding of carbon steel materials **welding** procedures. A minimum *of* two passes shall **be** used on all fillet welds. **A** 1/8" electrode must **be used** for all passes on 3/4" socket weld fittings.

c. Stainless Steel Piping

For all stainless steel piping welding use welding procedures for arc welding of chromium nickel stainless steel materials. Use filler metal type ER-308L.

3) Flanging

Where flanges mate with cast iron flanged fittings, valves, or equipment, they shall be provided with flat faces and full face gaskets. Provide full face gaskets between cast iron flanges. Flat ring type gaskets shall be used between steel flanges equipped with raised serrated faces.

Flanges shall be made up with meeting face in a plane that is exactly perpendicular to the axis of the pipe. Upon erection, flanges shall be so positioned in rotation that the bolt holes shall straddle the vertical flange centerline. All gaskets shall be evenly centered between the flange faces with ring gaskets engaging fully upon raised face flanges. The meeting flanges shall mate flush and true and the bolts shall be tightened uniformly to draw the flanges evenly and firmly upon the gasket. All bolt threads shall be coated with Crane high temperature compound prior to installation. When made up, the bolts shall extend through nuts by at least one full thread.

E. Hangers and Anchors

In general, the location and design of pipe hangers will be shown on the drawings. In some cases for pipe 2" and smaller, hangers may not be shown. The Subcontractor shall then provide suitable hangers selected from or patterned after those shown on the drawings.

The location and design of anchors shall be as shown on the drawings. The location and spacing of hangers shall be such that the piping is held in position without swaying, vibrating, or sagging excessively. Spacing shall not exceed maximum spans as follows:

Tubing	
Size	Span
1/2"	6'-0"
3/4"	6'-0"
1"	6'-0"
1 1/4"	7'-0"
1 1/2"	8'-0"
2"	9'-0"

Piping	
Size	Span
1/2"	8'-0"
3/4"	10'-0"
1"	12'-0"
1 1/4"	13'-0"
1 1/2"	15'-0"
2"	16'-0"
3"	20'-0"
4"	23'-0"

When supporting pipe which is subject to thermal expansion, hanger rods shall be set at slight angle so that when pipe expands the rods will be plumb.

4. MATERIAL SERVICE LISTING AND SPECIFICATIONS

Service symbol and material section numbers as listed hereinafter conform to service designations as shown on the drawings:

Symbol	Service	Conditions Maximum PSIG	Conditions Maximum °F	Material Section	Remarks
S SC	Steam & Steam condensate	150	480	101	C.S. screwed & butt welded
DW	Distilled water	150	400	107	S.S. screwed & butt weld
D	Drain	-0-	160	111	PVC & socket
N	Nitrogen	125	150	117	C.S. socketweld & copper brazed
0	Oxygen	150	250	119	C.S. socketweld
CW	Cold water (Sanitary)	125	130	124	Copper soldered & screwed
HW	Hot water (Sanitary)	125	130	124	Copper soldered & screwed
WS	Waste solution	150	150	128	S.S. butt weld
CA	Compressed Air	150	200	136	C.S. socketweld & copper brazed

5.105 - STEAM (S) & STEAM CONDENSATE (SC)

1. **SERVICE** RATING (Low Pressure)

Pressure Range: 0 to 150 psig
Maximum Temperature: 480°F

2. MATERIALS **AND EQUIPMENT**

The material list of this specificatien is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but those required for the **work** shall **be** selected from this listing unless otherwise indicated on the drawings.

A. Codes and Standards

Where details of fabrication are not shown on the drawings or specified herein, fabrication shall be in accordance with the applicable fabrication requirements of ANSI B31.1.

B. Materials

Item	Size (Incl.)	Specifications
Pipe	to 1 1/2"	Steel, seamless, Schedule 40, ASTM A106 Grade B
Fittings	to 1 1/2"	Steel, 2000 lb, **ASTM** A105 or A181 Grade 2, screwed ends, **ANSI** B16.11, EXCEPT use 3000 lb rating on couplings, half-couplings, reducers, and caps
Unions	to 2"	Steel, 3000 lbs, ASTM A105 or A181 Grade 2, with integral steel seats and screwed ends, dimensions per manufacturer's standard
Plugs	A11	Steel, solid type, square head screwed, ANSI B16.14
Valve Stem Packing (for repacking only)	A11	Johns-Manville No. C-14

Item	Size (Incl.)	Specifications
Dope		Threads: Crane high temperature thread compound Gaskets: Graphite and oil
Strainers		Cast steel, screwed, Y-pattern, 600 lb @ 800°F, Leslie 7200, or Armstrong BXSC Series

C. . Valves

See Section 5.610 for additional description.

Service	Size (Incl.)	Contractor's V No.
Gate	1/2" to 2"	V-6171
Check	1/2"	V-210
Globe	1/2"	V-1132

3. PIPING FABRICATION AND INSTALLATION

All steam and condensate piping shall be pitched down 1/4" per 10' in direction of flow unless otherwise indicated on the drawings.

4.1. CLEANING

Cleaning shall be as specified in Section 5.310.

5.5. TESTING AND INSPECTION

Testing and inspection shall be as specified in Section 5.410.

6.6. INSULATION (Thermal)

Insulation of steam and condensate lines shall be as specified in Se 5.210, 5.211, and 5.212.

7.7. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Sec

8. PAINTING

painting shall be as specified in Section 11.430.

1. SERVICE RATING

Maximum pressure: 150 psig
Maximum temperature: 400°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but those required for the work shall be selected from this listing unless otherwise shown on the drawings.

A. Codes and Standards

Where details of fabrication are not shown on the drawings or specified in this specification, fabrication shall be in accordance with the applicable requirements of ANSI B31.3, "Code for Pressure Piping, Petroleum Refinery Piping."

B. Materials

All stainless steel material shall have a maximum carbon content of 0.030% ladle analysis and shall be capable of passing the Huey Nitric Acid Test (ASTM A262) with a maximum average corrosion rate of 0.0020" penetration per month.

Item	Size (Incl.)	Specifications
Pipe	to 1"	Stainless steel, Type 304L, Schedule 10S, welded, ASTM A312
Fittings	to 1"	Stainless steel, Schedule 10S, ASTM A403, Grade WP-304L, butt weld ends, ANSI B16.9
Unions	to 1"	Use flanges
Flanges	to 1"	Stainless steel, Type 304L, corrosion weight, slip-on, ASTM A182, drilling and O.D. to match ANSI B16.5, 150# standard
Dope		Teflon, ribbon thread sealant, Permacel or Scotch brand
Valve Stem Packing (for repacking only)	All	Teflon, Chevron type
Valve Bonnet Gaskets (for replacement)		Teflon

c Valves

See Section 5.610 for additional description.

Service	Size (Incl.)	Contractor's V. No.
Ball	1/4" to 2"	V-6194

3. PIPING FABRICATION AND INSTALLATION

Piping fabrication and installation shall be as specified in Section 5.100.

4. CLEANING shall be as specified in Section 5.310.

5. TESTING AND INSPECTION shall be as specified in Section 5.410, Class B for distilled water.

6. IDENTIFICATION OF PIPING AND COLOR CODE shall be as specified in Section 5.510.

5.111 - DRAIN PIPING (D)

1. GENERAL

All drain piping from laboratory sinks and service fixtures shall be PVC pipe. Installation of drainage piping shall be as shown on design drawings. Where details of fabrication are not shown on drawings or specified in this section or other sections of this specification, fabrication and installation shall be in accordance with National Plumbing Codes.

2. MATERIALS

Item	Size (Incl.)	Specifications
Pipe	to 4"	Polyvinyl chloride, ASTM 01785, Type 1, Grade 1, Schedule 80, normal impact
Fittings	to 4"	Polyvinyl chloride, ASTM D2467, socket type, Schedule 80 (pipe and fittings shall be purchased from same manufacturer)
Gaskets	All	Teflon
Solvent cement	All	As supplied by manufacturer of pipe and fittings
Drum traps	7 1/2"	PVC or polyethylene, Hamilton Industries 341235
Cup sinks	All	PVC or polyethylene, Hamilton 34L143 with strainer

3. CLEANING

Prior to erection, the inside of all pipe and fittings shall be cleaned of all dirt and foreign materials. After installation, all drain piping shall be cleaned free of foreign deposits.

4. TEST AND INSPECTION

Test and inspection shall be as specified in Section 5.410,

5.117 - NITROGEN (N)

1. SERVICE RATING

Pressure range: 0 psig to 125 psig
Temperature range: -20°F to 150°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials listed will necessarily be required, but those required for the work shall be selected from this listing unless otherwise shown on the drawings.

A. Codes and Standards

Where details of fabrication are not shown on the drawings or specified in this specification, fabrication shall be in accordance with the applicable fabrication requirements of ANSI 831.3, "Code for Pressure Piping, Petroleum Refinery Piping."

B. Materials

Item	Size (Incl.)	Specifications
Pipe*	to 1/2"	Steel, welded, Schedule 40 ASTM A53, Grade B
Fittings	to 1/2"	Steel, 3000 lb, ASTM A105 or A781, Grade 2, socket weld ends, ANSI B16.11
Unions	to 1/2"	Use flanges
Flanges	to 1/2"	Steel, ASTM A105 or A181, Grade 1, 150 lb, slip on or welding neck, ANSI B16.5
Gaskets	All	Compressed asbestos, 1/16" thick, ring type, ASTM F104, Grade P1161A, Sepco Corp. No. 200
Bolts and Nuts	All	Steel, heavy hex or square head machine bolts, with semifinished heavy hex nuts, ASTM A307, Grade B

*Where threaded connections are required, Schedule 80 pipe shall be used.

Item	Size (incl.)	Specifications
Valve Stem Packing (for repacking only)	1/16" to 3/16" round	Garlock Company 117B
	1/4" and up square	Garlock Company 233
Dope		Red Glyptal or letharge and glycerine

C. Valves

See Section 5.610 for additional description.

Service	Size (Incl.)	Contractor's V No.
Globe	1/4" to 2"	V-6409

3. PIPING FABRICATION AND INSTALLATION

Piping fabrication and installation shall be as specified in Section 5.100.

4. CLEANING

Cleaning shall be as specified in Section 5.310.

5. TESTING AND INSPECTION

Testing and inspection shall be as specified in Section 5.410, Class A.

6. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Section 5.510.

7. PAINTING

Painting shall be as specified in Section 11.430.

5.119 - OXYGEN

1. SERVICE RATING

Pressure range: 0 psig to 150 psig
Temperature range: -20°F to 250°F

2. MATERIALS

Item	Size (Incl.)	Specifications
Pipe	to 1 1/2"	Steel, seamless, Schedule 40, ASTM A106, Grade B
Pipe Fittings	to 1 1/2"	Steel, 3000 lb, ASTM A105 or A181, Grade 2, socket weld ends, ANSI B16.11

3. CLEANING

Cleaning shall be as specified in Section 5.310.

4. TESTING AND INSPECTION

Testing and inspection shall be as specified in Section 5.410.

5. IDENTIFICATION OF PIPING

Identification of piping and color code shall be as specified in Section 5.510.

6. PAINTING

Painting shall be as specified in Section 11.430.

SECTION 5 - PIPING

5.124 - HOT AND COLD SANITARY WATER (HSW & CSW)

1. SERVICE RATING

Maximum pressure: 125 psi
Maximum temperature: 140°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials will necessarily be required, but those required for the work shall be selected from this listing unless otherwise shown on the drawings.

A. Codes and Standards

Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI A40.B, "National Plumbing Code."

B. Materials

Item	Size (Incl.)	Specifications
Pipe	to 2"	Copper, seamless water tube, hard drawn, ASTM B88, Type L in 20' straight lengths
Fittings	to 2"	Wrought copper'solder joint, ASTM B75, in accordance with ANSI 616.22
Unions*	to 2"	Wrought copper, solder joint, ANSI B16.22
Dope		Teflon tape
Valve Stem Packing (for repacking only)	1/16" to 3/16" round	Garlock Company 117B
	1/4" and up square	Garlock Company 233
Copper "Solder" Joints		Silver Braze Handy and Harmon Braze Technique (72% Ag, 28% Cu) RTSN per UCN-W-703

*When connecting copper to steel use dielectric unions with nonmetallic gasket suitable for connecting dissimilar metals to prevent corrosion.

C. Valves

See Section 5.610 for additional description.

Service	Size (Incl.)	Contractor's V No.
Gate	1/4" to 2"	V-6134

D. Backflow Preventer

Backflow preventer shall be 1 1/2" N.P.S. with valves, Beeco Aergap Model FRP-II. ~~DO NOT~~ SUBSTITUTE.

E. Safety Shower Assembly

Safety shower assembly shall have 8" head, stay-open ball valve with pull chains, rings, and interconnecting fittings, Speakman No. SE-226, or approved equal.

3. PIPING FABRICATION AND INSTALLATION

Adequate provisions shall be made to prevent water hammer, rattling of the pipe, chattering of valves and faucets, and other objectionable noises in the system. Full size air chambers, 2' to 3' vertical length, shall be provided at the top of all risers, at the end of all branches, and at individual fixtures where necessary. Whenever it is necessary to have a submerged sanitary water supply to a fixture, tank, or other equipment, a vacuum breaker shall be installed in the supply line at an elevation above the overflow line of the fixture. Valves shall be installed in all branches at the take-off from the main, at all risers before all connections to equipment, and as shown on the drawings. All other details of fabrication and installation shall be as specified in Section 5.100.

4. CLEANING

Cleaning of sanitary water systems shall be as specified in Section 5.310.

5. TESTING AND INSPECTION

Testing and inspection shall be as specified in Section 5.410.

6. INSULATION (Thermal)

Insulation shall be as specified in Section 5.218.

7. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Section 5.510.

8. PAINTING

Painting shall be as specified in Section 11.430.

5.128 - WASTE SOLUTION (WS)

1. SERVICE RATING

Maximum pressure: 150 psi
Maximum temperature: 32°F to 150°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials will necessarily be required, but those required for the work shall be selected from this listing unless otherwise shown on the drawings.

See SPECIAL CONDITIONS, APPENDIX II for contractor-furnished material applicable to the section.

A. Codes and Standards

Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI 831.3.

6. Materials

All stainless steel pipe and fittings shall be solution annealed, have a maximum carbon content of 0.030% ladle analysis, and shall be capable of passing the Huey nitric acid test (ASTM A262) with a maximum average corrosion rate of 0.0020" penetration per month.

Item	Size (Incl.)	Specifications
Pipe	1/2" to 4"	Stainless steel, type 304L, Schedule 10, welded, ASTM A312 (modified maximum carbon content of 0.03%)
Fittings	1/2" to 4"	Stainless steel, type 304L, Schedule 10, ASTM A403, Grade WP 304L, butt weld ends, per ANSI B16.9
Unions	All	Use flanges
Flanges	1/2" to 4"	Stainless steel, type 304L, corrosion weight welding neck or slip on (bored for Schedule 10 pipe), ASTM A182; drilling and OD to match ANSI B16.5, 150 lb standard

Item	Size (Incl.)	Specifications
Gaskets		Teflon, 1/8" thick, ring type
Dope		Teflon ribbon thread sealant, Permacel or Scotch brand
Valve Stem Packing (for repacking only)	1/8" and up	Teflon, chevron type
Valve Bonnet Gaskets (for replacement)		Teflon.
Bolts and Nuts		Steel, heavy hex or square head machine bolts with semifinished heavy hex nuts, ASTM A307, Grade B
Liquid Level Sight Cages		Valve material 316 stainless steel, for nitric acid service, high pressure Pyrex glass, Teflon gaskets, with ball check, Jacoby-Tarbox style T/HP

Tank	Center to Center
Solution Holdin'g (2)	40"
Solution Treatment (2)	42"

Liquid Level Switch		Type 316 stainless steel, sensor, standard model, Sensall No. 502, National Sonics (Division of Xertex Corp.) DO NOT SUBSTITUTE

C. Valves

See Section 5.610 for additional description.

Service	Size (Incl.)	Contractor's V No.
Plug	1/2" to 6"	V-6245

Service	Size (Incl.)	Contractor's V No.
Check		
Swing	1/4" to 10"	v-1100

3. PIPING FABRICATION AND INSTALLATION

Piping fabrication and installation shall be as specified in Section 5.100.

4. CLEANING

All waste solution piping shall be cleaned, ends sealed, and delivered to the construction site by the contractor.

5. TESTING AND INSPECTION

Testing and inspection shall be as specified in Section 5.410.

6. IDENTIFICATION OF PIPING AND COLOR CODE

Identification of piping and color code shall be as specified in Section 5.510.

SECTION 5 - PIPING

5.136 - DRY COMPRESSED AIR (CA)

1. SERVICE RATING

Maximum pressure: 150 psi
Maximum temperature: 200°F

2. MATERIALS AND EQUIPMENT

The material list of this specification is comprehensive in nature. It is not intended that all materials will necessarily be required, but those required for the work shall be selected from this listing unless otherwise shown on the drawings.

A. Codes and Standards

Where details of fabrication are not shown on the drawings or specified in this or other specifications, fabrication shall be in accordance with the applicable fabrication requirements of ANSI B31.3.

B. Materials

Item	Size (Incl.)	Specifications
Pipe	to 1 1/2"	Steel, seamless, Schedule 40, ASTM A106, Grade B
Fittings	to 1 1/2"	Steel, 3000 lb, ASTM A105 or A181, grade socket weld ends, ANSI B16.11
Plugs	All	Steel, square head, solid type, screwed, per ANSI 816.14
Strainers	1 1/2" and under	Cast steel, 125 lb, Y-pattern, socket weld ends, 40 mesh stainless steel screen

C. Valves

See Section 5.610 for additional description.

Service	Size (Incl.)	Contractor's V No.
Gate	1/4" to 2"	V-1

3. CLEANING

Cleaning shall be as specified in Section 5.310.

4. TESTING AND INSPECTION

Testing and inspection shall be as specified in Section 5.410.

5. IDENTIFICATION OF PIPING

Identification of piping and color code shall be as specified in Section 5.510.

6. PAINTING

Painting shall be as specified in Section 11.430.

5.210 - THERMAL INSULATION FOR PIPING AND EQUIPMENT

1. GENERAL

This section of the specification describes the general requirements relating to materials and the application of thermal insulation for piping. Specifications for specific types of insulation appear in the following sections. Refer to Paragraph 4 - THERMAL INSULATION SCHEDULE for insulation thickness for use in various services.

2. MATERIALS

Insulation and accessories shall be as specified in the following sections of this specification. All insulation materials shall be delivered to the job in their original cartons or containers which shall be labeled with the manufacturer's name and type of material contained. Insulation shall be stored in such a manner as to remain dry.

3. APPLICATION

It is not intended that all details outlined in this paragraph shall apply to all insulation on the job, but shall apply only as required in the individual sections. Additional requirements are also specified in the sections. Special details when required and not given will be indicated on the drawings. Manufacturer's instructions shall be followed when available with the material.

A. Insulation

Insulation shall be dry when applied to clean and dry surfaces.

B. Application to Piping

Install insulation in single layers of up to 3" thickness.

4. THERMAL INSULATION SCHEDULE

A. Piping

1) All steam lines 0 to 150 psig shall be insulated with 1 1/2" thick calcium silicate in accordance with Section 5.211.

2) All condensate lines shall be insulated with 1" thick calcium silicate up to an elevation of 7' above floor.

3) All hot and cold sanitary water (HSW and CSW) lines shall be insulated with 1/2" thick flexible elastomer in accordance with Section 5.218.

5. PAINTING

Painting shall be as specified in Section 11.430.

SECTION 5 - PIPING

5.211 - THERMAL INSULATION - CALCIUM SILICATE

1. **GENERAL**

This section of the specification describes the materials required and the application of calcium silicate insulation for piping operating at temperatures of 212°F to 1200°F. Section 5.210 is an integral part of this section.

2. MATERIALS

All materials listed are not necessarily required, but those required shall be selected from this listing:

A. Insulation

Pipe insulation shall be composed of hydrous calcium silicate blended with reinforcing mineral fibers in a suitable proportion, with or without inorganic filler added, conforming to ASTM C533 and shall be asbestos free.

The following insulations are acceptable: Johns-Manville, "Thermo 12;" Owens-Corning, "Kaylo 10AF;" Calsilite Corporation, "Calsilite AF;" and Fiberboard Corporation Pabco Division, Caltemp NA."

B. Accessory Materials

Item	Specifications
Wire	Stainless steel, type 304, 18 gauge (0.0475"), cold-drawn, bright annealed
Straps	Stainless steel, type 304, 3/8" x 0.015"
Seals	Stainless steel, type 304, 3/8" double-pronged, A. 3. Gerrard
Caulking Mastic	Benjamin Foster 30-45 Foamseal or Insul-Coustic IC-405 (flash point: 100°F)
Insulating Cement	Hydraulic setting, Johns-Manville No. 375, or Eagle-Picher One-Coat or Forty-Eight Quick-Set

Item	Specifications
Fabricating Cement	Benjamin Foster 81-93 or Refractory and Insulation Corporation's Block Stick
Lagging Adhesive	Benjamin Foster 81-42W Las Fas (red stripe) or Insul-Coustic IC-102 Sure-Lag, color - white

3. APPLICATION

A. Pipe

Install single layer insulation in a staggered position. Use 18 gauge (0.0457") stainless steel wire to secure insulation up to 11" O.D. Use 3/8" x 0.015" straps for insulation more than 11" O.D. Space wire and straps on 9" centers and not more than 4 1/2" from end joints. Point up all cracks and small depressions with insulating cement.

B. Fittings, Flanges, and Valves

Insulate with covers fabricated from the same materials and thickness as that specified for adjacent pipe. Fabricate the covers in accordance with ASTM C450. Join the pieces with fabricating cement and make the covers in two halves. Secure in place with wire or straps. Insulate fittings and valves 2" and smaller with insulating cement to a thickness equal to that specified for the pipe.

C. Exceptions

All flanges and valves shall be insulated with the proper thickness unless otherwise specified on the drawings. Terminate the insulation at uninsulated flanges. Do not insulate traps, unions, and control valves.

D. Supports

Install welded clips or a clamp ring support near the bottom of vertical runs in excess of 21' on insulated pipe 4" and larger. Add another support every 21'. A flanged joint is considered a support.

E. Surface Finish

Cover piping and fitting insulation with 8 oz canvas, adhered, and completely sized with lagging adhesive applied at the rate of one gallon per 85 square feet. Apply a 40 lb rosin sized paper under-layment on outside of piping insulation before covering with canvas.

SECTION 5 - PIPING

5.218 - THERMAL INSULATION - ELASTOMERIC - PIPE

1. GENERAL

This section of the specification describes the materials required and the application of elastomeric flexible insulation for piping operating at temperatures of 50°F to 220°F.

2. MATERIALS

A. Insulation

Insulation shall be composed of a flexible elastomer similar to Armstrong F/R Armaflex or Owens-Corning 0-C flexible tubing, 1/2" thick.

B. Adhesive

Adhesive shall be Armstrong 520 or Owens-Corning OC 500.

3. APPLICATION

Application procedures shall be in accordance with manufacturer's instructions.

SECTION 5 - PIPING

5.310 - CLEANING AND CONDITIONING OF PIPING SYSTEMS

1. SCOPE

This section of the specification describes the cleaning requirements for piping systems listed in Section 5.100.

2. GENERAL

A. The Contractor will furnish the water, nitrogen, and plant or compressed oil-free dry air, as required, for cleaning pipe or piping systems.

B. Block control valves in the open position, remove orifice plates, traps, and strainers prior to or during the process of cleaning. Introduce the flushing medium at the remote end of the piping system. Flush from the upstream side of check valves. Alternately open each extremity of the line so that the entire system is flushed.

C. The following piping systems (after chemical cleaning) must be kept absolutely free of oil, grease, dirt, paint, and other foreign materials before and after erection:

Subsection	Service
117	Nitrogen
119	Oxygen
136	Dry compressed air

Tools for assembling the piping must be degreased.

3. PIPING REQUIRING **CHEMICAL** CLEANING BEFORE ERECTION

A. Pipe, valves, and fittings for the following services shall be chemically cleaned:

Subsection	Service
107	Distilled water
117	Nitrogen
119	Oxygen
136	Dry compressed air

B. The Contractor will furnish all cleaning materials, perform all chemical cleaning, and cap or seal off all ends of pipe, valves, or fittings at no cost to the Subcontractor. Piping shall be cleaned in the largest practical assemblies, but dimensions shall not exceed 20' x 4' x 4' or contain

more than two fittings and shall not contain any valves. Weld two each lifting lugs, minimum 2" hole diameter, to each pipe or piping assembly to be cleaned by the Contractor. Lugs shall be spaced to provide for a balanced lift. They shall be removed after cleaning and before installation of the piping. Lifting lugs shall be provided when the following conditions exist:

1) Straight length of pipe 4" diameter or larger and 6' in length or longer

2) Any assembly of pipe and fittings regardless of pipe diameter, number of fittings or length.

C. The Subcontractor shall notify the Contractor at least three working days prior to furnishing materials to be cleaned. The Subcontractor shall provide all labor to load, unload, and transport materials to and from Building C-400. The Subcontractor shall pay for any recleaning required because of his negligence in handling and storage.

4. PIPING NOT REQUIRING CHEMICAL CLEANING BEFORE ERECTION

All pipe, valves, and fittings used in fabricating piping systems under this classification for conveying services other than those listed in Paragraph 3 will not require chemical cleaning. However, each component of any piping system under this classification shall be cleaned and inspected before erection as follows:

Inspect all pipe, valves, and fittings for physical defects; and replace broken, chipped, cracked, or defective items with new.

Remove all loose scale, rust, dirt, mud, and other foreign materials from interior surfaces by wire-brushing, scrubbing, or flushing with air or water.

Remove excess dirt, rust, grease, and oil from exterior surfaces.

Provide caps or protective covers over ends of pipe, valves, and fittings until ready to install.

5. PIPING SYSTEMS REQUIRING CLEANING AFTER ERECTION AND TESTING

A. By Flushing with Initial Test Medium

Piping systems conveying the following services shall be cleaned after erection and testing by flushing with initial test medium for five minutes:

Subsection	Services	Test Medium
5-101	Steam (0-150 psig)	Water
5-107	Distilled water	Water
5-124	Hot & cold sanitary water	Water

B. By Purging

Piping systems conveying the following services shall be cleaned after erection and testing by purging until the specified dew point is reached and held for 30 minutes:

Subsection	Service	Purge Gas	Dew Point
117	Nitrogen	Nitrogen	0°F
119	Oxygen	Nitrogen	0°F
136	Dry compressed air	Dry compressed air	-40°F

6. PIPING SYSTEMS NOT REQUIRING CLEANING AFTER ERECTION AND TESTING

Subsection	Service
111	Drain

7. PIPING SYSTEMS REQUIRING STERILIZATION

A. The following piping systems conveying sanitary water shall be sterilized after erection and testing:

Subsection	Service
124	Sanitary water (copper tubing)

B. Prior to a sterilization, the system shall be flushed with sanitary water for five minutes at a velocity of at least 2.5' per second. Drain system and then sterilize.

8. STERILIZATION MATERIALS AND METHODS

A. Materials

Use a disinfecting solution which contains a minimum of 50 ppm of chlorine by weight of water. Commerical high-test hypochlorite, known as HTH, with not less than 65% available chlorine, shall be used to prepare this solution.

Commercial laundry bleach with a minimum content of 5.25% available chlorine may be substituted for HTH in preparing the disinfecting solution in lines 1 1/2" and smaller. Use one-half pint of laundry bleach to each gallon of water in the system.

B. Quantities

The following table may be used as a guide for quantities required:

HYPOCHLORITE TABLE

Diameter of Pipe	12-foot Lengths	16-foot Lengths	40-foot Lenqths	50-foot Lenqths
6" and smaller	0.5 oz	0.5 oz	0.5 oz	0.5 oz

C. Method

Make a slurry in a suitable container using the proper amount of HTH. Add the slurry or laundry bleach, a little at a time, to the line as it is being filled with water. A uniform concentration throughout the system is required. Let the line stand full for at least 24 hours. At the end of this time, the chlorine content of the water shall not be less than 10 ppm. Flush the line until the chlorine content of the water is less than one ppm, then connect to the existing system.

D. Alternate Method

Where sterilizing by the above method is impractical (such as tie-ins up to first shutoff valve), the following alternate method, with the approval of the Contractor, may be used:

Before erection, thoroughly scrub pipe, valves, and fittings with a disinfecting solution made with one-half pint of laundry bleach to a gallon of water. Wash thoroughly with clean sanitary water and do not contaminate before installing.

E. Witness of Sterilization

Sterilizing shall be performed in the presence of an authorized representative of the Contractor. The Contractor will check chlorine content of the water after completion of the sterilizing process.

SECTION 5 - PIPING

5.410 - TESTING AND INSPECTION OF PIPING SYSTEMS

1. GENERAL

This section of the specification covers the testing and inspection of piping systems. The Seller shall furnish all labor, materials, equipment, tools, and services necessary for testing except for work, materials, and/or equipment to be furnished by the Company. Two classes of tests are included:

Class A - Pneumatic test
Class B - Hydrostatic test

The class of test to be applied is specified in the applicable sections.

2. DEFINITION FOR MAXIMUM WORKING PRESSURE OF A SYSTEM

The maximum working pressure of a system is defined as the predetermined value at which the piping system's safety relieving devices are set to prevent overpressurizing the system. Either the set pressure of the relieving devices or the maximum operating pressure of the piping system shall be specified on the drawings.

3. GENERAL TESTING REQUIREMENTS

General requirements for tests to be performed on installed piping systems under this specification shall be as follows:

A. Blank off or replace with spool pieces items of equipment (e.g., vessels, pumps, instruments, controls, safety, and relief valves) rated for pressures below the test pressure. Before performing final operating pressure test on a system, remove test blanks and spool pieces and reconnect protected instruments and equipment.

B. Inspect all parts of the system for leaks, especially at valves, flanges, welds, threaded connections, and packed joints. All leaks shall be repaired and the repaired joints retested.

C. Check that safety and relief valves have been inspected and set by the Company at the required set pressure.

D. Soap solution or soap testing shall be a soapless lather, leak detector solution, as manufactured by Industrial Colloids & Chemical, Inc., Knoxville, Tennessee, or Company-approved equal.

E. Use adequate precautions during pneumatic pressure testing. Clear the installation area of personnel not engaged in testing operations. Visually inspect the system installation for compliance with the design drawings and specifications.

F. The test shall be performed in the presence of an authorized representative of the Company.

7. WORK, MATERIALS, AND/OR EQUIPMENT FURNISHED BY COMPANY

The Company will furnish the test gauges and testing media required to conduct Class A and Class B tests.

8. CLASS A TESTING (PNEUMATIC PRESSURE TEST).

Class A testing consists of pneumatically pressure testing piping systems or isolated sections of piping systems with compressed air or nitrogen as specified in Table 1. Test pressures and test procedures shall be as follows:

A. Test Pressure

Test pressure for pneumatically testing pipe sizes 6" and under shall be 1.5 times the maximum working pressure but in no case less than 50 psig.

B. Test Procedure (When Test Pressure is 50 psig)

With equipment items protected and safety precautions taken in accordance with Paragraphs 3.A. and 3.E., pressurize system to 50 psig. Soap test all welds, joints, and connections. Repair leaks and retest repaired joints.

After instruments and equipment have been reconnected, these connections shall be pressurized and soap-tested at maximum operating pressure. Repair leaks and retest repaired joints.

C. Test Procedures (When Test Pressure Exceeds 50 psig)

With equipment items protected and safety precautions taken in accordance with Paragraphs 3.A. and 3.E., gradually pressurize system to 50% of the test pressure. Thereafter, the test pressure shall be increased in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Then reduce pressure to 75% of the test pressure. Soap test all welds, joints, and connections. Repair leaks and retest repaired joints.

After instruments and equipment have been reconnected, these connections shall be pressurized and soap-tested at maximum operating pressure. Repair leaks and retest repaired joints.

9. CLASS B TESTING (HYDROSTATIC TEST)

Class B testing consists of hydrostatically pressure testing piping systems or isolated sections of piping systems with water or another liquid as specified in Table 1. Test pressures and test procedures shall be as follows:

A. Test Pressure

Test pressure shall be 1.5 times the maximum working pressure unless otherwise specified on the drawings, but not less than 50 psig.

B. Test Procedures

With equipment items protected in accordance with Paragraphs 3.A. and 3.E., pressurize system to test pressure. Hold pressure while visually inspecting all welds, joints, and connections for leaks. Repair leaks and retest repaired joints.

Drain system and after instruments and equipment are reconnected, refill with service medium and apply maximum operating pressure. Hold pressure while visually inspecting these joints and connections for leaks. Repair leaks and retest repaired joints.

Table 1
(Showing Test Media for Piping Systems)

Subsection	Service	Class A Test	Class B Test	Test Pressure (psig)
101	Steam & condensate		Water	55
107	Distilled water		Water	50
111	Drains		(Service test with water)	
117	Nitrogen	Dry air or nitrogen	---	50
119	Oxygen	Nitorgen	---	50
124	Sanitary water	---	(Service test with water)	
128	Waste solution	---	Water	50
136	Compressed air	Dry air	---	50

SECTION 5 - PIPING

5.510 - IDENTIFICATION OF PIPE AND VALVES

1. GENERAL

This section of the specifications outlines details of identifying valves and exposed piping after erection, insulation, and painting are completed. Exposed piping is defined as all piping which is visible in the open or may be exposed by the removal of covers or panels designed to provide access for inspection or maintenance.

2. DESCRIPTION OF MARKERS

Identification markers shall be vinyl cloth having a self-adhesive backing that is resistant to moisture, oils, and most solvents and that will hold tight within a temperature range of -40 to 250°F. Label shall be weather and fade resistant and similar to those manufactured by W. H. Brady Company, Milwaukee, Wisconsin.

The labels shall be of specified background color upon which is printed the name of the flowing medium with specified letter color. The direction of flow in each pipe shall be indicated by any arrow on a label adjacent to the identification label and of the same color as the identification label.

Where additional information is required, a separate label shall be applied adjacent to the service identification label. Background color, letter color, and letter height shall be the same as service identification.

Services listed below require addition of line operating pressure information which will consist of individual numeral labels indicating normal line operating pressure plus a label containing the letters PSIG:

STEAM
DRY COMPRESSED AIR
NITROGEN

Labels shall conform to ANSI A13.1, "Scheme for the Identification of Piping Systems."

These labels and acrylic overcoating shall be furnished and installed by the Subcontractor.

Letter heights for use in titles are governed by the outside diameter of the pipeline including insulation. The minimum letter heights to be used are:

Outside Diameter	Letter Heights
1/2 - 3" included	5/8"
3 1/2" and up	1 1/4"

3. EXPLANATION OF COLOR CODE

The type of hazard of the flowing medium is indicated by the colors listed below:

Background Color	Flowing Medium	Letter Color
Yellow	Dangerous Materials	Black
Green	Generally Safe Liquids	Black
Blue	Generally Safe Gases	White

4. **LOCATION OF** MARKERS

Straight sections of pipelines shall bear identification markers at maximum intervals of 40'.

Branch lines shall be identified with a marker located not more than 5' from the main line.

Lines passing through walls or floors shall be identified on each side by a marker located not more than 5' from the wall or floor.

Markers on banks of piping shall be placed in a row, side by side, for ease of reference.

5. **METHOD** OF APPLYING LABLES

Surface to which labels are adhered must be free of scale, dirt, dust, grease, and moisture. Press the label firmly in place, rubbing thoroughly, particularly along the edges, until the adhesive makes a good bond.

Overcoat the entire label including 1/2" overlap at the edges with a heavy coat of Glidden Clear Silk, Screen Acrylic Y7135.

Mastic coatings on insulated lines, such a Vimasco's WC-1, Insul-Coustic's IC-551, and Benjamin Foster's 60-60, must be completely dry before applying label.

Service and Label Wording	Section Number	Label Background Ground
Steam	101	Yellow
Distilled Water	107	Green
Nitrogen	117	Blue
Oxygen	119	Yellow
Sanitary Water	124	Green
Waste Solution	128	Yellow
Compressed Air	136	Blue

6. IDENTIFICATION OF VALVES

All valves identified on the drawings and specifications with V-numbers shall be permanently identified with stainless steel tags embossed with the applicable V-numbers. Tags shall not be attached to handwheels or levers or other parts of valves which would interfere with operation. Tags and wire will be furnished by the Contractor. The Subcontractor shall submit a list of the required V-numbers to the Contractor.

5.610 - VALVE INDEX AND ACCEPTANCE MANUFACTURERS

1. GENERAL

The following information is given in the valve tabulation for each valve number included:

a. Valve number
b. Body material
c. Type of end connections
d. Type of valve
e. Specification section number in which valve is specified
f. List of acceptable valves giving manufacturer's name and model number

Valve Number	Body Material	Ends	Type	Section Number	Manufacturer Model No.
V-1	Brass or Bronze	Scr'd	Gate	5.136	Lunkenheimer 2125 Crane 428 Jenkins 62U
V-6134	Bronze	Solder	Gate	5.124	Nibco-Scott S-111 Powell 1812 Stockham B-109
V-6171	Cast or Forged Carbon Steel	Scr'd	Gate	5.101	Crane 3607XU Lunkenheirner 1311-W Vogt 13111
V-6194	Stainless Steel 304L	Socket-weld	Ball	5.107	Worcester 445T Powell 4206-T-SWE Hills-McCann S-303
V-6409	Bronze	Scr'd	Globe	5.117	Rego 2500 Series
V-1132	Forged Carbon Steel	Scr'd	Globe	5.101	Lunkenheimer 1711W Vogt 12141 Pacific 3661-2
v-210	Bronze	Scr'd	Check	5.101	Nibco-Scott T-453-B Crane 36 Walworth 420

Valve Number	Body Material	Ends	Type	Section Number	Manufacturer Model No.
V-1100	Stainless Steel 316	Scr'd	Check	5.128	Powell 2341 Jenkins 1330 Pacific 1001
V-6245	Stainless Steel 316	Scr'd*	Plug	5.128	Durco G432 Unichem V1S Xomox 066
		Flg'd*			Durco G411 Unichem V1F Xomox 067V

*1/2" thru 1 1/2" sizes use scr'd valves
2" and 3" sizes use flanged valves

SECTION 7 - ELECTRICAL

7.170 - ELECTRICAL CONSTRUCTION

1. GENERAL

A. Scope

This section of the specification relates to the furnishing of all labor, equipment, material, and performance of all work necessary for or incidental to the complete installation of electrical equipment and services in accordance with the drawings and as hereinafter specified.

B. Subcontractor's Responsibility

1) The Subcontractor shall provide complete electrical work, unless otherwise indicated, for all automatic and/or manual devices connected with or required for the control of electrical equipment associated with all equipment and systems covered under other sections of this specification.

2) The Subcontractor shall coordinate the requirements of all electrical equipment, perform tests, make adjustments wherever necessary to insure proper performance of the equipment, and identify equipment in accordance with the drawings and specifications.

C. Installation

1) The Subcontractor shall install work to conform to recommendations contained in the most recent issue of the National Electrical Code (NEC), the National Electrical Safety Code, and to the applicable rules of national standards and codes hereinafter referred to. In the event of conflict between the requirements of the specifications and any standards or code, the specifications shall govern.

2) All work required for the installation of electrical work shall be performed by craftsmen skilled in the electrical trade.

2. APPLICABLE CODES AND STANDARDS

All materials, equipment and work performed shall be in accordance with the appropriate sections of the latest issue of the following documents:

National Electrical Code
National Electrical Manufacturers Association
American National Standards Institute
Underwriters' Laboratories, Inc.

Federal Specifications
Institute of Electrical and Electronic Engineers
National Electrical Safety Code
Illuminating Engineering Society Lighting Handbook
Insulated Power Cable Engineers Association
American Society for Testing and Materials
Edison Electric Institute Specifications

3. DESCRIPTION OF WORK

The work shall include the installation of electrical feeders from existing motor control center "A" to a new 45 kVA transformer and from the transformer to a new lighting panel located on the ground floor of the C-409 building. The lighting panel will serve as power source for the C-409 liquid lab area. The lab area work shall include the installation of electrical receptacles, lighting, lab equipment wiring, and lab liquid containment system as shown on the drawings.

4. MATERIALS AND EQUIPMENT

A. General

All materials and equipment furnished, unless otherwise noted, shall be new and shall bear the label of the Underwriters' Laboratories, Inc., (UL), whenever standards have been established and label service is regularly furnished by that agency.

B. Substitutions

1) The use of brand names, catalog numbers or names of manufacturers is solely for the purpose of indicating the type and quality that will be acceptable. Unless otherwise specifically indicated by the words "no substitute", substitutes will be permitted as approved by the Contractor.

2) Vendor drawings shall be submitted to the Contractor for approval in accordance with Special Conditions, paragraph SC-11.

C. Lighting Fixtures

Lighting fixtures shall be of the type, size, and kind specified in the fixture schedule or legend on the drawings. Fluorescent fixtures shall be equipped with class P ballasts that shall be UL and CMB approved and of the high power factor type. They shall be sound rated A. The ballasts shall be protected from overheating by an internal thermally actuated, automatic reclosing device to limit winding temperature. Ballasts shall be of the high efficiency full output type suitable for use with both 35 watt and 40 watt lamps. Ballasts shall be Universal ballast "watt reducer", General Electric "low energy", or equal.

D. Lamps

All lamps shall be furnished and installed by the Subcontractor. Incandescent lamps for connection to 120 volt circuits shall be specifically rated for 125 volts unless otherwise specified. Fluorescent lamps shall be cool white type.

E. Lighting Panelboards

1) Lighting and low voltage panelboards, for operation on 208 or 240 volts, shall be of the dead front safety type complete with main circuit breaker, when specified on the drawings, rated for 240 volt ac. Panelboards shall be provided with the type, number and size of branch circuit breaker units as indicated on the drawings. Panelboards shall bear the UL label. 'Panel boards shall have fully rated isolated neutral buses and shall also be equipped with an equipment ground bus. Panelboards shall be comparable to Square-D Company type NQOB with QOB-GF1 frame bolt-in branch circuit breakers unless otherwise noted on the drawings.

2) The main circuit breaker shall be installed in the panelboard such that the breaker is closed when the operating handle is moved upward (for vertically mounted breaker) or to the right (for horizontally mounted breaker). The main and branch breakers shall have "off-on" markings to clearly indicate the handle position.

3) Cabinet boxes shall be constructed of zinc coated steel and shall conform to the requirements of the UL standard for cabinets and boxes. Panelboard fronts shall be door-in-door type. Trims shall be fitted with hinged doors having latches only. A directory holder shall be mounted on the inside of each door. A neatly typed directory properly identifying each circuit shall be mounted therein. Cabinets shall be supplied with standard side gutter wiring space and shall be for surface mounting as indicated on the drawings.

F. Receptacles

Duplex, 120 volts, 20 ampere, and single, 208 volts, 20 ampere type receptacles shall be as specified on the drawings.

G. Transformer - 45 kVA

1) The transformer shall be standard repetitive manufactured product of a 'reputable manufacturer and shall comply with NEMA standards and specifications.

2) The transformer shall be of the ratings and capacities, three-phase, as noted on the drawings, with all terminal surfaces either tin or silver plated. Unless specifically noted otherwise, the transformer shall be of the dry type for general light and power service. The transformer shall be suitable for indoor use for wall bracket or floor mounting as required by the drawings. Unless noted otherwise, the transformer shall have a minimum number of 2-1/2 percent fully rated kVA taps, 2 FCAN and 4 FCBN.

H. Manual Starters - Full Voltage

Manual starters for 120 volt motors shall be a toggle operated switch with trip free overload protection in suitable enclosure unless otherwise noted on the drawings. Overload relay heater elements shall be sized in accordance with the motor nameplate full load current.

I. Safety Switches

Safety switches shall be heavy duty type single throw, with visible blades in NEMA 3R enclosure for all switches located outdoors and NEMA 1 enclosures for all switches located indoors. Switches shall have quick-make, quick-break mechanism, front cover interlock and indicator handle. Switches shall be of the ampere and voltage ratings, number of poles, nonfusible, etc., as indicated on the drawings:

5. MISCELLANEOUS INSTALLATION METHODS

A. Fastenings

Fastenings to wood shall be by means of wood screws or bolts; to masonry by means of threaded metal inserts, metal expansion screws, metal expansion shields or toggle bolts; and to steel by means of machine screws, bolts or by welding. No wood or fiber plugs will be permitted. Fastenings to concrete may be accomplished with Ramset low powered gun fasteners, toggle bolts or expansion anchors.

B. Hangers and Supports

1) Hangers and supports shall be furnished and installed as shown on the drawings and as specified herein.

2) Equipment supports shall be Unistrut or structural steel, welded or bolted, rigid and workmanlike in appearance. Hex head machine bolts with spring lock washers shall be used.

3) Hangers shall be galvanized steel with approved conduit clamps and/or straps.

4) All angle iron, channel iron, Unistrut, rods, hangers and supports required to install and mount the electrical equipment shall be furnished and installed by the Subcontractor. Angle and channel iron members shall be cleaned of rust and scale and painted with one coat of metal primer after fabrication and then if not concealed, shall be painted in accordance with Section 11.

6. CONDUIT, FITTINGS AND ACCESSORIES

A. Heavy Wall Rigid Steel

1) Heavy wall rigid steel conduit shall be hot-dipped galvanized or electro-galvanized, inside and outside, in conformity with Federal Specifications WW-C-581A. Conduit couplings, elbows, nipples and

fittings fabricated from steel tubing shall conform in all respects to the same specifications. Conduit shall be National Electric Sherarduct, Youngstown Buckeye, or Triangle.

2) Aluminum fittings, boxes, condulets, etc., shall not be used with steel conduit except where specifically shown on the drawings.

B. Liquidtight Flexible Metal Conduit

1) Liquidtight flexible metal conduit shall be fabricated of galvanized steel flexible tubing with a synthetic jacket extruded over the tubing, similar to "Sealtite EF" manufactured by American Metal Hose Division of the American Brass Company.

2) All flexible conduit exposed to weather, water or other liquids'shall be liquidtight with connectors approved for this use.

3) Liquidtight conduit assemblies shall include on each end an insulated straight or 90 degree angle connector equal to Thomas & Betts Series No. 5300. This shall be the conduit assembly intended wherever a liquidtight assembly is called for on the drawings or in the specifications.

4) Liquidtight conduit assemblies shall be used between motor terminal boxes or other equipment subject to vibration and/or mechanical adjustment and the rigid conduit systems or elsewhere as shown on the drawings. Liquidtight conduit used to connect to motor terminal boxes for housing motor conductors shall not be less than 12 times the trade size in length but in no case less than 12 in.

C. Conduit Fittings

1) Cast malleable iron or steel conduit fittings shall be thoroughly coated with metallic zinc or cadmium inside and outside after all machine work is completed and, insofar as it applies, fittings shall conform to Federal Specifications W-F-406.

2) Nonmetallic insulating type bushings used on rigid conduit shall be O.Z. type A, Thomas & Betts 200 series, Efcor Type PB, or Appleton type BBU.

D. Boxes: Junction, Terminal, Pull

1) All junction and pull boxes shall be furnished and sized in accordance with the NEC where not sized on the drawings.

2) Junction and pull boxes located indoors in nonhazardous areas shall be code gauge galvanized sheet steel, welded construction, with conduit knockouts or raceway openings and hinged covers.

E. Installation

1) All wiring shall be installed in galvanized or sherardized rigid steel conduit.

2) Conduit shall be delivered to the job site in 10-foot lengths, each length bearing the UL label and the name of the manufacturer. Conduit, whether concealed or exposed, shall be adequately supported in accordance with NEC requirements and good practice. Supports shall be spaced not more than 7 ft. apart for one inch and smaller conduit or more than 10 ft. apart for conduit larger than one inch.

3) Conduit shall be secured to walls, building framing, etc., by the use of malleable iron galvanized "U" bolts, beam clamps, conduit straps, or Unistrut fittings when Unistrut racks or supports are used. Conduit shall be securely fastened to all outlet boxes, pull boxes, cabinets and switch boxes by double locknuts and insulating bushings unless boxes with conduit hubs are provided.

4) Conduit shall in no case be secured directly to other piping. Conduit parallel to or crossing uninsulated hot water or steam pipes must be separated from them by 12 in. if parallel or 6 in. if crossing. Where these lines are insulated, conduit parallel to or crossing them must clear the insulation surface by 2 in. Conduit shall not be run directly under cold water lines and shall be separated from them in other directions by at least 3 in,

5) Conduit shall be cut square and threaded with an approved conduit cutter and threader. The ends shall be reamed of burrs, and all metal shavings and cutting lubricants shall be removed before the conduit is connected to the conduit system.

6) Bends, offsets and bevels shall be avoided if practical; but if they are necessary, they shall be made with an approved bending device. Conduit crushed or deformed in bending will be rejected. The use of heat in bending conduit will not be permitted. Where a number of conduits are run together, the radii of any required bends shall be such that the installation will be neat in appearance.

7) All connections in rigid conduit shall be made with appropriate fittings and be securely tightened. Improperly made connections or terminations, as well as any which have not been adequately tightened, will be rejected. All conduit shall be installed by craftsmen skilled in the trade.

8) The exact locations and routing of conduit, when not shown in detail on the drawings, shall be determined by the Subcontractor subject to approval of the Construction Engineer.

9) Conduit which is run exposed shall be run at right angles to or parallel to building structural members wherever possible and shall be adequately supported by brackets, clamps, or braces wherever required. Diagonal runs shall not be made except in special cases or concealed in concrete slab.

10) In no case shall any electrical conduit be bent or any fabricated elbow be applied to less than the allowable bending radius of any installed conductor.

7. WIRE, CABLE AND CONNECTORS

A. Conductors

1) All conductors shall be stranded copper except lighting and receptacle circuit conductors may be solid. The minimum size conductor to be used for power and lighting circuits shall be No. 12 AWG.

2) All conductor sizes as specified on drawings are given in American Wire Gauge.

B. 600-Volt Insulation

1) Wire and cable with a 600-volt insulation rating shall be furnished and installed for all power feeders, motor leads, lighting and control circuits that are designed for operating voltages up to and including 550 volts: All conductors shall be listed by UL for the applications specified on the drawings.

2) All conductors shall have NEMA type XHHW insulation rated at 90°C.

3) Computer cable shall be 51 pair #22 AWG solid conductors, tinned copper, vinyl insulated with Beldfoil aluminum-polyester shield overall, 22 AWG 7x30 stranded drain wire with chrome vinyl jacket. Color coded from Belden Chart "C". Belden Catalog No. 8751 or equal.

C. Copper Conductor Connectors 300 Volts or Less

1) Splices, taps and terminations of stranded conductors No. 10 AWG and smaller shall be made with pressure connectors-, Thomas & Betts "Sta-Kon" or equal. Splices and taps in solid No. 10 AWG and smaller shall be made with split-bolt connectors or with insulated wire nuts, Thomas & Betts "Piggy" or equal. Terminations of solid conductors No. 10 AWG and smaller may be made by forming the wire to fit under a screw head, thus requiring no connector.

2) Splices and taps in copper conductors No. 8 AWG through No. 1 AWG and terminations of these sizes of conductors other than in equipment lugs (i.e., molded case circuit breakers) shall be made with either copper mechanical connectors or with wrought copper compression connectors.

Type of Connection	Type of Connector	Thomas & Betts Series No.
Splice	Mechanical - Split-Bolt	2T thru 8T
Tap	Mechanical - Split-Bolt	2T thru 8T
Termination	Mechanical - One-Hole Lug	#31000
Splice	Compression - Two-Way Connector	#54500
Tap	Compression - "C" Tap	#54700
Termination	Compression - One-Hole Lug	#54100

3) Splices and taps in copper conductors No. 1/0 AWG through No. 4/0 AWG and terminations of these sizes of conductors other than in equipment lugs (i.e., molded case circuit breakers) shall be made with wrought copper compression connectors.

Type of Connection	Type of Connector	Thomas & Betts Series No.
Splice	Two-Way Connector	#54500
Tap	"C" Tap	#54700
Termination	Two-Hole Lug	#54200

D. Copper Conductor Connectors over 300 Volts

All connectors specified for use with copper conductors carrying 300 volts or less are applicable for use with conductors carrying up to 600 volts, except insulated wire nuts shall not be used. Splices in conductors No. 10 and smaller shall be made with split-bolt connectors.

E. Wire Connections

1) Splices and taps shall be made in junction boxes or wiring gutters only.

2) Wire shall be thoroughly cleaned before connectors are applied.

F. Insulation of Splices and Taps 600 Volts

1) Splices and taps in thermoplastic (THW and XHHW) and rubber conductors shall first be insulated with rubber tape, Okonite Company "Okonite" type No. 10. Connection shall then be wrapped with all weather vinyl plastic tape, 3M Company "Scotch" No. 88. Connections not housed in a junction box or other metal enclosure shall have an additional protective wrapping of friction tape, Okonite Company "Manson" type No. 5, to protect the connection from abrasions.

2) All outdoor splices and taps in type THW and XHHW insulated conductors, such as splices at service entrances and any connections which are subjected to high humidity, shall be insulated as specified above, then wrapped with linen cloth tape and painted with two brushed-on coats of General Electric Company "Glyptal".

3) On all splices and taps, the tape applied directly over the connector shall be wrapped as tight as possible in a manner so as to pad the sharp edges and fill the indents of the connector. The outer tape shall be applied until the total area of the initial taping is covered with a minimum of four layers. The total thickness of the combination of tapes shall be at least equal to the thickness of the conductor insulation. Tape of an appropriate width shall be used.

8. IDENTIFICATION

A. Equipment

1) Safety switches, circuit breakers, motor starters, lighting panels, power panelboards and other similar electrical equipment shall be identified.

2) Light switches, receptacles and other similar electrical devices shall be identified as to voltage, phase and source of power. For example, a lighting switch on circuit 15 from panel B would be marked "120 Volt, 1Ø, LPB-15".

3) The means of identification shall be subject to approval of the Construction Engineer but in general shall be as follows:

4) Exterior surfaces of lighting switches and receptacles shall be identified by means of raised 1/4-inch high characters on 1/2-inch wide aluminum strips. Identification-tags shall be securely fastened to the equipment with noncorrosive rivets.

5) Safety switches, circuit breakers, motor starters, lighting panels, power panel boards and other similar electrical equipment shall be identified as per Sketch A-E-14469-A, Rev. 1 attached to this section of the specification.

6) Identification shall be in accordance with the one line diagram and shall include the following:

Maximum voltage
Equipment designation
Source of supply "Fed from.. .."
Equipment supplied

The "maximum voltage" and "source of supply" may be omitted on branch breakers in unit substations or panelboards where such is obvious. The "equipment supplied" notation may also be omitted where such is obvious.

Example: (1) 480 volts AC
(2) Power Dist panel "PDP"
(3) Fed from Sub 9A1
Compt 5A

7) Lighting and Distribution Panelboards

The panel directories in lighting panelboards shall be neatly filled out, showing for each circuit the equipment served, floor and column location and room number where applicable. Spare circuits shall be identified on the schedule.

B. Conductors

1) All single conductor power and control wiring shall be identified in all readily accessible junction boxes in the wiring system as well as at all terminations. Conductors need not be identified in pull boxes where no taps or splices are made. Identification shall be by means of taped on numbers or letters attached to each conductor.

2) All three-phase power feeder conductors shall be identified by phase designation, e.g., ØA, ØB, ØC.

9. **GROUNDING**

A. General

1) The grounding shall be in accordance with the drawings and the NEC.

2) All ground connections required by the NEC and any other additional grounding as shown on the drawings or as specified herein shall be furnished and installed. All enclosures for safety switches, circuit breakers, control devices, motor frames, cabinets, panelboards, etc., shall be grounded to the building common ground network with bare copper wire of the sizes as shown on the drawings or in accordance with the NEC. In general, grounding shall conform with the applicable requirements of the NEC except as amended herein.

3) Equipment and circuits shall be grounded by a continuous grounding conductor. The grounding conductor shall be run in the same conduit with the power conductors. The use of conduit as sole means of grounding will not be acceptable. Grounding or bonding of equipment to building steel as a sole means of grounding will not be acceptable.

4) All ground wires shall be copper. Aluminum ground wires are not permitted and will not be accepted. Ground wires No. 8 AWG and larger shall be stranded.

5) Connections to ground buses and connections of ground conductors to switch boxes, panel boxes, cabinets, etc., shall be made with compression connectors. Splices and taps in ground conductors need not be insulated.

6) All contact surfaces shall be thoroughly clean and bright before connections are made to insure making good electrical contact.

B. Lighting Fixture Enclosure Grounding

A continuous ground conductor, preferably a solid, bare wire sized in accordance with the drawings, shall be run in the same conduit as the circuit conductors and attached to the metal enclosure of each lighting fixture and related local switch box.

C. Receptacle Grounding

All receptacles, 120 and 208 volt, shall be provided with a grounding pole, which shall be attached to a continuous ground conductor sized in accordance with the drawings. The ground conductor shall be permanently grounded to the building grounding system.

D. Transformer Neutral Grounding

The secondary neutrals of all 208Y/120 volt, three-phase lighting transformer shall be grounded in accordance with Section 250-26 of the NEC.

10. FIELD TESTING

A. General

Test all wire, cable and electrical equipment furnished, installed or connected to assure proper installation, connection and function in accordance with the drawings, specifications and manufacturer's recommendations. Include all tests recommended by the equipment manufacturer whether specified or not, unless specifically waived by the Contractor. Include any additional tests issued by the Contractor that he deems necessary because of field conditions to determine that equipment, material and systems meet requirements of the specifications. Furnish qualified personnel and testing equipment as required to perform all tests. Maintain a complete and accurate written record of all tests showing date, personnel making test, equipment or material tested, tests performed, and results with copies furnished to the Contractor. The Subcontractor shall be responsible for any damage to equipment or material due to improper test procedures or test apparatus handling, and shall replace or restore to original condition any damaged equipment or material at no cost to the Contractor. Provide safety devices such as rubber gloves and blankets, protective screens and barriers, danger signs, etc., to adequately protect and warn all personnel in the vicinity of the tests.

B. Molded Case Circuit Breaker Tests

Check all connections, visually inspect each breaker and operate manually. Check for proper current rating for circuit to which connected. Megger each pole for freedom from grounds.

C. Phasing and Polarity Tests

Check all motors for proper rotation and determine that both phasing and phase rotation are correct for all circuits. Change all wiring where phasing or polarity is not correct and repeat tests.

D. 600 Volt Wire and Cable Tests

1) This section of the specification covers the electrical testing of all 600 volt insulated single and multiconductor wire and cable.

2) Test No. 1 - Continuity

a. Make test for continuity and correctness of wiring and identification on all conductors of lighting and receptacle branch circuit, power and control circuits and motor leads.

b. Test shall be made with a dc test device such as a bell, a buzzer or a light.

3) Test No. 2 - Insulation Resistance

a. All 600 volt power cables No. 4 AWG and larger shall be given an "Insulation Resistance Test" using a 1000 volt motor driven "Megger".

b. The test shall be made with the conductors disconnected at the equipment. Test shall be made between one conductor and ground with the other conductors grounded. Each conductor shall be tested in the same manner. The voltage shall be applied for a minimum of three minutes and until the reading reaches a nearly constant value.

c. Acceptable minimum resistance readings shall be 25 megohms. If megger readings indicate damaged insulation, the conductor shall be rejected and shall be replaced by the Subcontractor. The replacement conductor must pass the required megger test.

d. More than one conductor may be listed on the same cable test report provided all conductors listed are tested and accepted on the same date. Reports shall include complete identification of the feeder, megger readings vs. time data, ambient temperature and weather conditions.

E. Lighting Fixtures

Give all lighting fixtures an operational test. All fixtures must operate, all lenses must be clean and all local switches must function properly.

F. 120 Volt Receptacles

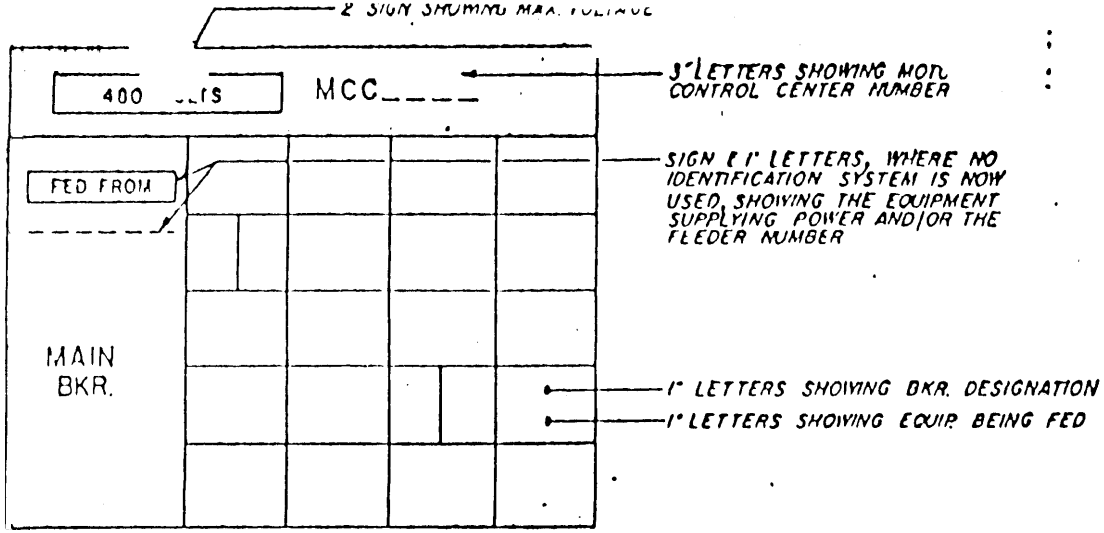
1) A random check of receptacles shall be made to insure that neutral and ground wires are connected properly.

2) After installation, all 120 volt receptacles shall be checked for correct wiring by the use of a Daniel Woodhead Model No. 1750 tester.

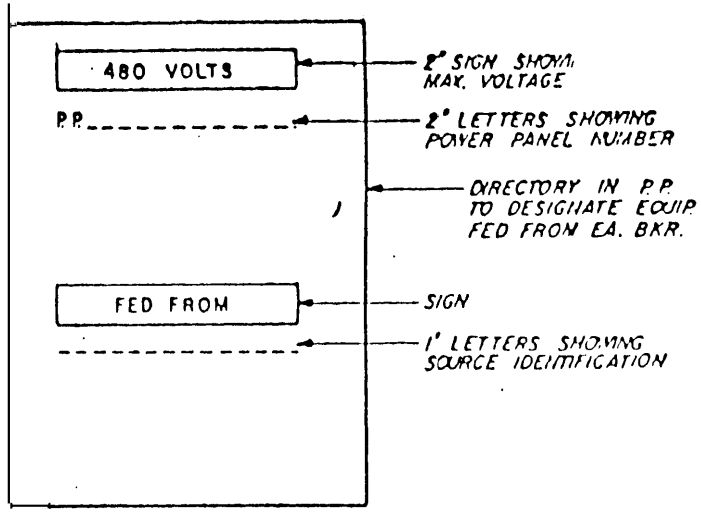
3) After completion of wiring test in Section 7-10.F.2, all 120 and 208 volt receptacles shall be given an equipment ground impedance test. The test shall be performed using a Daniel Woodhead Model No. 7040 "Ground Loop Impedance Tester". The maximum allowable impedance shall be 1.0 ohms.

CAUTION: This test shall be performed at each receptacle with no loads plugged into other receptacles sharing the same equipment ground conductor.

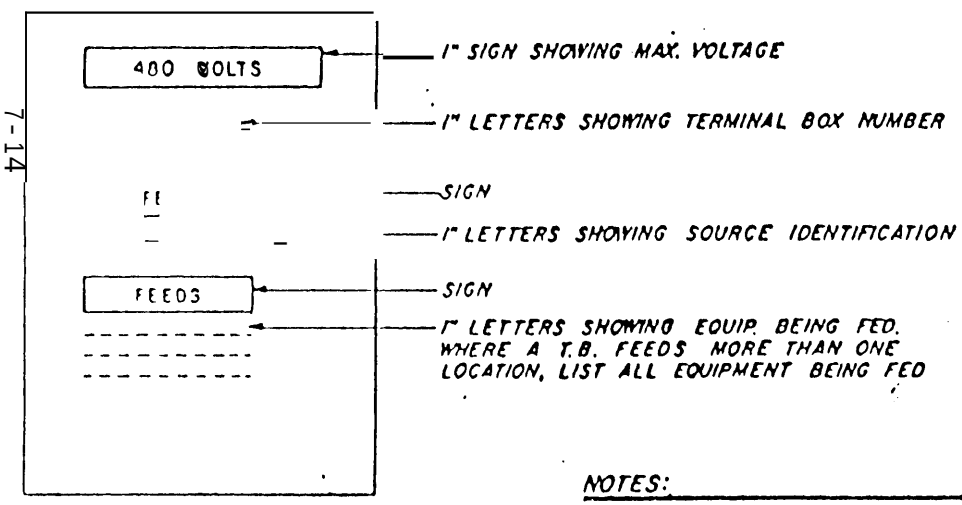
4) All receptacle checks shall be made by the Subcontractor using test equipment furnished by the Subcontractor and in the presence of the Construction Engineer. Any receptacles not passing the required tests shall be corrected by the Subcontractor and then verified by the Construction Engineer as being acceptable.



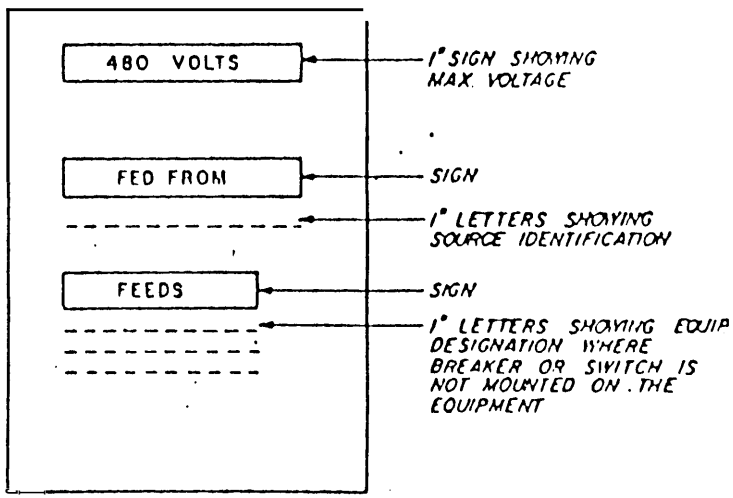
MOTOR CONTROL CENTER



POWER PANEL



TERMINAL BOX



DISCONNECT SWITCH
CIRCUIT BREAKER OR
MOTOR STARTER

NOTES:

1. ALL LETTERING IS OF YELLOW VINYL ADHESIVE BACKED LETTERS.
2. ALL SIGNS ARE VINYL ADHESIVE BACKED STRIPS WITH BLACK LETTERS ON A YELLOW BACKGROUND.
3. ALL EQUIP. SIGNS ARE TO BE SIZED TO SUIT THE EQUIPMENT. MATERIAL TO BE PHENOLIC ADHESIVE BACKED OR FIBER, DISC AS APPROPRIATE.
4. BEFORE THE APPLICATION OF PRESS ON SIGNS AND LETTERING THE SURFACE SHALL BE CLEANED W/SOLVENT SUCH AS VARSOL. AFTER APPLICATION SPRAY THE SIGNS & LETTERING WITH "KRYLON" LACQUER.
5. VINYL ADHESIVE BACKED LETTERS SHALL BE BRADY QAV QUIK-ALIGN LETTERS. VINYL CLOTH ADHESIVE BACKED STRIP SIGNS SHALL BE BRADY VOLTAGE MARKERS AND BRADY CUSTOM CONDUIT AND VOLTAGE MARKERS.
6. ALL STRIP SIGNS MAY BE REPLACED WITH EQUAL SIZE BRADY QAV QUIK-ALIGN LETTERS.

EQUIPMENT DESIGNATION

EQUIPMENT SIGNS
(SEE NOTE 3)

NO.	BY	APPD.	DATE	DESCRIPTION
1	[illegible]	[illegible]	[illegible]	REVISED NOTES

DESIGN BY D.A.S.	DATE 1975	UNION CARBIDE CORPORATION NUCLEAR DIVISION — PADUCAH PLANT
DRAWN BY JENKINS	3-18-1975	ELECTRICAL SYSTEM IDENTIFICATION SCHEME
CHECKED BY J.M.Q.	3-19-1975	
DEPT. [illegible]	3-19-75	
OPER. J.K.D.	3-21-75	
DIV. [illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	3-20-75	A-E-14469 REV. 1

11.430 - PAINTING

1. GENERAL

This specification covers the preparation of surfaces and the furnishing and application of paint and primers.

2. MATERIALS

A. Paints and Primers

Paints and primers specified are manufactured by **PPG** Industries, Inc. Equivalent painting systems as manufactured by Sherwin-Williams; Devoe and Reynolds Co., Inc.; The Glidden Company; Mobil; or an approved equal are acceptable.

B. Submittals

Any paint/primers other than that specified shall be submitted by the Subcontractor for approval by the Construction Engineer.

C. Sealed Packaaes

All materials shall be delivered to the site in the manufacturer's sealed packages and containers, with labels intact and seals unbroken. All materials shall be in covered containers with the descriptive labels of the material contained therein. Materials.-shall not be opened until required for use or for sampling.

D. Storaae

Paint materials and equipment shall be stored only in such places as may be approved **by** the Construction Engineer. The Subcontractor shall maintain the storage area and leave it free from fire hazards due to improperly stored rags, waste, or other combustible materials.

3. METHODS OF **WORKMANSHIP**

A. Preparation of Surfaces

Painting on any surface shall not be started until all preparation of the surface is completed. As a minimum preparation, all other new or existing painted surfaces to be painted shall be brushed clean of all dust, dirt, or loose paint before paint is applied. Dull all glossy surfaces with sandpaper, steel wool, or liquid sanding aid. The surfaces shall be smooth, free of grease, scale, rust, welding spots and slag or other adhering matter which would prevent a proper paint bond.

B. Application

In general, all paint shall be applied as specified and shall be done in a workmanlike manner, leaving the finished surfaces free from drops, ridges, waves, laps, and brush marks. Paint shall be applied under dry dust-free conditions.

All primer and intermediate coats of paint shall be unscarred at the time of application of each succeeding coat. Each coat of paint shall have a slight variation of color to distinguish it from the preceding coat. Sufficient time shall be allowed between coats to insure proper drying.

Spray or roller painting may be employed where practicable if approved by the Construction Engineer.

Paints shall be thoroughly stirred and kept at a uniform consistency during application and shall not be thinned in excess of the printed directions on the container. Solvents and thinners used shall be of the type compatible with the paint used.

C. Protection

During painting operations, the Subcontractor shall furnish and maintain in place adequate protective covers and drop cloths. Sprayed application shall be in conformity with all safety regulations in effect at the work site and the Subcontractor shall be responsible for protecting all adjoining work from spray particles. Sprinkler heads, heat and smoke detectors, etc., shall be covered with plastic or paper bags before painting operations, and all covers shall be removed after painting is completed. Area shall be well ventilated during painting. Any paint spots or spillage which may occur shall be promptly removed. "WET PAINT" signs shall be posted to protect newly painted surfaces.

D. Cleaning

During the work, or upon completion, the Subcontractor shall go over all areas and clean off misplaced paint from finished surfaces. Finishes of affected items shall be restored to their original condition.

E. Touch-up Painting

A primer shall be applied to all field welded joints, bare spots, and surfaces damaged by new construction. These spot primed areas shall be covered with one finish coat to match existing finish.

4. PAINTING SCHEDULE

A. General

Paint coverage shall consist of three coats on all new surfaces consisting of a primer, intermediate, and finish coat unless noted otherwise. All paints/No's. specified are manufactured by PPG Industries, Inc. Paint thickness is listed in minimum wet film thickness, in mils (MWF).

B. Coating System

1) Structural and miscellaneous steel, doors and frames, supports, hangers, etc.:

Shop/Field Prime: 6-204; Zinc chromate; 3.1 MWF
Intermediate Coat: 23-76; Vista Green; 3.1 MWF
Finish Coat: 23-76; Vista Green; 3.1 MWF

2) Floor checked plate, bar grating, and nosing angles:

Shop/Field Prime: 6-204; Zinc chromate; 3.1 MWF
Intermediate Coat: 23-49; Gray; 3.1 MWF
Finish Coat: 23-49; Gray; 3.1 MWF

3) Galvanized ribbed decking and sheet metal and stainless steel sheet metal will not be painted.

5. PIPE PAINTING

A. General

All uninsulated. carbon steel and black iron indoor piping shall be painted, except piping or valves enclosed in housings or above suspended ceilings. Exposed surfaces of insulation on insulated pipe shall be primed with coat of flat white undercoat and topcoated with one coat of enamel as hereafter described. Uninsulated pipe shall be primed and topcoated with one coat of enamel as hereafter described.

B. Colors

Paint for prime coating shall be a zinc-chromate equivalent to No. 6-204 as manufactured by Pittsburgh Paint Company. Paint for topcoating shall be "Speedhide Interior-Exterior Gloss Enamel" as manufactured by Pittsburgh Paint Company. The final color shall be as shown below:

Surface	Color	Chip Number
Compressed air	White	23-83
Nitrogen	Blue	23-77
Water	Gray	23-75
Oxygen	Green	3-20
Steam & condensate	Gray	23-75

Painting not required on bare copper tubing or stainless steel.

APPENDIX E

HAZARDOUS WASTE TANK ASSESSMENTS

HAZARDOUS WASTE TANK ASSESSMENT

ESO 16884

PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH, KENTUCKY

LOCKWOOD GREENE

HAZARDOUS WASTE TANK ASSESSMENT

ESO 16884

PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH, KENTUCKY

LOCKWOOD GREENE

SAFETY & WARNING INFORMATION

Industrial Hygiene – General Requirements

(To be attached to every MacDermid Material Safety Data Sheet.)

All food should be kept in a separate area away from the working location. Eating, drinking, smoking and carrying of tobacco products should be prohibited in areas where there is a potential for significant exposure to this material. Before eating, drinking or smoking, hands and face should be thoroughly washed.

SKIN CONTACT

Skin contact should be prevented through the use of impervious clothing, gloves and footwear. A face shield should be worn when use conditions could result in exposure to the material.

EYE CONTACT

Eye contact should be prevented through the use of chemical safety glasses, goggles or face shield.

INHALATION

This material should only be handled in open or well-ventilated areas. Where adequate ventilation is not available and there is possibility of vapor, aerosol or mist generation, control of inhalation can be achieved through the use of a NIOSH-approved, half-face-piece cartridge, air-purifying respirator.

General Storage Requirements for Hazardous Materials

CORROSIVE MATERIALS

Corrosive materials must not be above, below or adjacent to: Flammable Solids, Oxidizing Materials, Cyanide Bearing Materials (Poison).

FLAMMABLE LIQUIDS

Keep Flammable Liquids in a segregated area, preferably outside of your facility or in a Flammable Liquid storage cabinet.

Keep Flammable Liquids in a segregated area, preferably outside of your facility or in a Flammable Liquid

DOUBLE LABELED MATERIALS

(Example: Corrosive Liquid, Poisonous-NOS). Primary hazard is Corrostve, secondary hazard is Poison. Consider both hazards in storing the material. In this example, do not store near Flammable Solids, Oxidizing or Cyanide Bearing materials because of the corrosive element. Preferably keep double labeled materials separate from all other diamond labeled materials.

ACIDS/ALKALINES

Acid bearing material should be stored separate from Alkaline bearing material.

Although the information and recommendations set forth in this sheet are believed to be correct as of the date hereof, MacDermid, Inc. makes no further representations as to the completeness or accuracy of such information and recommendations.

MacDermid, Inc. shall in no event be responsible for any damages whatsoever, directly or indirectly resulting from the publication or use of or reliance upon such information and recommendations.

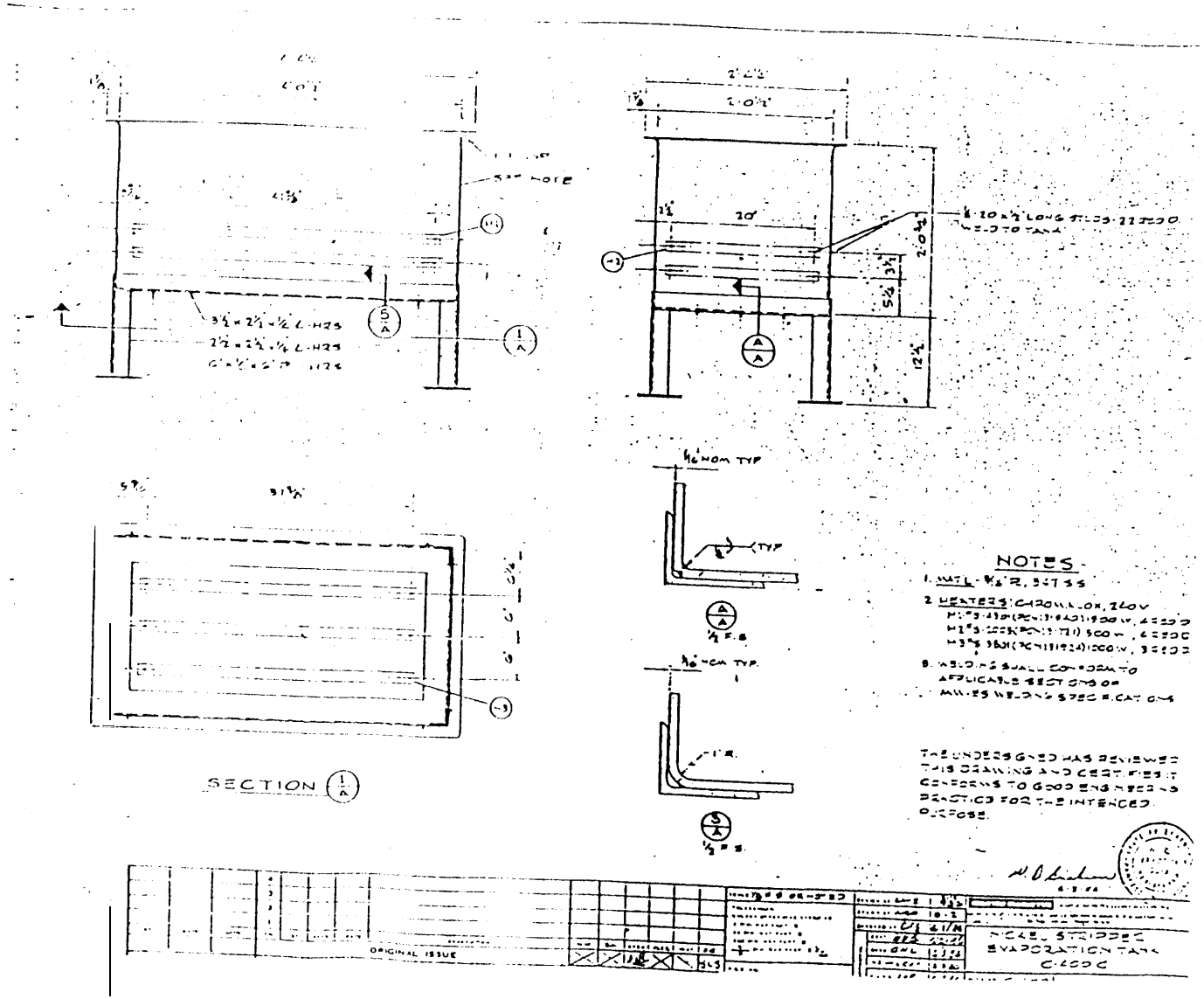
No other warranty, either express or implied, of merchantability or fitness or any other nature with respect to the product or the information or recommendations herein is made hereunder.

MacDermid

(203) 575-5700

EMERGENCY DIRECTORY ASSISTANCE

(313) 644-5626



SECTION 1/A
NOTES
1. MAT'L - 3/16" R, 347 SS
2. HEATERS: CHROMALOX, 240V
3. WELDING SHALL CONFORM TO APPLICABLE SECTIONS OF MIL-E-5 WELDING SPECIFICATIONS
THE UNDERSIGNED HAS REVIEWED THIS DRAWING AND CERTIFIES IT CONFORMS TO GOOD ENGINEERING PRACTICE FOR THE INTENDED PURPOSE.
ORIGINAL ISSUE
NICKEL STRIPPER EVAPORATION TANK
C-400 C

APPENDIX

EXHIBIT **E**

C-733 SUMP **INFORMATION**

4.310 - CONCRETE FOR STRUCTURAL USE

1. GENERAL:

This section of the specifications relates to the furnishing and installation of all poured-in-place concrete and related work as shown on the drawings and as specified.

2. CODES AND STANDARDS:

Codes and standards which are called for or referred to herein are hereby made a part of this specification to the extent indicated by the reference thereto. In the event of discrepancies between this specification and the codes and standards, this specification shall govern.

A. American Concrete Institute (ACI) Standards:

ACI 211.1-77	Recommended Practice for Selecting Proportions for Normal Weight Concrete
ACI 302-69	Recommended Practice for Concrete Floor and Slab Construction
ACI 304-75	Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
ACI 305-77	Recommended Practice for Hot Weather Concreting
ACI 306-78	Recommended Practice for Cold Weather Concreting
ACI 315-74	Manual of Standard Practice for Detailing Reinforcing Concrete Structures
ACI 318-77	Building Code Requirements for Reinforced Concrete
ACI 347-78	Recommended Practice for Concrete Formwork

B. American Society for Testing and Materials (ASTM) Standards:

ASTM A185-79	Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement

ASTM A306-64	Standard Specification for Carbon Steel-Bars Subject to Mechanical Property Requirements
ASTM A615-78	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C-31-69	Standard Method of Making and Curing Compressive and Flexural Strength Test Specimens in the Field
ASTM C-33-78	Standard Specification for Concrete Aggregates
ASTM C-39-72	Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens
ASTM C-94-78	Standard Specification for Ready-Mixed Concrete
ASTM C-143-78	Standard Method of Test for Slump of Portland Cement Concrete
ASTM C-150-78	Standard Specification for Portland Cement
ASTM C-231-78	Tentative Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C-260-77	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C-309-74	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C-494-79	Admixtures
ASTM D-2103-67	Standard Specification for Polyethylene Film and Sheeting

C. Federal Specifications (FS)

SS-S-164	Sealing Compound; Hot Poured Type, for Joints in Concrete
SS-S-00195	Sealing Compound, Two-Component, Elastomeric, Polymer Type, Cold Applied, Concrete Paving Joints
CCC-C-467	Cloth, Burlap, Jute, (or Kenaf)

U.S. Department of Commerce, National Bureau of Standards (NBS) Product Standards

PS-1	Softwood Plywood, Construction and Industrial

American Association of State Highway Officials (AASHO) Standard:

M 73 Cotton Mats for Curing Concrete

Kentucky Department of Highways (KDH):

"Standard Specifications for Road and Bridge Construction"

American Association of State Highway Officials (AASHO) Standard:

M 73 Cotton Mats for Curing Concrete

Kentucky Department of Highways (KDH):

"Standard Specifications for Road and Bridge Construction"

3. MATERIALS:

A. General. Except as otherwise specified herein, all materials shall conform to ACI 318 and ACI 211.1.

B. Aggregates. Aggregates shall conform to ASTM C 33 and have the following physical properties:

1) Coarse aggregate shall be gravel or crushed stone, well graded from fine to coarse within the prescribed limits. Maximum nominal coarse aggregate shall be 1 inch; except for slabs on grade and mass or foundation concrete, the sizes shall be 1-1/2 inch.

2) Fine aggregate shall be sand, clean and sharp.

C. Reinforcement.

1) Reinforcing bars shall conform to ASTM A 615 Grade 60 unless otherwise indicated on drawings.

2) Plain smooth rods or dowels shall conform to ASTM A 306, with minimum yield of 40,000 psi.

3) Provide metal accessories, including all spacers, chairs, *ties*, and other devices necessary for properly placing, spacing, and supporring reinforcement in place.

4) Wire mesh shall be welded wire fabric conforming to ASTM A185.

D. Premolded Expansion Joint. Premolded expansion joint filler strips shall conform to ASTM D1751 or D1752, or shall be a resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752, 1/2 inch thick unless otherwise indicated.

E. Joint Sealer. Joint sealer shall be the hot-poured elastic type conforming to ASTM D1190 or FS SS-S-164, or the cold-application type conforming to ASTM D1850 or FS SS-S-00195.

2) Slump Tests. A minimum of one test shall be made for each class of concrete used in a day, or if more than 50 cubic yards are placed in a day, one test shall be made for each 50 yards plus any fraction over 50 yards. Additional tests shall be made when visual inspection indicates that the consistency of the concrete being placed may exceed the limit for slump as specified. Excess slump will be cause of rejection of concrete. Slump will be determined in accordance vith ASTM C 143, for ASTM C360. When the penetration method is used fbr field control specified, slumps shall be converted to equivalent penetrations by factors established in advance. The Subcontractor shall provide all materials and equipment required for the Slump Test.

3) Cylinder Compression Testing. Compression testing of cylinders vill be in accordance with ASTM C 39.

4) Leak Test. Fill sump to top with water, allow 1 hour to reach equilibrium, adjust water level back to top of sump and hold for 24 hours. It is recommended that the Subcontractor place a plastic cover over the sump area to minimize evaporative losses. If leakage exceeds 0.40 inches during the test period, the Subcontractor shall remove the water, repair and retest at his expense until the leakage rate does not exceed the above cited criteria. Results will be verified by the Construction Engineer.

C-733 sump

5) Unsatisfactory Test Results. Where the strength of test specimens falls below specified values for 28 days strength, the Contractor may order removal of the concrete in question, at the Subcontractor's expense, or may approve alternate strength tests at the Subcontractor's expense. These may be either compression tests made with specimens secured from the structure In accordance with ASTM C 42, or actual load tests of the structure made in accordance with ACI-318. The Contractor may also approve additional controlled curing of the concrete in question, not to exceed 21 days before making either of the alternate tests. The basis for acceptance or rejection of the concrete in question as determined by these alternate tests shall be agreed upon by the Subcontractor and the Contractor before making the tests. All additional tests shall be made at the expense of the Subcontractor.

6) A log of all concrete pours shall be carefully kept by the Subcontractor. In general, the log shall contain the following data: Identifying nunber of pour, data made, time, weather and temperature at start of pour, weather and temperature at finish of pour, nunber of cubic yards in pour, slump record, identifying number of cylinders, test results at 7 days, test results at 28 days.

15. ANCHOR BOLTS:

Set all anchor bolts to template with required projection. Do not handset. Recheck after setting and correct all errors.

Incompatible, ignitable, flammable or reactive wastes will not be stored the tanks. Table D-3 provides a list, including characteristics of the fn [redacted] that may be stored in these tanks in the future. It is planned to use only three of the tanks for normal storage of waste materials. The other tank will remain empty for contingency use such as a spill or tank leak.

Table D-3

HAZARDOUS WASTE STORED [redacted] TANKS AT C-733

Waste	EPA Waste Number [redacted]	RGN	Approximate Specific Gravity
Spent Trichloroethylene, 1,1,1-Trichloroethane	F001	17	1.3 @ 25°C
Waste Oil Contaminated with Halogenated Solvents	F001	17	0.9 @ 25°C

D-2b Tank Corrosion and Erosion

The four storage tanks at C-733 are all constructed of carbon steel in accordance with the specifications provided in Appendix D, C-733 Specifications (Section 9). The tanks are unlined at the present time. Before storing the wastes other than those listed in Table D-3, a thorough literature review will be conducted to determine compatibility of the waste with the tank materials of construction. Laboratory testing may be conducted if results of the literature review are inconclusive. No material will be stored in the tanks if it is expected to cause significant corrosion. If the need develops to store a waste in the tanks that is incompatible with the tank material, the tank(s) may be lined with a coating appropriate to the waste to be stored. The coating will be applied to the internal surfaces in accordance with manufacturer's instructions, and safe work practices will be followed. Acceptable tank materials for PGDP wastes are listed in Table C-4 of the Waste Analysis Plan.

Table D-1

HAZARDOUS WASTES STORED AT C-733 IN CONTAINERS

	EPA Waste Number
Spent Trichloroethylene/ 1,1,1-Trichloroethane	F001
Mineral Spirits and Paint Waste	D001
Miscellaneous Discarded Laboratory Chemicals	(1)
Waste Oil and Halogenated Solvents	F001
TEHP/Hexane Solutions	D001
Scintillation Solution (Xylene/Carbitol)	F003
~~Spent Vacuum Pump Oil~~	~~D007~~
Waste Oil Contaminated with Uranium and Halogenated Solvents	F001
Waste Oil Contaminated with Halogenated Solvents, Uranium and PCBs	F001
Miscellaneous Flammable Liquids	D001

(1) To be determined depending on the waste when received

MARTIN MARIETTA

MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 1410
PADUCAH, KENTUCKY 42001

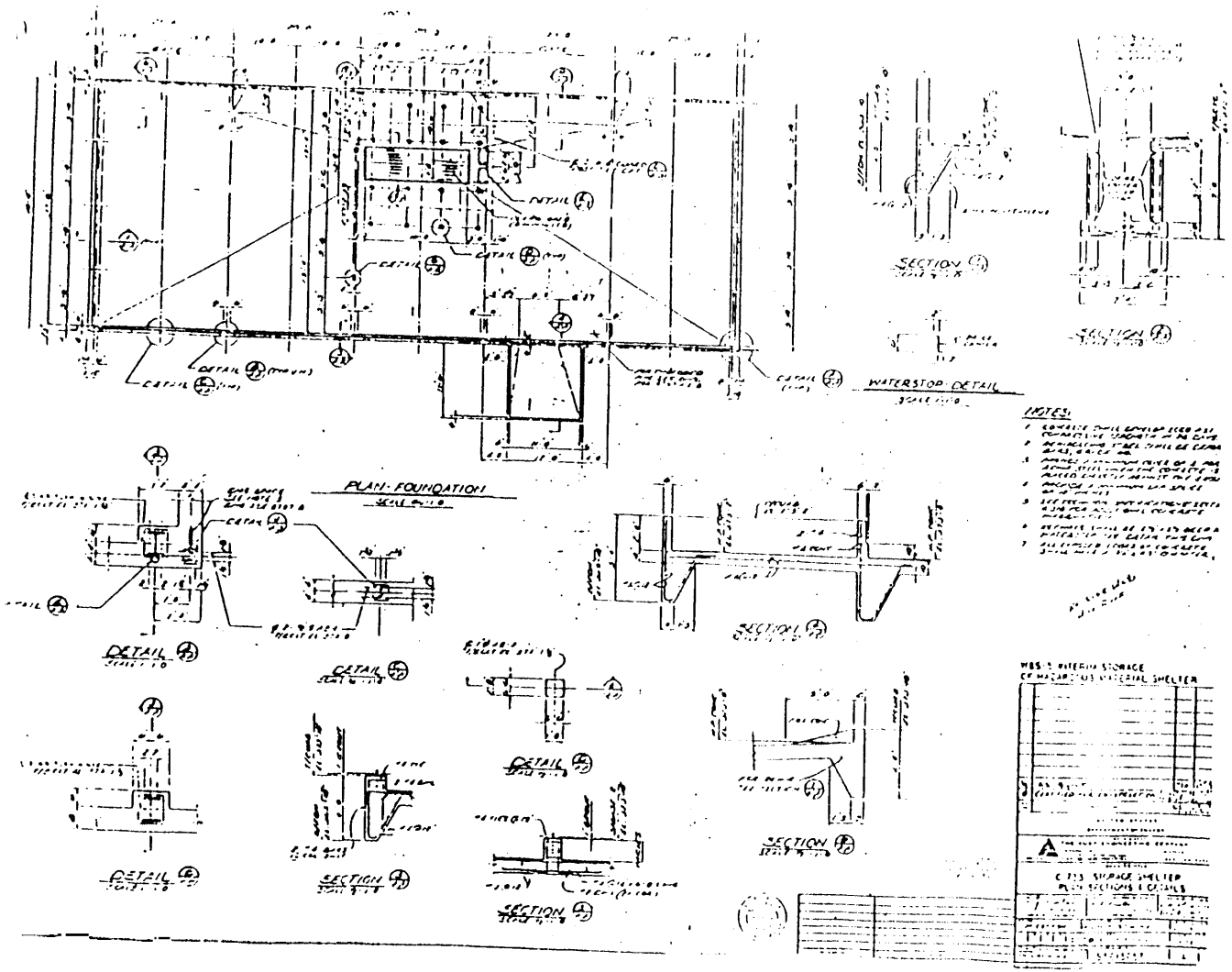
December 18, 1987

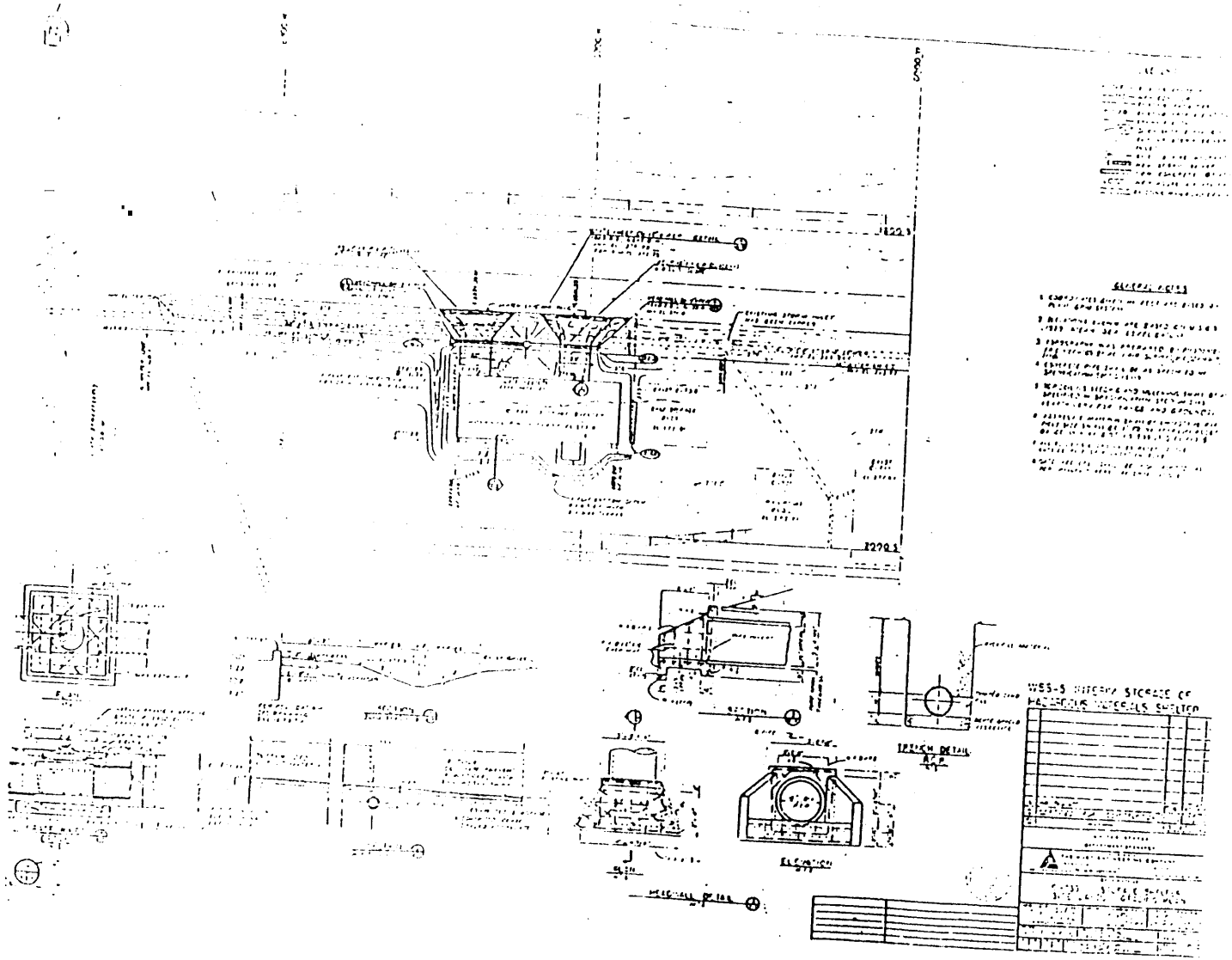
Mr. Charles Neely
Lockwook Green
P. O. Box 491
Spartanburg, S.C. 29304

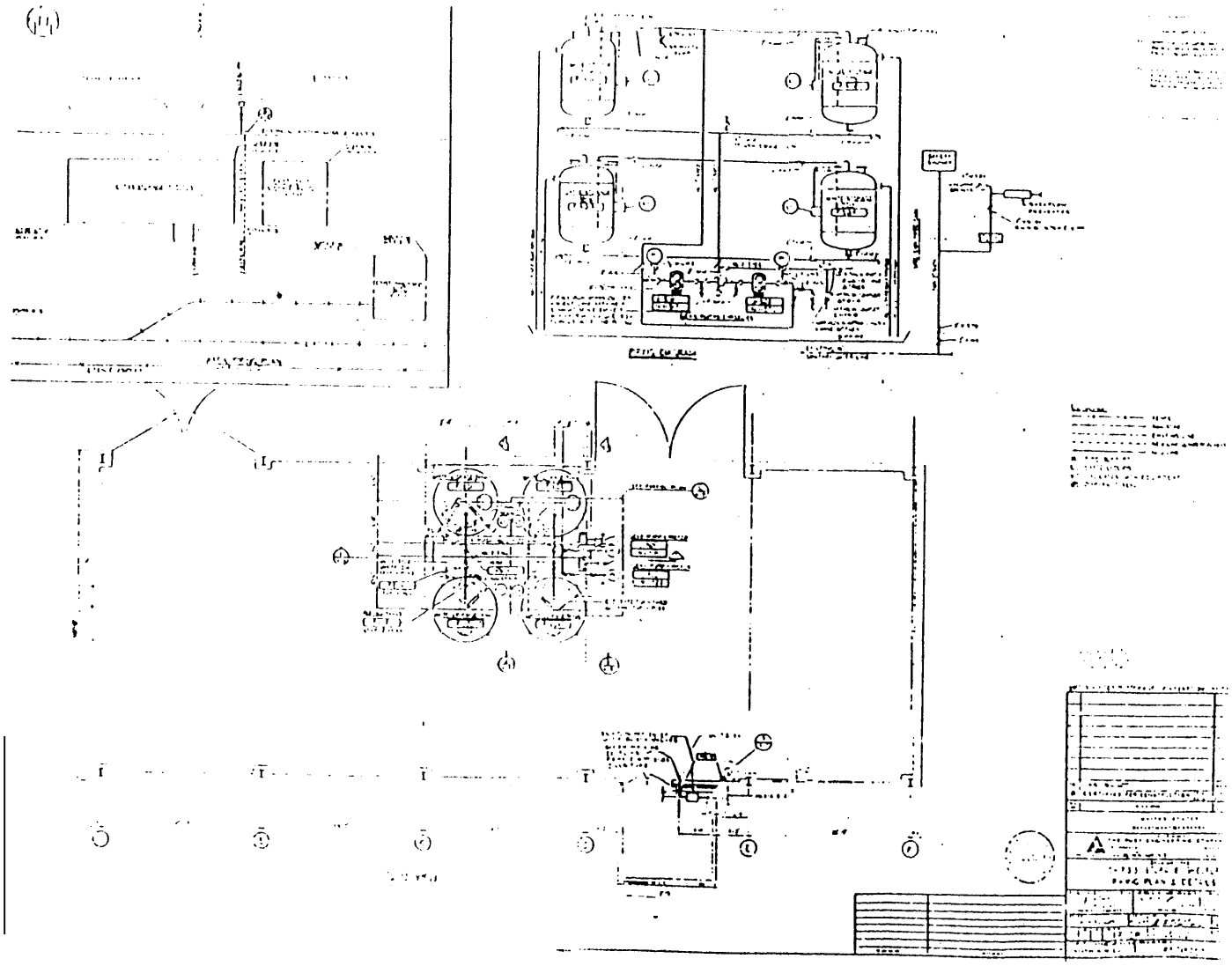
Mr. Neely:

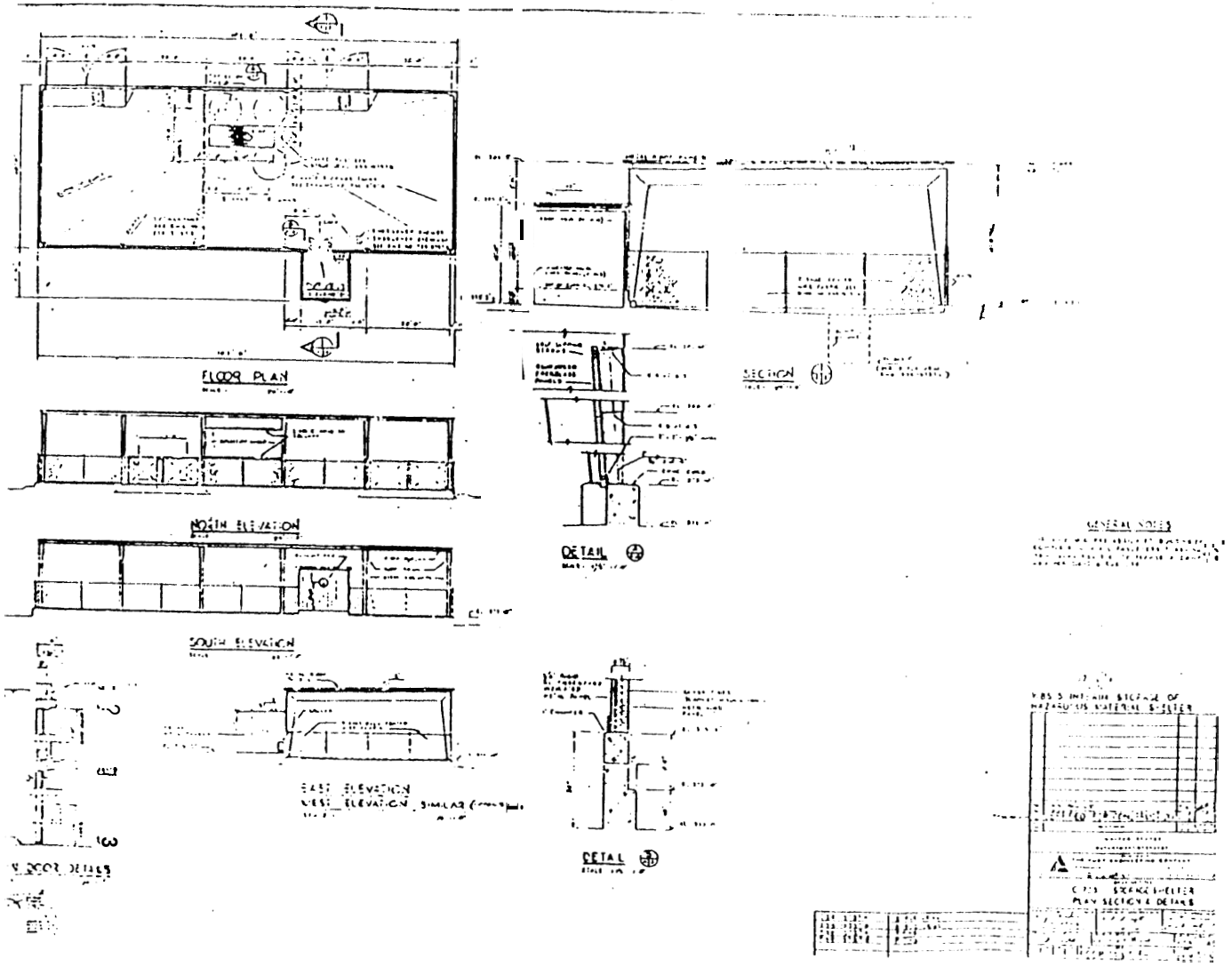
This is to certify that, as Principal Engineer on the project to construct the C-733 Interim Mazardous Materials Storage Shelter, I witnessed the leak test required by Section 4.310 Part 14.B.4 of FPSC 8072, issued 5-25-82. This test was successfully completed during the first quarter of FY-1983.

Robert L. Langston
Principal Engineer


PLAN-FOUNDATION
WATERSTOP DETAIL
NOTES:






FLOOR PLAN
NORTH ELEVATION
SOUTH ELEVATION
SECTION
DETAIL
DETAIL
GENERAL NOTES

APPENDIX

EXHIBIT F

C-409 SUMP INFORHATION

MARTIN MARIETTA ENERGY SYSTEMS, INC

January 12, 1988

D. E. Parker

C-409 Sump Leak Test

On January 7 and 8, 1988 a leak test was conducted on the C-409 Sump. The following criteria comprise the requirements of this leak test:

> Place water in sump to designated height, allow *two* hours to reach equilibrium, mark level on sides of sump and hold for 24 hours. Place plastic cover over sump to minimize evaporative losses. If leakage exceeds 0.40 inches during the *test* period the water shall be removed, the leak repaired and the test repeated until the leakage rate is not exceeded. Testing will be witnessed by one PGDP employee.

This is to inform you that R. L. Langston conducted the test and B. J. Kruger witnessed the test. No measurable loss of water was observed at the end of 24 hours which satisfied the requirements for acceptance of the C-409 sump as leak free.

R. L. Langston

R. L. Langston, C-100, PGDP (289)

RLL:jhf

cc: W. D. Brickeen
S. J. Kruger
A. B. Moore
S. Shell/R. Dierolf
File-RLL

SPECIAL FACILITIES

SECTION 7 - COSCRETE AND GROUTING

7.01 GENERAL

This section of the specifications relates to the furnishing and installation of reinforced and unreinforced concrete and grout, complete.

7.02 CODES AND STANDARDS

Codes and standards which are called for or referred to herein are hereby made a part of this specification. The latest edition shall apply. In the event of discrepancies between this specification and the codes or standards, this specification shall govern.

7.03 SHOP DRAWINGS

A. The drawings show the dimensions and form for all reinforced concrete work, and the sizes and typical arrangement of reinforcement. The work shall be installled in full accordance with the drawings, the approved shop drawings for reinforced concrete and reinforcing steel, and these specifications.

B. Shop drawings, including bar lists and bending and erection drawings of all reinforcing steel shall be submitted for approval, in accordance with the requirements of Section 2 - Special Conditions.

7.04 MATERIALS

A. General

Except as otherwise specified herein, all materials shall conform to the American Concrete Institute specifications "Building Code Requirements for Reinforced Concrete" (ACI 318) and "Recommended Practice for Slecting Proportions for Concrete" (ACI 613).

B. Concrete

Concrete shall be the equivalent of ready-mixed concrete manufactured and delivered in accordance with the requirements of ASTM C 94. The concrete mix or mixes shall be in accordance with ACI 613 and shall attain the properties of strength and slump as specified in paragraph 7.06 below.

7.04 MATERIALS (Cont'd)

C. Aggregates

Aggregates shall conform to ASTM C 33 and have the following physical properties:

1. Coarse aggregate shall be gravel or crushed stone, well graded from fine to coarse within the prescribed limits. Maximum nominal coarse aggregate shall be 1 inch, except for slabs on grade and mass or foundation concrete maximum size shall be 1-1/2 inch.

2. Fine aggregate shall be sand, clean and sharp.

D. Reinforcement

1. Reinforcing bars shall conform to ASTM A 615 Grade 40 unless otherwise indicated on drawings.

2. Plain smooth rods or dowels shall conform to ASTM A 306, with minimum yield of 40,000 psi.

3. Welded wire fabric shall conform to ASTM A 185, and be made of smooth, cold drawn wire conforming to ASTM A 82, bright basic finish.

4. Fabricated steel bar or rod mats shall conform to ASTM A 184.

5. Provide metal accessories, including all spacers, chairs, ties, and other devices necessary for properly placing, spacing, and supporting reinforcement in place.

E. Joint Filler Strips

Joint filler strips for expansion joints shall conform to ASTM D 1751 or D 1752, or shall be resin-impregnated fiberboard conforming to the Physical requirements of ASTM D 1752. Joint filler shall be 1/2 inch thick unless otherwise indicated.

F. Joint Sealer

Joint sealer shall be the hot-poured elastic type conforming to ASTM D 1190 or Federal Specification SS-s-1401, or the cold-application type conforming to ASTM D 1850 or Federal Specification SS-S-195.

7.04 MATERIALS (Cont'd)

C. Aggregates

Aggregates shall conform to ASTM C 33 and have the following physical properties:

1. Coarse aggregate shall be gravel or crushed stone, well graded from fine to coarse within the prescribed limits. Maximum nominal coarse aggregate shall be 1 inch, except for slabs on grade and mass or foundation concrete maximum size shall be 1-1/2 inch.

2. Fine aggregate shall be sand, clean 3nd sharp.

D. Reinforcement

1. Reinforcing bars shall conform to ASTM A 615 Grade 40 unless otherwise indicated on drawings.

2. Plain smooth rods or dowels shall conform to ASTM A 306, with minimum yield of 40,000 psi.

3. Welded wire fabric shall conform to ASTM A 185, and be made of smooth, cold drawn wire conforming to ASTM A 82, bright basic finish.

4. Fabricated steel bar or rod mats shall conform to ASTM A 184.

5. Provide metal accessories, including all spacers, chairs, ties, and other devices necessary for properly placing, spacing, and supporting reinforcement in place.

E. Joint Filler Strips

Joint filler strips for expansion joints shall conform to ASTM D 1751 or D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752. Joint filler shall be 1/2 inch thick unless otherwise indicated.

F. Joint Sealer

Joint sealer shall be the hot-poured elastic type conforming to ASTM D 1190 or Federal Specification SS-S-1401, or the cold-application type conforming to ASTM D 1850 or Federal Specification SS-S-195.

7.04 MATERIALS (Cont'd)

G. Vapor Barrier

Vapor barrier under lean concrete slabs shall be polyethylene sheeting conforming to Commercial Standard CS238, not less than 6 mil thickness.

H. Cover Materials for Curing

1. Burlap cloth shall conform to the requirements of Federal Specification CCC-C-467b.

2. Cotton mats shall conform to the requirements of Federal Specification DDD-M-148.

3. Liquid membrane-forming compounds shall conform to the requirements of "Specifications for Liquid Membrane-Forming Compounds for Curing Concrete", ASTM C-309.

J. Floor Hardener

Floor hardener shall be Lapidolith, or equal.

7.05 ADMIXTURES

The use of admixtures in the concrete shall be restricted to the specific applications outlined hereafter.

A. A cement dispersion agent, approved by the Contractor, may be used at the option of the Subcontractor. It shall conform to ASTM C 618 and shall be used in accordance with the manufacturer's instruction. Appropriate reductions in cement and water content shall be made to maintain the original slump and strength requirements.

B. All exterior concrete shall be air-entrained. Air content by volume shall be 5 to 7 percent as determined in conformance with ASTM C 231. Air entraining agents shall conform to ASTM C 260 or Corps of Engineers Specification CRD-C 13. The agent and the cement proposed for use shall be selected well in advance of concrete placing, and the Subcontractor shall provide satisfactory facilities for ready procurement of adequate test samples. Air entrainment shall be produced by either adding an air entraining agent at the mixer or by use of mill-produced air-entraining cement. When necessary to increase the air content to within the specified range, additional air-entraining admixture compatible with that already in the mixture shall be added at the mixer. Air content shall be based on measurements made in concrete mixtures at point of discharge at the jobsite.

7.06 DESIGN OF CONCRETE MIXES

A. General

All concrete shall be equivalent to ready-mixed concrete manufactured and delivered in accordance with the requirements of ASTM C 94. The concrete manufacturer shall assume the responsibility of the design of the concrete mix or mixes in accordance with the latest ACI 613 to attain the properties of strength, slump, entrained air, and rate of hardening in conformance with the following requirements.

B. Strength

Concrete used for equipment pads, reinforced or unreinforced, shall have a minimum compressive strength of 3000 psi at 28 days.

Concrete used for floor and slabs, reinforced or unreinforced, shall have a minimum compressive strength of 4000 psi at 28 days, and a minimum flexural strength of 600 psi at 28 days.

C. Slump

Concrete mixes shall be designed for the following slumps:

	Slump in Inches	
	Max.	Min.
2500 psi	5	3
3000 psi	4	2
4000 psi	2	1

7.07 COLD WEATHER REQUIREMENTS

When the temperature is below 40°F, or is likely to fall below 40°F before placing the concrete, and/or during the 24-hour period after placing, the Subcontractor shall strictly adhere to the recommendations of ACI 306, "Recommended Practice for Cold Weather Concreting."

7.08 HOT WEATHER REQUIREMENTS

Concrete deposited during hot weather shall have a temperature of not more than 75°F. The use of hot cement shall be avoided insofar as practicable, and cold mixing water shall be used in the mix. The Subcontractor shall strictly adhere to the

7.08 HOT WEATHER REQUIREMENTS (Cont'd)

recommendations of ACI C 605, "Recommended Practice for Hot Weather Concreting."

7.09 FORMWORK

A. Building Formwork

1. General

Formwork shall be in accordance with "Recommended practice for concrete formwork" (ACI 347).

2. Materials

Forms shall be of wood, metal, structural hardboard or other suitable material that will produce the required surface finish.

a. Concrete surfaces to be exposed or painted: Form surfaces that will be in contact with concrete shall be of material that is nonreactive with concrete, and that will produce concrete surfaces equivalent in smoothness and appearance to that produced by new plywood panels conforming to U. S. Product Standard PS 1 exterior type, Grade B-B, concrete form.

b. Concrete surfaces to be unexposed: Form surfaces that will be in contact with concrete shall be of So. 2 common or better lumber, or other material producing equivalent finish.

3. Chamfer Strips

Chamfer strips not less than 3/4 inch in size shall be used at external corners of columns, girders, beams or their juncture with masonry, foundation walls projecting beyond overlying masonry, and other external corners that will be exposed.

4. Removal of Forms

Forms shall be removed in a manner to insure complete safety of the structure after the following conditions have been met. Forms for walls, beam and girder sides, pedestals and simiisr vertical structural members may be removed after 24 hours, provided the concrete is sufficiently hard not to be injured thereby. Supporting forms or shoring shall not be

7.09 FORMWORK (Cont'd)

4. Removal of Forms (Cont'd)

removed until structural members have acquired sufficient strength to support safely their own weight and 3nv construction and/or storage load tc which they may be subjected, but in no case shall they be removed in iess than 7 days, nor shall forms used €or curing be removed before expiration of curing period.

7.10 **JOISTS**

A. Joints in Interior Slabs

1. Expansion Joints

Unless otherwise indicated, expansion joints between adjacent slabs and between slabs on grade that abut against vertical surfaces shall have pre-molded expansion joint filler strips, as specified, installed the full depth of the slab, except that where joint sealer is indicated the strip shall be installed at the proper level below the finished floor with a slightly tapered, dressed-and-oiled wood strip temporarily secured to the top thereof to form a groove not less than 3/4 inch deep. Edges of joints shall be finished slightly rounded or cleaned and filled with sealer as applicable.

2. Control Joints

Concrete shall be placed continuously so that each unit of operation will be monolithic in construction, and shall be compacted, screeded to grade and prepared for the indicated or specified finish. Concrete shall be placed so that control joints shall match joints in existing slabs. Control joints shall be expansion, contraction or construction joints. Joints not indicated on drawings shall be located at column center lines and at intermediate intervals so that each panel shall be not mote than 600 square feet in area. Panels shall be approximately square with dimension on one side of not more than 25 feet. Forms shall remain in place for at least 12 hours. Contraction joints may be formed by the insertion of hard-pressed fiberboard strips inserted into the plastic concrete or may be cut with an approved concrete sawing machine after the concrete has set, but no later than 24 hours after the concrete has been placed.

7.11 REINFORCEMENT

A. Reinforcement shall be placed in the position indicated on the drawings, securely fastened and supported to prevent displacement before and after placement of concrete Cleaning, bending and placing of reinforcemenr shall be done in accordance with the requirements of ACI 318.

B. Welded wire mesh for interior floor slabs shall be furnished in precut flat sheets. Concrete shall be place2 in three operations. The initial layer shall be uniformly struck off at a depth three inches above the top of the vapor barrier, and the mesh placed thereon. The second laver shall be uniformly struck off at a depth not less than 2 inches nor more than 3 inches below the proposed surface of the slab, and the mesh placed thereon. As each level of reinforcing the concrete shall be struck off to the entire width of the pour and a sufficient length to permit the sheets to be laid full length on the concrete in its final position without further manipulation of the reinforcement. The balance of the concrete shall be placed on the top layer of mesh. Displacement of the reinforcement during concrete operations shall be prevented.

7.12 CONVEYING

Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of the materials. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end and without separation of materials.

7.13 PLACING AND FINISHING CONCRETE

A. Building Concrete

1. General

Placing of concrete shall be done in accordance with the requirements of ACI 614. Concrete shall not be allowed to drop freely more than 5 feet in unexposed work nor more than 3 feet in exposed work; where greater drops are required, a tremie or other approved means shall be employed. Concrete shall be placed in the forms, as nearly as practicable in the final position, in uniform approximately horizontal layers not over 12 inches deep.

7.13 PLACING AND FINISHING CONCRETE (Cont'd)

2. Placing Concrete Through Reinforcement

Where congestion of the steel or other conditions will make placing or conpaction of concrete difficult, a layer of mortar shall be first deposited in the forms to a depth of approximately 1 inch. Mortar shall consist of equal parts of Portland Cement and fine aggregate by weight and not more than 6 gallons of water per sack of cement.

3. Compaction

Immediately after placing, each layer of structural concrete shall be compacted by internal concrete vibrators supplemented by hand-spading, rodding, and tamping. Air-entrained concrete shall not be vibrated for over 12 seconds. Tapping or other external vibrations of form will not be permitted. Vibrators shall not be used to transport concrete inside forms. Internal vibrators submerged in concrete shall maintain a speed of not less than 7,000 impulses per minute. The vibrating equipment shall at all times be adequate in number of units and power to properly consolidate all concrete. Spare units shall be on hand as necessary to insure such adequacy. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing objectionable segregation. The vibrator shall not be inserted into lower courses that have begun to set. Vibrators shall be applied at uniformly spaced points not farther apart than the visible effectiveness of the machine.

4. Surface Finishing Other Than Slabs

All exposed surfaces of equipment foundation, etc., shall be finished within 12 hours after forms are removed, and surface defects shall be corrected. Fins and loose material shall be removed. Honeycomb, aggregate pockets, voids over 1/2 inch in diameter, and holes left by the rods and bolts shall be cut out to solid concrete, thoroughly wetted, brush coated with neat cement grout, and filled with mortar.

5. Concrete Floor Slab Finishes

a. Monolithic Finish

Except where otherwise indicated, the concrete for floor slabs shall be screeded and floated

7.13 PLACING AND FINISHING CONCRETE (Cont'd)

a. Monolithic Finish

with straightedge to bring the surface to the required finish level with no coarse aggregate visible. The concrete, while still green but sufficiently hardened to bear a man's weight without deep imprint, shall be wood-floated to a true, even plane with no coarse aggregate visible. Sufficient pressure shall be used on the wood-floats to bring moisture to the surface. After the surface moisture has disappeared, surfaces shall be steel-troweled to a smooth, even, dense finish, free from trowel marks.

b. Wood Float Finish

Surfaces of interior or exterior foundations or slabs receiving equipment of machinery, and ramps, unless otherwise indicated, shall be screeded with straightedges to bring the surface to the required finish plane with no coarse aggregate showing. After surface moisture has disappeared the surfaces shall be finished to an even textured surface with a wood float.

c. Hardener

Where indicated on the drawings to receive hardener, floor slabs shall be treated with a liquid hardener applied in strict accordance with the manufacturer's directions. The floor surfaces shall be thoroughly cleaned and prepared as required to receive the hardener material. The material shall be mixed and applied strictly in accordance with the manufacturer's directions at the rate of one (1) gallon per 100 square feet per application, The floor shall be given three (3) applications minimum at the rate specified herein. The succeeding applications shall be applied as soon as the preceding application is thoroughly dry.

d. Surface Tolerances

Floor slab surfaces shall be true plane surfaces with no deviation in excessof one-eighth inch when tested with a 10 foot straightedge.

7.13 PLACING AND FINISHING COSCRETE (Cont'd)

6. Embedded Items

All embedded and anchorage items including anchor bolts, dowels, sleeves? slots, inserts, ties, hangers etc., shall be installed in sufficient number and sire as indicated or required to insure anchorage or use sufficient for the purpose intended. Coordinate with work under other sections of the specifications to insure that items not furnished under this specification have been provided prior to placing concrete. All anchor bolt threads shall be protected with a coat of grease before placing concrete, after which they shall be cleaned, regreased and wrapped in burlap Notch out for all slots, chases, recesses or openings indicated on the drawings or as required,

7.14 RECORDS OF EMBEDDED ITEMS

No concrete shall be placed to conceal ernbedded conduit, duct, piping, etc., until the Subcontractor has received approval from the Contractor following inspection and location of such items. The verification and recording of location of these items will be the responsibility of the Contractor.

7.15 CURING

A. Building Concrete

1. General

Immediately after placing or finishing, concrete surfaces not covered by forms shall be protected against moisture loss for not less than 7 days after placing. Curing shall be accomplished by one of the following methods or combination thereof, as approved.

2. Moist Curing

Unformed surfaces shall be covered with burlap, cotton, 'other approved fabric mats or sand, kept in intimate contact with the surface, and shall be kept continually wet. If the forms are removed before the end of the curing period, curing shall be continued as on unformed surfaces, using suitable materials.

7.15 CURING (Cont'd)

3. Waterproof-Paper Curing

Surfaces shall be covered with waterproof paper lapped 4 inches at edges and ends, and sealed with mastic or pressure-sensitive tape not less than 1-1/2 inches wide. Paper shall be weighted to prevent displacement, and tears or holes shall be patched.

4. Membrane-Forming Curing Compound

When permitted, membrane-forming compound shall be applied in a two-coat continuous operation using not less than 1 gallon for 200 square feet of surface for each coat, in accordance with manufacturer's directions. Membrane-forming compound shall not be used on surfaces that are to receive any subsequent treatment that depends upon adhesion or bonding to the concrete.

7.16 PLATFORM FILLS

Fills under lockers shall be of concrete not less than 2500 psi compressive strength at 23 days.

7.17 EQUIPMENT FOUNDATIONS AND GROUTING OF BASES, BEARING PLATES, AND FLOOR PLATES

A. General

Loose and attached column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates and floor plates shall be set with damp-pack bedding mortar. The space between the top of concrete or masonry bearing surfaces and the bottom of the base plate shall be approximately 1/24 of the width of the base or bearing plate, but not less than 1/2 inch for plates less than 12 inches wide. Plates shall be set and anchored to the proper line and elevation. Metal wedges, shims, and/or setting nuts shall be used for leveling and plumbing the structural members, including plumbing of columns. Concrete surfaces shall be rough, clean, free of oil, grease, and laitance, and shall be damp. Metal surfaces shall be clean and free of oil, grease and rust. Metal wedges or shims shall be removed after bedding mortar has set and cavities filled with bedding mortar. Where setting nuts are used, non-shrink or expansive grout must be used, and shall have a minimum compressive strength of not less than 8000 psi at 28 days.

7.17 EQUIPMENT FOUNDATIONS AND GROUTING OF BASES, BEARING PLATES, AND FLOOR PLATES (CONT'D)

B. Damp-Pack Bedding Mortar

Damp-pack bedding mortar shall consist of 1 part Type I Portland cement 3nd 2 to 2½ parts of fine aggregate conforming to ASTM C 33, proportioned by weight, and nor more than 4½ gallons of water per bag of cement.

7.13 SAMPLES AND TESTING

A. Samples

1. During the progress of the work, three compression test cylinders and four flexural test beams shall be taken from the concrete 3s mixed 3nd at the direction of the Contractor for each day's pour of concrete. If more than SO cu.yds. is placed in a day three additional cylinders and 4 flexural test beams shall be made for each 50 cubic yards plus any fraction thereof. One cylinder and two test beams shall be tested at 7 days and two cylinders and two test beams at 28 days.

2. The Contractor shall furnish the molds for taking concrete test specimens and shall furnish the labor and facilities required to take the test specimens and the nandling and storing of same at the site.

3. Test specimens shall be made and cured in accordance with ASTM C 31.

B. Testing

1. General

Testing will be accomplished by the Contractor.

2. Slump Tests

A minimum of one test shall be made for each class of concrete used in a day, or if more than 50 cubic yards is placed in a day, one test shall be made for each 50 yards plus any fraction over 50 yards. Additional tests shall be made when visual inspection indicates that the consistency of the concrete being placed may exceed the limt for slump as specified. Excess slump will be cause for rejection of concrete. Slump will be determined in accordance with "Method of Slump Test for Consistency of Portland Cement Concrete", ASTM C 143, or "Method of Test for Ball

7.18 SAMPLES AND TESTISG (Cont'd)

2. Slump Tests (Cont'd)

Penetration in Fresh Portland Cement Concrete", ASTM C 360. When the penetration method is used for field control, specified slumps shall be converted to equivalent penetrations by factors established in advance.

3. Cylinder Compression Testing

Compression testing of cylinders will be in accordance with ASTM C 39.

4. Flexural Testing

Flexural test beams shall be tested in accordance with ASTM C 78.

5. Unsatisfactory Test Results

Where there is any question as to the quality of the concrete because of strength of test specimens falling below specified values for 28 day strength, the Contractor *may* order removal of the concrete in question, at the Subcontractor's expense, or may approve alternate strength tests at the Subcontractor expense. These may be either compression tests made with specimens secured from the structure in accordance with ASTM C 42, or actual load tests of the structure made in accordance with ACI 313. The Contractor may also approve additional controlled curing of the concrete in question, not to exceed 21 days, before making either of the alternate tests. The basis for acceptance or rejections of the concrete in question as determined by these alternate tests shall be agreed upon by the Contractor and the Subcontractor before making the *tests.* All additional tests shall be at the expense of the Subcontractor.

6. A log of all concrete pcurc shall be carefully kept by the Subcontractor. In general, the log shall contain the following data: Identifying number of pour; date made; weather and temperature at start of pour; weather and temperature at finish of pour; location or locations of pour; number of cubic yards in pour; slump record; identifying number of cylinders and flexural test beams; test results at seven (7) days; test results at twenty-eight (28) days; and

7.18 SAMPLES AND TESTING (Cont'd)

6. (Cont'd)

such other pertinent information as may be directed by the Contractor. Log sheets shall be made available to the Contractor at the close of work each working day and shall be turned over to the Contractor at the completion of the project.

Date: October 10, 1986
Revision No. 1

Table 0-9

HAZARDOUS WASTES TREATED AT C-409

Waste Name	EPA Waste Number
Cleaning Tank Acids and Bases	0002, 0007, 0008
Photographic Solutions	D011
Nickel Stripper Sludge Residue	0002, 0006, 0007 D008
Miscellaneous Discarded Laboratory Chemicals	**
Waste Oil and Halogenated Solvents	F001
TEHP/Hexane Solutions	D001
Scintillation (Xylene/ Carbitol) Solution	F003, D001
Cascade Vacuum Dust	D007
Discarded Batteries Containing Lead, Mercury or Cadmium	D008, D009, 0006
Mixtures (Solids and/or Liquids) Containing Cyanide	0007, D011, P098 P121, P106, P104
Spent Trichloroethylene/ 1,1,1-Trichloroethane	F001
Mineral Spirits and Paint Waste	D001

Table D-9 (continued)

HAZARDOUS WASTES TREATED AT C-409

Waste Name	EPA Waste Number	
Uranium Salvage	D002, D007, D008	Acidic HNO3, H2SO4
~~Discarded Selenium Rectifiers~~	D010	
Fluorine Cell Electrolyte	D002	HF
Waste Oil Contaminated with Uranium and Halogenated Solvents	F001	
Nickel Stripper Solution	D001, D006, D007 D008	Caustic, Ammonia
Waste Oil Contaminated with Halogenated Solvents, Uranium, and PCBs	F001	
Miscellaneous Acids & Bases	0002	
Miscellaneous Flammable Liquids	D001	
Waste Mercury	0009	
Miscellaneous Aqueous Solutions Containing Toxic Metals	D002, D006, D007 D008	

46-413 TNEME-TAR

COAL TAR-EPOXY COATING

TNEMEC Company, Inc. 9p PAINTING MATERIALS

COATING PROFILE

DESCRIPTION	Chemical and corrosion-resistant coating with high film build, high bond strength, good abrasion resistance, and low vapor and moisture transmission.
TYPICAL USE	Coating steel and concrete in highly corrosive environments, or for underground or immersion service.
PRIMER	STEEL: Self-priming or 37-77 Chem-Prime. Do not use 37-77 Chem-Prime as a field primer under 46-413 Tneme-Tar. (See Surface Preparation instructions below.) CONCRETE: Self-priming
SURFACE PREPARATION	Prepare surfaces by method suitable for exposure and service. STEEL: Immersion Service—Near-White Blast Cleaning (SSPC-SP10) or Pickling (SSPC-SP8) Non-immersion Service—Commercial Blast Cleaning (SSPC-SP6) SHOP-APPLIED 37-77 CHEM-PRIME: Allow 37-77 Chem-Prime to cure 30 days before top-coating with 46-413 Tneme-Tar. Clean damaged areas by method suitable for exposure and service. DO NOT field-prime with 37-77 Chem-Prime. Apply 46-413 Tneme-Tar directly to cleaned steel. CONCRETE: Immersion Service—Brush-off blast. ALL SURFACES must be dry and clean.
COLOR	Black
FINISH	Semigloss
SOLIDS BY VOLUME	71.0% ± 1.0% (Mixed)
THEORETICAL COVERAGE	1,138 mil sq. ft. per gallon
DRY FILM THICKNESS	8.0 to 10.0 mils per coat
CURING TIME—AT 75 F.	To touch: 7 hours Minimum recoat: 4 hours Maximum recoat: 96 hours Immersion Service: 7 days Recoating 37-77 Chem-Prime: 30 days minimum
TEMPERATURE RESISTANCE	(Dry) Continuous 200 F. Intermittent 250 F.
MIXING RATIO	By volume—One (Part A) to One (Part B)

CHEMICAL RESISTANCE

IMMERSION	FREQUENT CONTACT	OCCASIONAL CONTACT
Aliphatic Hydrocarbons	Alkali Solutions	Organic Acids
Aromatic Hydrocarbons*	Alcohols	Mineral Acids
Salt Solutions	Ketones	Oxidizing Agents
Fresh Water	Vegetable Oils	
Waste Water		
Waste Water	See Chemical Resistance Chart.	
Mineral Oils	See Chemical Resistance Chart.	

*Discolors

SHIPPING & STORAGE

NUMBER OF COMPONENTS	Two—Part A and Part B
PACKAGED IN	5 gallon pails and 1 gallon cans—All sizes must be ordered in multiples of 2.
NET WEIGHT PER GALLON	Mixed: 10.4 ± 0.2 lbs.
STORAGE TEMPERATURE	Minimum 20 F. Maximum 110 F.
SHELF LIFE	12 months at recommended storage temperature
FLASH POINT—SETA	Part A and Part B: 81 F.

46-413 TNEME-TAR

APPLICATION INFORMATION

MIXING - Stir contents of each container, making sure no pigment remains on the bottom. Pour a measured amount of Part B into a clean container large enough to hold both components. Add an equal volume of Part A to Part B while under agitation. Continue agitation until the two components are thoroughly mixed. Do not use mixed material beyond pot life limits.

SPREADING RATE

	Dry Mils	Wet Mils.	Sq.Ft./Gal.
Suggested	9.0	13.0	126
Minimum	8.0	11.0	142
Maximum	10.0	14.0	114

Allow for overspray and surface irregularities. Film thickness is based on closest 0.5 mil. Application of coating below minimum or above maximum dry mil thickness recom-

THINNING Do not thin unless lower viscosity is necessary for proper application. Up to 10% No. 4 Thinner may be added,

POT LIFE: 8 hours at 60 F. 4 hours at 77 F. 3 hours at 100 F.

SURFACE TEMPERATURE - Minimum 60 F. Maximum 120 F. The surface should be dry and at least 5 F. above the dew point. Coating will not cure below minimum surface temperature.

APPLICATION EQUIPMENT - Air, airless spray or roller. Small areas may be brushed.

Air Spray Suggested equipment, or equal:

Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressure
DeVilbiss MBC or JGA	E	78	5/16" or 3/8"	1/2"*	75—100 psi	20—40 psi

*(Thiokol Solvent Resistant Type) Low temperatures or longer hoses require higher pot pressure.

Airless Spr

Tip Orifice	Atomizing Pressure	Mat'l Hose ID	Manifold Filter
0.017" to 0.021"	2400—3000 psi	3/8"	60 mesh

Use appropriate tip and atomizing pressure for equipment, applicator technique and weather conditions.

Roller Use roller cover with firm "carpet" nap. Keep roller cover saturated with material to get the required film thickness. Do not use the long nap (lamb's wool) cover.

Brush Brushing is recommended on small areas only. "Ladle" material on and then use flat side of brush to spread. Do not brush out to thin film as with conventional coatings.

Note Application over Zinc Rich Primers: Apply a wet mist coat and allow tiny bubbles to form. When bubbles disappear in 1 to 2 minutes, apply a full wet coat at specified mil thickness

CLEAN UP INSTRUCTIONS [illegible] with No. 4 Thinner. Flush and clean spray equipment before material sets up.

46-413 TNEME-TAR

SAFETY DATA

SAFETY INFORMATION

PART A CONTAINS XYLOL AND POLYAMIDE RESIN
WARNING! FLAMMABLE, VAPOR HARMFUL, MAY CAUSE IRRITATION.

Keep away If& heat, spacks and open flame. Use only with adequate ventilation breathing of vapor or spray mist. Avoid contact with eyes and skin. FOR USE IN FINED AREAS: Workmen must wear fresh airline respirators to avoid breathing co trated vapors. Circulate adequate fresh air continuously during application. Hypersen perms should wear gloves or use protective cream. All lights and electrical equip should be explosion-proof. Workmen should be required to use non-ferrous tools and conductive and non-sparking shoes in areas where explosion hazards exist. Keep clos tight and upright to prevent leakage. Keep container closed when not in use. In ca spillage, collect and dispose of in accordance with local applicable regulations event welding or flamecutting is performed on metal coated with this product, do s accordance with instructions in USA Standard Z49.1, "Safety in Welding and Cutting welded, burned or otherwise damaged areas should be prepared again to base meta recoated as specified. FIRST AID: In case of skin contact, flush with plenty of water eyes, flush with plenty of water for 15 minutes and get medical attention If affecte inhalation of vapor, remove to fresh air.

PART B CONTAINS EPOXY RESIN AND XYLOL
WARNING! FLAMMABLE, VAPOR HARMFUL, MAY CAUSE SKIN SENSITIZATION OTHER ALLERGIC RESPONSES

Avoid contact with eyes and skin. Keep away from heat and open flame. Use only with a quate ventilation. Avoid breathing of vapor or spray mist. FOR USE IN CONFINED AREA Workmen must wear fresh airline respirators to avoid breathing concentrated vapors culate adequate freshair continuously during application. Hypersensitive persons sho wear gloves or use protective cream. All lights and electrical equipment should explosion-proof. Workmen should be required to use non-ferrous tools and wear c ducttve and non-sparking shoes in areas where explosion hazards exist. Keep closu tight and upright to prevent leakage. Keep container closed when not in use In case spillage. collect and dispose of in accordance with local applicable regulations in event welding or flame cutting is performed on metal coated with this product do so accordance with instructions in USA Standard Z49.1, "Safety in Welding and Cutting welded, burned or otherwise damaged areas should be prepared agarn to base metal an recoated as specified. FIRST AID: In case of skin contact, flush with plenty of water eyes, flush with plenty of water for 15 minutes and get medical attention If affected b inhalation of vapor, remove to fresh air.

PART A & B (MIXED) Mixed materials m y have hazards of both components.

WARRANTY The technical data contained herein is accurate To the best of our knowledge. Tneme Company, Inc. warrants that coatings represented herein meet their formulation stand ards. No other warranty is expressed or implied, including warranties of merchantabilit and fitness for a particular purpose. Published technical data and instructions are subject to change without notice. Contact your Tnemec Representative for current technical data and instructions.

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permit application and has not yet filed Part B, the owner or operator shall file an amended Part A application:

(i) With the Regional Administrator, if the facility is located in a State which has not obtained interim authorization for phase II or final authorization, within six months after the promulgation of revised regulations under Part 261 listing or identifying additional hazardous wastes, if the facility is treating, storing, or disposing of any of those newly listed or identified wastes.

(ii) With the State Director, if the facility is located in a State which has obtained Phase II interim authorization or final authorization, no later than the effective date of regulatory provisions listing or designating wastes as hazardous in that State in addition to those listed or designated under the previously approved State program, if the facility is treating, storing, or disposing of any of those newly listed or designated wastes; or

(iii) As necessary to comply with provisions of § 270.72 for changes during interim status or with the analogous provisions of a State program approved for final authorization or interim authorization for Phase II. Revised Part A applications necessary to comply with the provisions of § 270.72 shall be filed with the Regional Administrator if the State in which the facility in question is located does not have Phase II interim authorization or final authorization; otherwise it shall be filed with the State Director (if the State has an analogous provision).

(2) The owner or operator of a facility who fails to comply with the updating requirements of paragraph (g)(1) of this section does not receive interim status as to the wastes not covered by duly filed Part A applications.

(h) *Reapplications.* Any HWM facility with an effective permit shall submit a new application at least 180 days before the expiration date of the effective permit, unless permission for a later date has been granted by the Director. (The Director shall not grant permission for applications to be submitted later than the expiration date of the existing permit.)

(i) *Recordkeeping.* Applicants shall keep records of all data used to complete permit applications and any supplemental information submitted under §§ 270.10(d), 270.13, 270.14 through 270.21 for a period of at least 3 years from the date the application is signed.

(j) *Exposure information.* (1) After August 8, 1985, any Part B permit application submitted by an owner or operator of a facility that stores, treats, or dispose of hazardous waste in a surface impoundment or a landfill must be accompanied by information, reasonably ascertainable by the owner or operator, on the potential for the public to be exposed to hazardous wastes or hazardous constituents through releases related to the unit. At a minimum, such information must address:

(i) Reasonably foreseeable potential releases from both normal operations and accidents at the unit, including releases associated with transportation to or from the unit;

(ii) The potential pathways of human exposure to hazardous wastes or constituents resulting from the releases described under paragraph (j)(1)(i) of this section; and

(iii) The potential magnitude and nature of the human exposure resulting from such releases.

(2) By August 8, 1985, owners and operators of a landfill or a surface impoundment who have already submitted a Part B application must submit the exposure information required in paragraph (j)(1) of this section.

(Approved by the Office of Management and Budget under control number 2050-0007)

[48 FR 14228, Apr. 1, 1983; 48 FR 30114, June 30, 1983, as amended at 50 FR 28751, July 15, 1985; 51 FR 10176, Mar. 24, 1986]

EFFECTIVE DATE NOTE: At 51 FR 10176, Mar. 24, 1986, § 270.10 was amended by adding paragraph (e)(1)(iii), effective September 22, 1986.

§ 270.11 Signatories to permit applications and reports.

(a) *Applications.* All permit applications shall be signed as follows:

(1) *For a corporation.* By a responsible corporate officer. For the purpose

APPENDIX

EXHIBIT NUMBER	DESCRIPTION	PAGE
A	KENTUCKY WASTE MANAGEMENT RULES	13
B	FEDERAL HAZARDOUS VASTE REGULATIONS	14
C	C-400-D LIME PRECIPITATION TANK INFORHATION	15
D	C-400-C NICKEL STRIPPER EVAPORATION TANK INFORMATION	16
E	C-733 SUMP INFORMATION	17
F	C-409 SUMP INFORMATION	18

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5	EXISTING CONDITIONS	6
6	PROFESSIONAL ENGINEERS CERTIFICATION	11

1. INTRODUCTION

Lockwood Greene Engineers was requested to assess the condition of four tanks at the Paducah, Kentucky, Gaseous Diffusion Plant. The four tanks are:

C-400-D	Lime Precipitation Tank
C-400-C	Nickel Stripper Evaporation Tank
c-733	Sump
C-409	Sump

The condition of each of the above is to be compared to the criteria established in Kentucky and Federal Regulations. Copies of the regulations are shown in Exhibits A and B of the Appendix.

2. ASSESSMENT

Federal Regulations 40 CFR 264.191 (b)1-5 and 40 CFR 264.17, discussed Chapters 3 and 4 of this document, outline the criteria for preparing a tank assessment. Chapter 5 provides the present status of the tanks in relation to the criteria. In chart form belov is a summary of the status of the tanks.

Criteria	C-400-D Lime Precipitation Tank	C-400-C Nickel Evaporation Tank	c-733 Sump	C-409 Sump
1	Appendix Exhibit C	Appendix Exhibit D	N.A.	Appendix Exhibit F
2	Appendix Exhibit C	Appendix Exhibit D	Appendix Exhibit E	Appendix Exhibit F
3	See Note 1	See Note 2	See Note 3	See Note 4
4	12 Years	1.0+ years	2.0+ years	15+ Years
5	See Note 5	Appendix Exhibit D	Appendix Exhibit E	Appendix Exhibit F

Notes:

(1) C-400-D Lime Precipitation Tank: The tank is constructed of stainless steel and has been in use in excess of 12 years. The metal thickness test contained in Exhibit C of the Appendix indicates a present wall and dish head metal thickness in excess of the original design thickness. The corrosive nature of the materials being treated have not deteriorated the tank over a 12 year period and should not cause significant deterioration in the future.

(2) C-400-C Nickel Stripper Evaporation Tank: The tank is constructed of 347 stainless steel and is used to receive spent stripping solution. This means that the spent solution. is high in nickel and does not have the capability to take into solution additional nickel. At worse case, the solution could strip nickel from the tank inner surface only. minor pitting could occur vhich vould not significantly effect the tank's life.*

*Per Mr. Peter Valantiejus of McDermid Incorporated

(3) C-733 Sump: The materials being stored in the 733 Building in small containers and in bulk storage are considered to hazardous but are not reactive vith each other. They are also not reactive vith concrete, therefore the concrete sump will not be damaged by the various materials.

(4) C-409 Sump: The sump is coated with a "Tnemec" cold tar epoxy. A data sheet on this epoxy is contained in Exhibit F of the Appendix. The materials being stored in this area are not reactive with the epoxy on a short term basis. Haterials are processed within 24 hours after placement in the sump.

(5) Lime Precipitation Tank: Prior to acceptance of the tank from the fabricator, the fabricator certified to Hartin Marietta Energy Systems that an atmospheric hydrostatic test had been performed and that the tank was sound with no leaks. This certification is on file vith Martin Marietta Energy Systems. The tank has been used on a day-to-day basis for 12 years in the treatment of the wastes listed in Exhibit C of the Appendix. The tank is operated full and no leakage has been observed during operations.

Based on the above data and the data contained in this document, the four vessels being examined meet the criteria outlined in the pertinent sections of the Code of Federal Regulations.

3. DISCUSSION OF REGULATIONS

The storage of hazardous materials is carefully regulated in the Code of Federal Regulations and in the hazardous regulations for the State of Kentucky.

Kentucky Waste Management Rules 401 KAR 34:190. Tanks and Federal Regulation 40 CFR 264.191 (b)1-5 define the conditions required to inspect and assess the condition of existing primary containment of hazardous wastes. Federal Regulation 40 CFR 264.17 and Kentucky Waste Management Rules 401 KAR 34:180 define the conditions required to inspect and assess the condition of existing secondary containment of hazardous vastes.

The regulations establish the criteria by which a Professional Engineer can evaluate the existing primary containment and either approve the containment or recommend the proper remedial work necessary to bring the vessel into compliance. The folloving items must be addressed for each primary containment vessel.

1. Provide the design standards by vhich the tank and attached equipment were designed (If available).
2. The characteristics of the waste(s) being stored.
3. Existing corrosion protection methods.
4. Documented age of the system if available.
5. Results of a leak test, internal inspection or other tank integrity examination.

A copy of each of the State and Federal Regulations are included in the Appendix in Exhibits A and B.

4. CONTAINMENT CONSIDERATIONS

The vessel which provides primary or secondary containment of hazardous wastes must be designed to meet the folloving criteria.

A. The vessel must be designed to resist the stresses produced by the hydrostatic load imposed by the liquid being stored.

B. The materials of construction must be selected to resist the corrosive effect of the hazardous waste being stored.

C. The vessel piping must be such that noncompatible chemicals can under no circumstances enter the tank to produce undesirable violent reactions or accelerated deterioration of the vessel walls, bottom or top.

D. The vessel must be sized to contain the volume of the largest single vessel or 10 percent of the total stored volume plus an allowance for precipitation plus freeboard.

5. EXISTING CONDITIONS

The existing tank drawings and general information are contained in the folloving Exhibits of the Appendix:

C	C-400-D	Lime Precipitation Tank
D	C-400-C	Nickel Stripper Evaporation Tank
E	C-733	Sump
F	C-409	Sump

C-400-D Lime Precipitation Tank

The lime precipitation tank has the following characteristics:

A. Volume is 3,000 Gallons.

B. Tank is cylindrical with 10.0 foot diameter, 6 foot-8 inch straight sides with a dished bottom and internal baffles. Original design sidt thickness was 1/4 inch and dished bottom was 3/8 inch. Recent measurement of the wall thickness was 0.271 inch to 0.282 inch and tank head thickness vas 0.468 inch.

C. Material of construction is stainless steel.

D. The tank is equipped with a mixer.

E. The tank is approximately 12 years old.

The tank is used in a batch type treatment operation. Chemicals from the list contained in Exhibit C of the Appendix are treated prior to disposal. The liquid is poured into the tank, lime is added and then mixed to maintain optimum contact and treatment. After a predetermined mixing time, which is dependent upon wastevater characteristics, the mix is pumped to a dewatering system.

The tank was tested after manufacturing and before placing into operation. In February 1985, tests were performed to determine the condition of the tank. Test data shoved that the tank walls and bottom had not deteriorated during the ten years of use. The tank is observed each operating day and no evidence of leaking has been observed. A copy of the test data is included in Exhibit C of the Appendix.

C-400-C Nickel Stripper Evaporation Tank

The nickel stripper tank contains a solution of three part nickel stripper solution composed of MacDermid Hetex Nickel Stripper SCB-A, Hetex nickel stripper SCB-B and water. The solution has a pH between 12.0 and 12.5. The liquid solution is maintained at a temperature of approximately 130°F for optimum stripping. The tank has the following characteristics:

A. The tank is constructed of 5/16 inch thick, *347* stainless steel and is of all welded construction. The tank contains electric heaters to maintain the required temperature.

B. The tank is approximately *4* feet-1/2 inch by 2 feet-1/2 inch by 2 feet-3/4 inch vith a vorking volume of approximately 115 gallons.

C. The tank is approximately one year old.

The tank is contained in an enclosure which is power vented vith the exhaust air being filtered prior to entering the atmosphere. The stripper solution after being exhausted and containing nickel is transferred to the evaporation tank. The liquid temperature is raised to the boiling point and excess water is evaporated. The residue in the tank is placed in suitable containers and shipped to a storage area.

The tank was fabricated on site and tested for atmospheric hydraulic integrity prior to use. A copy of the test procedure and results are contained in Exhibit D of the Appendix.

The nickel stripper manufacturer's data recommends that the solution be used in a steel tank vith the liquid pH maintained between 12 and 12.5 to prevent any attack on steel. The stainless steel tank has a much greater resistance to chemical corrosion and thus is satisfactory for the service intended.

The process information was obtained from Mr. Valter Vinnery of Martin Marietta Energy Systems, Inc., Paducah, Kentucky.

C-733 Sump

This sump is located in the C-733 storage shelter. Exhibit E of the Appendix contains a list of the materials stored in tanks or in small containers on the slab adjacent to the sump.

The sump has the folloving characteristics:

A. The sump is 5 feet-0 inches wide by 16 feet-0 inches long by 6 feet-0 inches deep and can contain approximately 3,590 gallons of liquid.

B. The sump has 10 inch reinforced concrete walls and a 12 inch reinforced concrete bottom. The concrete surface of the sump is not coated. Tventy-four ounce copper water stops vere used in the construction joints of the sump.'

The sump vas placed in operation in 1984. The sump vas hydraulically tested after completion. The test was witnessed by Mr. Robert L. Langston of Martin Marietta Energy Systems, Inc., Paducah, Kentucky. A copy of the test certification is included in Exhibit E of the Appendix.

The sump volume must contain the volume of the largest vessel or 10 percent of the total volume contained. The largest vessel is estimated to be 3,000 gallons. The total volume to be stored including small drum storage is estimated to be 34,000 gallons. Ten percent vould be 3,400 gallons vhich is less than the size of the sump.

The sump is not a part of the treatment system and is normally empty. Only after a spill event does the sump function. The liquid contained is tested and then pumped to containers for treatment or disposal. The sump is then cleaned in preparation for the next spill event.

C-409 SUMP

The "L" shaped sump is in a recessed area vhere materials are stored. The floor is sloped tovard the sump. All treatment equipment is above the recessed area and any spilled liquid will be captured and directed to the sump.

The sump has the folloving characteristics:

A. The volume of the sump is approximately 3,500 gallons.

B. The sump is constructed of 10 inch concrete walls and a minimum of 10 inch concrete bottom slab. The joints contain "Dumbbell" typ waterstops.

C. Mr. Langston reported that the contractor had coated the sump vith a "coal tar epoxy". "Tneme-Tar 46-413" was the coating used. A data sheet for this material is contained in Exhibit F of the Appendix. The 'liquids stored and treated in this area are shovn in Exhibit F of the Appendix.

The sump is not a part of the treatment system and is normally empty. Only after a spill event does the sump function. The liquid contained is tested and pumped to containers for treatment or disposal. The sump is then cleaned in preparation for the next spill event.

6, PROFESSIONAL ENGINEERS CERTIFICATION

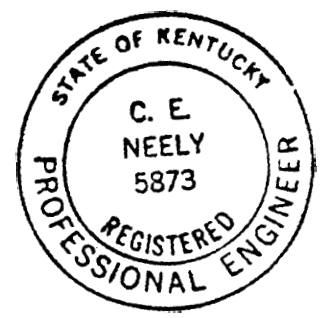
The assessment of the four tanks outlined in this report vas accompli with the help of the following:

Martin Marietta Energy Systems Inc.	Al Moore Bob Langston Valter Winnery
Lockwood Greene Engineers, Inc.	Dick Pearson Alan McClanahan

The data obtained from the above vas reviewed and the conclusions reached have been presented in the preceding chapters of this document, Based on the information received:

I certify under penalty of law that this document and all attachments ver. prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons vho manage the system, or those persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am avare that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knoving violations.

CHARLES E. NEELY, P.E.
KENTUCKY REGISTRATION NO. 5873



APPENDIX

APPENDIX

EXHIBIT **A**

KENTUCKY **WASTE HANAGEHENT RULES**

401 KAR 34:010 GENERAL PROVISIONS FOR FACILITIES

***401* KAR 34:190 TANKS**

401 **KAR 31:010 GENERAL PROVISIONS FOR HAZARDOUS WASTES**

***401* KAR 34:180 USE AND HANAGEHENT OF CONTAINERS**

(a) The designated facility listed on the manifest; or

(b) The alternate designated facility; or

(c) The next designated transporter; or

(d) The place outside the United States designated by the generator.

(9) If the hazardous waste cannot be delivered in accordance with subsection (8) of this section, the transporter must contact the generator for further directions and must revise the manifest and transport the waste according to the generator's lawful instructions.

Section 2. Recordkeeping. (1) A transporter of hazardous waste must keep a copy of the manifest signed by the generator, himself, and the next designated transporter or the owner/operator of the designated facility for a period of three (3) years from the date the hazardous waste was accepted by the initial transporter.

(2) For shipments delivered to the designated facility by rail or water (bulk shipment), each rail or water (bulk shipment) transporter must retain a copy of a shipping paper containing all the information required in Section 1(5)(b) of this regulation for a period of three (3) years from the date the hazardous waste was accepted by the initial transporter.

(3) For shipments of hazardous waste by rail within Kentucky:

(a) The initial rail transporter must keep a copy of the manifest and shipping paper with all the information required in Section 1(6)(b) of this regulation for a period of three (3) years from the date the hazardous waste was accepted by the initial transporter; and

(b) The final rail transporter must keep a copy of the signed manifest (or the shipping paper if signed by the designated facility in lieu of the manifest) for a period of three (3) years from the date the hazardous waste was accepted by the initial transporter.

(4) A transporter who transports hazardous waste out of the United States must keep a copy of the manifest indicating that the hazardous waste left the United States, for a period of three (3) years from the date the hazardous waste was accepted by the initial transporter.

(5) The periods of retention referred to in this section are extended automatically during the course of any unresolved enforcement action regarding the regulated activity or as requested by the EPA Administrator or the Secretary of the Natural Resources and Environmental Protection Cabinet.

401 KAR 33:030. Hazardous waste discharges during transportation.

Section 1. Appropriate Immediate Action. In the event of a discharge of hazardous waste during transportation, the transporter must take the appropriate immediate action to protect human health and the environment (e.g., notify local authorities, dike the discharge area).

Section 2. Removal of Hazardous Discharge. If a discharge of hazardous waste occurs during transportation and an official (state or local government or a federal agency) acting within the scope of his official responsibilities determines that immediate removal of the waste is necessary to protect human health or the environment, that official may authorize the removal of the waste by transporters who do not have EPA identification numbers and without the preparation of a manifest.

Section 3. Steps for Reporting Discharges. An air, rail, highway, or water transporter who has discharged hazardous waste must:

(1) Give notice if required by 49 CFR 171.15, to the National Response Center (800-424-8802 or 202-426-2675); and

(2) Report in writing as required by 49 CFR 171.16 to the Director, Office of Hazardous Materials Regulations, Materials Transportation Bureau, Department of Transportation, Washington, D.C. 20590.

(3) Report to the Kentucky Natural Resources and Environmental Protection Cabinet any incident or accident within two (2) hours of the time of occurrence which results in or could result in the discharge of hazardous waste; and provide the cabinet, if required, with a written report of the incident or accident within ten (10) days.

Section 4. Bulk Shipment Transporters. A water (bulk shipment) transporter who has discharged hazardous waste must give the same notice as required by 33 CFR 153.203 for oil and hazardous substances.

Section 5. Responsibility for Clean Up. A transporter must clean up any hazardous waste discharge that occurs during transportation or take such action as may be required or approved by Federal, State or local officials so that the hazardous waste discharge no longer presents a hazard to human health or the environment.

401 KAR 34:010. General provisions for facilities.

Section 1. Purpose, Scope and Applicability.

(1) The purpose of this chapter is to establish minimum standards which define the acceptable management of hazardous waste.

(2) The standards in this chapter apply to owners and operators of all hazardous waste sites or facilities which treat, store, or dispose of hazardous waste, except as specifically provided otherwise in this chapter or in 401 KAR Chapter 31.

(3) The requirements of this chapter apply to a person disposing of hazardous waste by means of ocean disposal subject to a permit issued under the Marine Protection, Research, and Sanctuaries Act only to the extent they are included in a permit by rule granted to such a person under 401 KAR Chapter 38.

(4) The requirements of this chapter apply to a person disposing of hazardous waste by means of underground injection subject to a permit issued under an Underground Injection Control (UIC) program approved or promulgated under the Safe Drinking Water Act only to the extent they are required by Section 5 of 401 KAR 38:060.

(5) The requirements of this chapter apply to the owner or operator of a POTW which treats, stores, or disposes of hazardous waste only to the extent they are included in a hazardous waste permit by rule granted to such a person under 401 KAR Chapter 38.

(6) The requirements of this chapter do not apply to:

(a) The owner or operator of a facility permitted by the cabinet to manage solid waste, if the only hazardous waste the facility treats, stores, or disposes of is excluded from regulation under Section 5 of 401 KAR 31:010.

(b) The owner or operator of a facility managing recyclable materials described in Section 6(1)(b) and (c) of 401 KAR 31:010 (except to the extent that requirements of this chapter are referred to in 401 KAR Chapter 36);

(c) A generator accumulating waste on-site in compliance with Section 5 of 401 KAR 32:030;

(d) A farmer disposing of waste pesticides from his own use in compliance with Section 2 of 401 KAR 32:050;

(e) The owner or operator of a totally enclosed treatment facility, as defined in 401 KAR 30:010;

(f) The owner or operator of an elementary neutralization unit or a wastewater treatment unit as defined in 401 KAR 30:010;

(g) 1. Except as provided in subparagraph 2 of this paragraph, a person engaged in treatment or containment activities during immediate response to any of the following situations:

a. A discharge of hazardous waste;

b. An imminent and substantial threat of a discharge of hazardous waste; or

c. A discharge of a material which, when discharged, becomes a hazardous waste.

2. An owner or operator of a facility otherwise regulated by this chapter must comply with all applicable requirements of 401 KAR 34:030 and 401 KAR 34:040.

3. Any person who is covered by subparagraph 1 of this paragraph and who continues or initiates hazardous waste treatment or containment activities after the immediate response is over is subject to all applicable requirements of this chapter and 401 KAR Chapter 38 for those activities.

(h) A transporter storing manifested shipments of hazardous waste in containers meeting the requirements of Section 1 of 401 KAR 34:030 at a transfer facility for a period of ten (10) days or less; or

(i) The addition of absorbent material to waste in a container or the addition of waste to absorbent material in a container, provided that these actions occur at the time waste is first placed in the container; and Section 2 fo 401 KAR 34:020, and Sections 2 and 3 of 401 KAR 34:180 are complied with.

Section 2. Relationship to Interim Status Standards. A facility owner or operator who has fully complied with the requirements for interim status, as defined in 401 KAR 30:010 and is regulated under 401 KAR 38:020, must comply with the regulations specified in 401 KAR Chapter 35 in lieu of this chapter until final administrative disposition of his permit application is made.

Section 3. Imminent Hazard Action. Notwithstanding any other provisions of these regulations, enforcement actions may be brought pursuant to KRS 224.071.

401 KAR 34:020. General facility standards.

Section 1. Applicability. (1) This chapter applies to owners and operators of all hazardous waste facilities, except as provided in 401 KAR 34:010, Section 1, and subsection (2) of this section.

(2) Section 9(2) of this regulation applies only to facilities subject to regulation under 401 KAR 34:180, 34:190, 34:200, 34:210, 34:220, 34:230 and 34:240 of this chapter.

Section 2. Identification Number. Every facility owner or operator must apply to the cabinet for an EPA identification number in accordance with the notification procedures.

Section 3. Required Notices. (1) The owner or operator of a facility that has arranged to receive hazardous waste from a foreign source must notify the director in writing at least four (4) weeks in advance of the date the waste is expected to arrive at the facility. Notice of subsequent shipments of the same waste from the same foreign source is not required.

(2) The owner or operator of a facility that receives hazardous waste from an off-site source (except where the owner or operator is also the generator) must inform the generator in writing that he has the appropriate permit(s) for, and will accept, the waste the generator is shipping. The owner or operator must keep a copy of this written notice as part of the operating record.

(3) Before transferring ownership or operation of a facility during its operating life, or of a disposal facility during the post-closure care period, the owner or operator must notify the new owner or operator in writing of the requirements of this chapter and 401 KAR Chapter 38.

Section 4. General Waste Analysis. (1)(a) Before an owner or operator treats, stores, or disposes of any hazardous waste, he must obtain a detailed chemical and physical analysis of a representative sample of the waste. At a minimum, this analysis must contain all the information which must be known to treat, store, or dispose of the waste in accordance with the requirements of this chapter or with the conditions of a permit issued under 401 KAR Chapter 38.

(b) The analysis may include data developed under 401 KAR chapter 31 and existing published or documented data on the hazardous waste or on waste generated from similar

(c) The analysis must be necessary to ensure that it is ac up to date. At a minimum, it must be repeated:

1. When the owner or operat fied, or has reason to believe, process or operation generating ardous waste has changed; and

2. For off-site facilities, when th of the inspection required in pa (d) of this subsection indicate t hazardous waste received at the does not match the waste design the accompanying manifest or sh paper.

(d) The owner or operator of an facility must inspect and, if nece analyze each hazardous waste movi received at the facility to deter whether it matches the identity o waste specified on the accompa manifest or shipping paper.

(2) The owner or operator must dev and follow a written waste ana sis which describes the procedures which will carry out to comply with subsect (1) of this section. He must keep a cop at the facility. At a minimum, the p must specify:

(a) The parameters for which each ha ardous waste will be analyzed and rationale for the selection of these para eters (i.e., how analysis for these param eters will provide sufficient informatio the waste's properties to comply with sub section (1) of this section);

(b) The test methods which will be used to test for these parameters;

(c) The sampling method which will be used to obtain a representative sample of the waste to be analyzed. A representative sample may be obtained using either the sampling methods described in 40 KAR 31:100.

(d) The frequency with which the initial analysis of the waste will be reviewed or repeated to ensure that the analysis is accurate and up to date;

(e) For off-site facilities, the waste analyses that hazardous waste generators have agreed to supply; and

(f) Where applicable, the methods which will be used to meet the additional waste analysis requirements for specific waste management methods as specified in Section 9 of 401 KAR 34:230. In Sec-

certifies that it has issued liability insurance covering bodily injury and property damage to (insert name of Insured), the "Insured," of (insert address of Insured) in connection with the Insured's obligation to demonstrate financial responsibility under 401 KAR 34:120 or 401 KAR 35:120. The coverage applies at (list EPA Identification Number, name, and address for each facility) for (insert "sudden accidental occurrences," "nonsudden accidental occurrences," or "sudden and nonsudden accidental occurrences"; if coverage is for multiple facilities and the coverage is different for different facilities, indicate which facilities are insured for sudden accidental occurrences, which are insured for nonsudden accidental occurrences, and which are insured for both.)

Fill in Alternative A for primary liability coverage. Fill in Alternative B for excess liability coverage.)

Alternative A

The limits of liability are (insert the dollar amount of the primary policy for "each occurrence") each occurrence and (insert the dollar amount of the primary policy for "annual aggregate") annual aggregate, exclusive of legal defense costs.

Alternative B

The limits of liability are (insert the dollar amount of the excess policy for "each occurrence") each occurrence and (insert the dollar amount of the excess policy for "annual aggregate") annual aggregate, which is exclusive of legal defense costs, in excess of the primary policy limits of (insert dollar amount of the primary policy for "each occurrence") each occurrence and (insert the dollar amount of the primary policy for "annual aggregate") annual aggregate, exclusive of legal defense costs.

The coverage is provided under policy number (insert the policy number), issued on (date). The effective date of said policy is (date).

2. The Insurer further certifies the following with respect to the insurance described in paragraph 1:

(a) Bankruptcy or insolvency of the insured shall not relieve the Insurer of its obligations under the policy.

(b) The Insurer is liable for the payment of amounts within any deductible applicable to the policy, with a right of reimbursement by the Insured for any such payment made by the Insurer. This provision does not apply with respect to that amount of any deductible for which coverage is demonstrated as specified in Section 6 of 401 KAR 34:120 or Section 6 of 401 KAR 35:120.

(c) Whenever requested by the Director of the Division of Waste Management in the Natural Resources and Environmental Protection Cabiner, hereinafter the Director of the Division, the Insurer agrees to furnish to the Director of the Division an originally signed duplicate of the policy and all endorsements.

(d) Cancellation of the Insurance, whether by the Insurer or the Insured, will be effective only upon written notice and only after the expiration of sixty (60) days after a copy of such written notice is received by the Director of the Division.

(e) Any other termination of the insurance will be effective only upon written notice and only after the expiration of thirty (30) days after a copy of such written notice is received by the Director of the Division.

I hereby certify that the wording of this instrument is identical to the wording specified in 401 KAR 34:176 as such regulation was constituted on the date first above written, and that the Insurer is licensed to transact the business of primary insurance in the Commonwealth of Kentucky or, if exempted by KRS 304.11-030, the Insurer is licensed to transact the business of primary insurance in one (1) state, or is licensed to provide insurance as an excess or surplus lines insurer in one (1) state.

(Signature of authorized representative of Insurer)

(Name, typed)

(Title, typed) Authorized Representative of (name of Insurer)

(Address of Representative, typed)

401 KAR 34:180. Use and management of containers.

Section 1. Applicability. This regulation applies to owners and operators of all hazardous waste sites or facilities that store containers of hazardous waste, except as Section 1 of 401 KAR 34:010 provides otherwise.

Section 2. Condition of Containers. If a container holding hazardous waste is not in good condition (e.g., severe rusting, apparent structural defects) or if it begins to leak, the owner or operator must transfer the hazardous waste from this container to a container that is in good condition or manage the waste in some other way that complies with the requirements of this chapter.

Section 3. Compatibility of Waste with Containers. The owner or operator must use a container made of or lined with materials which will not react with and are otherwise compatible with the hazardous waste to be stored so that the ability of the container to contain the waste is not impaired.

Section 4. Management of Containers. (1) A container holding hazardous waste must always be closed during storage except when it is necessary to add or remove waste.

(2) A container holding hazardous waste must not be opened, handled, or stored in a manner which may rupture the container or cause it to leak.

(3) A container holding hazardous waste shall be labeled "Hazardous Waste" upon the date that hazardous waste is first added to the container.

Section 5. Inspections. At least weekly, the owner or operator must inspect areas where containers are stored, looking for leaking containers and for deterioration of containers and the containment system caused by corrosion or other factors.

Section 6. Containment. (1) Container storage areas must be a containment system that is designed and operated in accordance with subsection (2) of this section except as otherwise provided in subsection (3) of this section.

(2) A containment system must be designed and operated as follows:

(a) A base must underly the containers which is free of cracks or gaps and is sufficiently impervious to contain leaks, spills, and accumulated precipitation until the collected material is detected and removed;

(b) The base must be sloped or the containment system must be otherwise designed and operated to drain and remove liquids resulting from leaks, spills, or precipitation, unless the containers are elevated or are otherwise protected from contact with accumulated liquids;

(c) The containment system must have sufficient capacity to contain ten (10) percent of the volume of containers or the volume of the largest container, whichever is greater. Containers that do not contain

free liquids need not be considered in this determination;

(d) Run-on into the container system must be prevented unless the collection system has sufficient excess capacity in addition to that required in paragraph (c) of this subsection to contain any run-on which might enter the system; and

(e) Spilled or leaked waste and accumulated precipitation must be removed from the sump or collection area in as timely a manner as necessary to prevent overflow of the collection system.

(3) Storage areas that store containers holding only wastes that do not contain free liquids need not have a containment system defined by subsection (2) of the section, except as provided by subsection (4) of this section or provided that:

(a) The storage area is sloped or is otherwise designed and operated to drain and remove liquid resulting from precipitation; or

(b) The containers are elevated or otherwise protected from contact with accumulated liquid.

(4) Storage areas that store containers holding the wastes listed in this subsection that do not contain free liquids must have a containment system as defined by subsection (2) of this section: F020, F021, F022, F023, F026, and F027 (chlorinated dioxins, dibenzofurans, and phenols).

Section 7. Special Requirements for Ignitable for Reactive Waste. Containers holding ignitable or reactive waste must be located at least fifteen (15) meters (approximately fifty (50) feet) from the facility's property line.

Section 8. Special Requirements for Incompatible Wastes. (1) Incompatible wastes, or incompatible waste and materials (see 401 KAR 34:330 for examples), must not be placed in the same container, unless Section 8(2) of 401 KAR 34:020 is complied with.

(2) Hazardous waste must not be placed in an unwashed container that previously held an incompatible waste or material.

(3) A storage container holding a hazardous waste that is incompatible with any waste or other materials stored nearby in other containers, piles, open tanks, or surface impoundments must be separated from the other materials or protected from them by means of a dike, berm, wall, or other device.

Section 9. Closure. At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases and soil containing or contaminated with hazardous waste or hazardous waste residues must be decontaminated or removed.

401 KAR 34:190. Tanks.

Section 1. Applicability. (1) This regulation applies to owners and operators of hazardous waste sites or facilities that use tanks to treat or store hazardous waste, except as Section 1 of 401 KAR 34:010 and subsection (2) of this regulation provide otherwise.

(2) This regulation does not apply to facilities that treat or store hazardous waste in covered underground tanks that cannot be entered for inspection.

Section 2. Design of Tanks. Tanks must have sufficient shell strength and, for closed tanks, pressure controls (e.g., vents) to assure that they do not collapse or rupture. The cabinet will review the design of the tanks, including the foundation, structural support, seams and pressure controls. The cabinet shall require that a minimum shell thickness be maintained at all times to ensure sufficient shell strength. Factors to be considered in establishing minimum thickness include the width, height, and materials of construction of the tank, and the specific gravity of the waste which will be placed in the tank. In reviewing the design of the tank and establishing a minimum thickness, the cabinet shall rely upon appropriate industrial design standards and other available information.

Section 3. General Operating Requirements. (1) Wastes and other materials (e.g., treatment reagents) which are incompatible with the material of construction of the tank must not be placed in the tank unless the tank is protected from accelerated corrosion, erosion or abrasion through the use of:

(a) An inner liner or coating which is compatible with the waste or material and which is free of leaks, cracks, holes or other deterioration; or

(b) Alternative means of protection (e.g., cathodic protection or corrosion inhibitors).

(2) The owner and operator must use appropriate controls and practices to prevent overfilling. These must include:

(a) Controls to prevent overfilling (e.g., waste feed cutoff system or by-pass to a standby tank); and

(b) For uncovered tanks, maintenance of sufficient freeboard to prevent overtopping by wave or wind action or by precipitation.

Section 4. Inspections. (1) The owner or operator must inspect:

(a) Overfilling control equipment (e.g., waste feed cutoff systems and by-pass systems) at least once each operating day to ensure that it is in good working order;

(b) Data gathered from monitoring equipment (e.g., pressure and temperature gauges) where present, at least once each operating day to ensure that the tank is being operated according to its design;

(c) For uncovered tanks, the level of waste in the tank, at least once each operating day to ensure compliance with subsection (2) of Section 3;

(d) The construction materials of the above-ground portions of the tank, at least weekly to detect corrosion or erosion and leaking of fixtures and seams; and

(e) The area immediately surrounding the tank, at least weekly to detect obvious signs of leakage (e.g., wet spots or dead vegetation).

(2) As part of the inspection schedule required in Section 6(2) of 401 KAR 34:020 and in addition to the specific requirements of subsection (1) of this section, the owner or operator must develop a schedule and procedure for assessing the condition of the tank. The schedule and procedure must be adequate to detect cracks, leaks, corrosion or erosion which may lead to cracks or leaks, or wall thinning to less than the thickness required under Section 2 of this regulation. Procedures for emptying a tank to allow entry and inspection of the interior must be established when necessary to detect corrosion or erosion of the tank sides and bottom. The frequency of these assessments must be based on the material of construction of the tank, type of corrosion or erosion protection used, rate of corrosion or erosion protection used, rate of corrosion or erosion observed during previous inspections, and the characteristics of the waste being treated or stored.

(3) (a) As part of the contingency plan required under 401 KAR 34:040, the owner or operator must specify the procedures he intends to use to respond to tanks or

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leakages, including procedures and time for expeditious removal of leaked or spilled waste and repair of the tank.

(b) For EPA Hazardous Waste Nos. F020, F021, F022, F023, F026, and F027, the contingency plan must also include the procedures for responding to a spill or leak of these wastes from tanks into the containment system. These procedures shall include measures for immediate removal of the waste from the system and replacement or repair of the leaking tank.

Section 5. Closure. At closure, all hazardous waste and hazardous waste residues must be removed from tanks, discharge control equipment, and discharge containment structures.

Section 6. Special Requirements for Ignitable or Reactive Wastes. (1) Ignitable or reactive waste must not be placed in a tank unless:

(a) The waste is treated, rendered, or mixed before or immediately after placement in the tank so that the resulting waste, mixture or dissolution of material no longer meets the definition of ignitable or reactive waste under 401 KAR Chapter 31, and Section 8(2) of 401 KAR 34:020 is complied with; or

(b) The waste is stored or treated in such a way that it is protected from any material or conditions which may cause the waste to ignite or react; or

(c) The tank is used solely for emergencies.

(2) The owner or operator of a facility which treats or stores ignitable or reactive waste in covered tanks must comply with the buffer zone requirements for tanks contained in Tables 2-1 through 2-6 of the National Fire Protection Association's "Flammable and Combustible Liquids Code" (1977 or 1981).

Section 7. Special Requirements for Incompatible Wastes. (1) Incompatible wastes, or incompatible wastes and materials, must not be placed in the same tank unless Section 8(2) of 401 KAR 34:020 is complied with.

(2) Hazardous waste must not be placed in an unwashed tank which previously held an incompatible waste or material, unless Section 8(2) of 401 KAR 34:020 is complied with.

Section 8. Special Requirements for Hazardous Wastes F020, F021, F022, F023, F026, and F027. In addition to the other requirements of this regulation, the following requirements apply to tanks storing or treating hazardous wastes F020, F021, F022, F023, F026, and F027.

(1) Tanks must have systems designed and operated to detect an adequately contained spills for leaks. The design and operation of any containment system must reflect consideration of all relevant factors, including:

(a) Capacity of the tank;

(b) Volumes and characteristics of wastes stored or treated in the tank;

(c) Method of collection of spills or leaks;

(d) The design and construction material of the tank and containment system; and

(e) The need to prevent precipitation and run-on from entering into the system.

(2) As part of the contingency plan required by 401 KAR 34:040, the owner or operator must specify such procedures for responding to a spill or leak from the tank into the containment system as may be necessary to protect human health and the environment. These procedures shall include measures for immediate removal of the waste from the system and replacemini-or repair of the leaking tank.

401 KAR 34:200. Surface impoundments.

Section 1. Applicability. This regulation applies to owners and operators of hazardous waste sites or facilities that use surface impoundments to treat, store or dispose of hazardous waste, except as Section 1 of 401 KAR 34:010 provides otherwise.

Section 2. Design and Operating Requirements. (1) Any surface impoundment that is not covered by subsection (3) of this section or Section 1 of 401 KAR 35:200 must have a liner for all portions of the impoundment (except for existing portions of such impoundments). After November 8, 1988 a surface impoundment shall not receive, store or treat hazardous waste unless such surface impoundment is in compliance with subsection (3) of this section. The liner must be designed, constructed, and installed to prevent any migration of wastes out of the impoundment to the adjacent subsurface soil or groundwater or surface water at any time during the active life (including the closure period) of the impoundment. The liner may be constructed of materials that may allow wastes to migrate into the liner (but not into the adjacent subsurface soil or groundwater or surface water) during the active life of the facility, provided that the impoundment is closed in accordance with Section 6(1)(a) of this regulation. For impoundments that will be closed in accordance with Section 6(1)(b) of this regulation, the liner must be constructed of materials that can prevent wastes from migrating into the liner during the active life of the facility. The liner must be:

(a) Constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients (including static head and external hydrogeologic forces), physical contact with the waste or leachate to which they are exposed, climatic conditions, geological conditions including, where applicable, karst features, the stress of installation, and the stress of daily operation;

(b) Placed upon a foundation or base capable of providing support to the liner and resistance to pressure gradients above and below the liner to prevent failure of the liner due to settlement, compression, uplift or geological conditions including, where applicable, karst features. At a minimum, synthetic liners shall be placed upon a one (1) foot thick soil liner of 1 x 10^{-7} cm/sec permeability; and

(c) Installed to cover all surrounding earth likely to be in contact with the waste or leachate.

(2) The owner or operator may be exempted from the requirements of this section (1) of this section if the cabinet finds, based on a demonstration by the owner or operator, that alternate design and operating practices, together with location characteristics, will prevent the migration of any hazardous constituents (Section 4 of 401 KAR 34:060) into the groundwater or surface water at any future time. In deciding whether to grant an exemption, the cabinet will consider:

(a) The nature and quantity of the wastes;

(b) The proposed alternate design and operation;

(c) The hydrogeologic setting of the facility, including the attenuative capacity and thickness of the liners and soils present between the impoundment and groundwater or surface water; and

(d) All other factors which would influence the quality and mobility of the leachate produced and the potential for it to migrate to groundwater or surface water.

(3) Prior to the issuance of a permit, and after any extended period of time (at least six (6) months) during which the impoundment was not in service, the owner or operator must obtain a certification from a qualified engineer registered in Kentucky that the impoundment's dike, including that portion of any dike which provides freeboard, has structural integrity. The certification must establish, in particular, that the dike:

(a) Will withstand the stress of the pressure exerted by the types and amounts of wastes to be placed in the impoundment; and

(b) Will not fail due to scouring or piping, without dependence on any liner system included in the surface impoundment construction.

Section 5. Emergency Repairs; Contingency Plans. (1) A surface impoundment must be removed from service in accordance with subsection (2) of this section when:

(a) The level of liquids in the impoundment suddenly drops and the drop is not known to be caused by changes in the flows into or out of the impoundment; or

(b) The dike leaks.

(2) When a surface impoundment must be removed from service as required by subsection (1) of this section, the owner or operator must:

(a) Immediately shut off the flow or stop the addition of wastes into the impoundment;

(b) Immediately contain any surface leakage which has occurred or is occurring;

(c) Immediately stop the leak;

(d) Take any other necessary steps to stop or prevent catastrophic failure;

(e) If a leak cannot be stopped by any other means, empty the impoundment; and

(f) Notify the cabinet of the problem in writing within seven (7) days after detecting the problem.

(3) As part of the contingency plan required in 401 KAR 34:040 the owner or operator must specify a procedure for complying with the requirements of this section.

(4) No surface impoundment that has been removed from service in accordance with the requirements of this section may be restored to service unless the portion of the impoundment which was failing is repaired and the following steps are taken:

(a) If the impoundment was removed from service as the result of actual or imminent dike failure, the dike's structural integrity must be recertified in accordance with Section 4(3) of this regulation.

(b) If the impoundment was removed from service as the result of a sudden drop in the liquid level, then:

1. For any existing portion of the impoundment, a liner must be installed in compliance with Sections 2 or 3 of this regulation; and

2. For any other portion of the impoundment, the repaired liner system must be certified by a qualified engineer as meeting the design specifications approved in the permit.

3. Determine, using water balance calculations in accordance with 401 KAR 34:050, how much liquid was lost, where the liquid went and take appropriate actions.

(5) A surface impoundment that has been removed from service in accordance with the requirements of this section and that is not being repaired within six (6) months time, as specified by the cabinet, must be closed in accordance with the provisions of *Section 6 of* this regulation.

Section 6. Closure and Post-Closure Care.

(1) At closure, the owner or operator must:

(a) Remove or decontaminate all waste residues, contaminated containment system components (liners, etc.), contaminated subsoils, and structure and equipment contaminated with waste and leachate, and manage them as hazardous waste unless Section 3 of 401 KAR 31:010 applies; or

(b) Treat in such a manner so as to:

1. Eliminate free liquids by removing liquid wastes or solidifying the remaining wastes and waste residues;

2. Stabilize remaining wastes to a bearing capacity sufficient to support final cover; and

3. Cover the surface impoundment with a final cover designed and constructed to:

a. Provide long-term minimization of the migration of liquids through the closed impoundment;

b. Function with minimum maintenance;

c. Promote drainage and minimize erosion or abrasion of the final cover;

d. Accommodate settling and subsidence so that the cover's integrity is maintained; and

e. Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.

(2) If some waste residues or contaminated materials are left in place at final closure, the owner or operator must comply with all post-closure requirements contained in Sections 7 through 10 of 401 KAR 34:070, including maintenance and monitoring throughout the post-closure care period (specified in the permit under Section 8 of 401 KAR 34:070). The owner or operator must:

(a) Maintain the integrity and effectiveness of the final cover including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events;

(b) Maintain and monitor the groundwater monitoring system and comply with all other applicable requirements of 401 KAR 34:060; and

(c) Prevent run-on and run-off from eroding or otherwise damaging the final cover.

(3)(a) If an owner or operator plans to close a surface impoundment in accordance with subsection (1)(a) of this section, and the impoundment does not comply with the liner requirements of Section 2(1) and is not exempt from them in accordance with Section 2(2) of this regulation, then:

1. The closure plan for the impoundment under Section 3 of 401 KAR 34:070 must include both a plan for complying with subsection (1)(a) of this section and a contingent plan for complying with subsection (1)(b) of this section, which is also in compliance with 401 KAR 38:500 and KRS 224.855(3), in case not all contaminated subsoils can be practicably removed at closure; and

2. The owner or operator must prepare a contingent post-closure plan under Section 8 of 401 KAR 34:070 for complying with subsection (2) of this section, which is also in compliance with 401 KAR 38:500 and KRS 224.855(3), in case not all contaminated subsoils can be practicably removed at closure.

(b) The cost estimates calculated under Section 1 of 401 KAR 34:090 and Section 1 of 401 KAR 34:100 for closure and post-closure care of an impoundment subject to this paragraph must include separate analyses of the cost of complying with the contingent closure plan and the contingent post-closure plan in addition to the cost of

(3) The owner or operator of each new surface impoundment, each new surface impoundment unit at an existing facility, each replacement of an existing surface impoundment unit, and each lateral expansion of an existing surface impoundment unit must install two (2) or more liners and a leachate collection system between such liners. The liners and leachate collection system must protect human health and the environment. The requirements of this subsection shall apply with respect to all waste received after the issuance of the permit. The requirement for the installation of two (2) or more liners in this subsection may be satisfied by the installation of a top liner designed, operated and constructed of materials to prevent the migration of any constituent into such liner during the period such facility remains in operation (including any post-closure monitoring period), and a lower liner designed, operated, and constructed to prevent the migration of any constituent through such liner during such period. For the purpose of the preceding sentence, a lower liner shall be deemed to satisfy such requirement if it is constructed of at least a three (3) foot thick layer of recompacted clay or other natural material with a permeability of no more than 1 x 10^{-7} centimeters per second.

(4) Subsection (3) of this section will not apply if the owner or operator demonstrates to the cabinet, and the cabinet finds for such surface impoundment, that alternative design and operating practices, together with location characteristics, will prevent the migration of any hazardous constituent into the ground water or surface water at least as effectively as such liners and leachate collection systems.

(5) The double liner requirement set forth in subsection (3) of this section may be waived by the cabinet for any monofill, if:

(a) The monofill contains only hazardous wastes from foundry furnace emission controls or metal casting molding sand, and such wastes do not contain constituents which would render the wastes hazardous for reasons other than the EP toxicity characteristics in Section 5 of 401 KAR 31:030; and

(b) 1.a. The monofill has at least one (1) liner for which there is no evidence that such liner is leaking. For the purposes of this subsection the term "liner" means a liner designed, constructed, installed, and operated to prevent hazardous waste from passing into the liner at any time during the active life of the facility, or a liner designed, constructed, installed, and operated to prevent hazardous waste from migrating beyond the liner to adjacent subsurface soil, ground water, or surface water at any time during the active life of the facility. In the case of any surface impoundment which has been exempted from the requirements of subsection (3) of this section on the basis of a liner designed, constructed, installed, and operated to prevent hazardous waste from passing beyond the liner, at the closure of such impoundment, the owner or operator must remove or decontaminate all waste residues, all contaminated liner material, and contaminated soil to the extent practicable. If all contaminated soil is not removed or decontaminated, the owner or operator of such impoundment will comply with appropriate post-closure requirements, including but not limited to ground water monitoring and corrective action;

b. The monofill is located more than one-forth (¼) mile from an underground source of drinking water (as that term is defined in Section 1 of 401 KAR 30:010); and

c. The monofill is in compliance with generally applicable ground water monitoring requirements for facilities with permits under KRS 224.855 and KRS 224.866; or

2. The owner or operator demonstrates that the monofill is located, designed and operated so as to assure that there will be no migration of any hazardous constituent into ground water or surface water at any future time.

(6) A surface impoundment must be designed, constructed, maintained, and operated to prevent overtopping resulting from normal or abnormal operations; overfilling; wind and wave action; rainfall; runon; malfunctions of level controllers, alarms, and other equipment; and human error.

(7) A surface impoundment must have dikes that are designed, constructed, and maintained with sufficient structural integrity to prevent massive failure of the dikes. In insuring structural integrity, it must not be presumed that the liner system will function without leakage during the active life of the unit.

(8) A new surface impoundment shall not be constructed in a floodway in accordance with 401 KAR 34:020, Section 9(2).

(9) A surface impoundment (including its underlying liners), for the treatment or storage of hazardous waste must be protected from inundation by waters of the 100-year flood in accordance with 401 KAR 34:020, Section 9(2).

(10) New surface impoundments for the disposal of hazardous waste must be located entirely above the seasonal highwater table, in accordance with 401 KAR 34:020, Section 9(2).

(11) The cabinet will specify in the permit all design and operating practices that are necessary to ensure that the requirements of this section are satisfied.

Section 3. Double-lined Surface Impoundments: 401 KAR 34:060 Groundwater Protection Requirements apply all surface impoundments including those with double-liner systems.

Section 4. Monitoring and Inspection.

(1) During construction and installation, liners (except in the case of existing portions of surface impoundments exempt from Section 2 of this regulation) and cover systems (e.g., membranes, sheets, or coatings) must be inspected for uniformity, damage, and imperfections (e.g. holes, cracks, thin spots, or foreign materials). Immediately after construction or installation:

(a) Synthetic liners and covers must be inspected to ensure tight seams and joints and the absence of tears, punctures, or blisters; and

(b) Soil-based and admixed liners and covers must be inspected for imperfections including lenses, cracks, channels, root holes, or other structural non-uniformities that may cause an increase in the permeability of the liner or cover.

(2) While a surface impoundment is in operation, it must be inspected weekly and after storms to detect evidence of any of the following:

(a) Deterioration, malfunctions, or improper operation of overtopping control systems;

(b) Sudden drops in the level of the impoundment's contents as computed by the water balance calculations required in 401 KAR 34:050 and as observed by the measuring devices etc.; and

(c) Severe erosion or any other signs of deterioration in dikes or other containment devices.

it is regenerated. Examples are recovery of lead values from spent batteries and regenerstion of spent solvents.

(e) A material is "used or reused" if it is either:

1. Employed as an ingredient (including use as an intermediate) in an industrial process to make a product (for example, distillation bottoms from one (1) process used as feedstock in another process). However, a material will not satisfy this condition if distinct components of the material are recovered as separate end products (as when metals are recovered from metal-containing secondary materials); or

2. Employed in a particular function or application as an effective substitute for a commercial product (for example, spent pickle liquor used as phosphorous precipitant and sludge conditioner in wastewater treatment).

(f) "Scrap metal" is bits and pieces of metal parts (e.g., bars, turnings, rods, sheets, wire) or metal pieces that may be combined together with bolts or soldering (e.g., radiators, scrap automobiles, railroad boxcars), which when worn or superfluous can be recycled.

(g) A material is "recycled" if it is used, reused, or reclaimed.

(h) A material is "accumulated speculatively" if it is accumulated before being recycled.

(i) A material is not accumulated speculatively, if the person accumulating it can show:

a. That the material is potentially recyclable and has a feasible means of being recycled; and

b. That — during the calendar year (commencing on January 1) — the amount of material that is recycled, or transferred to a different site for recycling, equals at least seventy-five (75) percent by weight or volume of the amount of that material accumulated at the beginning of the calendar year (including any material accumulated from previous years).

2. In calculating the percentage of turnover, the seventy-five (75) percent requirement is to be applied to each material of the same type that is recycled in the same way. Materials accumulating in units that would be exempt from regulation under Section 4(3) of this regulation are not to be included in making the calculation. (Materials that are already defined as wastes also are not to be included in making the calculation.) Materials are no longer in this category once they are removed from accumulation for recycling.

Section 2. Definition of a Waste. (1) A "waste" is any discarded material that is not excluded by Section 4(1) of this regulation or that is not excluded by a variance granted under section 1 or 2 of 401 KAR 30:080, or Section 8 or 9 of this regulation.

(b) A "discarded material" is any material which is:

1. "Abandoned," as explained in subsection (2) of this section; or

2. "Recycled," as explained in subsection (3) of this section; or

3. "Listed" in subsection (4) of this section.

(2) Materials are waste if "abandoned" by being:

(a) Disposed of; or

(b) Burned or incinerated; or

(c) Accumulated, stored, or treated (but nor-recycled) before or in lieu of being abandoned by being disposed of, burned, or incinerated.

(3) The following materials are wastes if they are "recycled" — or accumulated, stored, or treated before recycling — as specified in paragraphs (a) through (d) of this subsection.

(a) "Used in a manner constituting disposal."

1. Materials noted with a "(waste)" in column (1) of Table 1 in paragraph (c) of this subsection are wastes when they are:

a. Applied to or placed on the land in a manner that constitutes disposal; or

b. Used to produce products that are applied to or placed on the land or are otherwise contained in products that are applied to or placed on the land (in which case the product itself remains a waste).

2. However, commercial chemical products listed in Section 4 of 401 KAR 31:040 are not wastes if they are applied to the land and that is their ordinary manner of use.

(b) The following materials are "burned for energy recovery:"

1. Materials noted with a "(waste)" in column (2) of Table 1 in paragraph (c) of this subsection are wastes when they are:

a. Burned to recover energy;

b. Used to produce a fuel or are otherwise contained in fuels (in which cases the fuel itself remains a solid waste).

2. However, commercial chemical products listed in Section 4 of 401 KAR 31:040 are not wastes if they are themselves fuels.

(c) The following materials are "reclaimed." Materials noted with a "(waste)" in column (3) of Table 1 in paragraph (c) of this subsection are wastes when reclaimed.

(d) The following materials are "accumulated speculatively." Materials with a "(waste)" in column (4) of Table 1 in paragraph (c) of this subsection are wastes when accumulated speculatively.

(e) The following Table 1 identifies materials which are wastes when "used in a manner constituting disposal," "burned for energy recovery," "reclaimed," or "ac-

procedures in Section 6 of this regulation the cabinet may determine on a act-by-case basis that certain enclosed devises using controlled flame combustion are boilers, even though they do not otherwise meet the definition of boiler contained in Section 1 of 401 KAR 30:010 after considering the following criteria:

(1) The extent to which the unit has provisions for recovering and exporting thermal energy in the form of steam, heated flu-ids, or heated gases;

(2) The extent to which the combustion chamber and energy recovery equipment are of integral design:

(3) The efficiency of energy recovery; calculated in terms of the recovered energy compared with the thermal value of the fuel;

(4) The extent to which exported energy is utilized;

(5) The extent to which the device is in common and customary use as a "boiler" functioning primarily to produce steam, heated fluids: or heated gazes: and

(6) Other factors as appropriate.

Section 5. Variance to be Classified is an Industrial Furnace. In accordance with the standards and criteria in Section 1 of 401 KAR 30:010 (definition of "industrial furnace"), and the procedures in Section 6 of this regulation the cabinet may determine on a case-by-case basis that certain enclosed devices using controlled flame combustion are industrial furnaces, even though they do not otherwise meet the definition of industrial furnace contained in Section 1 of 401 KAR 30:010 after considering the following criteria:

(1) The design and use of the device primarily to accomplish recovery of material products;

(2) The use of the device to burn or reduce raw materials to make a material product;

(3) The use of the device to burn or reduce secondary materials as effective substitutes for raw materials, in processes using raw materials as principal feedstocks;

(4) The use of the device to burn or reduce secondary materials as ingredients in an industrial process to make a material product;

(5) The use of the device in common industrial practice to produce a material product; and

(6) Other factors, as appropriate.

Section 6. Procedures for Variances from Classification as a Waste or to be Classified as a Boiler or an Industrial Furnace. The cabinet will use the following procedures in evaluating applications for variances from classification as a waste or applications to classify particular enclosed flame combustion devices as boilers or industrial furnaces:

(1) For recyclers requesting a variance under Section 1 of this regulation from classification as a waste:

(a) The applicant must apply to the cabinet; and

(b) The application must address the relevant criteria contained in Section 3 of this regulation.

(2) For persons requesting a variance for classifying a particular enclosed flame combustion device as a boiler or an industrial furnace:

(a) The applicant must apply to the cabinet; and

(b) The application must address the relevant criteria contained in Section 3 of this regulation.

(3) The cabinet will evaluate the application and issue a draft notice tentatively granting or denying the application. Notification of this tentative decision will be provided by newspaper advertisement and radio broadcast in the locality where the recycler is located. The cabinet will accept comment on the tentative decision for thirty (30) days and may also hold a public hearing upon request or at its discretion. The cabinet will issue a decision after receipt of comments and after the hearing if any.

401 KAR 31:010. General provisions for hazardous wastes.

Section 1. Purpose and Scope. (1) This chapter identifies those wastes which are subject to regulation as hazardous wastes under 401 KAR Chapters 32 through 40 and which are subject to the notification and permitting requirements of KRS 224.830 through 224.877. In this chapter:

(a) This regulation defines the terms "waste" and "hazardous waste," identifies those wastes which are excluded from regulation under 401 KAR Chapter 32 through 40 and establishes special management requirements for hazardous waste produced by small quantity generators and hazardous waste which is used, reused, recycled or reclaimed.

(b) 401 KAR 31:020 sets forth the criteria used by the cabinet to identify characteristics of hazardous waste and to list particular hazardous wastes.

(c) 401 KAR 31:030 identifies characteristics of hazardous

(d) 401 KAR 31:040 lists particular hazardous wastes.

(2)(a) The definition of waste contained in this chapter applies only to wastes that are also hazardous for purposes of the regulations implementing those provisions of KRS Chapter 224 relating to hazardous waste management. This chapter identifies only some of the materials which are hazardous wastes under KRS 224.033(10), 224.071, and 224.877. For example, it does not apply to materials (such as non-hazardous scrap, paper, textiles, or rubber) that are not otherwise hazardous wastes and that are recycled.

(b) This chapter identifies only some of the materials which are wastes and hazardous wastes under KRS 224.033(10), 224.071, and 224.877. A material which is not defined as a waste in this chapter, or is not a hazardous waste identified or listed in this chapter is still a waste and a hazardous waste for purposes of this regulation if:

1. In the case of KRS 224.033(10), the cabinet has reason to believe that the material may be a waste within the meaning of KRS 224.005 and a hazardous waste within the meaning of KRS 224.005; or

2. In the case of KRS 224.071, the statutory elements are established.

(3) For the purposes of Sections 2, 6, 8 and 9 of this regulation:

(a) A "spent material" is any material that has been used and as a result of contamination can no longer serve the purpose for which it was produced without processing.

(b) "Sludge" has the same meaning used in Section 1 of 401 KAR 30:010.

(c) A "by-product" is a material that is not one (1) of the primary products of a production process and is not solely or separately produced by the production process. Examples are process residues such as slags or distillation column bottoms. The term does not include a co-product that is produced for the general public's use and is ordinarily used in the form it is produced by the process.

(d) A material is "reclaimed" if it is processed to recover a usable product, or if

cumulated speculatively." Materials noted with the word "(waste)" in Table 1 are considered to be wastes for the purposes of 401 KAR Chapters 32 through 40 and KRS Chapter 224. Materials noted with a dash "—" in Table 1 are not considered to be a waste for the purposes of 401 KAR Chapters 32 through 40 and KRS Chapter 224.

TABLE 1

	Use constituting disposal 401 KAR 31:010 Section 2(3)(a) (1)	Energy recovery/ fuel 401 KAR 31:010 Section 2(3)(b) (2)	Reclamation 401 KAR 31:010 Section 2(3)(c) (3)	Speculative accumulation 401 KAR 31:010 Section 2(3)(d) (4)
Spent materials	(waste)	(waste)	(waste)	(waste)
Sludges (listed in Sections 2 or 3 of 401 KAR 31:040)	(waste)	(waste)	(waste)	(waste)
Sludges exhibiting a characteristic of hazardous waste	(waste)	(waste)	—	(waste)
By-products (listed in Sections 2 or 3 of 401 KAR 31:040)	(waste)	(waste)	(waste	waste)
By-products exhibiting a characteristic of hazardous waste	(waste)	(waste)	—	(waste)
Commercial chemical products listed in Section 4 of 401 KAR 31:040	(waste)	(waste)	—	—
Scrap metal	(waste)	(waste)	(waste)	(waste)

NOTE — The terms "spent materials," "sludges," "by-products," and "scrap metal" are defined in Section 1 of this regulation:

APPENDIX

EXHIBIT **B**

FEDERAL **HAZARDOUS WASTE** REGULATIONS

40 CFR **264.17** SUBPART I-USE **AND MANAGEMENT OF** CONTAINERS

40 CFR *264.19* SUBPART **J-TANK** SYSTEHS

40 **CFR 270.11(D) PROFESSIONAL ENGINEERS CERTIFICATION**

furnish to the Regional Administrator a signed duplicate original of the policy and all endorsements.

(d) Cancellation of this endorsement, whether by the Insurer or the Insured, will be effective only upon written notice and only after the expiration of sixty (60) days after a copy of such written notice is received by the Regional Administrator(s) of the EPA Region(s) in which the facility(ies) is (are) located.

(e) Any other termination of this endorsement will be effective only upon written notice and only after the expiration of thirty (30) days after a copy of such written notice is received by the Regional Administrator(s) of the EPA Region(s) in which the facility(ies) is (are) located.

Attached to and forming part of policy No. ——— issued by [name of Insurer], herein called the Insurer, of [address of Insurer] to [name of insured] of [address] this — day of ———, 19—. The effective date of said policy is — day of ———, 19—.

I hereby certify that the wording of this endorsement is identical to the wording specified in 40 CFR 264.151(i) as such regulation was constituted on the date first above written, and that the Insurer is licensed to transact the business of insurance, or eligible to provide insurance as an excess or surplus lines insurer, in one or more States.

[Signature of Authorized Representative of Insurer]
[Type name]
[Title], Authorized Representative of [name of Insurer]
[Address of Representative]

(j) A certificate of liability insurance as required in § 264.147 or § 265.147 must be worded as follows, except that the instructions in brackets are to be replaced with the relevant information and the brackets deleted:

HAZARDOUS WASTE FACILITY CERTIFICATE OF LIABILITY INSURANCE

1. [Name of Insurer], (the "Insurer"), of [address of Insurer] hereby certifies that it has issued liability insurance covering bodily injury and property damage to [name of insured], (the "insured"), of [address of insured] in connection with the insured's obligation to demonstrate financial responsibility under 40 CFR 264.147 or 265.147. The coverage applies at [list EPA Identification Number, name, and address for each facility] for [insert "sudden accidental occurrences," "nonsudden accidental occurrences," or "sudden and nonsudden accidental occurrences"; if coverage is for multiple facilities and the coverage is different for different facilities, indicate which facilities are insured for sudden accidental occurrences, which are insured for nonsudden accidental occurrences, and which are insured for both]. The limits of liability are [insert the dollar amount of the "each occurrence" and "annual aggregate" limits of the Insurer's liability], exclusive of legal defense costs. The coverage is provided under [policy number ———, issued on [date]. The effective date of said policy is [date].

2. The Insurer further certifies the following with respect to the insurance described in Paragraph 1:

(a) Bankruptcy or insolvency of the insured shall not relieve the Insurer of its obligations under the policy.

(b) The Insurer is liable for the payment of amounts within any deductible applicable to the policy, with a right of reimbursement by the insured for any such payment made by the Insurer. This provision does not apply with respect to that amount of any deductible for which coverage is demonstrated as specified in 40 CFR 264.147(f) or 265.147(f).

(c) Whenever requested by a Regional Administrator of the U.S. Environmental Protection Agency (EPA), the Insurer agrees to furnish to the Regional Administrator a signed duplicate original of the policy and all endorsements.

(d) Cancellation of the insurance, whether by the Insurer or the insured, will be effective only upon written notice and only after the expiration of sixty (60) days after a copy of such written notice is received by the Regional Administrator(s) of the EPA Region(s) in which the facility(ies) is (are) located.

(e) Any other termination of the insurance will be effective only upon written notice and only after the expiration of thirty (30) days after a copy of such written notice is received by the Regional Administrator(s) of the EPA Region(s) in which the facility(ies) is (are) located.

I hereby certify that the wording of this instrument is identical to the wording specified in 40 CFR 264.151(j) as such regulation was constituted on the date first above written, and that the Insurer is licensed to transact the business of insurance, or eligible to provide insurance as an excess or surplus lines insurer, in one or more States.

[Signature of authorized representative of Insurer]
[Type name]
[Title], Authorized Representative of [name of Insurer]
[Address of Representative]

(Approved by the Office of Management and Budget under control number 2000-0445, for paragraphs (g), (i), and (j).)

Subpart I—Use and Management of Containers

§ 264.170 Applicability.

The regulations in this Subpart apply to owners and operators of all hazardous waste facilities that st containers of hazardous waste, exc as § 264.1 provides otherwise.

[*Comment:* Under § 261.7 and § 261.33(c) a hazardous waste is emptied from a c tainer the residue remaining in the cont er is not considered a hazardous waste if container is "empty" as defined in § 26 In that event, management of the conta is exempt from the requirements of Subpart.]

§ 264.171 Condition of containers.

If a container holding hazardo waste is not in good condition (e severe rusting, apparent structural fects) or if it begins to leak, the ow or operator must transfer the haza ous waste from this container to a C tainer that is in good condition manage the waste in some other w that complies with the requireme of this part.

§ 264.172 Compatibility of waste with c tainers.

The owner or operator must u container made of or lined with m rials which will not react with, and otherwise compatible with, the ardous waste to be stored, so that ability of the container to contain waste is not impaired.

§ 264.173 Management of containers.

(a) A container holding hazardo waste must always be closed du storage, except when it is necessary add or remove waste.

(b) A container holding hazardo waste must not be opened, handled stored in a manner which may rupt the container or cause it to leak.

[*Comment:* Reuse of containers in transportation is governed by U.S. Departmen Transportation regulations including t set forth in 49 CFR 173.28.]

§ 264.174 Inspections.

At least weekly, the owner or op lor must inspect areas where cont ers are stored, looking for leaking c tainers and for deterioration of c tainers and the containment sys caused by corrosion or other factors

[*Comment:* See §§ 264.15(c) and 264.171 remedial action required if deteriorati leaks are detected.]

§ 264.175 Containment.

(a) Container storage areas must have a containment system that is designed and operated in accordance with paragraph (b) of this section, except as otherwise provided by paragraph (c) of this section.

(b) A containment system must be designed and operated as follows:

(1) A base must underly the containers which is free of cracks or gaps and is sufficiently impervious to contain leaks, spills, and accumulated precipitation until the collected material is detected and removed;

(2) The base must be sloped or the containment system must be otherwise designed and operated to drain and remove liquids resulting from leaks, spills, or precipitation, unless the containers are elevated or are otherwise protected from contact with accumulated liquids;

(3) The containment system must have sufficient capacity to contain 10% of the volume of contamers or the volume of the largest container, whichever is greater. Containers that do not contain free liquids need not be considered in this determination;

(4) Run-on into the containment system must be prevented unless the collection system has sufficient excess capacity in addition to that required in paragraph (b)(3) of this section to contain any run-on which might enter the system; and

(5) Spilled or leaked waste and accumulated precipitation must be removed from the sump or collection area in as timely a manner as is necessary to prevent overflow of the collection system.

[*Comment:* If the collected material is a hazardous waste under Part 261 of this Chapter, it must be managed as a hazardous waste in accordance with all applicable requirements of Parts 262–266 of this chapter. If the collected material is discharged through a point source to waters of the United States, it is subject to the requirements of Section 402 of the Clean Water Act, as amended.]

(c) Storage areas that store containers holding only wastes that do not contain free liquids need not have a containment system defined by paragraph (b) of this section, except as provided by paragraph (d) of this section or provided that:

[264.175(c) introductory text amended by 50 FR 1999, January 14, 1985]

(1) The storage area is sloped or is otherwise designed and operated to drain and remove liquid resulting from precipitation, or

(2) The containers are elevated or are otherwise protected from contact with accumulated liquid.

(d) Storage areas that store containers holding the wastes listed below that do not contain free liquids must have a containment system defined by paragraph (b) of this section:

(1) FO20, FO21, FO22, FO23, FO26, and FO27.

(2) [Reserved]

[264.175(d) added by 50 FR 1999 January 14, 1985]

§ 264.176 Special requirements for ignitable or reactive waste.

Containers holding ignitable or reactive waste must be located at least 15 meters (50 feet) from the facility's property line.

[*Comment:* See § 264.17(a) for additional requirements.]

§ 264.177 Special requirements for incompatible wastes.

(a) Incompatible wastes, or incompatible wastes and materials (see Appendix V for examples), must not be placed in the same container, unless § 264.17(b) is complied with.

(b) Hazardous waste must not be placed in an unwashed container that previously held an incompatible waste or material.

[*Comment:* As required by § 264.13, the waste analysis plan must include analyses needed to comply with § 264.177. Also, § 264.17(c) requires wastes analyses, trial tests or other documentation to assure compliance with § 264.17(b). As required by § 264.73, the owner or operator must place the results of each waste analysis and trial test, and any documented information, in the operating record of the facility.]

(c) A storage container holding a hazardous waste that is incompatible with any waste or other materials stored nearby in other containers, piles, open tanks, or surface impoundments must be separated from the other materials or protected from them by means of a dike, berm, wall, or other device.

[*Comment:* The purpose of this section is to prevent fires, explosions, gaseous emission, leaching, or other discharge of hazardous waste or hazardous waste constituents which could result from the mixing of incompatible wastes or materials if containers break or leak.]

§ 264.178 Closure.

At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases, and soil containing or contaminated with hazardous waste or hazardous waste residues must be decontaminated or removed.

[*Comment:* At closure, as throughout the operating period, unless the owner or operator can demonstrate in accordance with § 261.3(d) of this chapter that the solid waste removed from the containment system is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of Parts 262–266 of this chapter.]

Subpart J — Tank Systems

[Subpart J revised by 51 FR 25470, July 14, 1986]

§ 264.190 Applicability.

The requirements of this Subpart apply to owners and operators of facilities that use tank systems for storing or treating hazardous waste except as otherwise provided in paragraphs (a) and (b) of this section or in §264.1 of this part.

(a) Tanks that are used to store or treat hazardous waste which contains no free liquids and are situated inside a building with an impermeable floor are exempted from the requirements in §264.193. To demonstrate the absence or presence of free liquids in the stored/treated waste, EPA Method 9095 (Paint Filter Liquids Test) as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (EPA Publication No. SW-846) must be used.

(b) Tanks, including sumps, as defined in §260.10, that serve as part of a secondary containment system to collect or contain releases of hazardous wastes are exempted from the requirements in §264.193 of this subpart.

[264.190(b) corrected by 51 FR 29430, August 15, 1986]

[Information collection requirement contained in paragraph (a) was approved by the Office of Management and Budget under control number 2050-0050.]

§264.191 Assessment of existing tank system's integrity.

(a) For each existing tank system that does not have secondary containment meeting the requirements of §264.193, the owner or operator must determine that the tank system is not leaking or is unfit for use. Except as provided in paragraph (c) of this section, the owner or operator must obtain and keep on file at the facility a written assessment

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reviewed and certified by an independent, qualified registered professional engineer, in accordance with §270.11(d), that attests to the tank system's integrity by January 12, 1988.

(b) This assessment must determine that the tank system is adequately designed and has sufficient structural strength and compatibility with the waste(s) to be stored or treated, to ensure that it will not collapse, rupture, or fail. At a minimum, this assessment must considar the following:

(1) Design standard(s), if available, according to which the tank and ancillary equipment were constructed;

(2) Hazardous characteristics of the waste(s) that have been and will be handled;

(3) Existing corrosion protection measures;

(4) Documented age of the tank system, if available (otherwise, an estimate of the age); and

(5) Results of a leak rest, internal inspection, or other rank integrity examination such that:

(i) For non-enterable underground tanks, the assessment must include a leak rest that is capable of taking into account the affects of temperature variations, tank end deflection, vapor pockets, and high water table effects, and

(ii) For other than non-enterable underground tanks and for ancillary equipment, this assessment must include either a leak test, as described above, or other integrity examination, that is certified by an independent, qualified, registered professional engineer in accordance with §270.11(d), that addresses cracks, leaks, corrosion, and erosion.

(Note. — The practices described in the American Petroleum Institute (API) Publication, Guide for Inspection of Refinery Equipment, Chapter XIII, "Atmospheric and Low-Pressure Storage Tanks," 4th edition, 1981, may be used, where applicable, as guidelines in conducting other than a leak test.)

(c) Tank systems that store or treat materials that become hazardous wastes subsequent to July 14, 1986, must conduct this assessment within 12 months after the date that the waste becomes a hazardous waste.

(d) If, as a result of the assessment conducted in accordance with paragraph (a), a tank system is found to be leaking or unfit for use, the owner or operator must comply with the requirements of §264.196.

(Information collection requirements contained in paragraphs (a) thru (d) were approved by the Office of Management and Budget under control number 2050-0050.)

[264.191 OMB No. corrected by 51 FR 29430, August 15, 1986]

§264.192 Design and installation of new tank system or components.

(a) Owners or operators of new tank systems or components must obtain and submit to the Regional Administrator, at time of submittal of Part B information, a written assessment, reviewed and certified by an independent, qualified registered professional engineer, in accordance with §270.11(d), attesting that the tank system has sufficient structural integrity and is acceptable for the storing and treating of hazardous waste. The assessment must show that the foundation, structural support, seams, connection, and pressure controls (if applicable) are adequately designed and that the tank system has sufficient structural strength, compatibility with the waste(s) to be stored or treated, and corrosion protection to ensure that it will not collapse, rupture, or fail. This assessment, which will be used by the Regional Administrator to review and approve or disapprove the acceptability of the tank system design, must include, at a minimum, the following information:

(1) Design standard(s) according to which tank(s) and/or the ancillary equipment are constructed;

(2) Hazardous characteristics of the waste(s) to be handled;

(3) For new tank systems or components in which the external shell of a metal tank or any external metal component of the tank system will be in contact with the soil or with water, a determination by a corrosion expert of:

(i) Factors affecting the potential for corrosion, including but not limited to:

(A) Soil moisture content;

(B) Soil pH;

(C) Soil sulfides level;

(D) Soil resistivity;

(E) Structure to soil potential;

(F) Influence of nearby underground metal structures (e.g., piping);

(G) Existence of stray electric current;

(H) Existing corrosion-protection measures (e.g., coating, cathodic protection; and

(ii) The type and degree of external corrosion protection that are needed to ensure the integrity of the tank system during the use of the tank system or component, consisting of one or more of the following:

(A) Corrosion-resistant materials of construction such as special alloys, fiberglass reinforced plastic, etc.;

(B) Corrosion-resistant coating (such as epoxy, fiberglass, etc.) with cathodic protection (e.g., impressed current or sacrificial anodes); and

(C) Electrical isolation devices such as insulating joints, flanges, etc.

(Note. — The practices described in the National Association of Corrosion Engineers (NACE) standard, "Recommended Practice (RP-02-85) — Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems," and the American Petroleum Institute (API) Publication 1632, "Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems," may be used, where applicable, as guides in providing corrosion protection for tank systems.)

(4) For underground tank system components that are likely to be adversely affected by vehicular traffic, a determination of design or operational measures that will protect the tank system against potential damage; and

(5) Design considerations to ensure that:

(i) Tank foundations will maintain the load of a full tank;

(ii) Tank systems will be anchored to prevent flotation or dislodgement where the tank system is placed in a saturated zone, or is located within a seismic fault zone subject to the standard of §264.18(a); and

(iii) Tank systems will withstand the effects of frost heave.

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(b) The owner or operator of a new tank system must ensure that proper handling procedures are adhered to in order to prevent damage to the system during installation. Prior to covering, enclosing, or placing a new tank system or component in use, an independent, qualified installation inspector or an independent, qualified, registered professional engineer, either of whom is trained and experienced in the proper installation of tank systems or components must inspect the system for the presence of any of the following items: [264.192 (b) introductory text corrected by 51 FR 29430, August 15, 1986]

(1) Weld breaks;

(2) Punctures;

(3) Scrapes of protective coatings;

(4) Cracks;

(5) Corrosion; or

(6) Other structural damage or inadequate construction/installation. All discrepancies must be remedied before the tank system is covered, enclosed, or placed in use.

(c) New tank systems or components that are placed underground and that are backfilled must be provided with a backfill material that is a noncorrosive, porous, homogeneous substance and that is installed so that the backfill is placed completely around the tank and compacted to ensure that the tank and piping are fully and uniformly supported.

(d) All new tanks and ancillary equipment must be tested for tightness prior to being covered, enclosed, or placed in use. If a tank system is found not to be tight, all repairs necessary to remedy the leak(s) in the system must be performed prior to the tank system being covered, enclosed, or placed into use.

(e) Ancillary equipment must be supported and protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction.

[Note.—The piping system installation procedures described in American Petroleum Institute (API) Publication 1615 (November 1979), "Installation of Underground Petroleum Storage Systems," or ANSI Standard B31.3, "Petroleum Refinery Piping," and ANSI Standard B31.4 "Liquid Petroleum Transportation Piping System," may be used, where applicable, as guidelines for proper installation of piping systems.]

(f) The owner or operator must provide the type and degree of corrosion protection recommended by an independent corrosion expert, based on the information provided under paragraph (a)(3) of this section, or other corrosion protection if the Regional Administrator believes other corrosion protection is necessary to ensure the integrity of the tank system during use of the tank system. The installation of a corrosion protection system that is field fabricated must be supervised by an independent corrosion expert to ensure proper installation.

(g) The owner or operator must obtain and keep on file at the facility written statements by those persons required to certify the design of the tank system and supervise the installation of the tank system in accordance with the requirements of paragraphs (b) through (f) of this section, that attest that the tank system was properly designed and installed and that repairs, pursuant to paragraphs (b) and (d) of this section, were performed. These written statements must also include the certification statement as required in §270.11(d) of this Chapter.

[Information collection requirements contained in paragraphs (a) and (g) were approved by the Office of Management and Budget under control number 2050-0050.]

§264.193 Containment and detection of releases.

(a) In order to prevent the release of hazardous waste or hazardous constituents to the environment, secondary containment that meets the requirements of this section must be provided (except as provided in paragraphs (f) and (g) of this section):

(1) For all new tank systems or components, prior to their being put into service;

(2) For all existing tank systems used to store or treat EPA Hazardous Waste Nos. F020, F021, F022, F023, F026, and F027, within two years after January 12, 1987;

(3) For those existing tank systems of known and documented age, within two years after January 12, 1987, or when the tank system has reached 15 years of age, whichever comes later;

[264.193 (a)(3) corrected by 51 FR 29430, August 15, 1986]

(4) For those existing tank systems for which the age cannot be documented, within eight years of January 12, 1987; but if the age of the facility is greater than seven years, secondary containment must be provided by the time the facility reaches 15 years of age, or within two years of January 12, 1987, whichever comes later; and

(5) For tank systems that store or treat materials that become hazardous wastes subsequent to January 12, 1987, within the time intervals required in paragraphs (a)(1) through (a)(4) of this section, except that the date that a material becomes a hazardous waste must be used in place of January 12, 1987.

(b) Secondary containment systems must be:

(1) Designed, installed, and operated to prevent any migration wastes or accumulated liquid out of the system to the soil, ground water, or surface water at any time during the use of the tank system, and

(2) Capable of detecting and collecting releases and accumulated liquids until the collected material is removed.

(c) To meet the requirements of paragraph(b) of this section, secondary containment systems must be at a minimum:

(1) Constructed of or lined with materials that are compatible with the waste(s) to be placed in the tank system and must have sufficient strength and thickness to prevent failure owing to pressure gradients (including static head and external hydrological forces), physical contact with the waste to which it is exposed, climatic conditions, and the stress of daily operation (including stresses from nearby vehicular traffic).

(2) Placed on a foundation or base capable of providing support to the secondary containment system, resistance to pressure gradients above and below the system, and capable of preventing failure due to settlement, compression, or uplift;

(3) Provided with a leak-detection system that is designed and operated so that it will detect the failure of either the primary or secondary containment structure or the presence of any release of hazardous waste or accumulated liquid in the secondary containment system within 24 hours, or at the earliest practicable time if the owner or operator can demonstrate to the Regional Administrator that existing detection technologies or site conditions will not allow detection of a release within 24 hours; and

(4) Sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills, or precipitation.

Spilled or leaked waste and accumulated precipitation must be removed from the secondary containment system within 24 hours, or in as timely a manner as is possible to prevent harm to human-health and the environment, if the owner or operator can demonstrate to the Regional Administrator that removal of the released waste or accumulated precipitation cannot be accomplished within 24 hours.

[Note. — If the collected material is hazardous waste under Part 261 of this chapter, it is subject to management as a hazardous waste in accordance with all applicable requirements of Parts 262 through 265 of this chapter. If the collected material is discharged through a point source to waters of the United States, it is subject to the requirements of sections 301, 304, and 402 of the Clean Water Act, as amended. If discharged to a Publicly Owned Treatment Works (POTW), it is subject to the requirements of section 307 of the Clean Water Act, as amended. If the collected material is released to the environment, it may be subject to the reporting requirements of 40 CFR Part 302.]

(d) Secondary containment for tanks must include one or more of the following devices:

(1) A liner (external to the tank);

(2) A vault;

(3) A double-walled tank; or

(4) An equivalent device as approved by the Regional Administrator.

(e) In addition to the requirements of paragraphs (b), (c), and (d) of this section, secondary containment systems must satisfy the following requirements:

(1) External liner systems must be:

(i) Designed or operated to contain 100 percent of the capacity of the largest tank within its boundary;

(ii) Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity to contain run-on or infiltration. Such additional capacity must be sufficient to contain precipitation from a 25-year, 24-hour rainfall event.

(iii) Free of cracks or gaps; and

(iv) Designed and installed to surround the tank completely and to cover all surrounding earth likely to come into contact with the waste if the waste is released from the tank(s) (i.e. capable of preventing lateral as well as vertical migration of the waste).

[264.193(e)(1)(iv) corrected by 51 FR 29430, August 15, 1986]

(2) Vault systems must be:

(i) Designed or operated to contain 100 percent of the capacity of the largest tank within its boundary;

(ii) Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity to contain run-on or infiltration. Such additional capacity must be sufficient to contain precipitation from a 25-year, 24-hour rainfall event;

(iii) Constructed with chemical-resistant water stops in place at all joints (if any);

[26.1 193(e)(2)(iii) corrected by 51 FR 29430, August 1 1986]

(iv) Provided with an impermeable interior coating or lining that is compatible with the stored waste and that will prevent migration of waste into the concrete;

(v) Provided with a means to protect against the formation of and ignition of vapors within the vault, if the waste being stored or treated:

(A) Meets the definition of ignitable waste under §262.21 of this chapter; or

(B) Meets the definition of reactive waste under §262.21 of this chapter, and may form an ignitable or explosive vapor.

(vi) Provided with an exterior moisture barrier or be otherwise designed or operated to prevent migration of moisture into the vault if the vault is subject to hydraulic pressure.

(3) Double-walled tanks must be:

(i) Designed as an integral structure (i.e., an inner tank completely enveloped within an outer shell) so that any release from the inner tank is contained by the outer shell.

(ii) Protected, if constructed of metal, from both corrosion of the primary tank interior and of the external surface of the outer shell; and

(iii) Provided with a built-in continuous leak detection system capable of detecting a release within 24 hours, or at the earliest practicable time, if the owner or operator can demonstrate to the Regional Administrator, and the Regional Administrator concludes, that the existing detection technology or site conditions would not allow detection of a release within 24 hours.

[Note. — The provisions outlined in the Steel Tank Institute's (STI) "Standard for Dual Wall Underground Steel Storage Tanks" may be used as guidelines for aspects of the design of underground steel double-walled tanks.]

(f) Ancillary equipment must be provided with secondary containment (e.g., trench, jacketing, double-walled piping) that meets the requirements of paragraphs (b) and (c) of this section except for:

(1) Aboveground piping (exclusive of flanges, joints, valves, and other connections) that are visually inspected for leaks on a daily basis;

(2) Welded flanges, welded joints, and welded connections, that are visually inspected for leaks on a daily basis;

[264.193(f)(2) corrected by 51 FR 29430, August 15, 1986]

(3) Sealless or magnetic coupling pumps, that are visually inspected for leaks on a daily basis; and

(4) Pressurized aboveground piping systems with automatic shut-off devices (e.g., excess flow check valves, flow meter shutdown devices, loss of pressure activated shut-off devices) that are visually inspected for leaks on a daily basis.

(g) The owner or operator may obtain a variance from the requirements of this section if the Regional Administrator finds, as a result of a demonstration by the owner or operator that alternative design and operating practices, together with location characteristics, will prevent the migration of any hazardous waste or hazardous constituents into the ground water or surface water at least as effectively as secondary containment during the active life of the tank system, or that in the event of a release that does migrate to ground water or surface water, no substantial present or potential hazard will be posed to human health or the environment. New underground tank systems may not, per demonstration in accordance with paragraph (g)(2) of this section, be exempted from the secondary containment requirements of this section.

(1) In deciding whether to grant a variance based on a demonstration of equivalent protection of ground water and surface water, the Regional Administrator will consider:

(i) The nature and quantity of the wastes;

(ii) The proposed alternate design and operation;

(iii) The hydrogeologic setting of the facility, including the thickness of soils

[Sec. 264.193(g)(1)(iii)]

present between the tank system and ... und water, and

(iv) All other factors that would influence the quality and mobility of the hazardous constituents and the potential for them to migrate to ground water or surface water.

(2) In deciding whether to grant a variance based on a demonstration of no substantial present or potential hazard, the Regional Administrator will consider:

(i) The potential adverse effects on ground water, surface water, and land quality taking into account:

(A) The physical and chemical characteristics of the waste in the tank system, including its potential for migration,

(B) The hydrogeological characteristics of the facility and surrounding land,

(C) The potential for health risks caused by human exposure to waste constituents,

(D) The potential for damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents, and

(E) The persistence and permanence of the potential adverse effects;

(ii) The potential adverse effects of a release on ground-water quality, taking into account:

(A) The quantity and quality of ground water and the direction of ground-water flow,

(B) The proximity and withdrawal rates of ground-water users,

(C) The current and future uses of ground water in the area, and

(D) The existing quality of ground water, including other sources of contamination and their cumulative impact on the ground-water quality;

(iii) The potential adverse effects of a release on surface water quality, taking into account:

(A) The quantity and quality of ground water and the direction of ground-water flow,

(B) The patterns of rainfall in the region,

(C) The proximity of the tank system to surface waters,

(D) The current and future uses of surface waters in the area and any water quality standards established for those surface waters, and

(E) The existing quality of surface water, including other sources of contamination and the cumulative impact on surface-water quality; and

(iv) The potential adverse effects of a release on the land surrounding the tank system taking into account:

(A) The patterns of rainfall in the region, and

(B) The current and future uses of the surrounding land.

(3) The owner or operator of a tank system for which a variance from secondary containment had been granted in accordance with the requirements of paragraph (g)(1) of this section, at which a release of hazardous waste has occurred from the primary tank system but has not migrated beyond the zone of engineering control (as established in the variance), must:

(i) Comply with the requirements of §264.196, except paragraph (d), and

(ii) Decontaminate or remove contaminated soil to the extent necessary to:

(A) Enable the tank system for which the variance was granted to resume operation with the capability for the detection of releases at least equivalent to the capability it had prior to the release; and

(B) Prevent the migration of hazardous waste or hazardous constituents to ground water or surface water; and

(iii) If contaminated soil cannot be removed or decontaminated in accordance with paragraph (g)(3)(ii) of this section, comply with the requirement of §264.197(b).

(4) The owner or operator of a tank system for which a variance from secondary containment had been granted in accordance with the requirements of paragraph (g)(1) of this section, at which a release of hazardous waste has occurred from the primary tank system and has migrated beyond the zone of engineering control (as established in the variance), must:

(i) Comply with the requirements of §264.196(a), (b), (c), and (d); and

(ii) Prevent the migration of hazardous waste or hazardous constituents to ground water or surface water, if possible, and decontaminate or remove contaminated soil. If contaminated soil cannot be decontaminated or removed or if ground water has been contaminated, the owner or operator must comply with the requirements of §264.197(b); and

(iii) If repairing, replacing, or reinstalling the tank system, provide secondary containment in accordance with the requirements of paragraphs (a) through (f) of this section or reapply for a variance from secondary containment and meet the requirements for new tank systems in §264.192 if the tank system is replaced. The owner or operator must comply with these requirements even if contaminated soil can be decontaminated or removed and ground water or surface water has not been contaminated.

(h) The following procedures must be followed in order to request a variance from secondary containment:

(1) The Regional Administrator must be notified in writing by the owner or operator that he intends to conduct and submit a demonstration for a variance from secondary containment as allowed in paragraph (g) according to the following schedule:

(i) For existing tank systems, at least 24 months prior to the date that secondary containment must be provided in accordance with paragraph (a) of this section.

(ii) For new tank systems, at least 30 days prior to entering into a contract for installations.

(2) As part of the notification, the owner or operator must also submit to the Regional Administrator a description of the steps necessary to conduct the demonstration and a timetable for completing each of the steps. The demonstration must address each of the factors listed in paragraph (g)(1) or paragraph (g)(2) of this section;

(3) The demonstration for a variance must be completed within 180 days after notifying the Regional Administrator of an intent to conduct the demonstration and

(4) If a variance is granted under this paragraph, the Regional Administrator will require the permittee to construct and operate the tank system in the manner that was demonstrated to meet the requirements for the variance.

(i) All tank systems, until such time as secondary containment that meets the requirements of this section is provided, must comply with the following:

(1) For non-enterable underground tanks, a leak test that meets the requirements of §264.191(b)(5) or other tank integrity method, as approved or required by the Regional Administrator, must be conducted at least annually.

[264.193(i)(1) corrected by 51 FR 29430, August 15, 1986]

(2) For other than non-enterable underground tanks, the owner or operator must either conduct a leak test as in paragraph (i)(1) of this section or develop a schedule and procedure for an assessment of the overall condition of the tank system by an independent, qualified registered professional engineer. The schedule and procedure must be adequate to detect obvious cracks, leaks, and corrosion or erosion that may lead to cracks and leaks. The owner or operator must remove the stored waste from the tank, if necessary, to allow the condition of all internal tank surfaces to be assessed. The frequency of these assessments must be based on the material of construction of the tank and its ancillary equipment, the age of the system, the type of corrosion or erosion protection used, the rate of corrosion or erosion observed during the previous inspection, and the characteristics of the waste being stored or treated.

[264.193(i)(2) corrected by 51 FR 29430, August 15, 1986]

(3) For ancillary equipment, a leak test or other integrity assessment as approved by the Regional Administrator must be conducted at least annually.

[Note. — The practices described in the American Petroleum Institute (API) Publication Guide for Inspection of Refinery Equipment, Chapter XIII, "Atmospheric and Low-Pressure Storage Tanks," 4th edition, 1981, may be used, where applicable, as guidelines for assessing the overall condition of the tank system.)

(4) The owner or operator must maintain on file at the facility a record of the results of the assessments conducted in accordance with paragraphs (i)(1) through (i)(3) of this section.

(5) If a tank system or component is found to be leaking or unfit for use as a result of the leak test or assessment in paragraphs (i)(1) through (i)(3) of this section, the owner or operator must comply with the requirements of §264.196.

[Information collection requirements contained in paragraphs (c), (d), (e), (g), (h), and (i) were approved by the Office of Management and Budget under control number 2050-0050.]

§264.194 General operating requirements.

(a) Hazardous wastes or treatment reagents must not be placed in a tank system if they could cause the tank, its ancillary equipment, or the containment system to rupture, leak, corrode, or otherwise fail.

(b) The owner or operator must use appropriate controls and practices to prevent spills and overflows from tank or containment systems. These include at a minimum:

(1) Spill prevention controls (e.g., check valves, dry disconnect couplings);

(2) Overfill prevention controls (e.g., level sensing devices, high level alarms, automatic feed cutoff, or bypass to a standby tank); and

(3) Maintenance of sufficient freeboard in uncovered tanks to prevent overtopping by wave or wind action or by precipitation.

(c) The owner or operator must comply with the requirements of §264.196 if a leak or spill occurs in the tank system.

[Information collection requirements contained in paragraph (c) were approved by the Office of Management and Budget under control number 2050-0050]

§264.195 Inspections.

(a) The owner or operator must develop and follow a schedule and procedure for inspecting overfill controls.

(b) The owner or operator must inspect at least once each operating day:

(1) Aboveground portions of the tank system, if any, to detect corrosion or releases of waste;

(2) Data gathered from monitoring and leak detection equipment (e.g., pressure or temperature gauges, monitoring wells) to ensure that the tank system is being operated according to its design; and

(3) The construction materials and the area immediately surrounding the externally accessible portion of the tank system, including the secondary containment system (e.g., dikes) to detect erosion or signs of releases of hazardous waste (e.g., wet spots, dead vegetation).

[Note. — Section 264.15(c) requires the owner or operator to remedy any deterioration or malfunction he finds. Section 264.196 requires the owner or operator to notify the Regional Administrator within 24 hours of confirming a leak. Also, 40 CFR Part 302 may require the owner or operator to notify the National Response Center of a release.]

(c) The owner or operator must inspect cathodic protection systems, if present, according to, at a minimum, the following schedule to ensure that they are functioning properly:

(1) The proper operation of the cathodic protection system must be confirmed within six months after initial installation and annually thereafter; and

(2) All sources of impressed current must be inspected and/or tested, as appropriate, at least bimonthly (i.e., every other month).

[Note. — The practices described in the National Association of Corrosion Engineers (NACE) standard, "Recommended Practice (RP-02-85) — Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems," and the American Petroleum Institute (API) Publication 1632, "Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems," may be used, where applicable, as guidelines in maintaining and inspecting cathodic protection systems.]

(d) The owner or operator must document in the operating record of the facility an inspection of those items in paragraphs (a) through (c) of this section.

[Information collection requirements contained in paragraph (a) and (d) were approved by the Office of Management and Budget under control number 2050-0050]

§264.196 Response to leaks or spills and disposition of leaking or unfit-for-use tank systems.

A tank system or secondary containment system from which there has been a leak or spill, or which is unfit for use, must be removed from service immediately, and the owner or operator must satisfy the following requirements:

(a) *Cessation of Use; prevent flow or addition of wastes.* The owner or operator must immediately stop the flow of hazardous waste into the tank system or secondary containment system and inspect the system to determine the cause of the release.

(b) *Removal of waste from tank system or secondary containment system.* (1) If the release was from the tank system, the owner/operator must, within 24 hours after detection of the leak or, if the owner/operator demonstrates that it is not possible, at the earliest possible time, remove as

much of the waste as is necessary to prevent further release of hazardous waste to the environment and to allow inspection and repair of the tank system to be performed.

(2) If the material released was to a secondary containment system, all released materials must be removed within 24 hours or in as timely a manner as is possible to prevent harm to human health and the environment.

(c) *Containment of visible releases to the environment.* The owner/operator must immediately conduct a visual inspection of the release and, based upon that inspection:

(1) Prevent further migration of the leak or spill to soils or surface water; and

(2) Remove, and properly dispose of, any visible contamination of the soil or surface water.

(d) *Notification, reports.* (2) Any release to the environment, except as provided in paragraph(d)(2) of this section, must be reported to the Regional Administrator within 24 hours of its detection. If the release has been reported pursuant to 40 CFR Part 302, that report will satisfy this requirement.

(2) A leak or spill of hazardous waste is exempted from the requirements of this paragraph if it is:

(i) Less than or equal to a quantity of one (1) pound, and

(ii) Immediately contained and cleaned-up.

[264.196(d)(2) corrected by 51 FR 29430, August 15, 1986]

(3) Within 30 days of detection of a release to the environment, a report containing the following information must be submitted to the Regional Administrator:

(i) Likely route of migration of the release;

(ii) Characteristics of the surrounding soil (soil composition, geology, hydrogeology, climate);

(iii) Results of any monitoring or sampling conducted in connection with the release (if available). If sampling or monitoring data relating to the release are not available within 30 days, these data must be submitted to the Regional Administrator as soon as they become available.

(iv) Proximity to downgradient drinking-water, surface water, and populated areas; and

[264.196(d)(3)(iv) corrected by 51 FR 29430, August 15, 1986]

(v) Description of response actions taken or planned.

(e) *Provision of secondary containment, repair, or closure.* (1) Unless the owner/operator satisfies the requirements of paragraphs (e)(2) through (4) of this section, the tank system must be closed in accordance with §264.197.

(2) If the cause of the release was a spill that has not damaged the integrity of the system, the owner/operator may return the system to service as soon as the released waste is removed and repairs, if necessary, are made.

(3) If the cause of the release was a leak from the primary tank system into the secondary containment system, the system must be repaired prior to returning the tank system to service.

(4) If the source of the release was a leak to the environment from a component of a tank system without secondary containment, the owner/operator must provide the component of the system from which the leak occurred with secondary containment that satisfies the requirements of §264.193 before it can be returned to service, unless the source of the leak is an aboveground portion of a tank system that can be inspected visually. If the source is an aboveground component that can be inspected visually, the component must be repaired and may be returned to service without secondary containment as long as the requirements of paragraph (f) of this section are satisfied. If a component is replaced to comply with the requirements of this subparagraph, that component must satisfy the requirements for new tank systems or components in §§264.192 and 264.193. Additionally, if a leak has occurred in any portion of a tank system component that is not readily accessible for visual inspection (e.g., the bottom of an inground or onground tank), the entire component must be provided with secondary containment in accordance with §264.193 prior to being returned to use.

(f) *Certification of major repairs.* If the owner/operator has repaired a tank system in accordance with paragraph (e) of this section, and the repair has been extensive (e.g. installation of an internal liner; repair of a ruptured primary containment or secondary containment vessel), the tank system must not be returned to service unless the owner/operator has obtained a certification by an independent, qualified, registered, professional engineer in accordance with §270.11(d) that the repaired system is capable of handling hazardous wastes without release for the intended life of the system. This certification must be submitted to the Regional Administrator within seven days after returning the tank system to use.

[Note. — The Regional Administrator may, on the basis of any information received that there is or has been a release of hazardous waste or hazardous constituents into the environment, issue an order under RCRA sections 3004(u), 3008(h), or 7003(a) requiring corrective action or such other response as deemed necessary to protect human health or the environment.]

[264.196 Note corrected by 51 FR 29430, August 15, 1986]

[Note. — See §264.15(c) for the requirements necessary to remedy a failure. Also, 40 CFR Part 302 may require the owner or operator to notify the National Response Center of certain releases.]

[Information collection requirements contained in paragraphs (d), (e), and (f) were approved by the Office of Management and Budget under control number 2050-0050]

§264.197 Closure and post-closure care.

(a) At closure of a tank system, the owner or operator must remove or decontaminate all waste residues, contaminated containment system components (liners, etc), contaminated soils, and structures and equipment contaminated with waste, and manage them as hazardous waste, unless §261.3(d) of this Chapter applies. The closure plan, closure activities, cost estimates for closure, and financial responsibility for tank systems must meet all of the requirements specified in Subparts G and H of this Part.

(b) If the owner or operator demonstrates that not all contaminated soils can be practicably removed or decontaminated as required in paragraph (a) of this section, then the owner or operator must close the tank system and perform post-closure care in accordance with the closure and post-closure care requirements that apply to landfills (§264.310). In addition, for the purposes of closure, post-closure, and financial responsibility, such a tank system is then considered to be a landfill, and the owner or operator must meet all of the requirements for landfills specified in Subparts G and H of this Part.

(c) If an owner or operator has a tank system that does not have secondary containment that meets the requirements of §264.193(b) through (f) and is not exempt from the secondary containment requirements in accordance with §264.193(g), then:

(1) The closure plan for the tank system must include both a plan for complying with paragraph (a) of this section and a contingent plan for complying with paragraph (b) of this section.

(2) A contingent post-closure plan for complying with paragraph (b) of this section must be prepared and submitted as part of the permit application.

(3) The cost estimates calculated for closure and post-closure care must reflect the costs of complying with the contingent closure plan and the contingent post-closure plan, if those costs are greater than the costs of complying with the closure plan prepared for the expected closure under paragraph (a) of this section.

(4) Financial assurance must be based on the cost estimates in paragraph (c)(3) of this section.

(5) For the purposes of the contingent closure and post-closure plans, such a tank system is considered to be a landfill, and the contingent plans must meet all of the closure, post-closure, and financial responsibility requirements for landfills under Subparts G and H of this Part.

(Information collection requirements contained in paragraphs (a)-(c) were approved by the Office of Management and Budget under control number 2050-0050)

§264.198 Special requirements for ignitable or reactive wastes.

(a) Ignitable or reactive waste must not be placed in tank systems, unless:

(1) The waste is treated, rendered, or mixed before or immediately after placement in the tank system so that:

(i) The resulting waste, mixture, or dissolved material no longer meets the definition of ignitable or reactive waste under §§261.21 or 261.23 of this Chapter, and

(ii) Section 264.17(b) is complied with; or

(2) The waste is stored or treated in such a way that it is protected from any material or conditions that may cause the waste to ignite or react; or

(3) The tank system is used solely for emergencies.

(b) The owner or operator of a facility where ignitable or reactive waste is stored or treated in a tank must comply with the requirements for the maintenance of protective distances between the waste management area and any public ways, streets, alleys, or an adjoining property line that can be built upon as required in Tables 2-1 through 2-6 of the National Fire Protection Association's "Flammable and Combustible Liquids Code." (1977 or 1981), (incorporated by reference, see §260.11).

§264.199 Special requirements for incompatible wastes.

(A) Incompatible wastes, or incompatible wastes and materials, must not be placed in the same tank system, unless §264.17(b) is complied with.

(b) Hazardous waste must not be placed in a tank system that has not been decontaminated and that previously held an incompatible waste or material, unless §264.17(b) is complied with.

Subpart K — Surface impoundments

[Subpart K revised by 47 FR 32349, July 26, 1982, effective January 26, 1983]

§264.220 Applicability.

The regulations in this subpart apply to owners and operators of facilities that use surface impoundments to treat, store, or dispose of hazardous waste except as § 264.1 provides otherwise.

§264.221 Design and ope-raring- requirements.

(a) Any surface impoundment that is not covered by paragraph (c) of this section or §265.221 of this chapter must have a liner for all portions of the impoundment (except for existing portions of such impoundments). The liner must be designed, constructed, and installed to prevent any migration of wastes out of the impoundment to the adjacent subsurface mil-or ground water or surface water at any time during the active life (including the closure period) of the impoundmem. The liner may be constructed of materials that may allow wastes to migrate into the liner (but not into the adjacent subsurface soil or ground water or surface water) during the active life of the facility, provided that the impoundment is closed in accordance with §264.228(a)(1). For impoundments that will be closed in accordance with §264.228(a)(2), the liner must be constructed of materials that can prevent wastes from migrating into the liner during the active life of the facility. The liner must be:

[264.221(a) introductory text revised by 50 FR 28742, July 15, 1985]

(1) Constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients (including static head and external hydrogeologic forces), physical contact with the waste or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation;

(2) Placed upon a foundation or base capable of providing support to the liner and resistance to pressure gradients above and below the liner to prevent failure of the liner due to settlement, compression, or uplift; and

(3) Installed to cover all surrounding earth likely to be in contact with the waste or leachate.

(b) The owner or operator will be exempted from the requirements of paragraph (a) of this section if the Regional Administrator finds, based on demonstration by the owner or operator, that alternate design and operating practices, together with location characteristics, will prevent the migration of any hazardous constituents (see § 264.93) into the ground water or surface water at any future time. In deciding whether to grant an exemption, the Regional Administrator will consider:

(1) The nature and quantity of the wastes;

(2) The proposed alternate design and operation;

(3) The hydrogeologic setting of the facility, including the attenuative capacity and thickness of the liners and soils present between the impoundment and ground water or surface water; and

(4) All other factors which would influence the quality and mobility of the leachate produced and the potential for it to migrate to ground water or surface water.

(Sec. 264.221(b)(4))

[New 264.221(c)—(e) added by 50 FR 8742, July 15, 1985]

(c) The owner or operator of each new surface impoundment, each new surface impoundment unit at an existing facility each replacement of an existing surface impoundment unit, and each lateral expansion of an existing surface impoundment unit, must install two or more liners and a leachate collection system between such liners. The liners and leachate collection system must protect human health and the environment: The requirements of this paragraph shall apply with respect to all waste received after the issuance of the permit. The requirement for the installation of two or more liners in this paragraph may be satisfied by the installation of a top liner designed, operated and constructed of materials to prevent the migration of any constituent into such liner during the period such facility remains in operation (including any post-closure monitoring period), and a lower liner designed, operated, and constructed to prevent the migration of any constituent through such liner during such period. For the purpose of the preceding sentence, a lower liner shall be deemed to satisfy such requirement if it is constructed of at least a 3-foot thick layer of recompacted clay or other natural material with a permeability of no more than 1×10^{-7} centimeter per second.

(d) Paragraph (c) of this section will not apply if the owner or operator demonstrates to the Regional Administrator, and the Regional Administrator finds for such surface impoundment, that alternative design and operating practices, together with location characteristics, will prevent the migration of any hazardous constituent into the ground water or surface water at least as effectively as such liners and leachate collection systems.

(e) The double liner requirement set forth in paragraph (c) of this section may be waived by the Regional Administrator for any monofill, if:

(1) The monofill contains only hazardous wastes from foundry furnace emission controls or metal casting molding sand, and such wastes do not contain constituents which would render the wastes hazardous for reasons other than the EP toxicity characteristics in §261.24 of this chapter; and

(2)(i)(A) The monofill has at least one liner for which there is no evidence that such liner is leaking. For the purposes of this paragraph, the term "liner" means a liner designed, constructed, installed, and operated to prevent hazardous waste from passing into the liner at any time during the active life of the facility, or a liner designed, constructed, installed, and operated to prevent hazardous waste from migrating beyond the liner to adjacent subsurface soil, ground water, or surface water at any time during the active life of the facility. In the case of any surface impoundment which has been exempted from the requirements of paragraph (c) of this section on the basis of a liner designed, constructed, installed, and operated to prevent hazardous waste from passing beyond the liner, at the closure of such impoundment, the owner or operator must remove or decontaminate all waste residues, all contaminated liner material, and contaminated soil to the extent practicable. If all contaminated soil is not removed or decontaminated, the owner or operator of such impoundment will comply with appropriate post-closure requirements, including but not limited to groundwater monitoring and corrective action.

(B) The mono611 is located more than one-quarter mile from an underground source of drinking water (as that term is defined in §144.3 of this chapter); and

(C) The monofill is in compliance with generally applicable gorund-water monitoring requirements for facilities with permits under RCRA §3005(c); or

(ii) The owner or operator demonstrates that the monofill is located, designed and operated so as to assure that there will be no migration of any hazardous constituent into ground water or surface water at any future time.

[Former 264.221(c)—(e) redesignated as (f)—(h) by 50 FR 28742, July 15, 1985]

(f) A surface impoundment must be designed, constructed, maintained, and operated to prevent overtopping resulting from normal or abnormal operations; overfilling; wind and wave action; rainfall; run-on; malfunctions of level controllers, alarms, and other equipment; and human error.

(g) A surface impoundment must have dikes that are designed, constructed, and maintained with sufficient structural integrity to prevent massive failure of the dikes. In ensuring structural integrity, it must not be presumed that the liner system will function without leakage during the active life of the unit.

(h) The Regional Administrator will specify in the permit all design and operating practices that are necessary to ensure that the requirements of this section are satisfied.

[Approved by the Office of Management and Budget under control number 2050-0007]

[264.221 amended by 50 FR 4513, January 31, 1985]

§ 264.222 Double-lined surface impoundments: Exemption from Subpart F ground-water protection requirements.

[264.222 removed by 50 FR 28742, July 15, 1985]

§§ 264.223—264.225 [Reserved]

§ 264.226 Monitoring and inspection.

(a) During construction and installation, liners (except in the case of existing portions of surface impoundments exempt from § 264.221(a)) and cover systems (e.g., membranes, sheets, or coatings) must be inspected for uniformity, damage, and imperfections. (e.g., holes; cracks, thin spots, or foreign materials). Immediately after construction or installation:

(1) Synthetic liners and covers must be inspected to ensure tight seams and joints and the absence of tears, punctures, or blisters; and

(2) Soil-based and admixed liners and covers must be inspected for imperfections including lenses, cracks, channels, root holes, or other structural non-uniformities that may cause an increase in the permeability of the liner or cover.

(b) While a surface impoundment is in operation, it must be inspected weekly and after storms to detect evidence of any of the following:

(1) Deterioration, malfunctions, or improper operation of overtopping control systems;

(2) Sudden drops in the level of the impoundment's contents; and

Severe erosion or other signs of deterioration in dikes or other containment devices.

[Former 264.226(b)(3) removed and (4) redesignated as (3) by 50 FR 28742, July 15, 1985]

(c) Prior to the issuance of a permit, and after any extended period of time (at least six months) during which the impoundment was not in service, the owner or operator must obtain a certification from a qualified engineer that the impoundment's dike, including that portion of any dike which provides freeboard, has structural integrity. The certification must establish, in particular, that the dike:

(1) Will withstand the stress of the pressure exerted by the types and amounts of wastes to be placed in the impoundment; and

[Sec. 264.226(c)(1)]

permit application and has not yet filed Part B, the owner or operator shall file an amended Part A application:

(i) With the Regional Administrator, if the facility is located in a State which has not obtained interim authorization for phase II or final authorization, within six months after the promulgation of revised regulations under Part 261 listing or identifying additional hazardous wastes, if the facility is treating, storing, or disposing of any of those newly listed or identified wastes.

(ii) With the State Director, if the facility is located in a State which has obtained Phase II interim authorization or final authorization, no later than the effective date of regulatory provisions listing or designating wastes as hazardous in that State in addition to those listed or designated under the previously approved State program, if the facility is treating, storing, or disposing of any of those newly listed or designated wastes; or

provisions of § 270.72 for changes during interim status or with the analogous provisions of a State program approved for final authorization or interim authorization for Phase II. Revised Part A applications necessary to comply with the provisions of § 270.72 shall be filed with the Regional Administrator if the State in which the facility in question is located does not have Phase II interim authorization or final authorization; otherwise it shall be filed with the State Director (if the State has an analogous provision).

(2) The owner or operator of a facility who fails to comply with the updating requirements of paragraph (g)(1) of this section does not receive interim status as to the wastes not covered by duly filed Part A applications.

(h) *Reapplications.* Any HWM facility with an effective permit shall submit a new application at least 180 days before the expiration date of the effective permit, unless permission for a later date has been granted by the Director. (The Director shall not grant permission for applications to be submitted later than the expiration date of the existing permit.)

(i) *Recordkeeping.* Applicants shall keep records of all data used to complete permit applications and any supplemental information submitted under §§ 270.10(d), 270.13, 270.14 through 270.21 for a period of at least 3 years from the date the application is signed.

(j) *Exposure information.* (1) After August 8, 1985, any Part B permit application submitted by an owner or operator of a facility that stores, treats, or dispose of hazardous waste in a surface impoundment or a landfill must be accompanied by information, reasonably ascertainable by the owner or operator, on the potential for the public to be exposed to hazardous wastes or hazardous constituents through releases related to the unit. At a minimum, such information must address:

(i) Reasonably foreseeable potential releases from both normal operations and accidents at the unit, including releases associated with transportation to or from the unit;

(ii) The potential pathways of human exposure to hazardous wastes or constituents resulting from the releases described under paragraph (j)(1)(i) of this section; and

(iii) The potential magnitude and nature of the human exposure resulting from such releases.

(2) By August 8, 1985, owners and operators of a landfill or a surface impoundment who have already submitted a Part B application must submit the exposure information required in paragraph (j)(1) of this section.

(Approved by the Office of Management and Budget under control number 2050-0007)

[48 FR 14228, Apr. 1, 1983; 48 FR 30114, June 30, 1983, as amended at 50 FR 28751, July 15, 1985; 51 FR 10176, Mar. 24, 1986]

EFFECTIVE DATE NOTE: At 51 FR 10176, Mar. 24, 1986, § 270.10 was amended by adding paragraph (e)(1)(iii), effective September 22, 1986.

§ 270.11 Signatories to permit applications and reports.

(a) *Applications.* All permit applications shall be signed as follows:

(1) *For a corporation:* By a responsible corporate officer. For the purpose

of chis section. a responsible corporate officer means (i) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal. business function. or any other person who performs similar policy- or decisionmaking functions for the corporation, or (ii) the +manager of, one or more manufacturing, production or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

NOTE: EPA does not require specific assignments or delegations of authority to responsible corporate officers identified in § 270.11(a)(1)(i). The Agency will presume that these responsible corporate officers have the requisite authority to sign permit applications unless the corporation has notified the Director to the contrary. Corporate procedure governing authority to sign permit applications may provide for assignment or delegation to applicable Corporate positions under § 270.11(a)(1)(ii) rather than to specific individuals.

(2) For *a partnership* or sole *proprietorship;* by a general partner or the proprietor. respectively; or

(3) For *a municipality, State, Federal,* or *other public agency:* by either a principal executive officer or ranking elected official. For purposes of this section. a principal executive officer of a Federal agency includes: (i) The chief executive officer of the agency, or (ii) a senior executive officer, having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).

(b) *Reports)* All reports required by permits and othe: information requested by the *Director shall be signed by a person described in paragraph (a) of this section. or by a duly authorized representative of that person. *A* person is a duly authorized representative only.if:

(1) The authorization is made in writing by a Person described in paragraph (a) of this section;

(2) The authorization specifies either an individual or a position having responsibility for overall operation o! the regulated facility or activity such as the p(n of Plant manager, operator of a well or a well field, superintendent, or position of equivalent responsibility. (A duly authorized representative may thus be either a named individual or any individual occupying a named position); and

(3) The written authorization is submitted to the Director.

(c) *Changes to authorization.* If an authorization under paragraph (b) of this section is no longer accurate because a different Individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph (b) of this section must be submitted to the Director prior to or together with any reports, information. or applications to be signed by an authorized representative.

(d) *Certification.* Any person signing a document under paragraph (a) or (b) of this section shall make the following certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on *my* inquiry of the person or persons who manage the system, or those persons directly responsible lor gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties lot rubmitting false information, including the possibility of fine and imprisonment for knowing violations.

(Clean Water Act (33 U.S.C. 1251 et seq.), *Safe* Drinking Water Act (42 U.S.C. 300f et seq.), Clean Air Act (42 U.S.C. 7401 et seq.), Resource Conservation and Recovery Act (42 U.S.C. 6901 et seq.))

[48 FR 14228. Apr. 1, 1983, as amended at 48 FR 39622. Sept. 1, 1983]

§ 270.12 Confidentiality of information.

(a) In accordance With 40 CFR Part 2, any information submitted to EPA pursuant to these regulations may be claimed as confidential by the submitter. Any such claim must be asserted at the time of submission in the manner prescribed on the application form or instructions or, in the case of other submissions, by stamping the words "confidential" business informa-

APPENDIX

EXHIBIT C

C-400-D LIME PRECIPITATION TANK INFORHATION

SECTION 6

MECHANICAL EQUIPMENT

6.01 GENERAL

This section of the specifications relates to the furnishing, installation and testing of the following equipment:

A. Caustic Pump P-1

B. Filtrate Transfer Pump P-2

C. Precoat and Precipitate Transfer Pump P-3

D. Bagged Lime Hopper

E. Drum Straddle Truck

F. Vacuum Filter System

G. Filter Discharge Chute

H. Precipitation Tank

I. Mixer M-1

6.02 CODES AND STANDARDS

A. Codes and standards which are called for or referred to herein are hereby made a part of this specification, The latest edition shall apply. In the event of discrepancies between this specification and the codes and standards, this specification shall govern.

B. The following codes and standards shall constitute a part of this specification:

American Gear Manufacturer's Association (AGMA)

American Iron and Steel Institute (AISI)

American National Standards Institute (ANSI)

American Society of Mechanical Engineers (ASME)

American Society for Testing Materials (ASTM)

American Welding Society (AWS)

Anti-Friction Bearing Manufacturers Association (AFBMA)

National Electrical Manufacturers Association (NEMA)

Occupational Safety and Health Act (OSHA)

Table D-8

HAZARDOUS WASTES WHICH MAY BE TREATED IN THE C-400-D LIME PRECIPITATION UNIT

Waste Name	EPA Waste Number	Specific Gravity
Uranium Salvage	D002, D007, D008	1.1 @ 25°C
Cleaning Tank Acid; Cleaning Tank Acids and Bases	D002, D007, D008	1.2 @ 25°C
Misc. Acids and Bases	D002	1.4 @ 25°C (max)
Misc. Aqueous Solutions Containing Toxic Metals	D001, D002, D006, D008	1.2 @ 25°C (max)

H a (1) Description of Containers [401 KAR 34:180 Sections 2 and 3] -- Containers used for the hazardous wastes are tested in Table C-3 of the Waste Analysis Plan. Container types are chosen according to DOT criteria and are specified by the Material Management Department.

D-1a(2) Container Management Practices [401 KAR 34:180 Section 4] -- Management practices at PGDP are designed to assure that wastes are handled in the safest manner possible. Specific management practices are described below.

- Container closure -- The containers are inspected prior to transportation to the processing area to ensure that they are closed. Containers are kept closed unless being filled or emptied.

MARTIN MARIETTA ENERGY SYSTEMS INC
P O BOX 1410 PADUCAH KENTUCKY 42001

QUALITY EVALUATION REPORT

COMPONENT #5 Dissolver C-400 Disposal System		VENDOR Modern Welding Co.	Year Built 1976	ESO	Pg 1
ORDER No.	R R No. / IT. No.	DWG. No. GA-E-C-14288-C	REV. 0	SPEC. No.	REV. / CAT No.
QUAN. REC.	QUAN. INSP. 1	INSPECTOR Frank Arnett	DATE 2/13/85	SUPERVISOR TM [signature] PE# 10930	DATE 2/13/8

FEATURE	CONFORM YES	CONFORM NO	FEATURE	CONFORM YES
Welds	✓		Tank Wall	
			Thickness .250	271/282
Leaks	✓			
			Tank Head	
Cracks	✓		Thickness .375	468
			Dished Head Radius =	
Erosion	✓		Head Dia. 10 Ft.	✓
Pitting	✓			
Corrosion	✓			
Swelling	✓			
Softening	✓			
Liner or Coating	*			
Obvious Nonconformities	✓			

NONCONFORMANCE DISPOSITION:
- ☐ ACCEPT - NO QUALITY COMPROMISE
- ☐ ACCEPT - QUALITY COMPROMISE
- ☐ REJECT
- ☐ REWORK

...TION AUTHORITY | DATE

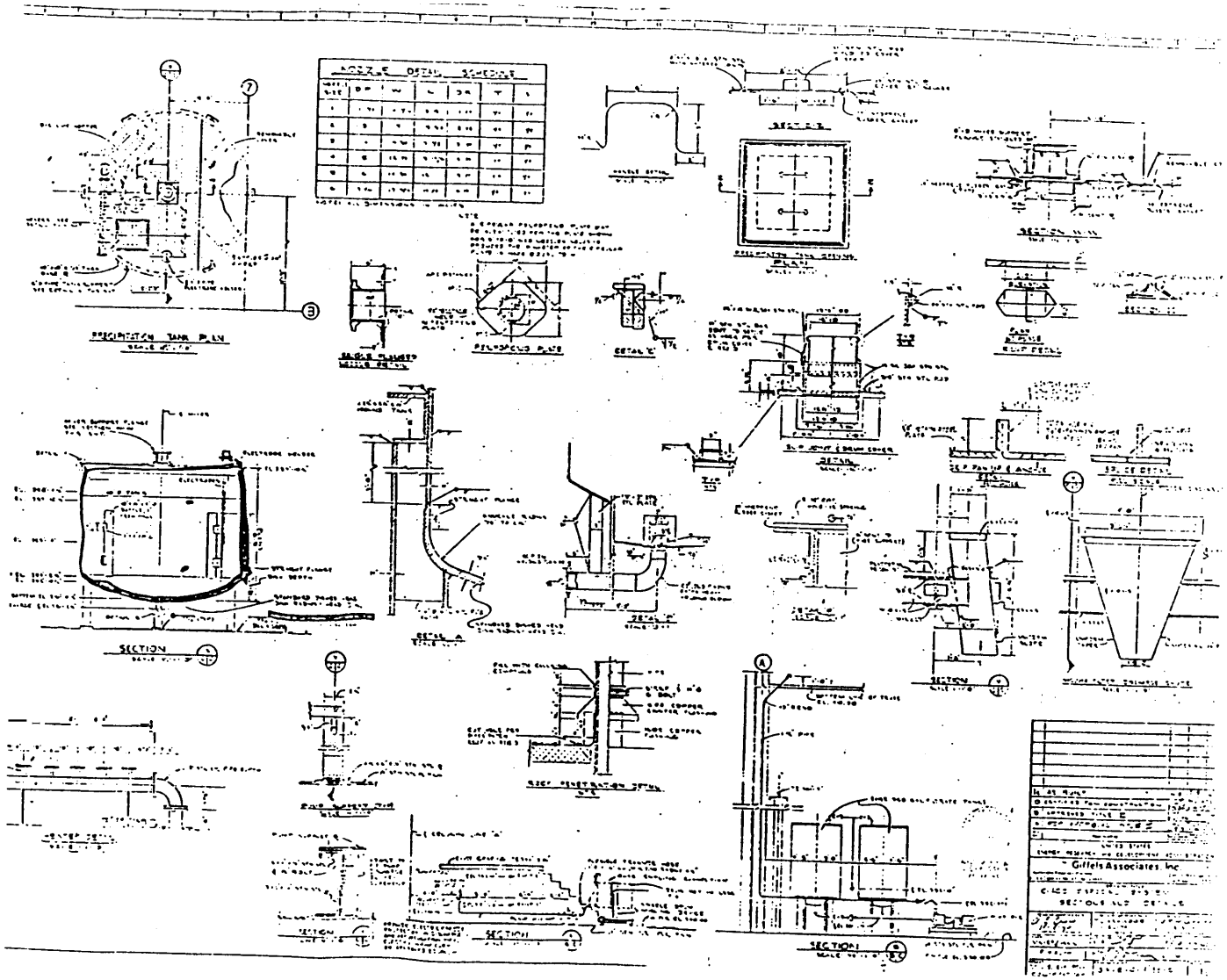
TRIBUTION
Don Parker C-400
Walt Whinnery C-400

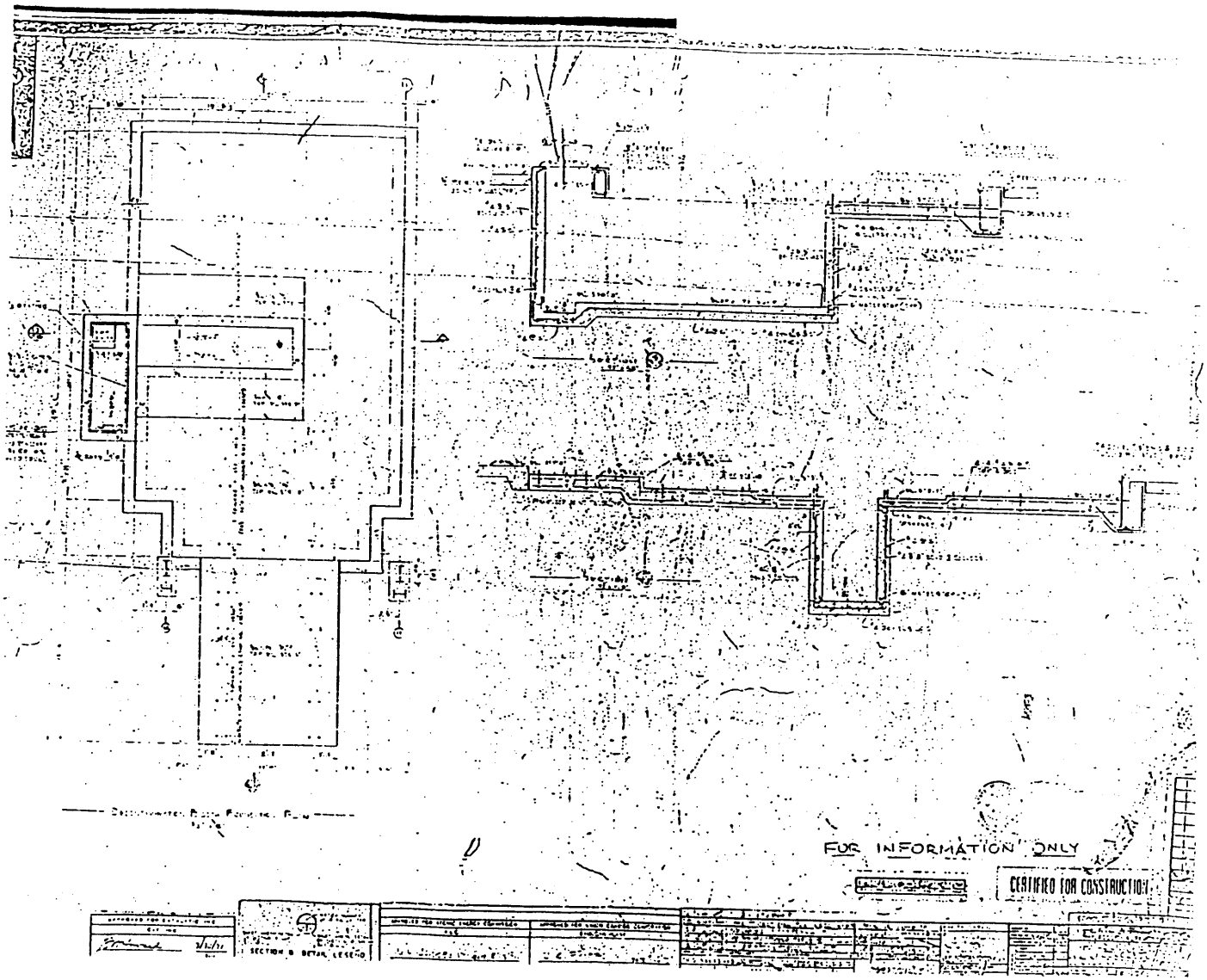
QE DISPOSITION
- ☐ NONCONFORM ____ EACH

QE FINAL DISPOSITION
- ☑ ACCEPT ____ EACH
- ☐ REJECT ____ EACH
- ☐ OUT OF TEST DATE

INSPECTION COMMENTS:
* No liner in Tank
Tank material Stainless St.

PT-2423




FOR INFORMATION ONLY
CERTIFIED FOR CONSTRUCTION

APPENDIX

EXHIBIT D

C-400-C NICKEL STRIPPER EVAPORATION TANK INFORHATION

'ARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 1410
PADUCAH, KENTUCKY 42001

December 28, 7987

Mr. Charles Neely
Lockwood Greene
Post Office Box 491
Spartanburg, South Carolina 29304

Dear Sir:

The Nickel Stripper Evaporation Tank as shown on Martin Marietta Drawing Number M5C-16628-A Rev. 0 is of watertight construction and was filled with water and tested with an atmospheric hydrostatic test prior to placing the tank in service.

This information is provided to you for the purpose of conducting your Hazardous Waste Tank Assessment.

Sincerely yours,

Walter Whinnery
Chemical Operations

WNW:st

cc: G. W. Lamb
R. L. Langston
D. E. Parker
H. Pulley
File - NoRC

TECHNICAL DATA SHEET

NO. 3705

MacDermid Incorporated

METEX
NICKEL STRIPPER SCB

WATERBURY, CT (203) 575-5700 — FERNDALE, MI (313) 399-3553 — LOS ANGELES, CA (818) 240-9573

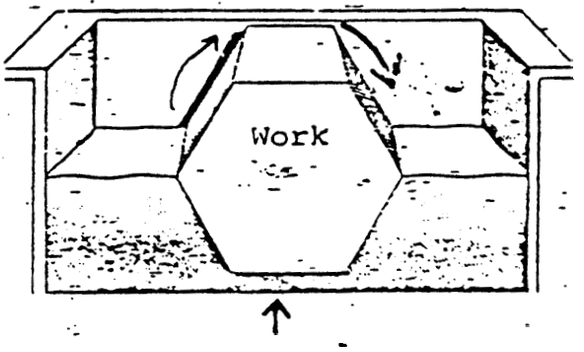
TO STRIP ELECTROLYTIC AND ELECTROLESS NICKEL FROM COPPER, BRASS, AND STEEL

Metex Nickel Stripper SCB is a two-component system designed to strip dull, semi-bright, bright or duplex nickel electrodeposits, or electroless nickel from copper, brass, steel or assemblies of these materials. The solution will also strip nickel from steel with brazed joints and electroless nickel from copper, brass, steel and assemblies of these materials.

Metex Nickel Stripper SCB-A is a dry powder and Nickel Stripper SCB-B is an alkaline liquid. The two are mixed together with water to form the stripping solution. Both materials are free of cyanide.

FEATURES	BENEFITS
Strips electroless nickel and electrolytic nickel from ferrous metals and copper alloys.	One product does many jobs. Simpler storage and inventory control.
Does not contain cyanide.	simpler waste treatment.
Works by immersion.	No DC current or racking is necessary.
Excellent stability.	Product does not decompose upon standing at ambient temperatures.
No objectionable odor	Eliminates the objections of working with obnoxious odors.

Rotating Polypropylene Barrel



Metex SCB Solution
Good Stripping Practice

Parts stripped in Metex Nickel Stripper SCB can be replated, after removing the smut that develops on the work, in 2-4 oz/gal 15-30 g/l sodium cyanide, or 50% by volume muriatic acid. In all cases, removal of this film is easiest when it is not allowed to dry on the work.

OPERATING CONDITIONS - For Stripping Electrolytic Nickel

	For Stripping Electrolytic Nickel
Concentration	Metex Nickel Stripper SCB-A, 8 oz/gal (60 g/l). Metex Nickel Stripper SCB-B, Nickel Stripper SCB-A in warm water; add, with stirring, Metex Nickel Stripper SCB-B. Bring to final volume with water.
Temperature	160-180°F (71-82°C) 160°F (71°C) preferred
Tank	
Baskets	Steel
Heater	Steel
Ventilation	Required. 100 cfm/sq ft of solution surface
Agitation	Recommended for best stripping efficiency. Agitate work or solution. DO NOT USE air agitation.

Large ratios of work to solution volume (5 sq ft/gal [12.5 sq dm/l]) and a large heating surface will give maximum economy of operation. One gallon of this stripper will dissolve approximately 50 sq ft of a nickel-deposit 0.1-mil thick. (One liter of stripper will dissolve approximately 125 sq dm of nickel 2.5 microns thick.)

Stripping speed at 180°F (82°C) is approximately 2.5 to 3.0 mils/hr (60 to 80 microns/hr).

If higher speeds are desired, heat the bath to 190°F (88°C). However, high temperature, over 180°F (82°C), will reduce the life of the solution.

Chromium plate over the nickel should first be stripped in Metex Chromium Strip M-681 (Data Sheet No. 4016). Conventional alkaline electrolytic, anodic strippers may passivate the nickel surface after chromium stripping. Reactivate passive nickel in hydrochloric acid (25% by volume) for about 30 seconds at room temperature.

Nickel plated parts to be stripped should be cleaned, preferably in Metex T-103 (Data Sheet No. 0113), 8 oz/gal (60 g/l) 180°F (82°C), 2 to 3 minutes.

TYPICAL CYCLE

1. Strip chromium plate in Metex Chromium Strip M-681, 2 lbs/gal (240 g/l), 120-140°F (50-60°C), 6 to 12 volts.
2. Cold water rinse.
3. Activate in hydrochloric acid (25% by volume),
4. Cold water rinse.
5. Strip nickel in Metex Nickel Stripper SCB.
6. cold water rinse.
7. Desmut in sodium cyanide, 4 oz/gal (30 g/l) of 50% (volume) hydrochloric acid, or bright dip in Metex Chemical Polish 3CB (Data Sheet No. 5001).
8. Cold water rinse.
9. Dry or replate.

The pH must be maintained at 12 to 12.5 with sodium hydroxide (caustic soda) to prevent any attack on steel.

WARNING: Do not leave copper alloys in the stripper longer than necessary. Excessive immersion *tines* may cause substrate attack.

ELECTROLESS NICKEL

Metex Nickel Stripper SCB *is* the preferred product for stripping electtoless nickel from copper, brass, steel or assemblies of these materials.

MAKE-UP (For Stripping Electroless Nickel):

Metex Nickel Stripper SCB-A	8 oz/gal (60 g/l)
Metex Nickel Stripper SBC-B	50% by volume
sodium hydroxide [caustic soda)	2 oz/gal (15 g/l)
Water Balance	

NOTE: Since electroless nickels vary in composition and metallurgy, the stripping rate (time) will vary.

Work agitation will accelerate the stripping rate. The use of a rotating plating barrel for stripping bulk work is recommended.

It is not practical to strip electrolytic and electroless nickel in the same solution.

MAINTENANCE

When a dark film fails to develop on the nickel plate immersed in the stripping bath, it indicates that the solution is inoperative because of exhaustion, copper or cadmium poisoning, or loss of activator. To overcome the effects of copper or cadmium, add 2% by volume Metex Nickel Stripper SCB Activator after first diluting it 1:4 with water. If this fails to restore the stripping activity, the bath should be considered exhausted and discarded.

TROUBLESHOOTING

Effect	Probable Cause	Remedy
Low stripping rate	Improper make-up	Check data sheet
	Low temperature	Increase to 160°F (70°C)
	Low pH	Add sodium hydroxide to pH 12 (electrolytic nickel): Add 2 oz/gal (15 g/l) for electroless nickel
	High metal content; solution exhausted	Discard and renew
	Chrome not stripped	Strip chrome
	Passive nickel	Activate (Step 3 under Typical Cycle)
	Dirty or oily work	Pre-clean
	Copper or cadmium poisoning	Add Metex SCB Activator (see Maintenance)
	Stripper old, overheated, decomposed	Discard and renew

TROUBLESHOOTING (continued)

Effect	Probable Cause	Remedy
Low stripping rate	Excessive plate thickness	Check thickness
	High metal content;	
Low capacity (many of the factors causing low rate will also affect the capacity)	solution exhausted	Discard and renew
	Old, overheated, decomposed	Discard and renew
	High loading factor (a large number of small parts can quickly exhaust a low volume of stripper)	Check total plated area

STANDARD PACKAGE: 55 gallon drum

MACDERMID INCORPORATED
WATERBURY, CONNECTICUT

Metex Nickel Stripper SCB

This bulletin is a revision of Issue DO-I which is now obsolete and should be destroyed.

Metex is a registered trademark of MacDermid Incorporated.

WARNING INFORMATION

WARNING

SOLUTIONS OF METEX NICKEL STRIPPER SCB-A AND SCB-B ARE OXIDIZING AND STRONGLY ALKALINE. AVOID SKIN AND EYE CONTACT. WEAR GOGGLES AND PROTECTIVE CLOTHING. AVOID BREATHING VAPORS. PROTECT EYES AND SKIN WHEN HANDLING SOLUTIONS OF METEX NICKEL STRIPPER SCB-A AND SCB-B. FLUSH EXPOSED AREAS IMMEDIATELY WITH CLEAN, COLD WATER. EYE EXPOSURE SHOULD BE FLUSHED FOR *20* MINUTES OR MORE. CONSULT A PHYSICIAN IMMEDIATELY IN CASE OF INJURY.' OSHA 20 FORKS ARE AVAILABLE FROM MACDERMID INCORPORATE~.

WASTE DISPOSAL

NEUTRALIZE THE SPENT BATH SLOWLY, WITH AGITATION, AND CAUTION USING DILUTE SULFURIC ACID (25% BY VOLUME 'SOLUTION) TO A pH OF 8 TO 9. ALLOW TEE SOLIDS TO SETTLE IN A TANK OR' IN SETTLING LAGOON. FILTER OR DECANT SUPERNATANT LIQUID. FLUSH FILTRATE DOWN TEE SEWER. OBSERVE LOCAL WASTE DISPOSAL REGULATIONS.

STORAGE

METEX NICKEL STRIPPER SCB-B CAN FREEZE NEAR 32°F (0°C). STORE AT 37°F (3°C) OR HIGHER. IF FROZEN, THAW AT ROOM TEMPERATURE, THEN STIR WELL TO PREVENT STRATIFICATION. FREEZING DOES NOT DAMAGE THE PRODUCT.'

MATERIAL SAFETY DATA SHEET

(R) 4/17/86

CODE 1370

SECTION I

Manufacturer's Name MacDermid Incorporated	EMERGENCY TELE 203-575-57
ADDRESS (Number, Street, City, State, Zip Code) 526 Huntingdon Avenue Waterbury, CT. 06720	MFSA EMERGENCY HOTLINE: (313) - 644 -
CFR-49 - DOT Proper Shipping Name Non Hazardous	
CHEMICAL NAME AND SYNONYMS N/A	TRADE NAME AND Nickel Stripper SC
CHEMICAL FAMILY Anti-Reducing Agent	FORMULA Mixture

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVE & SOLVENTS	%	TLV (UNITS)	ALLOYS & METALLIC COATINGS	%	TLV
	N/A			N/A	
PIGMENTS	"		BASE METAL	"	
CATALYST	"		ALLOYS	"	
VEHICLE	"		METALLIC COATINGS	"	
SOLVENTS	"		FILLER METAL PLUS OR CORE FLUX	"	
ADDITIVES	"		OTHERS	"	
OTHERS	"				

HAZARDOUS MIXTURES OR OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV
Salt of nitro aryl sulfonic acid	100	

SECTION III - PHYSICAL DATA

BOILING POINT (F)	N/A	SPECIFIC GRAVITY (H_2O = 1)	
VAPOR PRESSURE (MM. HG.)	0	PERCENT VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR = 1)	N/A	EVAPORATION RATE (= 1)	
SOLUBILITY IN WATER	Appreciable		

Pale yellow to tan powder - odorless

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

SED) N/A	FLAMMABLE LIMITS

Waterspray, CO., alcohol, foam, dry chemical.

SPECIAL FIRE FIGHTING PROCEDURES

If material is smoldering, spread burning material out thinly and douse with water.

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE

EMERGENCY AND FIRST AID PROCEDURES

Eyes: Flush with water for 15 minutes. Contact physician.

Internal: Give water; induce vomiting; contact physician.

SECTION VI - REACTIVITY DATA

	CONDITIONS TO AVOID
UNSTABLE	
STABLE	X

INCOMPATIBILITY (MATERIALS TO AVOID)

Strong Oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS

Oxides of sulfur, carbon and nitrogen, oxygen gas

HAZARDOUS POLYMERIZATION	CONDITIONS TO AVOID
MAY OCCUR	
WILL NOT OCCUR	X

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Scoop up with steel shovel. Flush remaining material *to* chemical drain with water.

WASTE DISPOSAL METHOD

Flush to drain. Check government disposal regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE)

Not normal required.

VENTILATION	LOCAL EXHAUST	SPECIAL
	MECHANICAL (GENERAL)	OTHER

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

PREPARED BY: Cherrie D. Gillis

DATE: 4/17/89

13705