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SPACE NUCLEAR PROPULSION OFFICE
CLEVELAND, OHIO

SPECIFICATIONS
FOR

ETS-1 EXHAUST DUCT

NUCLEAR ROCKET DEVELOPMENT STATION
JACKASS FLATS, NEVADA

19 JUNE 1964/SPECIFICATION 6884

REVISED JANUARY 1966

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EXHAUST DUCT

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SPECIFICATION
FOR
EXHAUST DUCT

1. SCOPE: The work covered by these specifications consists of furnishing all labor, equipment, materials (except Government-furnished equipment and material), supplies, services, etc., and performing all operations necessary to furnish, install, and test one exhaust duct, complete, with all supplemental items including pipe, pipe connections, tubing, and in strict accordance with these specifications and the applicable drawings and subject to the terms and conditions of the contract.

1.1 DESCRIPTION: The exhaust duct assembly as referred to herein is the complete fabrication as shown and consists of:

- (a) Upper truss
- (b) Lower truss
- (c) Duct (3 sections)

Primary section

Elbow duct section

Secondary ejector section including steam
ejector

1.2 VERIFICATION OF DIMENSIONS: The Contractor shall visit the jobsite and thoroughly familiarize himself with all pertinent site details including interfaces with the duct support systems, the working conditions, to verify all dimensions, and advise the Contracting Officer of any discrepancy before starting the work. Drawings and specifications for the duct support features will be available for inspection at the office of the Contracting Officer. One complete set of support drawings will be furnished to the Contractor upon request without cost to the Contractor.

2. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

2.1 FEDERAL SPECIFICATIONS:

P-C-437 & Am-1	Cleaning Compound, High Pressure (Steam) Cleaner
QQ-P-416a & Am-1	Plating, Cadmium (Electrodeposited)
RR-G-661a	Gratings, Steel, Floor (Except for Naval Vessels)
TT-P-38a	Paint, Aluminum, Ready-Mixed
PPP-C-843a & Am-2	Cushioning Material, Cellulosic

2.2 MILITARY SPECIFICATIONS:

MIL-B-131C & Am-2	Barrier Material, Water Vaporproof, Flexible
MIL-S-862B & Am-1	Steel Bars, Corrosion Resisting, and Steel Billets, Corrosion Resisting, Reforging Application
MIL-A-907C	Antiseize Compound, High Temperature
MIL-Y-1140E	Yarn, Cord, Sleeving, Cloth, and Tape- Glass
MIL-F-5509A	Fittings, Flared Tube, Fluid Connection
MIL-T-5542B	Thread Compound, Antiseize and Sealing, Oxygen Systems
MIL-C-6021E	Castings, Classification and Inspection of
MIL-S-6721B & Am-2	Steel, Corrosion- and Heat-Resistant (Chemically Stabilized) Plate, Sheet, and Strip
MIL-H-006875C	Heat Treatment of Steels (Aircraft Practice, Process For)
MIL-P-8585A	Primer Coating, Zinc Chromate, Low- Moisture-Sensitivity

MIL-A-8625A	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-S-8660B & Am-1	Silicone Compound
MIL-T-8808A	Tubing, Steel, Corrosion-Resistant (18-8 Stabilized), Aircraft Hydraulic Quality
MIL-L-8937 & Am-1	Lubricant, Solid Film, Heat Cured
MIL-Q-9858A	Quality Program Requirements
MIL-B-16166A & Am-1	Bronze, Aluminum, Forgings, Heat Treated
MIL-A-18455B	Argon, Technical
MIL-C-20079C & Am-1	Cloth, Glass; Tape, Textile, Glass; and Thread, Glass
MIL-S-25043B	Steel Plate, Sheet, and Strip, 17-7 PH, Corrosion Resistant, Precipitation Hardening
MIL-P-27401B	Propellant Pressurizing Agent, Nitrogen

2.3

MILITARY STANDARD:

MIL-STD-129C	Marking for Shipment and Storage
MIL-STD-130B	Identification Marking of U. S. Military Property
MS-33540	Safety Wiring, General Practices for
MS-33584B	Tubing End, Standard Dimensions for Flared
MS-33586A	Metals, Definition of Dissimilar
MS-33611	Tube Bend Radii
MS-33656C	Fitting End, Standard Dimensions for Flared Tube Connection and Gasket Seal
MS-35303	Screw, Cap, Hexagon Head (Finished Hexagon Bolt), Alloy Steel, Cadmium of Zinc Finish, UNC-2

- 2.4 AIR FORCE - NAVY AERONAUTICAL STANDARDS:
- AN 815 Union - Flared Tube
- AN 816 Nipple - Flared Tube and Pipe Thread
- AN 900 Gaskets - Copper-Asbestos Annular
- AN 960 Washer, Flat
Rev. 8
- 2.5 AIR FORCE - NAVY AERONAUTICAL DESIGN STANDARD:
- AND 10050 Bosses, Standard Dimensions for
Gasket Seal Straight Thread
- AND 10059 Fittings - Styles of Pipe Threaded,
Flared Tube and Hose
- AND 10064 Fittings - Installation of Flared
Tube, Straight Thread Connectors
- 2.6 U. S. AIR FORCE SPECIFICATION BULLETIN:
- NR 515 Control of Nonconforming Supplies (As
Modified in AMCM 74-1 in the Quality
Control Bulletin)
- 2.7 U. S. DEPARTMENT OF COMMERCE (NATIONAL BUREAU OF
STANDARDS) CIRCULAR:
- 561 Reference Tables for Thermocouples
- 2.8 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION QUALITY
PUBLICATIONS:
- NPC 200-3 Inspection System Provisions for
Suppliers of Space Materials, Parts,
Components and Services
- 2.9 ALUMINUM ASSOCIATION:
- Aluminum Construction Manual
- 2.10 AMERICAN INSTITUTE OF STEEL CONSTRUCTION:
- Specification for the Design, Fabrication, and Erection
of Structural Steel for Buildings
- 2.11 AMERICAN SOCIETY OF CIVIL ENGINEERS:
- Specification for Structures of Aluminum Alloy 6061

2.12

AMERICAN SOCIETY OF MECHANICAL ENGINEERS:

Boiler and Pressure Vessel Code and Interpretations,
Section VIII, Rules for Construction of Unfired
Pressure Vessels, 1962 and Errata, and 1962-63
Addenda

Boiler and Pressure Vessel Code and Interpretations,
Section IX, Qualification Standard for Welding and
Brazing Procedures, Welders, Brazers, and Welding
and Brazing Operators, 1962, With 1962-63 Addenda

Case Ruling 1338 Ultrasonic Examination of Plates and
Forgings

2.13

AMERICAN SOCIETY FOR TESTING AND MATERIALS STANDARDS:

A 193-62 T	Alloy-Steel Bolting Materials for High-Temperature Service
A 194-62 T	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High- Temperature Service
A 213-62 T	Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat Exchanger Tubes
A 240-63	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Fusion-Welded Unfired Pressure Vessels
A 276-63	Hot-Rolled and Cold Finished Stainless and Heat Resistant Steel Bars
A 298-62 T	Corrosion-Resisting Chromium and Chromium-Nickel Steel Covered Welding Electrodes
A 307-64	Low-Carbon Steel Externally and Inter- nally Threaded Standard Fasteners
A 312-62 T	Seamless and Welded Austenitic Stainless Steel Pipe
A 320-64	Alloy-Steel Bolting Materials for Low- Temperature Service
A 371-62 T	Corrosion-Resistant Chromium and Chromium-Nickel Steel Welding Rods and Bare Electrodes
A 376-62 T	Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service

A 358-63a T	Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service
A 388-59	Ultrasonic Testing and Inspection of Heavy Steel Forgings
A 403-61 T	Factory-Made Wrought Austenitic Steel Welding Fittings
A 430-62 T	Austenitic Steel Forged and Bored Pipe for High-Temperature Service
A 473-63	Stainless and Heat Resisting Steel Forgings
B 148-52	Aluminum Bronze Sand Castings
B 209-62	Aluminum-Alloy Sheet and Plate
B 221-64	Aluminum-Alloy Extruded Bars, Rods, Shapes, and Tubes
B 308-62	Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded
B 316-61	Aluminum-Alloy Rivet and Cold Heading Wire and Rods
E 113-55 T	Ultrasonic Testing by the Resonance Method
E 114-63	Ultrasonic Testing by the Reflection Method Using Pulsed Longitudinal Waves Induced by Direct Contact
E 164-62 T	Ultrasonic Contact Inspection of Weldments
E 165-60 T	Liquid Penetrant Inspection

2.14

AMERICAN STANDARDS ASSOCIATION STANDARDS:

B2.1-1960	Pipe Threads (Except Dryseal)
B16.5-1961	Steel Pipe Flanges and Flanged Fittings
B31.1-1955 & Add: B31.1a-1961	Code for Pressure Piping
B31.3-1962	Petroleum Refinery Piping

2.15 AMERICAN WELDING SOCIETY STANDARDS:

D1.0-46 Code for Welding in Building
Construction

D2.0-63 Specification for Welded Highway
and Railway Bridges

2.16 INSTRUMENT SOCIETY OF AMERICA REPORTS:

RP1.1 thru Thermocouples and Thermocouple
RP1.7 Extension Wire

2.17 SOCIETY OF AUTOMOTIVE ENGINEERS - AEROSPACE MATERIAL
SPECIFICATIONS:

AMS 5644C Steel, Bars and Forgings, Corrosion-
Resistant, 17 Cr - 7 Ni - 1 Al

3. CONTRACT DRAWINGS: The contract drawings indicate the extent and arrangement of the work. If any departure from the contract drawings is deemed necessary by the Contractor, details of such departure and the reason therefor accompanied by all backup design calculations, laboratory test data, and changes in related portions of the project, including estimate of changes in cost, if any, shall be submitted, in writing, as soon as practicable to Contracting Officer, for approval in accordance with the terms and conditions of the contract.

4. SHOP DRAWINGS: Shop drawings shall be submitted for approval in accordance with the terms and conditions of the contract. The shop drawings shall show the locations of weld seams; sizes of welds, plate, and shape thicknesses; weight; details of drains; details required for fabrication of the duct, duct cooling, and duct support details; and a complete bill of materials; and all nondestructive testing requirements. Information shall also be furnished with the shop drawings showing the specific metals to be used, including references to the ASME Code Case Interpretations, if applicable.

4.1 CATALOG DATA: Catalog data and outline drawings on all standard items of equipment to be furnished by the Contractor shall be submitted to the Contracting Officer in accordance with the terms and conditions of the contract.

4.2 SPECIAL ITEMS: For all items to be furnished under this contract for which catalog data is not available, the Contractor shall, prior to purchase, furnish the Contracting Officer with information, calculations, graphs, experience history, and test data as required to indicate that the proposed item will meet the specified requirements.

5. SHOP INSPECTIONS: Representatives of the Contracting Officer shall have access to fabricating plants at any reasonable time for the purpose of inspection of work and materials. Presence or absence of such representatives shall not relieve Contractor of responsibility for satisfactory performance of work. Defective materials or faulty workmanship will not be accepted. Contractor shall notify Contracting Officer at least 5 days before inspections and testing of the complete duct structure in order that Contracting Officer or a duly authorized representative may be present to witness such checkout.

5.1 OFFICE SPACE: The Contractor shall provide office space in the fabricating plant for the use of the Contracting Officer's representative.

6. GOVERNMENT-FURNISHED EQUIPMENT:

6.1 GENERAL: The type and quantity of Government-furnished materials and equipment are as scheduled herein. Any materials or equipment in excess of that ultimately required upon completion

of the work shall remain the property of the Government and shall be returned thereto in good condition. No modification of Government-furnished equipment will be provided without Contractor's request in writing and subsequent approval by the Contracting Officer.

6.2 RECEIPT BY CONTRACTOR: The Contractor shall check the quantity and condition of Government-furnished materials and equipment when received by him. Acknowledgement of receipt thereof and report of any shortage or damage thereto shall be made in writing to the Contracting Officer within 24 hours of receipt.

6.3 DELIVERY: The Government will have Government-furnished equipment required for shop assembly of the duct delivered to the railhead nearest the Fabricator's plant if shipped by rail, or to the plant site if shipped by truck. Government-furnished equipment not required at the Contractor's plant will be shipped by truck directly to the jobsite. The Contractor shall provide all personnel and equipment necessary to unload and transport all materials and equipment to the work area where materials and equipment shall be unpacked and prepared for connection to the duct. It shall be the Contractor's responsibility to unload as quickly as possible. Demurrage charges, if any, shall be at the Contractor's expense.

6.4 INSTALLATION: All Government-furnished materials and equipment shall be installed as shown and specified.

6.4.1 INSTALLATION MATERIALS: All items required for interface or other connection and/or tie-down such as bolts, gaskets, shim stock, doweling, hangers, and supports shall be furnished by the Contractor to complete necessary fabrication and installation requirements.

6.4.2 ASSEMBLY AND CONNECTIONS: All connections shall be indicated size. No modification of Government-furnished equipment to meet project requirements will be permitted without prior Contracting Officer approval.

6.4.3 ITEM DELIVERY: The Government-furnished equipment will be delivered either fully assembled or in subassemblies as per vendor's respective requirements to minimize shipping damage. Contractor shall make all assemblies necessary to install such equipment.

6.5 EQUIPMENT LIST: In accordance with specified requirements the Contractor shall assemble on the duct and thereafter treat as part of the duct assembly the following Government-furnished equipment.

<u>Item</u>	<u>Quantity</u>	<u>Description</u>	<u>Approx. Wt. Lbs.</u>	<u>Anticipated Delivery Date</u>
1	1	Upper duct clamp and seal assem- bly including Marmon clamp, clamp actuation motors, bellows, bellows support turnbuckles, and hardware and one set metal seals (Conoseals)	10,000	1 Feb. 1965
2	4	Copper gaskets		1 Feb. 1965

7. MATERIALS AND EQUIPMENT LIST: As soon as practicable the Contractor shall submit to the Contracting Officer for approval a complete list, in triplicate, of materials and equipment to be incorporated in the work. This list shall include manufacturer's style or catalog numbers when they are standard products. Cuts or other descriptive data shall be furnished when required by the Contracting Officer. No consideration will be given to partial lists submitted from time to time. Approval of materials will be based on manufacturer's published data; approval of materials and equipment will be tentative subject to submission of complete shop drawings indicating compliance with the contract documents, and the certified test reports proving compliance with the specifications.

7.1 STANDARD PRODUCTS: The materials and equipment to be furnished under this specification shall be the standard catalog products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate materials and equipment that have been in satisfactory use for at least 2 years. Where 2 or more units of the same type of equipment are required, these units shall be the products of a single manufacturer.

7.2 QUALIFICATION OF SPECIALTY MANUFACTURERS: At the time of submittal of materials and equipment list, the Contractor shall submit the following information on the qualifications of manufacturers of expansion joints and clamps.

7.2.1 CERTIFICATION: The Contractor shall provide certification that the manufacturer is qualified as a supplier of such devices to the Government or that identical components have been quality tested by an approved independent testing laboratory or Government agency and has demonstrated satisfactory performance.

7.3 PURCHASE ORDERS: Three copies of each purchase order or subcontract issued by the Contractor or his subcontractors for materials or equipment to be incorporated into the project shall be furnished the Contracting Officer, or his representative, as soon as issued. At the option of the Contractor, these copies of purchase orders or subcontracts may, or may not, indicate the price of the articles involved.

8. MATERIALS: Materials shall be new and shall conform to the drawings, specifications, and other requirements specified herein, in the appendix attached hereto, and in referenced specifications, codes, and other publications. Tests called for in referenced publications, to the extent that they are applicable to the materials furnished, shall be performed unless specifically waived in writing by the Contracting Officer. Certified mill and laboratory test reports in triplicate must be submitted to the Contracting Officer at no additional cost to the Government indicating proof of conformance with specification requirements. Materials and equipment which are defective or damaged in the course of fabrication, shipment, installation, or test shall be replaced or repaired to the satisfaction of the Contracting Officer. Nonconforming material shall be rejected. Control shall be as specified in USAF Bulletin NR 515 as modified in revision of AMCM 74-1 in the Quality Control Bulletin. Stainless steel sheet materials shall have a bright cold-rolled mill finish. Where columbium-tantalum stabilized Type 347 stainless steel is specified the alloy composition shall be further limited as follows: 0.020 maximum of phosphorus, 0.035 maximum of phosphorus and sulphur, and carbon shall be limited to 0.04 minimum and 0.08 maximum, per cent. Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other. Dissimilar metals are as defined in Military Standard MS-33586. Carbon steel shall not be permitted as part of the work under this contract, except as otherwise shown or specified. Tooling, fixtures, supports, bracing, and other equipment used in fabrication and heat treatment and not supplied under this contract as part of the exhaust duct, may be carbon steel only if contact surfaces are stainless steel or other approved materials.

8.1 DUCT: Duct shall be fabricated of Type 347 columbium-tantalum (Cb-Ta) stabilized stainless steel conforming to Military Specification MIL-S-6721, except alloy composition shall be limited as specified in Paragraph 8. Surface finishes shall be No. 2B for sheet material or 32 rms for those sheets that are ground, and No. 2 for strip material rather than No. 2D and No. 1 as listed in Military Specification MIL-S-6721. Material thickness and dimensions shall be as shown on the drawings, except where otherwise specified. Parent sheet stock used to form the internal diameter of the duct and coolant channels of the duct shall have wall thicknesses of 0.095 inch plus or minus 0.005 inch. Splices will be permitted by butt-welding the channels provided surfaces within the flow passages are smooth within 0.010 inch.

8.1.1 COOLANT TUBES: If welded tubing is used, the weld seam shall be placed on the outside. Coolant tubes in the elbow section of the duct and all tubes shall be Type 347 stainless steel and shall conform to Military Specification MIL-T-8808 Type I (preferred) or Type II, except composition shall be limited (see Paragraph 8), and permissible depth of defects shall be .005, maximum. Tubes shall have 0.095 plus or minus 0.005 inch wall thickness. Splicing will not be permitted in the coolant tubes.

8.1.1.1 TUBING ACCEPTANCE TESTS: In addition to the acceptance tests specified in Military Specification MIL-T-8808, each tube shall be hydrotested at 400 psig and eddy current tested by the tubing manufacturer. The eddy current procedure shall be capable of detecting OD and ID flaws in the longitudinal and transverse directions of .005 inches in depth and 1/2 inch long. Suggested procedures shall be submitted to the Contracting Officer for approval prior to implementation.

8.1.2 SEVERANCE CLAMPS: Each severance clamp shall have integral guides to assure axial alinement without offset before the clamping ring is closed. Minimum engagement of the guides shall be 1/20 of the nominal pipe diameter. Guides shall be tapered and shall be designed to resist shear between the joint halves at least equal to 10 per cent of the shear capacity of the pipe when total disengagement is 1/40 of the nominal pipe diameter. Each clamp shall be equipped with guide support plates that, in addition to supporting the clamp ring, will assure concentricity with the geometric center of the flanges when the clamp is in the fully open position. Each clamp shall be shipped with 2 complete sets of spare gaskets marked with clamp item number. Each clamp shall be at least as strong as the pipe connected to it and shall be capable of withstanding all pressures, moments, and forces that are within capability of the pipe using the same metal stresses and factor of safety specified in ASA Code B31.3.

8.1.2.1 DUCT SEVERANCE CLAMP: This clamp shall be manually operated, double-seal type, Item MJH 59302 as manufactured by the Marman Division of Aeroquip Corporation except as modified in accordance with drawings herein. The male flange shall be equipped with eight 1/8-inch diameter vent holes equally spaced on the circumference and a female weld boss, as shown on the drawings, drilled for pressurizing the space between the inner and outer gaskets with gaseous nitrogen. The weld boss shall be tapped for a 1/4 inch AND fitting using "Voi-Shan" conical seals. Clamp material shall be as follows:

<u>Part</u>	<u>Material</u>
Flanges and Guide Plates	AISI Type 347 (composition limited, Paragraph 8)
Sealing Gaskets	Aluminum 7050-0, 6061-0, or approved alternate
Clamp Ring and Pins	AISI Type 347 (composition limitation, Paragraph 8, not applicable)
Bolts	ASTM A 193, Grade B8 or approved alternate
Trunnions and Bushings	Aluminum-bronze or approved alternate

8.1.2.2 REMOTE OPERATED SEVERANCE CLAMPS - ITEMS 50-C-1, 50-C-2, AND 50-C-3: Each of these clamps shall be equipped with an impact-type gaseous nitrogen (air) motor as described in "EQUIPMENT SPECIFICATIONS." The air motor and clamp ring shall be mounted in a manner such that these parts remain with the top half of the severance clamp and are not removed with the duct from the vault. The "air" motors shall be capable of developing the required torque to open the clamp when supplied a maximum of 100 psig nitrogen. The impact motors shall be of a manufacturer's standard basic design. All parts shall be metallic; lubricant materials shall be dryfilm such as molybdenum disulphide; external carbon steel surfaces shall be cadmium-plated per Federal Specification QQ-P-416, Class 1. Motors shall be of weather-proof construction, and shall have exhaust ports extended downward a sufficient distance to prevent deluge water from splashing into the motor case. Internal parts of the motor shall be protected to prevent corrosion during long periods of disuse. The clampmotor drive arrangement shall be designed with a positive lock or shear device to absolutely prevent the clamp screw from rotating due to vibration during a test firing. Since the clamps will be manually closed, the design must also include provisions for defeating or uncoupling the locking device when closing the clamp. The actuator design must give assurance that the clamp components will not be damaged by continued operation of the impact-motor for a brief period after the clamp has completely opened. The clamp and motor assemblies shall be shop tested by the clamp manufacturer to check proper opening without exceeding nitrogen pressures specified. Clamp material shall be as follows:

<u>Part</u>	<u>Material</u>	
	<u>50-C-1 and 50-C-2</u>	<u>50-C-3</u>
Flanges and Guide Plates	AISI Type 304	AISI Type 347 (composition limited, Para- graph 8)
Sealing Gaskets	Aluminum 7075-0, 6061-0 or approved alternate	
Clamp Ring and Pins	AISI Type 304	AISI Type 347 (composition limitation Paragraph 8 not applicable)
Bolts	ASTM A 193, Grade B8 or approved alternate	

8.2 TRUSS AND PIPING: All piping including pressure lines and structural members of the truss shall be stainless steel conforming to ASTM A 312, identification symbol TP304, or ASTM A 376, identification symbol TP304. Size and wall thicknesses of structural members shall be as shown. Pressure piping shall be as shown and as specified in the Appendix A. Nonpipe member shall be of the same composition as the truss unless otherwise specified.

8.3 TUBING: All tubing, other than coolant tubes, shall conform to Tubing Material Specification "T" in the Appendix A.

8.3.1 FLEXIBLE TUBING: Flexible tubing shall be constructed entirely of 300 series stainless steel having a corrugated core or bellows covered with a stainless steel braid welded to the nipples at both ends of the braid. Overall length shall be at least 12 inches and each section shall be capable of at least 1/2-inch lateral movement in any direction from the axial centerline.

8.3.1.1 1/4-INCH FLEXIBLE TUBING: At the option of the Contractor, and provided sufficient space is available, either a coiled length of standard tubing or a larger diameter length of flexible tubing may be substituted for 1/4-inch flexible tubing. If a coil of 1/4-inch tubing is used the coil diameter shall be about 8 inches. Flexible tubing of larger diameter shall not be over 1/2-inch nominal.

8.4 DELETED :

8.5 FORGINGS: Forgings shall be of Type 347 stainless steel and shall conform to ASTM A 473, or as otherwise noted. Castings may be used in lieu of forgings on written approval of the Contracting Officer and provided such castings conform to Military Specification MIL-C-6021, Class 1A.

8.5.1 ALUMINUM BRONZE FORGINGS: Aluminum bronze forgings shall conform to Military Specification MIL-B-16166. Aluminum bronze castings may be used provided such castings conform to ASTM B 148, Alloy 9B.

8.6 EXPANSION JOINTS: All expansion joints shall be provided with plain ends beveled for welding and bored to inside diameter of the pipe to which it is connected. Material shall be approved stabilized austenitic stainless steel for the bellows, and Type 304, 316, 321, or 347 stainless steel for the pipe sections except 347 composition limitation (Paragraph 8) is not applicable. At least 4 through-bolts shall be provided for each bellows using ASTM A 193 Grade B8 stainless steel and ASTM A 194 Grade B8 nuts. Each nut shall be drilled and wire-locked into its final position. Required movement, design pressures and temperatures and hydrostatic test pressures shall be as shown on the attached data sheets. Each bellows shall be dye penetrant tested over entire surface after the hydrostatic test. Circumferential welds on the bellows will not be accepted except on the water tank seal.

8.6.1 PRESSURE BALANCED ELL-TYPE: Expansion joints of the pressure balanced elbow type shall be "through-bolted" to eliminate axial thrust from internal pressure. Each "through-bolt" shall be equipped with at least 4 nuts positioned to restrict axial movement in either direction of the end of the compensated bellows in relation to one end of the elbow. The other end of the elbow shall be cold-sprung, when specified on the data sheets by temporary connections to the through bolts. A tag shall be wired to each cold sprung joint describing the amount and direction of cold spring and that the temporary connections must be removed after installation.

8.6.2 JOINT 50-EJ-34: Each bolt shall be equipped with 4 nuts. The 8 "inner" nuts positioned by drilling and through-wiring to limit the amount of compression and the 8 "outer" nuts shall be positioned by drilling and through-wiring to limit the amount of expansion. The total amount of compression and expansion required shall be as shown on the data sheets.

8.6.3 THERMOCOUPLE EXPANSION JOINTS: Thermocouple penetrations into the elbow section coolant tubes require bellows to provide a flexible connection between the coolant tubes and the water jacket wall. The bellows shall be designed for the pressure on the inside of the bellows and installed as shown on the drawings. Maximum working pressure is 240 psig at 180 degrees F maximum, and bellows shall be hydrostatically tested at 360 psig.

8.6.4 DELETED

8.7 INSTRUMENTS:

8.7.1 ORIFICES:

8.7.1.1 PLATE TYPE: Plate type orifices shall be fabricated from Type 304 stainless steel conforming to ASTM A 240. They shall be provided with an identification tab protruding beyond the outside diameter of flange stamped with item number and orifice diameter. Size of plates and orifices shall be as shown on data sheets in the appendix.

8.7.1.2 ORIFICE FLANGES: Orifice flanges shall be of Type 304 stainless steel and shall be faced and drilled to 300 pound ASA standard with 1/16 inch raised face and 1/4 inch pressure tap connections conforming to AND 10050. They shall be equipped with suitable jack screws to spread flanges for easy removal of orifice plate and have 2 Johns-Manville Spirotallic No. 913, or approved equipment, gaskets.

8.7.1.3 UNION TYPE: Union-type orifices shall be as detailed on the drawings.

8.7.2 DELETED

8.7.3 DELETED

8.7.4 FLOW ELEMENTS: Flow tubes shall be as specified in appendix.

8.8 DELETED

8.9 STAINLESS STEEL BOLTS AND NUTS: All bolts shall be strain-hardened and shall conform to ASTM A 193 or A 320, Grade B8 series. Nuts shall conform to ASTM A 194, Grade 8. All nuts, bolts, and cap screws shall be safety-wired by approved methods unless other means of antivibration protection are indicated or approved by the Contracting Officer.

8.10 ALUMINUM: Platform, ladders, and miscellaneous metal items of aluminum shall be of alloy 6061-T6 conforming to requirements of ASTM B 308, alloy GS11A, temper T6, and ASTM B 209, alloy GS11A (6061), temper T6. Grating shall be of pattern and type conforming to Federal Specification RR-G-661, Type I, size as shown. Same alloy and temper conforming to ASTM B 221 may be substituted for ASTM B 308.

8.10.1 ANODIC COATING: Anodic coating shall conform to Military Specification MIL-A-8625, Type I.

8.10.2 ALUMINUM BOLTS: Bolts shall conform to ASTM B 316, CG-42A (2024), temper T4. Nuts shall be of an approved self-locking type of same material as the bolts or may be of stainless steel when bolt is anodized. (Aluminum bolts may be used for aluminum members only.) Aluminum bolts and washers shall be anodized.

8.11 DRY AIR: Dry air shall be oil-free air which has been processed through a dehydrator so that its dew point is minus 40 degrees F at one atmosphere.

8.12 NITROGEN: Nitrogen shall conform to Military Specification MIL-P-27401, and which has been filtered through a 40-micron absolute rated filter with an element constructed of stainless steel dutch twill weave. The filter shall have been cleaned to insure that it does not contaminate the system with which used, in excess of the filter rating.

8.13 CLEAN DOMESTIC WATER: All water used in washing and testing shall be clean, of good purity, and have a low chloride content.

8.14 DRY LUBRICANT: All surfaces so designated on the drawings shall be lubricated with molybdenum disulphide, or other approved dry lubricant having the properties of Electrofilm No. 5396 by Electrofilm, Inc., P.O. Box 106, North Hollywood, California, or approved equal. The technique of process of application shall be in accordance with the manufacturer's recommendations for the specific application and materials to be coated and otherwise shall conform to Military Specification MIL-L-8937.

8.15 STEEL FOR TRUSS TRUNNIONS: Steel for trunnions shall be 17-4 precipitation-hardening stainless steel for forging, Condition H 900, with the following chemical composition and approximate mechanical properties:

Chemical Composition

Carbon	0.07 maximum	Silicon	1.00 maximum
Manganese	1.00 maximum	Chromium	15.50 - 17.50 per cent
Phosphorus	0.04 maximum	Nickel	3.00 - 5.00 per cent
Sulphur	0.03 maximum	Copper	3.00 - 5.00 per cent
Columbium plus tantalum	0.25 - 0.45 per cent		

Mechanical Properties

Shear strength approximately 70 per cent of ultimate strength; Condition H 900, hardened 900 degrees F. one hour, air cooled.

Ultimate Strength, psi Tension 200,000

0.2 Per Cent Yield Strength, psi

Tension	185,000
Compression	178,000

Endurance Strength, psi

10 Million Cycles	90,000
100 Million Cycles	80,000

Elongation in 2 inches
or 4 x D per cent

14

Reduction of Area, per cent

50

Charpy V-Notch Impact, Ft. Lbs.

20

Hardness

Rockwell	C44
Brinell	420

Modulus of Elasticity

Tension	28,500,000
Torsion	10,500,000

8.16 SLEEVES FOR DUCT HINGES (SLIDING AND FIXED): Sleeves for hinges shall be formed of 17-7PH stainless steel, heat treated, and shall conform to Military Specification MIL-S-25043, Condition TH-1050 or AMS-5644.

8.17 STEAM PIPING INSULATION: Steam piping shall be insulated where and as indicated on the drawings.

8.17.1 INNER INSULATION: Inner insulation shall be 1-1/2 inches thick by 3 feet long, preformed type of calcium silicate suitable for a maximum temperature of 1500 degrees F. Thermal conductivity shall be 0.80 Btu/hr/sq. ft./deg. F/inch maximum at a mean temperature of 800 degrees F. Density shall be 12 pounds per cubic foot maximum, and flexural strength shall be 90 psi minimum.

8.17.2 OUTER INSULATION: Outer insulation shall be 1-1/2 inches thick by 3 feet long preformed type calcium silicate suitable for a maximum temperature of 1000 degrees F. Thermal conductivity shall be 0.55 Btu/hr/sq. ft./deg. F/inch maximum at a mean temperature of 600 degrees F. Density shall be 11 pounds per cubic foot maximum, and flexural strength shall be 50 psi minimum.

8.17.3 WIRE HANGERS: Inner and outer layers shall each be secured to the pipe with 3 bands of 16 gage soft annealed wire per 3-foot length of insulation blocks. Center band shall be more tightly drawn to permit insulation to expand freely toward the ends.

8.17.4 LAP JOINTS: Outer layer joints shall overlap inner layer joints by 3 inches minimum.

8.17.5 ALUMINUM JACKET: Outer jacket shall be 4 feet 3 inches long, .015 inch thick embossed aluminum with longitudinal backing seam installed with 2-1/2 inch overlap at side, applied to shed water.

8.17.6 STAINLESS STEEL JACKET ENCLOSURES: Where drawings show closures and jacketing in contact with the bare steam line, Type 347 or Type 304 stainless steel, 22 gage minimum thickness, shall be used for the closure or jacket.

8.17.7 JACKET BANDS: Outer jacket shall be secured to pipe with at least two 1/2 inch wide, .015 inch thick stainless steel and adjustable tension bands per length. Place one band at lap joint and one band at a point midway between lap joints. Middle tension band shall be more tightly drawn to permit movement between adjoining sections of the outer jacket as the pipe expands and contracts.

8.17.8 PREFORM JACKET ELBOWS: Outer jacket at elbows shall be preformed, 2 piece, .025 inch thick aluminum jacketing elbows.

8.17.9 WEATHERPROOF JACKET SEAL: All jacket seams and joints must be sealed and/or fitted together in a manner which will not allow any water to penetrate into the insulation.

8.18 NONCONFORMING MATERIAL:

8.18.1 MATERIAL REVIEW: The Contractor shall provide for the review, control, and disposition of nonconforming material including both raw and fabricated. Each nonconformance shall be reviewed, a disposition made by personnel vested with this responsibility, and positive corrective action taken to prevent recurrence of similar discrepancies. Except as provided in Subparagraph "REWORK WITHOUT MRB," the Contractor may offer material having minor nonconformance for review of a decision-making material review board (MRB). Each MRB shall be composed of one Contractor representative whose primary responsibility is design, one Contractor representative whose primary responsibility is product quality, and one Government representative acting on behalf of the Contracting Officer. Acceptance of nonconforming material shall be determined by unanimous agreement of the MRB. Pertinent technical competence and thorough knowledge of product quality and functional requirements shall be prerequisite qualifications for all MRB members. Material review board members may consult with other organizations and personnel as required to arrive at optimum decisions. The decisions of the board shall be supported by records of all cases submitted for action, including material that can be reworked to specification, and corrective action taken. Pertinent drawings and documentation shall be changed or initiated as necessary.

8.18.1.1 SUBCONTRACTOR MRB: These requirements also shall apply to subcontractors to whom MRB responsibility is delegated by the Contractor. The Contractor shall limit the authority of the subcontractor's MRB dispositions to those of a minor or incidental nature not affecting safety, function, or interchangeability.

8.18.2 APPROVAL OF CONTRACTING OFFICER: Written requests for approval of the Contracting Officer shall be made if the nonconformance may adversely affect safety, reliability, durability, performance, or the basic objectives of the contract.

8.18.3 CONTROL OF NONCONFORMING MATERIAL: The Contractor shall provide facilities for the segregation and positive identification of defective articles. The method of identification shall describe the nature and probable cause of the defect and indicate whether the defective articles are to be returned for repair in accordance with approved procedures, are to be reworked to drawing, or are to be submitted to material review for disposition. In cases where departures from drawings or specifications are authorized by the MRB for particular characteristics, the articles shall be identified as nonconforming and accepted by MRB so that an evaluation may be made at later assembly, inspection, and test points as to the effect on higher levels of assembly.

8.18.4 REWORK WITHOUT MRB: Disposition of nonconforming material in the categories of "return for completion of operations" or "return for rework to drawing" may be authorized without formal material review only if written procedures clearly define the types of rework included in these categories, and reinspections are performed to ensure that the reworked material meets drawing and specification requirements.

8.19 GLASS CLOTH: Glass cloth shall conform to Military Specification MIL-C-20079, Type I, Class 2, heavy-weight, untreated. Yarn for stitching shall conform to Military Specification MIL-Y-1140.

8.20 STAINLESS STEEL BARS: Stainless steel bars shall conform to ASTM A 276, Condition A (annealed), hot rolled or cold finished. Type 347 material shall have composition limited (see Paragraph 8).

9. WORKMANSHIP AND PROCEDURES: Materials and equipment shall be fabricated and installed in accordance with approved procedures specified herein and shall conform to the specifications, drawings, and other contract documents. The installation shall be accomplished by workmen highly skilled in the type of work required. Normal commercial practice will not necessarily be considered as adequate for work under this contract. It is the intent of these specifications to obtain the best quality workmanship. The welding procedures and techniques to be used for fabrication under this contract including slag removal methods shall be submitted to the Contracting Officer, for approval, prior to the start of fabrication. Particular attention shall be given to neatness and thoroughness of installation and assembly processes such as welding, bending, routing, finish, and freedom of parts from burrs and sharp edges. All work shall be subject to the approval of the Contracting Officer. Rejected work shall be replaced or repaired, as directed, with no additional costs to the Government. All parts, subassemblies, brackets, hardware, and associated sections shall be assembled true to line and plane, and all tolerances shown and/or specified shall be maintained. When control samples are welded to determine proper welding technique, welding current, voltage, and welding speed shall be recorded for each sample.

9.1 QUALIFICATION OF PIPE WELDERS: Before assigning any welder to work on piping fabrication, the Contractor shall provide the Contracting Officer with the name of welders to be employed, together with the certification that these welders have passed qualification tests as prescribed in Paragraph 327.5 of ASA B31.3. Welders qualified more than 6 months shall be requalified in each material and position. All qualification test procedures will be witnessed by a representative of the Contracting Officer when qualification tests are made. Each welder shall be specifically qualified for each position and type of material on which he is assigned work. The Contractor shall require any welder to retake the tests when the work of the welder creates a reasonable doubt as to his proficiency. Welders failing a requalification test shall not be permitted to work under this contract.

9.2 QUALIFICATION OF WELDERS AND WELDING OPERATORS FOR ALL WELDING OTHER THAN PIPING: Before assigning any welder or welding operator to work on duct fabrication, the Contractor shall provide the Contracting Officer with the names of welders and welding operators to be employed, together with the certification that these welders and welding operators have been qualified under the requirements of Section IX of the ASME Boiler and Pressure Vessel Code within the previous 3 months. The Contractor shall make available to a representative of the Contracting Officer a certified copy of the record of the qualification tests of each welder and welding operator. The Contracting Officer or his inspector shall have the right at any time to call for and witness tests of the ability of any welder or welding operator when there is a reason to question his ability to make welds in accordance with this specification. Welders failing such a qualification test shall not be permitted to work under this contract.

9.3 WELDING PROCEDURES FOR DUCTS AND APPURTENANCES: The welding procedure employed in the fabrication of the duct and appurtenant or accessory parts other than piping shall be qualified under the provisions of Section IX of the ASME Boiler and Pressure Vessel Code, or approved equal.

9.3.1 WELDING PROCEDURE QUALIFICATIONS: Welding procedure qualification tests shall be conducted to meet requirements of Section IX of the ASME Boiler and Pressure Vessel Code and the additional requirements as set forth below. This procedure shall contain full information on all of the factors set forth in Recommended Form Q-1 of Appendix II, Section IX of the ASME Boiler and Pressure Vessel Code, and shall be recorded and submitted to the Contracting Officer for review and approval.

9.3.1.1 SEPARATE QUALIFICATION TESTS: Separate qualification tests shall be made on the maximum joint thickness for each type of weld for each material, each position, and each procedure used in fabrication for each type joint, double welded butt, single welded joints, fillets, etc. Procedures qualified for thicknesses greater than those used in fabrication of this specific contract shall be acceptable without requalification. The joint design used in the test plates and test sections shall be the same as for the joints used in fabrication. A requalification shall be made for any change in the nominal weld metal composition, as well as for changes in any of the essential variables listed in Paragraph Q-11 of Section IX of the ASME Boiler and Pressure Vessel Code, and a separate qualification test shall be made for each joint design. During the time period when cooling tubes and channels are to be welded on the duct, a welded sample at least 3 inches long and 3 tubes or 3 angles in width shall be approved each morning for each welder before starting work on the duct itself. For welds between coolant channels, the test specimen shall include duct material as well as channel and angle material.

9.3.1.2 RADIOGRAPHING: In addition to the tests specified in Section IX of the ASME Boiler and Pressure Vessel Code, the procedure qualification test specimens shall be radiographed following the same heat treating procedure used in fabrication, and using the radiographic procedures specified for production welds, the radiographs shall meet the requirements of this specification for radiographic quality.

9.3.2 CONTINUITY OF BACKING RING: Backing ring shall be permitted only for weld joints which, due to access limitations, cannot be welded from both sides and then only where shown or with written permission

of the Contracting Officer, except that under no circumstances will backing element be permitted within the duct. If a backing bar, strap, or ring is used on the inside of the single-butt weld joints, the ends of the backing bar shall be welded to produce a continuous backing element.

9.4 ELECTRODES AND FLUXES: Electrodes and fluxes used shall be dry. Flux and electrodes shall be stored to obviate contamination and deterioration by moisture. A drying oven or heater shall be used as necessary to remove moisture.

9.5 NOZZLES OR OUTLETS: Nozzles or outlets shall be as shown on the drawings. Such nozzles or outlets shall be made in conformance with Figures UW-16.1 q1, q2, q3, or q4, as applicable or UG-38(a) of Section VIII of the ASME Boiler and Pressure Vessel Code, and shall be fully reinforced. Flanged outlets shall conform to the provisions of ASA B16.5 or shall be designed in accordance with Paragraph UA-45 of Section VIII of the ASME Boiler and Pressure Vessel Code. All nozzles or outlets shall be suitable for the pressures specified. Material for nozzles or outlets and flanges shall preferably conform to that of the duct, but may be of the connecting piping material. Where shown on the drawings, outlets shall be suitable for connection of stainless steel positive mechanical high pressure threaded-type fittings.

9.6 SLAG: Slag shall be removed after each weld layer has been placed in all weld joints, and each layer of the weld shall be visually inspected for undercut, lack of fusion, irregularity of weld deposit, slag inclusions, cracks, and porosity. The welds shall be dye penetrant tested where indicated on the drawings and as specified or shown. All corrections shall be made before the next weld layer is deposited.

9.7 DEFECTS: Defects listed in codes shall be cause for rejection. Tungsten inclusions in TIG welding will be considered the same as porosity. Drips, icicles or other lack of smooth continuity on inner surfaces of duct, pipes, or coolant passages will be cause for rejection.

9.8 MATERIAL HANDLING AND STORAGE: Material used under this contract shall be handled and stored with care, out of the weather, protected from accidental damage. Materials which show deformations, notches, indentations, or other indications of having been damaged or are chemically contaminated or etched are subject to rejection and shall not be used in whole or in part as determined by the Contracting Officer. Careful shop practice shall be observed at all times including but not limited to the following:

(a) Sheet stock shall be stored on edge, suitably supported and protected in special racks designed for the purpose. Wood blocking or other suitable material shall be used to protect lower edges.

(b) Sheet stock shall be handled by means of suction cups or other approved methods which will not crimp or otherwise deform the material.

(c) Tubing, cables, bars, strip, and all thin or light materials shall be stored in racks designed to protect the material from distortion by gravity, damage by accident, and the effect of weather and chemicals.

(d) Materials shall not be stored nor worked on in areas subject to fumes or splash from corrosive chemicals (e.g. plating, pickling, cleaning areas) except when brought to such areas for the specific service required, in which case care shall be taken to prevent accidental damage.

(e) Materials shall be segregated by type (e.g., stainless steels, aluminum, alloys, copper alloys, and carbon steels shall not be stored in contact with each other).

(f) Personnel shall not stand nor walk on materials, fabrications, or assemblies.

(g) Materials shall not be stored nor worked on close to vehicular traffic, nor in the path of pedestrian traffic unless barricaded.

(h) Temporary supports shall be provided under pieces being worked on if they tend to sag or bend.

(i) Materials, equipment, assemblies, etc. shall always be lifted into place by means of handling equipment properly designed for the purpose and never pulled or pushed over floors, around corners, or over obstacles.

10. FABRICATION:

10.1 GENERAL: The plant shall have convenient access to all phases of fabrication, having machine shops, plate, pipe, tube bending equipment, machining, and heat treating facilities for handling all components of the sizes specified. Shop fabrication shall include all duct fabrication, piping, installation of all wiring, thermocouples, sliding hinge supports, duct severance clamp and pneumatic (nitrogen) motors, double bellows, support rings, coolant channels, coolant tubes,

elbow, jacket plates, guide reinforcing plates, support channel rings, instrument connections, pressure compensators, flow elements, manifold-ing, severance plane seals, platforms, ladders, and all other appurtenances and accessories required to complete the exhaust duct assembly. Duct and piping fabrication shall conform to applicable parts of ASME Code for Unfired Pressure Vessels and the ASA Code for Pressure Piping, respectively, and other exceptions as may be specified or shown on the drawings. Fabrication and assembly shall be made to meet dimensions and tolerances shown at 70 degrees F. Safety wiring in accordance with Military Standard MS-33540 shall be provided where shown.

10.1.1 EQUIPMENT AND PROTECTION: All items of equipment shall be so designed and manufactured, and shall be in such condition, as to enable qualified operators to follow the procedures and attain the results specified elsewhere herein. Tooling shall be of type required to achieve given tolerances. All test equipment shall be in perfect operating condition, and proof shall be available upon request indicating calibration is within tolerances applicable to the requirements specified.

10.1.2 BENDING AND FORMING: All change in direction of piping shall be made with standard fittings and segments of elbow fittings, unless otherwise shown on the drawings. Where bending or forming operations are necessary, the Contractor shall submit procedure specifications, for approval, and shall perform such operations in strict accordance with the approved procedure specifications. Coolant tubing shall be bent only with tools and dies designed for the particular diameter of the tubing being bent and which do not produce flattening or out-of-roundness exceeding 5 per cent of tube outside diameter.

10.1.2.1 FORGING: Forgings conforming to ASTM A 473 may be used instead of weldments at the option of the Contractor, provided, in each case, permission in writing, is obtained from the Contracting Officer and procedures approved. All forgings shall be 100 per cent radiographed or ultrasonic tested in accordance with ASTM E 113 or ASTM E 114 with the acceptance level per ASME Case Ruling 1338. Castings, if used in lieu of forgings, shall be 100 per cent radiographed.

10.1.2.2 COLD FORMING: Stainless steel parts may be cold formed provided they are stress relieved as specified for the duct.

10.1.3 THREADING: Threads shall conform to ASA Standard B2.1 and shall be concentric with the outside diameter of the pipe or fitting, unless otherwise specified or shown.

10.1.4 SHRINK FITTING: Where shrink fitting is shown or required, it shall be performed by cooling the inside part and/or, if original temper is not affected, by heating the outside part. Fit shall be as indicated on the drawings.

10.1.5 MECHANICAL CLEANING: Prior to fabrication, all materials shall be cleaned of dirt, rust, or mill scale. Before coolant channels are welded into place, interior surfaces shall be completely cleaned of all scale, spatter, slag, and all other foreign matter so that surfaces are visible clean and bright, smooth to the touch.

10.1.6 TORQUEING FOR FLANGED JOINTS: The Contractor shall submit for approval his proposed method for torqueing the bolts on all flanged joints and at the upper bellows seal. In addition, the Contractor shall employ at least one full-time Quality Assurance Engineer, in the field, to maintain conformance to the accepted method for torqueing. Bolt torques to be applied in assembly of flanged joints shall be in accordance with the following table unless otherwise shown. Torque shall be measured with new and calibrated torque wrenches. Antisieze compound shall conform to Military Specification MIL-A-907, MIL-S-8660, or MIL-T-5542.

Nominal Diameter (Inches)	Torque (Ft-Lb)			
	B8 Series Material - ASTM A193 or A320			
	Solution Treated		Strain Hardened	
	Min.	Max.	Min.	Max.
3/8	4	6	12	18
1/2	10	15	30	45
5/8	20	30	60	90
3/4	35	50	100	150
7/8	55	80	160	240
1	80	120	245	368
1-1/8	130	195	355	533
1-1/4	180	275	500	750
1-3/8	250	365	680	1020
1-1/2	300	435	800	1200
1-5/8	400	600	1100	1650
1-3/4	550	775	1500	2250
1-7/8	700	1050	2000	3000
2	800	1125	2200	3300
2-1/4	1050	1590	3180	4770
2-1/2	1500	2200	4400	6600
2-3/4	2000	2960	5920	8880
3	2600	3860	7720	11580

10.2 WELDING: All welds shall be made in close conformance to the qualified welding procedure specification approved for the type of weld by qualified welders. The welding current shall be maintained within the ranges recommended by the manufacturers of the welding sets and electrodes, consistent with the production of satisfactory welds.

10.2.1 STAINLESS STEEL: The inert gas shielded tungsten arc welding process (TIG) shall be used for welding the hot wall side (inner wall) of the duct (tubes and smooth wall), the channel attachment to the duct, and the steam ejector. MIG welds or coated electrodes

may be used only with written permission of the Contracting Officer and after approval of procedures and qualification samples. If MIG welding is used as an alternate for welding the tubes on the inside of the 90 degree elbow, the width of the weld shall not exceed $3/8$ inch, and the weld bead contour shall not be convex. If the width of the weld bead is less than $3/8$ inch, the bead contour may be convex, providing it would not protrude above the theoretical surface of a $3/8$ inch wide bead with a flat contour. All other welds (e.g., foldbacks, stiffeners, outside of 90-degree elbow, etc.) shall be welded by any approved method of welding after such method has been approved for the particular application. The Contractor shall take extra pains in welding the channels to the inner shell to keep the weld bead to a minimum in the primary shock zones of the duct. The primary shock zones are defined as, (i) the part of the primary section starting at the top and extending approximately one diameter below the upper cone, and (ii) the outer radius of 45 degree exit elbow and extending 45 degree on either side of the outside vertical centerline. The first pass on all water carrying members shall be TIG welded, except field welds may be welded with coated electrodes provided the welds are 100 per cent radiographed or made with back up strips left in place. All other welds on the truss shall be MIG or TIG welded, or welded with coated electrodes. Internal inert gas backup shall be provided unless otherwise directed or approved, except on solely structural members of truss. Inert gas shall be helium, Grade "A" as produced by the U. S. Bureau of Mines, or argon, conforming to Military Specification MIL-A-18455. Other gases or gas mixtures may be used only with written permission of the Contracting Officer. When desired by the Contractor, and approved in writing, automatic welding will be permitted.

10.2.2 ALUMINUM WELDING:

10.2.2.1 GENERAL: Welding shall conform to recommendations and regulations in the ASME Code for Boilers and Pressure Vessels. The following detail requirement shall be followed.

10.2.2.2 PREPARATION FOR WELDING: Dirt, grease, forming or machining lubricants, or any organic material shall be removed from the areas to be welded by cleaning with a suitable solvent or by vapor degreasing. Additional operations to remove the oxide coating, just prior to welding, are required when the inert gas tungsten arc welding method is used.¹ This may be done by etching or by scratch brushing. The oxide coating may not need to be removed if the welding is performed with the automatic or semiautomatic inert gas shielded metal arc. Suitable edge preparation to assure 100 per cent penetration in butt welds shall be used. Flame cutting shall not be used. Sawing, chipping, machining, shearing, heliarc cutting, or plasma arc cutting may be used.

10.2.2.3 WELDING PROCEDURE: Parts shall be welded with an arc or resistance welding process. No welding process that requires the use of a welding flux shall be used. The filler metal shall be Aluminum Alloy 5556, 5356, or 4043. Other filler metal alloys may be

used, provided that they are capable of meeting the qualification test requirements and result in welds having resistance to corrosion equal to, or greater than, welds made with Filler Alloys 5556, 5356, and 4043. Preheating for welding is permissible provided the temperature does not exceed 400 degrees F for a total time of 30 minutes.

10.2.3 REWELDING DEFECTS: Portions of joints that have been rejected on inspection because of defects may be repaired only by rewelding. The defective area shall be removed by grinding, filing, or machining. Flame cutting shall not be used. Method of removal and repairs of the duct hot wall and steam ejector must be approved by the Contracting Officer, in writing (and at his discretion, subject to MRB review), before removal and repair of weld is begun. Before rewelding, the joint shall be inspected to insure that all of the defective weld has been removed and that the joint is accessible so that the welding operator can obtain full penetration through the joint.

10.2.4 END PREPARATION: The ends to be joined shall be prepared in accordance with approved sketches. These sketches should show bevels and grooves, where required. Just prior to welding, the ends to be joined and adjacent surfaces shall be cleaned with clean stainless steel wool. During welding, cleaning shall be done with a stainless steel wire brush which has never been used on carbon steel or nonferrous metals.

10.2.5 ELECTRODES: The electrode material size, filler wire size, machine output, and number of passes shall be as indicated in approved welding procedures. Electrodes and filler wire shall be of the same composition or slightly higher in alloy content than base metal, and be of a type recommended for use with the base metal by code or by the electrode manufacturer (e.g., Type E308 filler rod and electrodes per ASTM A 298 or ASTM A 371 for welding Type 304 stainless steel to itself; E347 rod for welding Type 347 to itself and to Type 304). Coated electrodes shall be dried and/or baked in accordance with the manufacturers instructions prior to use. The size of the electrodes shall be that best suited for the position and the material to be welded. Deposited weld metal shall be approximately equal to base metal in mechanical characteristics and corrosion resistance. Electrodes and filler wire used for welding Type 347 stainless steel with chemical composition further limited per Paragraph 8 of this specification shall have chemical composition similarly limited. Chemical analysis reports for all such electrodes and filler wire shall be submitted to the Contracting Officer.

10.2.6 LAYOUT OF JOINTS: Unless otherwise shown on the drawings, welding groove details of piping shall conform to those indicated in Section 6 of the ASA Standard B31.1. Templates shall be used for laying out all connections.

10.2.7 ALINEMENT: Joints shall be carefully alined, preferably by the use of suitable clamps. Where practicable, pipe shall be rotated to secure minimum possible variation between the diameters of the matching pipe ends at any given point. Maximum allowable variation shall be no greater than that allowed for the pipe specified.

10.2.8 TACK WELDS: Tack welding may be used for temporary erection and to maintain proper root spacing during welding. Tack welds of sound metal with proper penetration, which have been made by qualified welding operators and passed a 10-power magnification visual inspection, may be fused and puddled in with the first bead so as to form a continuous weld. The qualified procedure shall be strictly followed when making tack welds. Large or defective tack welds are not acceptable and shall be removed before completing the joint.

10.2.9 WELD QUALITY: The manner of depositing shall be such as to produce a progressive series of fine ripples. Undercutting shall be held to a minimum in the side walls of the welding groove, and is prohibited in the base metal adjacent to the edges of the final pass of welding. The surface of the finished welds shall have a bright metallic luster after cleaning; shall be fairly smooth with regular even ripples; and shall be uniform in contour. Except as necessary to correct defects, the surfaces shall not be dressed, smoothed, or finished for improving their appearance unless required specifically by the drawings or the approved shop drawings of the work.

10.2.10 MARKING OF WELDS: Each welding operator shall be assigned an identification symbol which shall be applied by electric etch or by using a vibrating tool, Vibratool or equal, adjacent to and along welds made by him in a manner conforming to applicable paragraphs in Military Standard MIL-STD-130, except that welding on the inner duct wall and elbow coolant tubes shall not be etched but shall be identified and recorded in an acceptable manner.

10.2.11 DEFECTS FOUND BETWEEN SUCCESSIVE PASSES: All defects such as cracks, blowholes, inclusions, etc., found on the surface of any pass of welding shall be completely corrected before laying down the next successive pass. Defective or unsound welds shall be corrected by removing and replacing the welds, or as follows, except that procedure for such repairs shall be submitted for approval for welds of coolant tubes.

- (a) Excessive convexity. Grind to required size.
- (b) Undercutting, shrinkage cracks, craters, blowholes, and excessive porosity. Grind to sound weld and/or base metal, and deposit additional weld metal.
- (c) Undersize and excessive concavity. Clean and deposit additional weld metal.

- (d) Overlapping. Remove excess weld by grinding.
- (e) Slag inclusions. Grind to remove slag and fill with weld metal.
- (f) Removal of adjacent base metal during welding. Grind to sound base. Reweld metal, and form full size by depositing additional weld metal.
- (g) Lack of fusion. Remove weld to sound metal by grinding, and then reweld.

Weld defects which cannot be rewelded satisfactorily shall be replaced with new sections of base metal at the Contractor's expense. Calking of welds shall not be done. Before adding weld metal, or rewelding, the surfaces shall be cleaned thoroughly and dye penetrant tested. The removal of weld metal from a defective weld shall not extend into the base metal beyond the weld penetration. Where incomplete fusion is disclosed by grinding to correct defects, that part of the weld shall be removed and rewelded.

10.2.12 STRESS RELIEVING: Duct parts and directly connected accessories shall be stress relieved at 1300 degrees F plus or minus 25 degrees F for 45 minutes, then furnace-cooled to 1000 degrees F before opening doors. Coolant passages shall be purged with nitrogen during stress relief. Stress relieving procedures shall be submitted in writing to the Contracting Officer, for approval, incorporating applicable portions of Military Specification MIL-H-6875 prior to stress relieving. Procedures shall specifically indicate temperatures, rate of heating, time for soaking at annealing temperature, and rate of cooling. The Contractor shall be responsible for the following, at no additional cost to the Government.

- (a) Completely stress relieving the duct as shown on the drawings.
- (b) Maintain dimensional stability. The Contractor shall provide blocks, supports, reinforcements, restraints, and other devices to prevent distortion, misalignment, or any other damage during stress-relieving operations.
- (c) Records of heat treatment shall be maintained and one copy submitted to the Contracting Officer.

10.3 ALUMINUM FABRICATION: The current rules and practices set forth in the ASCE "Specification for Structures of Aluminum Alloy, 6061-T6," and the Aluminum Construction Manual, shall govern this work, except as otherwise specified. Fabrication and erection tolerances not specified in the above shall be as specified in AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings

(Riveted, Bolted, and Arc-Welded Construction)," latest edition. Aluminum work shall be completely fitted and shop assembled. Work shall be executed in strict accordance with the drawings, details, and approved shop drawings. Screws shall be countersunk into exposed work and finished flush therewith. Jointing and intersection of metals shall be accurately made, tightly fitted, and made in true planes with adequate fastenings. Bolted work shall be firmly tightened and locknuts used to prevent loosening. Holes and connections for the work of other trades to connect thereto shall be provided as required or as indicated on the drawings. Contact surfaces of dissimilar metals shall be insulated from each other.

10.3.1 CONNECTIONS: Connections shall be as shown on the drawings. When details are not shown, the connections shall conform to the requirements for AISC standard connections for aluminum and the Aluminum Construction Manual for aluminum structural material. One-sided or other types of eccentric connections will not be permitted unless shown in detail on the contract drawings. Unless otherwise indicated on drawings, bolted connections shall be made in accordance with the requirements of the applicable specification. No rivets will be permitted in any aluminum connection. Welded connections shall be made where indicated on the drawings or authorized by the Contracting Officer.

10.3.2 WELDING: Welding of aluminum shall be as specified.

10.3.3 HOLES: Holes in aluminum connections shall be drilled and reamed for driving fit and in accordance with the requirements of ASCE Specification 6061, Section I-4. Holes shall not be made or enlarged by burning, nor will the burning of unfair holes in the shop or field be acceptable. Holes shall be provided in members to permit connecting the work of the other trades by means of templates or detail shop drawings as may be required.

10.3.4 DRAW: Allowance shall be made for draw in aluminum tension members.

10.3.5 NUTS: Nuts shall be of an approved self-locking type.

10.4 MECHANICAL INSTRUMENTATION AND TUBING FABRICATION AND ASSEMBLY:

10.4.1 TUBING:

10.4.1.1 TUBING ASSEMBLIES: Tubing assemblies, where indicated or required, shall have both ends flared. Assemblies shall be blown free of all foreign material before installation. Tubing assemblies shall be free of oil and moisture.

10.4.1.2 FLARING: All sizes of tubing shall be machine flared in accordance with Military Standard MS-33584.

10.4.1.3 FLARE POLISHING: Tubing flares shall not be polished unless scratches and/or grooves running in an axial direction, or shallow nicks, appear on the sealing surface. Imperfections that cannot be removed with a minimum of polishing shall be cause for rejection. The sealing surface of tubing flares having slight imperfections shall be corrected by polishing with fine emery cloth held in a revolving, cone-shaped tool conforming to the angle of the flare.

10.4.1.4 BENDING: Tube bends shall be used in lieu of elbows wherever practicable. Tube shall be bent only with tools and dies designed for the particular diameter of tubing being bent, which do not produce flattening or out-of-roundness exceeding 5 per cent of the tube diameter. Tubing shall be bent only to the degree necessary to accomplish the intended purpose. The minimum tubing bend radii shall be in accordance with Military Standard MS-33611.

10.4.1.5 FITTINGS: Fittings shall be installed per Air Force-Navy Aeronautical Design Standard AND 10064. Type 304 stainless steel fittings shall conform to Military Standard MS-33656. Stainless steel fittings only shall be permitted. Copper seals shall be Voi Shan in accordance with Tubing Specification "T."

10.4.2 ASSEMBLY: Tubing shall be installed as specified in Joint Industry Conference Hydraulic Standards for Industrial Equipment, except as otherwise shown on the drawings or specified herein. Tubing shall be installed in parallel or perpendicular lines through or around structures with sufficient clearance to permit easy installation, removal, and/or maintenance. Unless otherwise shown, lines shall be pitched in the direction of flow for drainage. Adjacent lines shall be grouped in the same horizontal or vertical planes. Lines shall be sufficiently supported so that when filled with liquid, gravity deflection will not occur. No lines shall have pockets in their course due to changes in elevations. Transducers shall be installed to allow gravity drain of water.

10.4.2.1 CLAMPS AND CLAMP SUPPORTS: Tubing shall be clamped and supported within 3 inches of each joint, and this distance between clamps and clamp supports shall not exceed 3 feet. Clamp supports shall be Type 347 stainless steel (composition limitation, Paragraph 8, not applicable). Clamps or clamp supports shall be welded or bolted to piping or equipment. U-bolts or other types of approved clamps shall be used. (See Appendix, Tubing Specification "T").

10.4.2.2 PIPING TO TUBING CONNECTIONS: All piping and flanges furnished with pipe thread connections shall be fitted with a tube to pipe adapter conforming to AN 816, and the pipe thread joint heliarc seal welded to prevent leakage.

10.4.3 INSTRUMENT CONNECTIONS: Pressure taps for instruments shall be 1/4 inch in accordance with Standard Drawing FS-6469, in Appendix A, except to duct cooling channels or tubes, or except as noted on the drawings.

10.5 DELETED

10.6 LUBRICANTS AND SEALANTS:

10.6.1 LUBRICANTS: Lubricants are used primarily as thread lubricants to prevent the galling of tubing connections. A minimum amount of lubricant should be applied so that the excess is squeezed to the outside when the connection is made. No lubricant should be allowed to enter the system. For example: When making a "B" nut connection, apply a small amount of the lubricant to the male threads of the "B" nut after engaging a minimum of 3 threads. Wipe off all excess after the connection is completed.

10.6.2 SEALANTS: Sealants are used to eliminate leakage through pipe threads and flanged connections. Apply in the same manner as a lubricant. Never attempt to correct a bad leak by applying excessive amounts of the sealant.

10.7 RESPONSIBILITY FOR ERRORS: The Contractor alone shall be responsible for all errors of fabrication and for the correct fitting of members.

11. QUALITY CONTROL:

11.1 GENERAL: All materials, equipment, assemblies, systems, and completed duct installation shall be inspected, analyzed, and tested individually and collectively at the mill, in the shop, and in the field to insure the highest quality work and conformance with the specifications and drawings. Duct, piping, and components shall be tested as herein specified. The Contractor shall furnish all special valves, fittings, gages, thermometers, radiographic equipment, flowmeters, pumps, and all other equipment required for test purposes. Testing devices shall be of laboratory precision type and shall be calibrated to insure accuracy. Test materials, including temporary covers, bolts, gaskets, plugs, nitrogen, etc., shall be furnished by the Contractor and retained by him after test. Unless otherwise specified, Contractor shall furnish test instruments and line fluids for field tests, except power and demineralized water will be furnished by the Government for tests at the job-site (ETS-1). Inspection will be by a representative of the Contracting Officer who will witness all tests, approve all test procedures and reject all parts of material not in conformance with the specifications or which do not meet these requirements. Not less than 48 hours prior to performing any test herein specified, the Contractor shall advise the Contracting Officer of the time the test will be made and the nature of the test. Instruments, components, and other items that are not designed to withstand specified test pressures shall be removed from the lines and/or otherwise be positively isolated from the pressure.

11.1.1 QUALITY CONTROL PLAN: The Contractor's quality control program plan shall comply with the intent of NASA NPC-200-3 or Military Specification MIL-Q-9858. A quality control manual or similar document shall present as minimum requirements the systems utilized for control of:

- (a) Preparation and submittal of an inspection plan.
- (b) Qualification of special processes and certification of applicable personnel.
- (c) Drawing/specification releases and changes.
- (d) Supplier selection and quality level.
- (e) Material acceptance.
- (f) Inspection measuring and test equipment.
- (g) Disposition of nonconforming articles.
- (h) Documentation.

A copy of the quality program plan document shall be submitted to the Contracting Officer for review within 6 weeks after award of contract. The inspection plan required in (a) above shall be submitted to the Contracting Officer with the shop drawings. This plan shall show the major fabrication steps (i.e., forming, welding, stress relieving, and corresponding inspection points e.g., material release, nondestructive tests, dimensional checks, hydrostatic tests, leak tests, shop acceptance test plan, field assembly, installation, and acceptance test plan) for the major subassemblies and complete assembly. During the life of the contract, any changes made to the quality program plan or inspection plan shall be transmitted to the Contracting Officer prior to implementation.

11.1.2 QUALIFICATIONS FOR TESTING: Four copies of certification shall be submitted with shop drawings, showing adequate facilities and personnel to provide all tests specified or required for the components to be provided. Where Contractor is unable to provide certain tests, he may elect to use the services of a qualified testing laboratory. Contractor shall submit, in writing, the name of any proposed testing laboratory and shall not use any such agency until written acceptance has been granted by Contracting Officer.

11.1.3 INSPECTION: The Contractor shall perform all inspections and tests, and provide all information, documents, records, reports, facilities, equipment, samples, materials, and assistance to Government representatives, or persons designated to act on behalf of the Contracting Officer, as required by the contract or subcontract, and this specification. Except as the contract may otherwise provide, these shall be provided without additional charge to the Government. Periodic unscheduled inspection may be performed or permanent residency established in the fabricating shop by representatives of Contracting Officer to determine or confirm methods and procedures used and ascertain extent of quality control which is utilized by the Contractor. Free access to manufacturing, fabricating, assembly, and test facilities shall be provided at all times that work on this contract is in progress in the Contractor's plant and that of the subcontractors, suppliers, and test laboratories.

11.2 MATERIAL TESTS AND INSPECTION:

11.2.1 MECHANICAL PROPERTIES TESTING: All destructive tests shall be performed on samples made from waste scrap cut from materials used for fabrication. In the event no such scrap is available, then tests shall be performed on metal from the same mill rolling and from the same heat and so identified and certified on the report.

11.2.1.1 DUCT: Two tension tests and one bend test shall be made from each parent sheet as rolled from a slab or ingot. Plates which are quenched and tempered by the steel supplier shall be tested by performing

one bend test and one homogeneity test from each parent sheet as rolled from a slab or ingot, and 2 tension tests from each plate as heat treated. In addition, one tension test shall be made on each quenched and tempered sheet used for the duct when the heat treatment is performed by the fabricator instead of at the mill.

11.2.2 MILL AND FACTORY REPORTS: The Contractor shall furnish 3 certified copies of all mill reports covering the chemical and physical properties of the materials used and 3 certified copies of factory reports certifying compliance with the specifications. For standard items manufactured in quantity, the test results of prototype or bulk sampling procedures will be accepted, if applicable. Each certificate shall be signed by an authorized officer of the manufacturing company and shall contain the name and address of the Contractor, the project name and location, and the quantity and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfactory material, if, after tests are performed on selected samples, the material is found not to meet the specific requirements.

11.3 INSPECTION AND NONDESTRUCTIVE TESTS (SHOP AND FIELD):

11.3.1 GENERAL: Tests specified in the following are non-destructive and are intended to qualify that materials and components to be furnished are suitable for the specified operation and are capable and safe for the service and for the conditions as defined in the data sheets. Inspection and tests shall be performed on work as it proceeds in both shop and field. "Maximum allowable ASA pressure," referred to herein, means the maximum pressure allowed within the ASA class adjusted to 100 degrees F, and will generally be given on the component data sheet after "Pressure Class."

11.3.2 LIMITATIONS: Test requirements defined herein shall be minimum. Care shall be taken to insure that maximum design limitations are not exceeded (e.g., cause stresses beyond the design limits).

11.3.3 FLAW CHECK: Components or parts thereof subject to stress in operation shall be subjected to a flaw location check during fabrication and before assembly. Pipe, flanges, and fittings which have been manufactured under the requirements as set forth in ASTM specifications for steel piping materials will not require additional inspection provided that parts are installed without modification. Welded assemblies, bellows delivered to the duct fabricating plant as finished units, castings, and forgings shall be inspected for flaws. Listed below are methods to be used for determining flaw locations:

- (a) Dye penetrant inspection as specified herein.
- (b) Radiographic inspection as specified herein.
- (c) Ultrasonic inspection in accordance with applicable portions of ASTM A 388 and ASTM E 164, and/or E 113 and E 114.
- (d) Bubble, hydrostatic, and pneumatic tests as specified.
- (e) Manufacturer's standard method may be used as an alternate where permitted by the Contracting Officer. Approval must be in writing.

11.3.4 MEASUREMENTS: Measurements shall be made to insure that fabrication is within given tolerances. Average diameters of duct shall be determined by the measurements taken at no less than 4 equally spaced locations as determined by the Contracting Officer.

11.3.5 EXAMINATION OF WELDS:

11.3.5.1 VISUAL: All welded joints, including the base metal immediately adjacent to the weld metal, shall be subject to careful visual examination. Approximately 10 per cent of welds marked "visual" shall, in addition, be given a dye penetrant test where designated by the Contracting Officer. Permanent tack welds shall be visually inspected under 10 power magnification. Any evidence of weld defects, burnthrough, or thinning of walls opposite welds (e.g., in the coolant tubes) shall be cause for rejection.

11.3.6 DYE PENETRANT INSPECTION: Where drawings designate that welds are to be dye penetrant inspected, the first and last weld layers shall be individually inspected with penetrant dye and defects corrected before proceeding with successive welds. Dye penetrant examination shall also be performed on all other welds, including welds to be radiographed, to the 10 per cent extent specified in paragraph entitled "VISUAL." The Contractor shall, prior to use, submit to the Contracting Officer for approval, a written liquid penetrant test procedure incorporating the requirements in the ASME Code for Unfired Pressure Vessels, Section VIII, including the mandatory Appendix 8 as shown in the Summer 1963 Addenda. In addition to the acceptance standards provided, there shall be no rounded indication 1/8 inch or larger in the smaller dimension read in accordance with minimum development time as specified in the approved procedures. All dye penetrant material shall be removed from the weldment prior to the continuation of welding.

11.3.7 RADIOGRAPHIC INSPECTION: The Contractor shall employ an expert in the field of radiography, approved by the Contracting Officer, to take the radiographs, and to make the interpretation of the radiographs and certify the reports to the Contracting Officer. Radiographic inspection

procedures and techniques accompanied by sketches shall be submitted to the Contracting Officer for approval before implementation. The radiographic film used shall be the type designated as "fine grain" in the literature of the supplier of the film. Acceptability of welds shall be as determined by ASME Boiler Code, except that tungsten inclusions shall be considered as porosity, and except that all porosity or tungsten inclusions 0.025 inches in diameter or greater, in the 0.095 inch thick material or in the inner shell of the drain elbow, shall be reported on the reports to the Contracting Officer, evaluated as to depth, and repaired if judged to be 0.025 inches or greater in depth. Each area that is radiographed shall have limits of radiograph marked on the metal and identified with a code number by means of electric etching except that radiographed area on the inner duct wall and elbow coolant tubes shall not be etched but shall be identified and recorded in an acceptable manner. Identifying code number shall be marked on the radiograph.

11.3.7.1 WELDED PIPE JOINTS: All welded longitudinal pipe joints in pressure piping 2¹/₄ inches and larger, all welding on steam piping to the steam ejector, and elsewhere as shown on the drawings, shall be radiographed 100 per cent. Radiographic technique and interpretation shall be in accordance with the provisions of Section 336.4 of ASA B31.3, except as herein modified. The Contracting Officer may, at Government expense, require additional radiographs. In the event defects are discovered, repairs and reradiographs shall be at the Contractor's expense. The Contractor shall submit the negative and the interpretation report to the Contracting Officer's representative after taking the radiographs. The Contracting Officer's representative will examine both the interpretation and the negative and, if not in agreement with the interpretation, he will so notify the Contractor. Unacceptable areas of joints shall be cut out, remade, and reradiographed to the satisfaction of the Contracting Officer at no additional cost to the Government. All films shall be available for examination by representatives of the Government and shall be submitted with the report to the Contracting Officer's representative at the fabricator's plant, for approval. Piping radiograph negatives will be returned to the Contractor and shall be stored with the "duct" negatives as specified herein.

11.3.7.2 WELD JOINTS IN DUCT: All longitudinal and circumferential joints of the duct, and elsewhere in duct, and truss as indicated on the drawings, shall be 100 per cent radiographed. Radiographic technique and interpretation therefor shall be in accordance with Paragraph UW-51 of Section VIII of the ASME Boiler and Pressure Vessel Code. Paragraph UW-51 is considered the minimum requirement. Backing strips, where permitted and if used, shall be of design and dimension which shall not interfere with the interpretation of radiographs. The radiographic negatives shall be submitted with the report to the Contracting Officer's representative at the fabricator's plant for approval. Unacceptable welds shall be repaired and reradiographed in accordance with the requirements of Section VIII of the ASME Boiler and Pressure Vessel Code. Upon approval, the negatives shall be returned to, and filed by, the manufacturer as required by the ASME Boiler and Pressure Vessel Code. During the 5-year storage period of negatives, the files shall be accessible to representatives of the Government as may be required for reference.

11.3.7.3 REPAIR OF DEFECTS: Defects shall be repaired by use of approved procedures. Whenever a defect is removed, and repair by welding is not required, the affected area shall be blended into the surrounding surface so as to avoid sharp notches, crevices, or corners. After a defect is thought to have been removed, and prior to making repairs, the area shall be examined by approved dye penetrant procedures to insure that the defect has been eliminated. After repairs have been made, the repaired area shall be re-examined by the same methods that were originally required for the area. Any indication of a defect which is believed to be nonrelevant shall be regarded as a defect unless, upon re-evaluation by nondestructive methods and/or by surface conditioning, it is shown that no unacceptable defect is present. Before any such work is done on inside of duct, approval of Contracting Officer must be obtained for the specific work to be done. Repair of defects and retesting shall be performed by the Contractor at no additional cost to the Government.

11.4 SHOP TESTS: The following tests shall be performed in the shop and the test results approved by the Contracting Officer before shipment of duct-truss assemblies.

11.4.1 PIPE SYSTEMS AND COOLANT PASSAGE HYDROSTATIC TEST: Hydrostatic test shall be in accordance with applicable portions of ASA and ASME Codes, and such tests shall be conducted as specified therein. Connections for test equipment shall not be welded to any permanent part of the duct or other system connections. Hydrostatic test pressure for components shall be not less than 1-1/2 times the design working pressure. Test pressures used shall be no less than 360 psig for coolant water lines (except coolant tubes shall be tested at 360 plus or minus 15 psi).

WARNING: Inlet water shield and elbow outer water jacket shall not be subjected to water system hydrostatic test pressures. They shall be hydrostatically tested at 30 psig plus or minus 5 psi.

When testing in shop, parts which are only tack welded for assembly in order to disassemble for shipment shall not be pressure tested in the shop. Each of the duct sections shall be pressurized separately and after duct has been completely assembled in the shop, the complete coolant system shall be tested.

11.4.1.1 TEST MEDIUM: Use clean domestic water for hydrostatic tests.

11.4.1.2 BLEED: Bleed all spaces subjected to hydrostatic tests as required so that air pockets are eliminated before component is pressurized.

11.4.1.3 PRESSURIZE: Component shall then be pressurized as specified and visual inspection made of joints, seals, and exposed pressurized surfaces. Test pressure shall be held for not less than 5 minutes prior to inspection.

11.4.1.4 LEAKS: During hydrostatic test, no leaks will be permitted which are detectable by wet spots or pressure decay.

11.4.2 BUBBLE TESTS: Bubble test, where noted or specified, shall be performed using leak test compound conforming to Military Specification MIL-L-25567, Type I. The system or part to be tested shall be internally pressurized with clean dry nitrogen gas and the leak test compound liberally applied externally on all joints, welds, seals, and around connections.

11.4.2.1 ELBOW SECTION: Prior to attaching the elbow water jacket, the ends of the elbow shall be closed and the elbow internally pressurized to 1/2 psig with nitrogen. A leak check shall then be conducted on all weld joints between tubes using bubble test. No leakage will be permitted.

11.4.2.2 STEAM EJECTOR NITROGEN BUFFER SPACE: The buffer space on the steam ejector including the space between expansion joints 50-EJ-27A and 50-EJ-27B shall be pressurized to 5 psig with nitrogen and a leak (bubble) test shall be performed on all visible internal and external welds and joints. No leakage will be permitted.

11.4.2.3 SEVERANCE PLANE SEAL: After duct has been assembled in the shop the severance plane seal (not the Government-furnished equipment duct-to-facility seal) shall be pressurized to 5 psig with nitrogen and leak (bubble) tested all around both sides of the clamp. No leaks will be permitted.

11.4.3 WATER SHIELD TANK: The water shield tank in the upper section of the truss shall be filled with water and visually inspected for leaks. For this purpose, the glass cloth seal at the base of the tank shall be installed and the tank outlet plugged. The tank need be maintained full only long enough for thorough visual inspection. All leaks, other than through the glass cloth seal, indicated by drips shall be repaired by the Contractor and tank retested.

11.4.4 COOLANT PASSAGE FLOW TEST: During fabrication and after duct coolant tubes or passages (of a duct section) are welded in place and prior to stress relieving and welding on the foldbacks and manifolds, each individual coolant tube and passage shall be flow tested with domestic water at the required pressure differential (psid) noted below. Pressure differential shall be measured between water supply inlet and outlet (open to atmosphere). Pressure drop through the coolant passage and measured flow rate shall be tabulated for each tube and passage. Each tube and passage shall be identified with a code number by means of electric-etch. This code number shall appear on all corresponding shop drawings, flow reports, and tabulations. Determine and record the inlet and outlet cross-sectional area of 2 tubes and channels in each quadrant of each duct section. Record this area with the respective flow rate. Test points shall be tabulated for the following section.

	<u>Test Points</u>
Primary Duct Section	35 and 40 psid
Elbow Duct Sections	60 and 65 psid
Secondary Duct Section	35 and 40 psid

If the flow rate varies more than plus or minus 10 per cent for a given pressure differential for any 10 adjacent tubes or channels, that passage shall be flow checked again and noted. Flow reports shall be submitted to the Contracting Officer for approval before installing fold-backs and manifold. In the event of discrepancies in flow rates due to improper tube configuration, blockage, or other cause traceable to workmanship, the Contractor shall repair or replace defective part to the satisfaction of the Contracting Officer and at no additional cost to the Government the Contractor shall repeat all tests on the affected area after repair.

11.4.5 DELETED

11.4.6 DIMENSIONAL LAYOUT DATA: While the exhaust duct is completely erected at the duct fabricator's plant, very accurate layout plans shall be prepared showing exact data on interface points; trailer lift points; outside dimensions of complete assembly; duct to facility structure, and duct to duct support piping and instrumentation connection supports. These data shall be used subsequently in reassembly of the exhaust duct at the jobsite. Detail dimensions, corrected to 70 degrees F, shall be accurate to the following tolerances:

Dimensions to plus or minus 1/32 inch

Angles to plus or minus 0 degrees 0.5 minute

11.4.7 DEFECTS OR NONCOMPLIANCE: Defects or noncompliance with drawings and specifications discovered by shop tests and inspections shall be repaired or replaced by use of approved procedures. After repairs or replacements have been made, the corrected areas shall be re-examined by the same methods that were originally required. Before any work is done on inside of duct, approval of Contracting Officer must be obtained for the specific work to be done. Repairs, replacements, and retesting shall be performed at no additional cost to the Government.

11.4.8 SHOP CLEANING INSPECTION: The presence of dirt, oil, grease, flux, or other foreign material detected by a visual and tactile examination shall be cause for rejection of cleaning. Internal surfaces shall be examined with the help of mirrors, periscopes, borescopes, and lights.

11.4.9 TEST REPORTS: Test reports shall be submitted to the Contracting Officer in quantities required by terms and conditions of the contract to show that the duct has been inspected and tested and conforms

to the requirements of this specification. One complete set of certificates of compliance and one copy of each inspection and test report made during the progress of the work shall be bound into a looseleaf binder. All shop tests will be witnessed and the report signed by the Contracting Officer's representative prior to shipment.

11.4.10 APPROVAL: Approval of the certificates of compliance, laboratory tests, millreports, working and testing procedures inspections, workmanship tests, and the shop tests by the Contracting Officer or his representative shall not be construed as a complete check but will indicate only that the general methods of operation and test and the results are apparently satisfactory up to that time. Such approvals will not relieve the Contractor of the responsibility for any error, omission or noncompliance which may exist, as the Contractor shall be responsible for compliance with all requirements specified or shown, directly or by reference, and the satisfactory erection, installation, testing, and final checkout at ETS-1.

11.5 FIELD TESTS: Unless otherwise permitted by the Contracting Officer, field tests shall be performed after the assembled exhaust duct has been moved into the vault, and all connections completed to systems and structure as required.

11.5.1 SURVEY: After erection of the exhaust duct and truss and before moving into the vault, all dimensions shall be checked against the dimensioned layout drawings made in the shop. The vault conditions and interfaces shall be verified to assure proper fit. Interferences, if any, shall be reported immediately to the Contracting Officer.

11.5.2 HYDROSTATIC AND PNEUMATIC TESTS: After completion of field assembly, installation in the vault, and connection of all piping, the following tests shall be performed except that instruments and components subject to damage shall be blocked off.

(a) WATER PIPING AND COOLANT PASSAGES: Water piping and coolant passages shall be hydrostatically tested as a complete system as described for the shop test (360 psig plus or minus 15 for coolant water lines, and coolant tubes).

(b) NITROGEN SYSTEMS: All nitrogen systems shall be subjected to operating pressures with clean, dry nitrogen. All exposed joints, seals, clamps, welds, and connections subject to test pressures shall be leak tested as specified for shop bubble test.

11.5.2.1 LEAKS: No leaks are acceptable. The Contractor shall repair all leaks or replace part or component which failed test. Repair or replacement shall be to the satisfaction of the Contracting Officer and

in a manner approved by the Contracting Officer before repair or replacement is made. After repair or replacement has been completed, all tests required for the original shall be repeated. Repairs, replacements, and retests shall be made at no additional cost to the Government.

11.5.3 DELETED

11.5.4 DELETED

11.5.5 FINAL CHECKOUT: The Contractor shall be responsible for checkout of all components and lines furnished and installed under this contract. The Contractor shall furnish the personnel, tools, and testing equipment for operating the systems during the checkout and test, except the facility controls (water and power) will be operated by personnel furnished by the Contracting Officer at the Contractor's request. The Contractor shall furnish all labor required to adjust, repair, or replace nonconforming components furnished and installed under this contract; however in the event of any malfunction in existing facility the repair of such malfunction shall not be the responsibility of this Contractor. The Government will furnish all water and electricity for the final checkout and tests at the jobsite. All operating devices under this contract shall be cycled no fewer than 3 times and results indicated (e.g., clamps shall be manually closed and then opened using the nitrogen valves). All work performed under this contract shall remain the responsibility of the Contractor until all systems have been checked out; conformance with specified requirements has been indicated by the test results; and the complete exhaust duct assembly has been approved. The Contractor shall submit, for approval, a form to be used for checkout and sign-off of the complete exhaust duct system, including requirements for cleaning, testing, and inspection. The sheets shall be sufficiently detailed to provide information so that the requirements can be back-checked where necessary. Sign-off provisions for the completed duct assembly shall include space for sign-off by the Contracting Officer and the Contractor.

11.5.6 DEFECTS OR NONCOMPLIANCE: Defects or noncompliance with drawings and specifications discovered by field tests and inspections shall be repaired or replaced by use of approved procedures. After repairs or replacements have been made, the corrected areas shall be re-examined by the same methods that were originally required. Before any work is done on inside of duct, approval of Contracting Officer must be obtained for the specific work to be done. Repairs, replacements, and retesting shall be performed at no additional cost to the Government.

11.5.7 FIELD CLEANING INSPECTION: The presence of dirt, oil, grease, flux, or other foreign material on internal and external surfaces detected by a visual and tactile examination shall be cause for rejection of cleaning.

11.5.8 CERTIFICATION OF TEST RESULTS: Certification shall be submitted in accordance with Paragraph "END ITEM REPORTS" showing that conditions of required tests as set forth herein in the approved test procedures have been complied with. Certification of components and devices shall show the maximum allowable working pressures and temperature limits for which the component or device has been approved. Tests may be made of samples where specified herein, or when approved in writing by the Contracting Officer. However, when sample testing is permitted, certification shall further indicate that the sample tested is identical in design, fabrication, and materials with the part or unit of like designation to be supplied.

11.5.9 END ITEM REPORTS: The Contractor shall furnish certified copies in the quantities indicated in the terms and conditions of the contract and one certified reproducible of the reports of all tests, including calculations necessary to indicate test results conformance to the specification and data sheet requirements.

Mill and Factory Certificates
Flaw Tests
Hydrostatic and Pneumatic Tests
Bubble (leak) Tests
Flow Test
Calibration Curves
Dimensional Layout Data With Field Check
Cleaning Inspection
Final Checkout
All Other Reports Called for in This
Specification

12. CLEANING: The internal surfaces of exhaust duct shall be clean.

12.1 CLEANING DURING FABRICATION: Descaling may be accomplished prior to welding of the final seam. As the coolant passages are welded, each passage shall be completely cleaned of oxide, flux, and spatter before closing. Precautions shall be taken in the fabrication and assembly of the components, particularly all water passages and relatively inaccessible areas, to insure that metal particles, chips, slivers, filings, extraneous dirt, oil, grease, and grime do not remain in the system. Frequent cleaning with appropriate brushes and/or vacuum machines shall be employed in all such areas. The use of steel wool as a cleaning medium is prohibited. Aluminum wool may be used on aluminum. Stainless steel brushes which have not been used on other metals shall be used on stainless steel surfaces. As much of the structure as physically

possible shall be steam cleaned prior to the stress-relieving cycle. Cleaning shall be effected by subjecting all surfaces, tubes, and passages to a stream of high pressure steam with a cleaning compound conforming to Federal Specification P-C-437 followed by a stream of steam alone to remove all cleaning compound. All entrapped condensate shall be removed. Proper precautions shall be taken to minimize oxidation of the cooling channels and tubes during the heat treat cycle.

12.2 CLEANING PRIOR TO SHIPMENT AND FINAL CLEANING: Before shipping and again after testing has been completed in the field, the duct-truss assembly shall be cleaned of all dirt, oil, grease, filings, flux, spatter, and other foreign materials. Cleaning shall be performed by procedures selected by the Contractor and approved by the Contracting Officer.

13. SEALING:

13.1 SEALS: The duct and all pipe and tube openings shall be sealed immediately after it has been determined that they are clean. Seals shall be tight enough to prevent contamination and shall be protected so that they will not be broken or warped. Tape for sealing shall not leave any residue on connections when removed.

13.2 FLANGED OPENINGS: Flanged openings shall be sealed as above with sheet plastic and all machined facings shall be protected from mechanical damage by means of tempered hardboard or other approved material. Where bolting is used on stainless steel, the bolts shall be protected to prevent carbon steel contact. Sheet plastic materials, gaskets, and flanges shall be cleaned as required by this specification.

13.3 RECLEANING: Should cleanliness fail to pass inspection, the cleaning shall be repeated at no additional cost to the Government.

14. DISASSEMBLY AND PREPARATION FOR SHIPMENT: All parts shall be thoroughly cleaned and all openings and wiring connections sealed with polyethylene bags or sheets, or other suitable waterproof coverings. Gaskets, seals, nuts, bolts, anchors, and all parts shall be packed in separate polyethylene or other approved casings with reinforcements and supports where necessary to maintain "assembled" configuration.

14.1 PREPARATION FOR DELIVERY: In addition to sealing, the sections of the duct and the piping and tubing shall be prepared as follows:

14.1.1 PHYSICAL PROTECTION: Adequate measures shall be taken to prevent damage to the duct parts or components during shipment. Desiccant, conforming to Military Specification MIL-D-3464, shall be used where required. Cushioning, blocking, bracing, bolting, wrapping, and sealing shall be such as to insure safe delivery of the component and shall conform to Military Specification MIL-B-131. Blocking and bracing shall be designed to provide adequate protection to the equipment and its wrapping during transportation. Suitable and sufficient blocking and bracing shall be installed in the upper duct-truss assembly to secure the duct in position during all handling and transportation. Machined surfaces and flanges shall be protected during shipping and handling by rigid covers or enclosures. Each opening shall be sealed to prevent entry of moisture or contaminants. Equipment shall be wrapped with sheets of film material, heat sealed, with taped edges. Film shall be protected by cushioning with cellulosic cushioning material in accordance with Federal Specification PPP-C-843. The duct-truss assemblies, bellows assemblies, loose, and other nonrigid parts shall be protected to withstand an acceleration of 4g in any direction during transportation. Temporary supports, blocking, and bracing or isolation mounts shall be used to meet this requirement and shall be clearly marked for removal during installation. Extra care shall be taken to protect external tubing, exposed machined surfaces, extra bracing and blocking at expansion joints and bellows, special covers over protruding connections. All parts which cannot be properly protected in place shall be removed (except where welded). A suitable battery operated impactograph shall be installed on the duct equipment to monitor and record "g" loads imposed on the equipment during shipment.

14.2 TAGGING: Each separate package and item shall be clearly identified with name and address of Contractor, destination, contract number, and identification of part in accordance with Military Standards MIL-STD-129 and 130. Tags shall be fastened to smaller packages in a manner which will preclude accidental loss during shipment and storage. Notations shall not be affected by sun, wind, rain, or other weather conditions.

14.3 SHIPMENT: The exhaust-duct-assembly dismantled and sealed as specified herein, shall be shipped by motor truck or other carrier approved by the Contracting Officer. Extra sets of all nuts, bolts, gaskets, and seals shall be packed separately and delivered to the Contracting Officer at the site.

15. FIELD ASSEMBLY AND INSTALLATION: The Contractor shall reassemble the exhaust duct and truss assembly, at a location near the test stand, selected by the Contractor and approved by the Contracting Officer. After reassembly the exhaust duct shall be moved to the test stand vault and shall be connected as required to the structure and systems where and as indicated on the drawings. The installation shall include, but not be limited to, connecting the upper and lower duct-truss assemblies, positioning the butterfly

truss members and water headers, preparing all unfinished connecting ends, positioning the assembly in the vault, connecting the coolant headers and steam line, attaching the (GFE) upper duct clamp assembly to the roof of the vault, and adjusting all existing support system connections so that all connections can be made without forcing while the entire weight of the exhaust duct assembly is temporarily supported on the 4 truss jack points. Specifications for fabrication and other shop work are applicable to work at the jobsite unless specified otherwise under this paragraph. The Contractor shall transport the duct from the selected assembly location to the test stand vault using his own forces and equipment. The proposed method of moving the assembled duct shall be submitted to the Contracting Officer for approval prior to making the move.

15.1 DIMENSIONS AND TOLERANCES:

15.1.1 FIELD VERIFICATION: The Contractor shall verify in the field all interface dimensions shown on the contract drawings and on shop and dimensional layout drawings. He shall also check the structure for possible interference after completing field fabrication and prior to installation.

15.1.2 COORDINATION: The Contractor shall base all fabrication and installation on certified manufacturer's drawings of equipment and on certified as-built dimensions of fabricated equipment that will be connected. The Contractor shall assume all responsibility for field fit-up regardless of the dimensions of such equipment shown on the reference drawings. Coordination, as required with other fabricators, or other contractors, shall be the Contractor's responsibility.

15.2 WELDING AT THE JOBSITE: Welding shall be performed by approved qualified welders using approved procedures as specified herein. Welding shall not be done when the atmospheric temperature is less than zero degrees F, when the surfaces are wet, when rain or snow is falling or moisture condensing on the surfaces to be welded, nor during periods of high wind, unless the welder and the work are protected properly.

15.2.1 BASE METAL PREPARATION: Preparation of pipe ends shall be done by machining and/or grinding. Preparation of ends for butt welds shall conform to requirements in Paragraph "FABRICATION." Preparation of ends for fillet welds for flanges and fittings shall be in accordance with approved details. The ends of pipe-to-pipe and pipe-to-fitting

joints shall be aligned accurately within a tolerance of 10 per cent of the pipe thickness. Alinement shall be maintained during welding by suitable clamps, jigs, tack welds, or other devices. If tack welds are used to maintain alinement they shall be kept below the outside surface of the pipe, shall not exceed twice the pipe thickness in length or 2/3 the pipe thickness in depth, shall be the same quality as the final welds, and, if acceptable under 10-power magnification visual inspection, shall be fused thoroughly in the final weld. Defective tack welds shall be removed before the final weld is made.

15.3 CORROSION PROTECTION:

15.3.1 ANODIZED COATING: Aluminum, except gasket material, shall be anodized to conform to Military Specification MIL-A-8625 wherever required for interface protection between aluminum and concrete and between contact surfaces of dissimilar metals. Aluminum gaskets shall be protected by means of Alodining or other approved method.

15.3.2 PAINT: Where aluminum surfaces are in contact with stainless steel or other dissimilar metal, the aluminum and the other metal surface shall be given a prime coat of zinc chromate conforming to Military Specification MIL-P-8585, limited to the contact area and then the contact metal surface shall be given one coat of aluminum paint conforming to Federal Specification TT-P-38 to cover the prime coat before assembly.

15.3.3 ALCLAD COATING: Alclad coating, or equal, shall conform to the aluminum manufacturer's recommendations and shall have Contracting Officer's approval.

15.4 SUNDRY METAL ITEMS: Sundry items including shims, spacers, and other sundry erection items not specifically mentioned herein nor in other sections, but which are required to complete the work, shall be provided and installed in accordance with the best standard practice of the trade. Items shown diagrammatically on the contract drawings shall be fabricated to the Contractor's shop details as approved by the Contracting Officer.

15.5 ANCHORS, BOLTS, AND STRAPS: All necessary anchors, bolts, straps, ties, and miscellaneous fastenings required for the work shall be furnished and installed. Such items not definitely specified or shown shall conform to the best practice and shall be of austenitic stainless steel (Type 304, 316, 321, or 347, if to be welded), unless otherwise shown.

15.6 CUTTING AND REPAIRING: The Contractor shall install his work in such a manner and at such times as will require a minimum of cutting and repairing of structure or equipment. In the event any cutting is necessary, it shall be done only with the permission of the Contracting Officer. All cutting and repairing shall be performed by mechanics of a trade equivalent to the trade which originally executed the work. Repairs shall match the original condition.

15.7 ERECTION: Work shall be made and erected square, plumb, straight and true, accurately fitted, and with joints and inter-sections tight. Work shall be finished smooth with even, close joints and neat connections. All work shall be set at the proper locations and levels as shown on the drawings and/or as directed by the Contracting Officer. Safety wiring shall be provided when shown in accordance with Military Standard MS-33540.

15.8 JACKS AND DRIFT PINS: Jacks, drift pins, or other forcing devices shall not be used to bring together the several parts without prior and specific approval of the Contracting Officer.

15.9 GAS CUTTING: The use of the gas cutting torch in the field will not be permitted. All cutting and drilling shall be by machine, however, arc cutting with a tungsten arc torch on light structural members not under stress may be permitted after the approval of the Contracting Officer has been obtained in writing in each case.

15.10 CLEANING: The Contractor shall be responsible for maintaining cleanliness in all the existing work and all new work. The Contracting Officer will make periodic cleanliness inspections and contaminated systems shall be recleaned by the Contractor at no additional cost to the Government.

15.11 FIELD HYDROTEST: After field installation is completed and all connections are made and all valves closed, vents and drains plugged, all piping, tubing, and water passages except nitrogen lines shall be hydrotested in accordance with Paragraph "QUALITY CONTROL." Nitrogen line shall be pneumatically tested with nitrogen.

15.12 DELETED

15.13 DELETED

16. DEFECTIVE WORK: All defective work, materials, or equipment indicated by the inspection and testing shall be repaired or replaced with new materials or equipment, as approved by the Contracting Officer, at no additional cost to the Government.

17. OPERATIONS AND MAINTENANCE MANUALS: Six complete sets of operation and maintenance instructions covering the operation and maintenance of each major item of equipment and controls shall be furnished to the Contracting Officer. The manuals shall contain complete information for assembly, operation, adjustment, installation maintenance, and repair of equipment and instruments, together with detailed parts lists and recommendations of parts to be stocked for one year's normal maintenance.

18. CLEAN UP: At the completion of the work, all parts of the installation shall be cleaned thoroughly and approved by the Contracting Officer. All surplus materials and debris from work shall be removed as directed. Duct, all equipment, and piping shall be cleaned. Any stoppage, discoloration, or other damage to the vault structure, existing piping, or other features, or any finishes due to the Contractor's failure to properly install, clean, or operate the equipment shall be repaired without cost to the Government.

19. ACCEPTANCE: Final acceptance and approval will be made at the jobsite after all Field Tests and Checkout, and all end-item reports have been completed satisfactorily, approved, and signed by the Contracting Officer.

20. DRAWINGS: The work shall conform to the following contract drawings, all of which form a part of these specifications:

<u>CONTRACT DRAWINGS</u>		
<u>Drawing No.</u>	<u>SNPO-C Drawing No.</u>	<u>Title</u>
F-19204 A	3300-13.1	Index Drawing
F-19205	3301-C22	General Layout
F-19206 C	3305-M36.2	Process Flow Diagram
F-19207 C	3305-M37.2	P & I Flow Diagram
F-19208 B	3350-S201.1	Duct-Truss Assembly
F-19209 C	3350-S202.3	Primary Duct Section
F-19210 C	3350-S203.3	Inlet Water Shield & Details
F-19211 C	3350-S204.3	Bellows & Upper Seal
F-19212 A	3350-S205.1	Primary Duct Details
F-19213 A	3350-S206.1	Primary Duct Lower Support
F-19214	3350-S207	Primary Duct Upper Support
F-19215 B	3350-S208.2	Severance Plane Seal
F-19216 C	3350-S209.3	Cooling Water Couplings
F-19217 B	3350-S210.2	Elbow Duct Section
F-19218 A	3350-S211.1	Elbow Duct Sections & Details
F-19219 C	3350-S212.3	Water Jacket
F-19220 B	3350-S213.2	Water Jacket Sections
F-19221	3350-S214	Water Jacket Sections & Details
F-19222 C	3350-S215.3	Steam Ejector

<u>Drawing No.</u>	SNPO-C <u>Drawing No.</u>	<u>Title</u>
F-19223 A	3350-S216.1	Steam Ejector Sections
F-19224 A	3350-S217.1	Steam Ejector Details No. 1
F-19225 B	3350-S218.2	Steam Ejector Details No. 2
F-19226 A	3350-S219.1	Secondary Duct Section
F-19227 B	3350-S220.2	Secondary Duct Exit Elbow
F-19228 C	3350-S221.3	Secondary Duct Exit Elbow Details
F-19229 A	3350-S222.1	Secondary Duct Supports
F-19230 C	3350-S223.3	Upper Truss Plans & Elevation No. 1
F-19231 C	3350-S224.3	Upper Truss Plans & Elevation No. 2
F-19232 B	3350-S225.2	Lower Truss Plan & Elevations
F-19233 C	3350-S226.3	Lower Truss Elevation & Sections No. 1
F-19234 B	3350-S227.2	Lower Truss Elevation & Sections No. 2
F-19235 B	3350-S228.2	Truss Platform Details No. 1
F-19236 A	3350-S229.1	Truss Platform Details No. 2
F-19237 C	3350-S230.3	Truss Details No. 1
F-19238 A	3350-S231.1	Truss Details No. 2
F-19307 A	3350-S232.1	Truss Details No. 3
F-19239	3350-I 35	Deleted
F-19240	3350-I 36	Deleted
F-19241	3350-I 37	Deleted
F-19242	3350-I 38	Deleted
F-19243	3350-I 39	Deleted
F-19244	3350-I 40	Deleted
F-19245	3350-I 41	Deleted
F-19246	3350-I 42	Deleted
F-19247	3350-I 43	Deleted

<u>Drawing No.</u>	SNPO-C <u>Drawing No.</u>	<u>Title</u>
F-19248	3350-I 44	Deleted
F-19249	3350-I 45	Deleted
F-19250	3350-I 46	Deleted
F-19251	3350-I 47	Deleted

REFERENCE DRAWINGS

F-19175	3305-M35	Exhaust Duct Support - Piping & Instrumentation Flow Diagram
F-19176	3350-S80	Exhaust Duct Support - Duct Vault General Arrangement
F-19181	3350-M10	Exhaust Duct Support - Trunnion Assembly
F-19185	3350-P26	Exhaust Duct Support - Piping Plan
F-19186	3350-P27	Exhaust Duct Support - Piping Sections
F-19187	3350-P28	Exhaust Duct Support - Piping Sections & Details No. 1
F-19188	3350-P29	Exhaust Duct Support - Piping Sections & Details No. 2
F-19191	3350-I22	Deleted
F-19193	3350-I24	Deleted

APPENDIX A

MATERIAL AND EQUIPMENT
SPECIFICATIONS AND DATA SHEETS

APPENDIX A
MATERIAL AND EQUIPMENT
SPECIFICATIONS AND DATA SHEETS

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PIPING MATERIAL SPECIFICATION

PROJECT ETS-1 SERVICE Process Water SPEC AW
 LOCATION Jackass Flats, Nev. SYMBOL _____ JOB SPEC PW PAGE 1 OF 3
 PLANT Exhaust Duct BY jls REV _____ DATE 4/22/64

ASA B16 5 FLANGE CLASS Special 300 lb

PRIMARY PRESS-TEMP RATING 240

100 °F

ASA B31 3 PIPING SYSTEMS MATERIAL Stainless Steel

GENERAL

Operating pressure and temperature: 170 psig at 160° F

Maximum pressure and temperature: 240 psig at 170° F

ITEM	SIZE (INCHES)	DESCRIPTION
<u>Pipe:</u>		Material - Stainless steel ASTM A 312 Gr. TP 304 or TP 347, ASTM A 358 Gr. 304, or ASTM A 376 Gr. TP 304 or TP 347. Gr. TP 347 shall be used where, and only where, pipe is stress-relieved as part of a duct section. Welded pipe may be used. All longitudinal welds on sizes 24" O.D. and over are 100% radiographed for joint efficiency of 1.00 per ASA Code for Pressure Piping.
	1" and Smaller	Use Tubing Spec. "T"
	1-1/2" to 24" O.D.	See Drawings
	36" O.D.	Wall - 3/8" thickness - min. Beveled ends
<u>Fittings:</u>		Material - Forged stainless steel ASTM A 403, Gr. WP-304H. Welded pipe may be used if all longitudinal welds are 100% radiographed for joint efficiency of 1.00 and openings are reinforced per ASA Code for Pressure Piping.
<u>High Point Vents and Low Point Drains:</u>	1/2" Special Weld Boss for Vents and 3/4" and 1" Special Weld Bosses for drains	Material - Forged stainless steel weld boss, ASTM A 182 Gr. F 304 or F 347, with Voi Shan VSF 1211 and AN 806 plug installed with copper conical seals, Voi Shan VSF 1015.

PIPING MATERIAL SPECIFICATION

PROJECT ETS-1 SERVICE Process Water SPEC AW
 LOCATION Jackass Flats, Nev. SYMBOL PW JOB SPEC   PAGE 2 OF 3
 PLANT Exhaust Duct BY jls REV   DATE 4/22/64

ITEM	SIZE (INCHES)	DESCRIPTION
<u>Flanges:</u>		A. <u>For Orifices</u> Material - Forged stainless steel ASTM A 182 Gr. F 304. Jack screws for spreading flanges to remove orifice plates shall be provided. Rating - 300 lb ASA weld neck orifice type Facing - 1/16" raised face with concentric serrations. Bore - to suit pipe. Pressure tap connections shall be 1/4", AND 10050-4. B. <u>For Truss Severance Joints</u> ASTM A 182 Gr. F 304 forged stainless steel Rating - 300 lb ASA welding neck flanges with large tongue and groove type joints and inside diameter bored to the ID of adjoining pipe. Tongue and groove shall have concentric serrations. C. <u>For Other Water Lines Not Part of Truss</u> ASTM A 182 Gr. F 304 forged stainless steel Rating - 150 lb ASA weld neck 1/16" raised face with concentric serrations.
<u>Gaskets:</u>		A. <u>For Raised Face Flanges</u> Johns-Manville #913 or equal spirothallic with soft iron compression ring, Type 304 stainless corrugated metal strip spirally wound with a cushion of asbestos strip. B. <u>For Large Tongue and Groove Flanges</u> Soft aluminum per Aluminum Association AA + 100.0 flat ring, 1/8" thick.
<u>Bolts:</u>		Material - Stainless steel ASTM A 320 Gr. B8, with hex head. Drill and continuous wire through all bolt heads.

PIPING MATERIAL SPECIFICATION

PROJECT ETS-1 SERVICE Process Water SPEC AW
 LOCATION Jackass Flats, Nev. SYMBOL PW JOB SPEC   PAGE 3 OF 3
 PLANT Exhaust Duct BY jls REV   DATE 4/22/64

ITEM	SIZE (INCHES)	DESCRIPTION
<u>Nuts:</u> <u>Hydrostatic Testing:</u> <u>Cleaning:</u> <u>Special Requirement</u>		Material - Stainless steel ASTM A 194 Gr. 8C Heavy semifinished hexagon, drilled and stainless-steel-wired for positive locking. Hydrostatic test all materials this specification to 360 psig after cleaning. See Paragraph 12, "Cleaning" Provide two sets of spare gaskets for each pair of flanges.

PIPING MATERIAL SPECIFICATION

PROJECT ETS-1 SERVICE See Below SPEC T
 LOCATION Jackass Flats, Nev. SYMBOL GN JOB SPEC _____ PAGE 1 OF 2
 PLANT Exhaust Duct BY jls REV _____ DATE 4/23/64

ASA B16.5 FLANGE CLASS None

PRIMARY PRESS-TEMP RATING 275° F PSIG @ 100 °F

ASA B31.3 PIPING SYSTEMS MATERIAL Stainless Steel Tubing

GENERAL

Use this tubing where referred to for sizes 1" & smaller.

Service: Process Water & Gaseous Nitrogen

ITEM	SIZE (INCHES)	DESCRIPTION
<u>Tubing:</u>	Tube Size (O.D.) 1/4" 3/8" 1/2" 3/4" 1"	Material - Stainless steel ASTM A 269, Gr. TP304, TP316, TP321, or TP347, seamless, annealed, and pickled. Minimum wall thickness - For "AS" Spec. (150 lb.) to 275 psig .035" .035" .035" .049" .049" Ends - 37° Flare. Flare .072" and over with safety approved ballistic tool.
<u>Fittings:</u>	1" & smaller	Material - Stainless Steel, ASTM A 182, Gr. F304, F316, F321, or F347. Type AND 10059 per MIL-F-5509
<u>Components:</u>		Components shall have AND 10050 end connections. Female ends are preferred. Components supplied with pipe thread ends shall be supplied with flared tube to pipe thread nipple (AN 816) and the pipe thread joint heliarc seal welded.
<u>Branches:</u>	Branch same size as main or smaller	Tubing tee fitting or tubing tee fitting and reducer.
<u>Testing:</u>		Pneumatic test for leaks all Gaseous Nitrogen Piping at operating pressure of the nitrogen lines as shown on the Process Flow Drawing.

PIPING MATERIAL SPECIFICATION		PROJECT <u>ETS-1</u> SERVICE <u>Gaseous Nitrogen & Process Water</u> SPEC <u>T</u> LOCATION <u>Jackass Flats, Nev.</u> SYMBOL <u>GN&PW</u> JOB SPEC <u> </u> PAGE <u>2</u> OF <u>2</u> PLANT <u>Exhaust Duct</u> BY <u>jls</u> REV <u> </u> DATE <u>4/23/64</u>		
ITEM	SIZE (INCHES)	DESCRIPTION		
<u>Cleaning:</u> <u>Fitting</u> <u>Seals:</u>		See Paragraph 12, "Cleaning" All flared fittings in the specification shall be equipped with a Voi-Shan or approved equal copper conical seal. See Voi-Shan Mfg. Co. drawings: VSF 1015 - Sheet 1 & 2 of 2 Seal VSD 1000 - Sheet 1 & 2 of 2 Bosses for Conical Seal. VSFT 3400 - Sheet 1 of 1 Porting Tool VSFT 3401 - Sheet 1 of 1 Roughing Tool		

PAGES A-40 THRU A-44 DELETED

PART NUMBER
VSFT 3400-XX

4 FLUTE - 2 THRU - 24

6 FLUTE - 28 AND - 32

8 FLUTE - 40 AND - 48

PART NUMBER	THREAD SIZE	A REF.	B DIA.	C DIA.	NO. OF FLUTES * HSS ONLY
VSFT3400 - 2	5/16-23UNF-3B	5	1/2	.692	4
VSFT3400 - 3	3/8-24UNF-3B	5	1/2	.770	4
VSFT3400 - 4	7/16-20UNF-3B	5-1/4	1/2	.848	4
VSFT3400 - 5	1/2-20UNF-3B	5-1/4	1/2	.926	4
VSFT3400 - 6	9/16-18UNF-3B	5-1/4	1/2	.989	4
VSFT3400 - 8	3/4-16UNF-3B	5-1/4	1/2	1.208	4
VSFT3400 - 10	7/8-14UNF-3B	5-1/4	3/4	1.364	4
VSFT3400 - 12	1-1/8-12UN-3B	5-1/2	3/4	1.645	4
VSFT3400 - 16	1-5/16-12UN-3B	5-1/2	1	1.930	4
VSFT3400 - 20	1-5/8-12N-3B	5-3/4	1	2.290	4
VSFT3400 - 24	1-7/8-12N-3B	5-3/4	1	2.580	4
VSFT3400 - 28	2-1/4-12UN-3B	6-1/4	1	3.030	6
VSFT3400 - 32	2-1/2-12UN-3B	6-1/4	1	3.500	6
VSFT3400 - 40	3-1/2UN-3B	7-1/2	1-1/2	4.630	8
VSFT3400 - 48	3-1/2-12UN-3B	7-1/2	1-1/2	5.830	8

NOTES:

1. THIS TOOL TO BE USED IN CONJUNCTION WITH VSFT 3401, ROUGHING TOOL.
2. TOOL AVAILABLE IN HIGH SPEED STEEL OR CARBIDE TIPPED. ADD "C" AFTER DASH NO. FOR CARBIDE.
3. ALL CARBIDE TIPPED TOOLS ARE FOUR FLUTE.
4. FOR PROPER END RESULTS THIS TOOL TO BE USED IN CONJUNCTION WITH VSF 1075 CONICAL SEAL.

EXAMPLE OF
PART NUMBER

VSFT 3400 - 2 (C)

DENOTES CARBIDE

DENOTES TUBE SIZE IN 16THS

BASIC PART NUMBER

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PATENT APPLIED FOR.

DIMENSIONS IN INCHES

APPROVED DATE

4 MAY 1961

LATEST REVISION DATE

3 JANUARY 1962

TITLE

PORTING TOOL

FOR VSD 1000

CODE IDENT. NO.

92215

STANDARD

VSFT 3400

VSFT 1 OF 1

Revised

A-45

PART NUMBER
VSFT 3401-XX

PART NUMBER	THREAD SIZE	A	B DIA.		NO. OF FLUTES
VSFT3401 - 2	5/16-24UNF-3B	2-1/2	.250		2
VSFT3401 - 3	3/8-24UNF-3B	2-13/16	.313		2
VSFT3401 - 4	7/16-20UNF-3B	3	.359		2
VSFT3401 - 5	1/2-20UNF-3B	3-3/8	.422		2
VSFT3401 - 6	9/16-18UNF-3B	3-11/16	.484		2
VSFT3401 - 8	3/4-16UNF-3B	4-1/2	.656		2
VSFT3401 - 10	7/8-14UNF-3B	5-1/8	.766		2
VSFT3401 - 12	1-1/16-12UN-3B	5-3/4	.938		2
VSFT34-1 - 16	1-5/16-12UN-3B	6-5/8	1.188		2
VSFT3401 - 20	1-5/8-12N-3B	7-1/2	1.500		2
VSFT3401 - 24	1-7/8-12N-3B	8	1.750		2
VSFT3401 - 28	2-1/4-12N-3B	8	2.000		2
VSFT3401 - 32	2-1/2-12UN-3B	8	2.250		2
VSFT3401 - 40	3 - 12UN-3B	8	2.750		2
VSFT3401 - 48	3-1/2-12UN-3B	8	3.250		2

NOTES:

1. THIS TOOL TO BE USED IN CONJUNCTION WITH VSFT 3400, PORTING TOOL.
2. MATERIAL: HIGH SPEED STEEL
3. FOR PROPER END RESULTS THIS TOOL TO BE USED IN CONJUNCTION WITH VSF 1075 CONICAL SEAL.

EXAMPLE OF
PART NUMBER:

VSFT 3401 - 2

DENOTES TUBE SIZE IN 16THS
BASIC PART NUMBER

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DIMENSIONS IN INCHES

PATENT APPLIED FOR.

APPROVED DATE

4 MAY 1961

LATEST REVISION DATE

3 JANUARY 1962

TITLE

ROUGHING TOOL
FOR VSD 1000

CODE IDENT. NO.

92215

STANDARD

VSFT3401

SHEET 1 OF 1

Revised

A-45a

VOI-SHAN MANUFACTURING COMPANY A DIVISION OF VSI CORPORATION

DASH NO.	TUBE SIZE O.D.	THREAD T	A	B ±.010	C ±.010	D MIN	E ±.010	F MIN DIA.
2	1/8	5/16-24 UNF-3B	.062	.323	.202	.252	.335	.672
3	3/16	3/8-24 UNF-3B	.125	.385	.265	.283	.366	.750
4	1/4	7/16-20 UNF-3B	.172	.448	.327	.332	.432	.878
5	5/16	1/2-20 UNF-3B	.234	.510	.382	.332	.432	.906
6	3/8	9/16-18 UNF-3B	.297	.572	.441	.330	.441	.969
8	1/2	3/4-16 UNF-3B	.391	.760	.619	.371	.496	1.188
10	5/8	7/8-14 UNF-3B	.484	.885	.732	.453	.596	1.344
12	3/4	1-1/16-12 UN-3B	.609	1.072	.909	.501	.668	1.625
16	1	1-5/16-12 UN-3B	.845	1.322	1.158	.548	.715	1.910
20	1-1/4	1-5/8-12N-3B	1.080	1.635	1.468	.544	.711	2.270
24	1-1/2	1-7/8-12N-3B	1.314	1.885	1.720	.658	.825	2.560
28	1 3/4	2-1/4-12UN-3B	1.550	2.260	2.095	.710	.877	3.010
32	2	2-1/2-12UN-3B	1.784	2.510	2.343	.825	.992	3.400
40	2-1/2	3-12UN-3B	2.294	3.010	2.739	.670	.837	3.900
48	3	3-1/2-12UN-3B	2.714	3.510	3.229	.748	.915	4.500

- NOTES:
1. REMOVE ALL HANGING BURRS AND SLIVERS.
  2. MAXIMUM SURFACE ROUGHNESS (REF. MIL-STD 10) 125 RHR UNLESS OTHERWISE SPECIFIED.
  3. PITCH DIA. OF THREAD, DIMENSION C AND THE 37° ANGLE MEASURED AND CALCULATED AS AN INCLUDED ANGLE SHALL BE CONCENTRIC WITHIN .008 TH.
  4. 37° SURFACE SHALL BE FREE FROM BURRS, LONGITUDINAL AND SPIRAL TOOL MARKS AND VISIBLE FLAT SPOTS. ANNULAR TOOL MARKS WILL BE ALLOWED TO 63 RHR MAXIMUM.
  5. SURFACE OF BOSS SHALL BE SPOT-FACED, DIAMETER "F".
  6. USE VSFT 3401 ROUGHING TOOL AND VSFT 3400 PORTING TOOL TO FABRICATE VSD 1000 BOSS.

DIMENSIONS IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED ANGLES ± 1° DECIMALS ± .005 FRACTIONS ± 1/64 FOR USE WITH VSF 1075 CONICAL SEAL AND FITTING ENDS PER AND10056 OR MS33656

PATENT APPLIED FOR.

TITLE

BOSSSES, STANDARD DIMENSIONS FOR
CONICAL SEAL STRAIGHT THREAD

STANDARD

VSD 1000

SHEET 1 OF 2

APPROVED DATE

10 June 1960

LATEST REVISION DATE

3 JANUARY 1962

VOI-SHAN MANUFACTURING COMPANY A DIVISION OF VSI CORPORATION

PROCEDURE FOR INSTALLATION OF AND10056 OR MS33656 FITTING END.

1. INSTALL CONICAL SEAL ON THE FITTING AS SHOWN IN DETAIL 1.
2. SCREW THE FITTING ASSEMBLY INTO THE BOSS UNTIL IT BOTTOMS TIGHTLY IN THE BOSS AS SHOWN IN DETAIL 2.
3. USE STANDARD AND10064 TORQUES.
4. FOR PROPER END RESULTS THIS DESIGN TO BE USED IN CONJUNCTION WITH VS 1073 CONICAL SEAL.

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PATENT APPLIED FOR.

TITLE

BOSSSES, STANDARD DIMENSIONS FOR
CONICAL SEAL STRAIGHT THREAD

STANDARD

VSD 1000

SHEET 2 OF 2

APPROVED DATE

10 June 1960

LATEST REVISION DATE

3 JANUARY 1962

VOI-SHAN MANUFACTURING COMPANY
 A DIVISION OF VSI CORPORATION

DASH NO.	TUBE SIZE O.D.	A REF.	B $\pm .000$ $-.015$	C $\pm .005$ $-.000$	D $\pm .015$ $-.000$	T MAT'L SIZE
2	1/8	.340	.060	.345	.105	.005
3	3/16	.302		.307	.166	
4	1/4	.354		.359	.213	
5	5/16	.416	.075	.421	.275	
6	3/8	.471		.476	.320	
7	7/16	.534		.539	.401	
8	1/2	.649	.095	.654	.446	.010
9	9/16	.717		.722	.529	
10	5/8	.742		.747	.562	
11	11/16	.877	.105	.882	.625	
12	3/4	.933		.938	.667	
14	7/8	1.045		1.070	.826	
16	1	1.183	.125	1.188	.936	.015
18	1-1/8	1.370	.075	1.375	1.046	
20	1-1/4	1.496		1.501	1.175	
24	1-1/2	1.745	.125	1.750	1.410	
28	1-3/4	2.120		2.125	1.680	
32	2	2.370		2.375	1.913	
40	2-1/2	2.877	.085	2.882	2.500	
44	2-3/4	3.127		3.132	2.742	.015
47	2-15/16	3.225	.080	3.245	3.015	
48	3	3.377	.095	3.382	3.290	

 COPYRIGHT 1964
 VSI CORPORATION

U.S. PATENT NUMBER 3,137,294

 TITLE
 SEAL - CONICAL
 FLARED FITTING

 CODE IDENT NO.
 92215

STANDARD

VSF 1015

SHEET 1 OF 2

 APPROVED DATE
 5 NOVEMBER 1959

 LATEST REVISION DATE
 10 NOVEMBER 1964

VOI-SHAN MANUFACTURING COMPANY
 A DIVISION OF VSI CORPORATION

NOTES:

1. REMOVE ALL SHARP EDGES AND BURRS.
2. THESE PARTS ARE ANNEALED. DIMENSIONS "A" AND "C" SHALL BE VERIFIED BY INSTALLING THE GASKET ON A STANDARD FITTING PER AMS BASES OR MS DASH NO. APPROXIMATE SIZE AN OUT-OF-ROUND CONDITION WHICH DOES NOT PREVENT SUCH INSTALLATION SHALL NOT BE CAUSE FOR REJECTION UNLESS THE GASKET MATERIAL IS LAMINATED OR NICKED.

MAT'L & FINISH

- A ALUMINUM ALLOY 1100/751 SHEET CONDITION "O" PER QQ-A-451 OR MIL-A-148
 AT ALUMINUM ALLOY 1100/751 SHEET, CONDITION "O" PER QQ-A-451 OR MIL-A-148 TYPED PER AMS 2408-2 OR MIL-T-10727 TYPE II
 C OXYGEN FREE COPPER STRIP, SOFT-ANNEALED PER QQ-C-159
 CT OXYGEN FREE COPPER STRIP, SOFT-ANNEALED PER QQ-C-159, TIN-PLATED PER AMS 2408-2, OR MIL-T-10727 TYPE II
 N LOW-CARBON NICKEL STRIP, ANNEALED PER ASTM-B142 TIN-PLATED PER AMS 2408-2, OR MIL-T-10727 TYPE II
 NT LOW-CARBON NICKEL STRIP, ANNEALED PER ASTM-B142 SILVER-PLATED PER AMS 2410
 NS LOW-CARBON NICKEL STRIP, ANNEALED PER ASTM-B142 SILVER-PLATED PER AMS 2410
 S CORROSION RESISTANT STEEL PER AISI 305 SOFT-ANNEALED PER VS-2A-15
 SS CRS PER AISI 301, SOFT-ANNEALED PER VS-2A-15
 T TIN PER MIL-T-12074

CLEANING & PACKAGING

1. PARTS TO BE CLEANED AND PACKAGED IN ACCORDANCE WITH VOI-SHAN SPECIFICATION VS-VSF-5-1. NO CODING WILL APPEAR IN THE PART NUMBER.
2. PARTS MARKED IN BULK WILL BE CODED WITH LETTER "B" AFTER DASH NUMBER.
3. PARTS TO BE CLEANED AND PACKAGED IN ACCORDANCE WITH PMA-80 SPECIFICATION, WILL BE CODED WITH LETTERS "UA" AFTER DASH NO.

EXAMPLE OF CODE:

VSF 1015 N 12
 DASH NUMBER (TUBE O.D. IN 16THS.)
 MATERIAL & FINISH
 BASIC PART NUMBER

VSF 1015 CT 8
 DASH NUMBER (TUBE O.D. IN 16THS.)
 MATERIAL & FINISH
 BASIC PART NUMBER

VSF 1015 I 4 8
 CODE FOR NON-LOX CLEAN BULK PACKAGING
 DASH NUMBER (TUBE O.D. IN 16THS.)
 MATERIAL & FINISH
 BASIC PART NUMBER

VSF 1015 C 4 UA
 CLEANED & PACKAGED PER PMA-80
 DASH NUMBER (TUBE O.D. IN 16THS.)
 MATERIAL & FINISH
 BASIC PART NUMBER

 COPYRIGHT 1964
 VSI CORPORATION

U.S. PATENT NUMBER 3,137,294

 TITLE
 SEAL - CONICAL
 FLARED FITTING

 APPROVED DATE
 5 NOVEMBER 1963

 REV. (TITLED) AND DATE
 10 NOVEMBER 1964

 CODE IDENT NO.
 92215

STANDARD

VSF 1015

SHEET 2 OF 2

EQUIPMENT SPECIFICATION

PROJECT ETS-1 ITEM Expansion Joints
LOCATION Jackass Flats, Nev. SPEC _____ PAGE 1 OF 1
PLANT Exhaust Duct BY jls REV _____ DATE 4/23/64

DATA	DESCRIPTION
Service	Demineralized Process Water
Type	Pressure Balanced -ELL
End Connection	8" Schedule 10S Pipe
	Plain End Beveled for Welding
Material	100% Stainless Steel, Types 304, 316, 321, or 347 except bellows shall be Types 321 or 347 only
Bellows:	
Axial Motion - Expansion	1-1/4" Maximum from cold position
Axial Motion - Compression	0 Maximum
Inside Diameter	Inside Pipe Diameter - Minimum
Lateral Motion	1/4" Maximum
Spring Constant - Axial	1500 #/inch Maximum
Spring Constant - Lateral	1500 #/inch Maximum
Liner-Internal	Not Required
Shroud-External	Not Required
Tie Bars	Yes - Four External to Resist Compression and Expansion from Thrust Caused by Internal Pressure (Internal Spider Acceptable)
Operating Temperature	85°F to 180°F Maximum
Operating Pressure	170 psig to 240 psig Maximum
Tests	Hydrostatic Test at 360 psig
	Bellows shall be dye penetrant tested after hydrostatic test
Special Feature	Flow end shall contain two bellows if necessary to obtain required lateral deflection. End opposite flow end shall be equipped with a 3/4" female weld boss Voi-Shan VSF 1211 and AN 806 plug with copper conical seal Voi-Shan VSF 1015.
	Bellows in the flow section of elbow shall be cold sprung in compression 5/8"

[illegible]

EQUIPMENT SPECIFICATION

PROJECT ETS-1 ITEM Expansion Joints
LOCATION Jackass Flats, Nev. SPEC   PAGE 1 OF 1
PLANT Exhaust Duct BY jls REV   DATE 4/23/64

[illegible] [illegible]

EQUIPMENT
SPECIFICATION

PROJECT ETS-1 ITEM Expansion Joint
 LOCATION Jackass Flats, Nev. SPEC _____ PAGE 2 OF 2
 PLANT Exhaust Duct Support BY Sears REV _____ DATE 3/20/64

DATA	DESCRIPTION
Service Type	Secondary Steam Ejector Steam Line Expansion Joint
Size - Pipe	20" O.D. x 0.25 wall
End Connection	Bevel for Welding
Material - Body	Type 347 Stainless Steel
Bellows:	
Material	Type 347 Stainless Steel
Number Laminations	Min. of 3 (Note 1)
Axial Movement	3/4" Max.
Angular Movement	None
Liner Internal	Not Required
Spring Constant	5117 #/inch (Max.)
Operating Pressure - psid	23 psid External
Design Do Do	30 psid External
Hydrostatic Test Press psig	70 psid External (Note 2)
Operating Temperature of	1000°F
Design Do Do	1200°F
Shutdown Do Do	1200°F
Special Features	3 laminations required to keep spring constant within allowable limits Cold Spring 50% Compression 50% Cold Spring = 3/8"
REMARKS:	ITEM NO.
1. If welded longitudinal joints are used they shall be 100% radiographed to obtain 100% joint efficiency.	20" O.D.
2. Based on allow design stress of 12500 psi at 1200°F and creep life of over 1000 hours.	25 1/2" O.D.
	28" O.D.
	33 1/2" O.D.
	50 EJ-27A
	1-ST-20"-CR
	CODE:
	SIZE:

EQUIPMENT
SPECIFICATION

PROJECT ETS-1 ITEM Expansion Joints
 LOCATION Jackass Flats, Nev. SPEC jls PAGE 1 OF 1
 PLANT Exhaust Duct BY jls REV 4/23/64 DATE

DATA	DESCRIPTION																						
Service	Demineralized Process Water																						
Type	Pressure Balanced -ELL																						
End Connection	8" Schedule 10S Pipe																						
Material	Plain End Beveled for Welding																						
	100% Stainless Steel, Types 304, 316, 321, or 347 except bellows shall be 321 or 347 only																						
Bellows:																							
Axial Motion - Expansion	1/4" Maximum																						
Axial Motion - Compression	1/4" Maximum																						
Inside Diameter	Inside Pipe Diameter - Minimum																						
Lateral Motion	1/8" Maximum																						
Spring Constant - Axial	2400 #/inch Maximum																						
Spring Constant - Lateral	1500 #/inch Maximum																						
Liner-Internal	Not Required																						
Shroud-External	Not Required																						
Tie Bars	Yes - Four External to Resist Compression and Expansion from Thrust Caused by Internal Pressure (Internal Spider Acceptable)																						
Operating Temperature	85°F to 180°F Maximum																						
Operating Pressure	170 psig to 240 psig Maximum																						
Tests	Hydrostatic Test at 360 psig																						
	Bellows shall be dye penetrant tested after hydrostatic test.																						
Special Feature	Flow end shall contain two bellows if necessary to obtain required lateral deflection. End opposite flow end shall be equipped with 1-inch for 50-EJ-30 and -31 and 1/2-inch for 50-EJ-32 and -33 female boss Voi-Shan VSF 1211 and AN 806 plug with copper conical seal Voi-Shan VSF 1015.																						
REMARKS:	<table border="1"> <thead> <tr> <th>Item No.</th> <th>Line No.</th> </tr> </thead> <tbody> <tr> <td>50 EJ 30</td> <td>57 PW 8" AW</td> </tr> <tr> <td>50 EJ 31</td> <td>58 PW 8" AW</td> </tr> <tr> <td>50 EJ 32</td> <td>55 PW 8" AW</td> </tr> <tr> <td>50 EJ 33</td> <td>56 PW 8" AW</td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> </tbody> </table>	Item No.	Line No.	50 EJ 30	57 PW 8" AW	50 EJ 31	58 PW 8" AW	50 EJ 32	55 PW 8" AW	50 EJ 33	56 PW 8" AW												
Item No.	Line No.																						
50 EJ 30	57 PW 8" AW																						
50 EJ 31	58 PW 8" AW																						
50 EJ 32	55 PW 8" AW																						
50 EJ 33	56 PW 8" AW																						
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EQUIPMENT
SPECIFICATION

PROJECT ETS-1 ITEM Expansion Joints
LOCATION Jackass Flats, Nev. SPEC _____ PAGE 1 OF 1
PLANT Exhaust Duct BY _____ REV _____ DATE 4/23/64

DATA	DESCRIPTION
Service	Demineralized Process Water
Type	Pressure Balanced -ELL
End Connection	12" Schedule 10S Pipe
	Plain End Beveled for Welding
Material	100% Stainless Steel Types 304, 316, 321, or 347
	except bellows shall be Types 321 or 347 only
Bellows:	
Axial Motion - Compression	1/4" Maximum
Axial Motion - Expansion	1/4" Maximum
Inside Diameter	Inside Pipe Diameter - Minimum
Lateral Motion	3/16" Maximum
Spring Constant - Axial	2000 #/inch Maximum
Spring Constant - Lateral	2000 #/inch Maximum
Liner-Internal	Not Required
Shroud-External	Not Required
Tie Bars	Yes - Four External to Resist Compression and Expansion from Thrust Caused by Internal Pressure (Internal Spider Acceptable)
Operating Temperature	85°F to 180°F Maximum
Operating Pressure	170 psig to 240 psig Maximum
Tests	Hydrostatic Test at 360 psig
	Bellows shall be dye penetrant tested after hydrostatic test.
Special Feature	Flow end shall contain two bellows if necessary to obtain required lateral deflection. End opposite flow end shall be equipped with a 3/4" female weld boss Voi-Shan VSF 1211 and AN 806 plug with copper conical seal Voi-Shan VSF 1015.

REMARKS:

ITEM NO.

Line No.

50 EJ 25	61 PW 12" AW
50 EJ 26	62 PW 12" AW
50 EJ 28	84 PW 12" AW
50 EJ 29	85 PW 12" AW

CODE:

SIZE:

PAGE A-54 SEE PAGE A-51a

EQUIPMENT SPECIFICATION

PROJECT ETS-1 ITEM Expansion Joints
LOCATION Jackass Flats, Nev. SPEC _____ PAGE _____ OF _____
PLANT Exhaust Duct BY jls REV _____ DATE 5/18/64

[illegible]

PROJECT ETS-1 ITEM Pipe Severance Clamps
LOCATION Jackass Flats, Nev. SPEC _____ PAGE _____ OF _____
PLANT Exhaust Duct BY jls REV _____ DATE 5/20/64

[illegible]

REMARKS:

ITEM NO.

Line No.

50-C-1

43-PW-36" AW

50-C-2

~~38-PW-36" AW~~

CODE:

SIZE:

[illegible]

EQUIPMENT SPECIFICATION

PROJECT ETS-1 ITEM Restriction Orifices
LOCATION Jackass Flats, Nev. SPEC _____ PAGE _____ OF _____
PLANT Exhaust Duct BY jls REV _____ DATE 4/24/64

DATA	DESCRIPTION
Service	Shield Water for Top of Duct
Nominal Pipe Size	2" Schedule 40-S Pipe
Orifice Diameter	0.518" $\pm$ 0.001
Orifice Plate Thickness	3/16"
End Connections	300# ASA Orifice Type Flanges
	1/16" Raised Face
Pressure Tap Connections	1/4" AND 10050 & AN 806 Plug with copper conical seal. Voi-Shan VSD 1015
Operating Flow Conditions	
Temperature °F	160°F; 180°F Maximum
Pressure - Upstream	112 psig
Pressure - Downstream	12 psig
Drop across orifice	100 psi including 8% recovery
Flow Rate	50 GPM
Material	
Flanges	Type 304 Stainless Steel
Fittings	Type 304 Stainless Steel
Studs	Stainless Steel ASTM A 320
	Gr. B-8, strain hardened
Nuts - 2 per stud	Stainless Steel ASTM A 194
	Gr. 8C Heavy semifinished hexagon
Gaskets	Johns-Manville #913 or equal spiroallic
	with soft iron compression ring, Type 304
	stainless corrugated metal strip spirally
	wound with a cushion of asbestos strip
Special Requirement	Show orifice diameter and item number on ear of the plate which protrudes beyond O.D. of flange.
	Provide two sets of spare gaskets and one spare orifice plate drilled with 1/4" pilot hole instead of above drilling.

REMARKS:

ITEM NO

Line No.

50R0-84

73PW-2"-AW

50R0-85

74PW-2"-AW

CODE:

SIZE:

INSTRUMENTATION TAP ORIENTATION
(SEE DATA SHEETS FOR FLOW ELEMENTS)

<u>TAG NO.</u> <u>IDENTIFICATION</u>	<u>PRESSURE TAP</u> <u>ORIENTATION</u>	<u>REMARKS</u>
50-FE-54	Orient taps to point toward top of duct	
50FE-55	Orient taps to point toward top of duct	
50-FE-56	Orient taps to point toward top of duct	
50-FE-57	Orient taps to point toward top of duct	
50-FE-58	Orient taps to point toward rear of duct	Consider this line to be vertical for tap orientation purposes.
50-FE-59	Orient taps to point toward rear of duct	Consider this line to be vertical for tap orientation purposes.
50-FE-60	Orient taps to point toward front of duct	
50-FE-72	Orient taps to point toward front of duct	
50-FE-73	Orient taps to point toward front of duct	
50-FE-74	Orient taps to point toward top of duct	Consider this line to be horizontal for tap orientation purposes.
50-FE-75	Orient taps to point toward top of duct	Consider this line to be horizontal for tap orientation purposes.
50-FE-76	Orient taps to point toward rear of duct	
50-FE-77	Orient taps to point toward rear of duct	
50-FE-78	Orient taps to point toward top of duct	Consider this line to be horizontal for tap orientation purposes.
50-FE-79	Orient taps to point toward top of duct	Consider this line to be horizontal for tap orientation purposes.

EQUIPMENT SPECIFICATION	Project <u>ETS-1</u>	Item <u>Flow Element</u>
	Location <u>Jackass Flats, Nev.</u>	Spec _____
	Plant <u>Exhaust Duct</u>	By <u>WEG</u> Rev _____
	Page _____ of _____	Date <u>3/17/64</u>

DATA	DESCRIPTION	
Identification Tag No.	*	*
Make or Approved Equal	Foster	Foster
Catalogue or Part No.	Gentile Type "D"	Gentile Type "D"
Type	Impact Type Head Meter	Impact Type Head Meter
Process Fluid	Demineralized Water	Demineralized Water
Specific Gravity	1.00	1.00
Maximum Flow	4500 gpm	6025 gpm
Normal Flow	4325 gpm	5800 gpm
Operating Pressure	190 psig	191 psig
Operating Temperature	Ambient	Ambient
Body Rating	150# ASA	150# ASA
Body Material	304 Stainless Steel	304 Stainless Steel
Pipe Connections	8" sch. 10, Butt Weld	8" sch. 10, Butt Weld
Instrument Connections	(1/4") AND 10050 - 4	(1/4") AND 10050-4
End-to-End Dimension	12"	12"
Differential	500" W.C. at Max. Flow	500" W.C. at Max. Flow
Unrecovered Press. Loss	45" W.C. at Max. Flow	35" W.C. at Max. Flow
Accuracy	± 1% in System	± 1% in System
Special Construction & Notes:	*Tag No. Line No. 50-FE-54 55-PW-8"-AW 50-FE-55 56-PW-8"-AW Furnish Calibration Curve & Sizing Calculations	*Tag No. Line No. 50-FE-56 57-PW-8"-AW 50-FE-57 58-PW-8"-AW Furnish Calibration Curve & Sizing Calculations
Operates With:	50-FE-54 & 55	50-FE-56 & 57
Service:	Inlet Flow Vertical Section	Inlet Flow Elbow Section

EQUIPMENT SPECIFICATION	Project <u>ETS-1</u>	Item <u>Flow Element</u>	
	Location <u>Jackass Flats, Nev.</u>	Spec _____	Page _____ of _____
	Plant <u>Exhaust Duct</u>	By <u>wgg</u> Rev _____	Date <u>3/17/64</u>

DATA	DESCRIPTION	
Identification Tag No.	*	*
Make or Approved Equal	Foster	Foster
Catalogue or Part No.	Gentile Type "D"	Gentile Type "D" or Type VDM
Type	Impact Type Head Meter	Impact Type Head Meter
Process Fluid	Demineralized Water	Demineralized Water
Specific Gravity	1.00	1.00
Maximum Flow	5475 gpm	400 gpm
Normal Flow	5250 gpm	
Operating Press	187 psig	16 psig
Operating Temperature	Ambient	160 Normal, 180 Max.
Body Rating	150# ASA	150# ASA
Body Material	304 Stainless Steel	304 Stainless Steel
Pipe Connections	8" sch. 10 Butt Weld	6" sch. 10 Butt Weld
Instrument Connections	(1/4") AND 10050-4	(1/4") AND 10050-4
End-to-End Dimension	12"	9"
Differential	500" W.C. at Max Flow	100" W.C. at Max Flow
Unrecovered Press. Loss	40" W.C. at Max Flow	40" W.C. at Max Flow
Accuracy	± 1% in System	± 1% in System
Special Construction & Notes:	* Tag No. Line No. 50-FE-58 59-PW-8"-AW 50-FE-59 60-PW-8"-AW Furnish Calibration Curve & Sizing Calculations	* Tag No. Line No. 50-FE-60 91-PW-6"-AW Furnish Calibration Curve & Sizing Calculations
Operates With:	50-FE-58 & 59	50-FE-60
Service:	Inlet Flow Horizontal Section	Elbow Jacket Flow

EQUIPMENT
SPECIFICATION

PROJECT ETS-1 ITEM Flow Elements
 LOCATION Jackass Flats, Nev. SPEC _____ PAGE _____ OF _____
 PLANT Exhaust Duct BY jls REV _____ DATE 5/21/64

DATA	DESCRIPTION																										
Service	Demineralized Water Leaving Top of Elbow Section																										
Orifice Diameter	5.310 $\pm$ 0.001"																										
Orifice Plate Thickness	1/4"																										
Nominal Pipe Size	8" Sch. 10S																										
End Connections	300# ASA Orifice Type Welding Neck Flanges 1/16" Raised Face, bored to be flush with inside diameter of Sch 10S pipe and beveled for welding.																										
Pressure Tap Connections	1/4" AND 10050 & AN 806 plug with copper conical seal per Voi-Shan Dwg VSD 1015																										
Operating Flow Conditions																											
Temperature	160°F, 180°F Maximum																										
Pressure Upstream	60 psig																										
Pressure Downstream	45 psig																										
Drop across orifice	15 psi (including recovery)																										
Flow Rate	2899 GPM																										
Material																											
Flanges	Type 304 Stainless Steel																										
Fittings	Type 304 Stainless Steel																										
Studs	ASTM A 193 Stainless Steel Grade B-8 Strain hardened																										
Nuts	ASTM A 194 Grade 8C Heavy Semifinished																										
Gaskets	Johns-Manville #913 or equal spiroallic with soft iron compression ring, Type 304 stainless strip spirally wound with a cushion of asbestos strip																										
Special Requirement	Provide two sets of spare gaskets and one spare orifice plate with 1/4" diameter pilot hole instead of above drilling																										
	Show orifice diameter and item number on ear of the plate which shall protrude beyond O.D. of the flange																										
REMARKS:	<table border="1"> <thead> <tr> <th>ITEM NO.</th> <th>Line No.</th> </tr> </thead> <tbody> <tr> <td>50-FE-74</td> <td>63-PW-8"AW</td> </tr> <tr> <td>50-FE-79</td> <td>75-PW-8"AW</td> </tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> </tbody> </table>	ITEM NO.	Line No.	50-FE-74	63-PW-8"AW	50-FE-79	75-PW-8"AW																				
ITEM NO.	Line No.																										
50-FE-74	63-PW-8"AW																										
50-FE-79	75-PW-8"AW																										
	CODE: _____ SIZE: _____																										

EQUIPMENT
SPECIFICATION

PROJECT ETS-1 ITEM Flow Elements
 LOCATION Jackass Flats, Nev. SPEC _____ PAGE _____ OF _____
 PLANT Exhaust Duct BY jls REV _____ DATE 5/21/64

DATA	DESCRIPTION																								
Service	Demineralized Water																								
Orifice Diameter	4.500 $\pm$ 0.001"																								
Orifice Plate Thickness	3/8"																								
Nominal Pipe Size	8" Sch 10S																								
End Connections	300# ASA Orifice Type Welding Neck Flanges, 1/16" Raised Face, bored to be flush with Inside Diameter of Sch 10S pipe and beveled for welding.																								
Pressure Tap Connections	1/4" AND 10050 & AN 806 plug with copper conical seal per Voi-Shan Dwg VSD 1015																								
Operating Flow Conditions																									
Temperature - °F	160°F; 180°F Maximum																								
Pressure - Up-stream	112 psig																								
Pressure - Down-stream	30 psig																								
Drop across orifice	82 psi (including recovery)																								
Flow rate	4273 GPM																								
Material																									
Flanges	Type 304 Stainless Steel																								
Fittings	Type 304 Stainless Steel																								
Studs	ASTM A 193 Stainless Steel Grade B-8 Strain hardened																								
Nuts	ASTM A 194 Grade 8C Heavy Semifinished																								
Gaskets	Johns-Manville #913 or equal spirothallic with soft iron compression ring, Type 304 stainless strip spirally wound with a cushion of asbestos strip																								
Special Requirement	Provide two sets of spare gaskets and one spare orifice plate drilled with 1/4" pilot hole instead of above drilling																								
	Show orifice diameter and item number on ear of the plate which shall protrude beyond O.D. of flange																								
REMARKS:	<table border="1"> <thead> <tr> <th>ITEM NO.</th> <th>Line No.</th> </tr> </thead> <tbody> <tr> <td>50-FE-72</td> <td>65-PW-8"AW</td> </tr> <tr> <td>50-FE-73</td> <td>66-PW-8"AW</td> </tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> </tbody> </table>	ITEM NO.	Line No.	50-FE-72	65-PW-8"AW	50-FE-73	66-PW-8"AW																		
ITEM NO.	Line No.																								
50-FE-72	65-PW-8"AW																								
50-FE-73	66-PW-8"AW																								

REMARKS:

ITEM NO.

Line No.

50-FE-72

65-PW-8"AW

50-FE-73

66-PW-8"AW

CODE:

SIZE:

EQUIPMENT SPECIFICATION

PROJECT ETS-1 ITEM Flow Elements
LOCATION Jackass Flats SPEC _____ PAGE _____ OF _____
PLANT Exhaust Duct BY jls REV _____ DATE 5/21/64

DATA	DESCRIPTION
Service	Demineralized Water Leaving Secondary Duct Section
Orifice Diameter	5.350 $\pm$ .001"
Orifice Plate Thickness	5/8"
Nominal Pipe Size	12" Sch 10S
End Connections	300# ASA Orifice Type Welding Neck Flanges, 1/16" Raised Face, bored to be flush with Inside Diameter of Sch 10S pipe and beveled for welding
Pressure Tap Connections	1/4" AND 10050 & AW 806 plug with copper conical seal per Voi-Sham Dwg VSD 1015
Operating Flow Conditions	
Temperature	160°F, 180°F Maximum
Pressure - Upstream	122 psig
Pressure - Downstream	45 psig
Drop Across Orifice	77 psi including recovery
Flow Rate	5240 GPM
Material	
Flanges	Type 304 Stainless Steel
Fittings	Type 304 Stainless Steel
Studs	ASTM A 193 Stainless Steel Grade B-8 Strain hardened
Nuts	ASTM A 194 Grade 8C Heavy Semifinished
Gaskets	Johns-Manville #913 or equal spiritallic with soft iron compression ring, Type 304 stainless strip spirally wound with a cushion of asbestos strip
Special Requirement	Provide two sets of spare gaskets and one spare orifice plate with 1/4" diameter pilot hole instead of above drilling
	Show orifice diameter and item number on ear of the plate which shall protrude beyond O.D. of the flange

REMARKS:

ITEM NO

Line No.

50-FE-76

61-PW-12"AW

50-FE-77

62-PW-12"AW

CODE:

SIZE.

EQUIPMENT
SPECIFICATION

PROJECT ETS-1 ITEM Flow Elements
 LOCATION Jackass Flats, Nev. SPEC _____
 PLANT Exhaust Duct BY jls REV _____
 PAGE _____ OF _____
 DATE 5/21/64

DATA	DESCRIPTION
Service	Demineralized Water
Orifice Diameter	0.546 $\pm$ 0.001
Orifice Plate Thickness	3/16"
Nominal Pipe Size	2" Sch. 10S
End Connections	300 #ASA Orifice Type Welding Neck Flange
Pressure Tap Connections	1/4" AND 10050 & AN 806 plug with copper conical seal per Voi-Shan Dwg. VSD 1015
Operating Flow Conditions	
Temperature	160°F, 180°F Maximum
Pressure Upstream	170 psig
Pressure Downstream	10 psig
Drop Across Orifice	160 psi (including recovery)
Flow Rate, Max.	
Material	
Flanges	Type 304 Stainless Steel
Fittings	Type 304 Stainless Steel
Studs	ASTM A193 Grade B8, Strain-Hardened
Nuts - 2 per Stud	ASTM A 194 Grade 8C Heavy Semifinished
Gaskets	Johns-Manville #913 or equal spirothallic with soft iron compression ring, Type 304 Stainless Strip spirally wound with a cushion of asbestos strip
Special Requirements	Provide 2 sets of spare gaskets
	Provide one spare orifice plate with 1/4" dia. pilot hole instead of above drilling.
	Show orifice diameter and item number on ear of the plate which shall protrude beyond O.D. of the flange.

REMARKS:

ITEM NO.

50-FE-86

Line No.

94-PW-2"-AW

CODE:

SIZE:

EQUIPMENT
SPECIFICATION

PROJECT ETS-1 ITEM Flow Elements
 LOCATION Jackass Flats, Nev. SPEC _____ PAGE _____ OF _____
 PLANT Exhaust Duct BY jls REV _____ DATE 5/21/64

DATA	DESCRIPTION
Service	Demineralized Water
Orifice Diameter	1.750 $\pm$ 0.005
Orifice Plate Thickness	3/16"
Nominal Pipe Size	3" Sch. 10S
End Connections	300 #ASA Orifice Type Welding Neck Flange
Pressure Tap Connections	1/4" AND 10050 & AW 806 plug with copper conical seal per Voi-Shan Dwg. VSD 1015
Operating Flow Conditions	
Temperature	160°F, 180°F Maximum
Pressure Upstream	100 psig
Pressure Downstream	45 psig
Drop Across Orifice	55 psi (including recovery)
Flow Rate, Max.	560 GPM
Material	
Flanges	Type 304 Stainless Steel
Fittings	Type 304 Stainless Steel
Studs	ASTM A193 Grade B8, Strain-Hardened
Nuts - 2 per Stud	ASTM A 194 Grade 8C Heavy Semifinished
Gaskets	Johns-Manville #913 or equal spirotalllic with soft iron compression ring, Type 304 Stainless Strip spirally wound with a cushion of asbestos strip
Special Requirements	Provide 2 sets of spare gaskets
	Provide one spare orifice plate with 1/4" dia. pilot hole instead of above drilling.
	Show orifice diameter and item number on ear of the plate which shall protrude beyond O.D. of the flange.

REMARKS:

ITEM NO.

50-FE-87

Line No.

92-PW-3"-AW

CODE:

SIZE:

APPENDIX B DELETED