

UNITED STATES
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
LEWIS FLIGHT PROPULSION LABORATORY
21000 BROOKPARK ROAD
CLEVELAND 11, OHIO

SPECIFICATIONS
FOR
SUPPLY, PROPELLANT, HIGH PRESSURE
GAS, AND SERVICE PIPING SYSTEMS
FOR THE
ROCKET ENGINE RESEARCH FACILITY

PROJECT NO. C-1537

LOCATED
AT THE
LEWIS FLIGHT PROPULSION LABORATORY
21000 BROOKPARK ROAD
CLEVELAND 11, OHIO

SPECIFICATION NO. C-5525

JANUARY 10, 1956

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NOTE: This index is for convenience only. Its accuracy is not guaranteed and it is not to be considered as part of the specifications. In case of discrepancy between the index and the specifications, the specifications shall govern.

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SECTION I - DESCRIPTION, SCOPE, ETC.

1-01. Description:

- (a) This specification describes piping systems for liquid and gaseous service, including tanks, control valving, pressure regulators and other equipment associated with supply, propellant, high pressure gas, and service piping for the Rocket Engine Research Facility.
- (b) The supply piping shall serve two (2) areas permitting: transfer of hydrocarbons (or alcohol) and ammonia from the respective storage tanks in the fuel storage area to the fuel propellant tanks of the Test Cell Building (this piping to include an ammonia vapor return line); transfer of liquid oxygen and liquid nitrogen from the respective storage tanks in the oxygen and nitrogen areas to the oxidant propellant tanks of the Test Cell Building and of liquid nitrogen to a pump and evaporator unit adjacent to the liquid nitrogen storage area.
- (c) The propellant piping shall serve the fuel and oxidant pits and the test cell, providing high pressure liquid flow lines from the four (4) propellant tanks (oxidant and fuel) to the rocket thrust stand in the test cell. The fuel and oxidant immersion tank drains and the rocket starting system are included in this piping. The starting system shall provide for gaseous oxygen and propane flow from the oxidant and fuel pits, respectively, to the rocket test stand.
- (d) High pressure gas piping shall include helium and nitrogen charging piping, cylinder bank distribution manifolds, pressurizing piping and related vent and purge piping. The helium charging piping shall serve a helium-supply tube-trailer, and a helium compressor, transmitting helium gas to the high pressure gas cylinder banks adjacent to the southeast corner of the Test Cell Building. A helium return line is to be included, connecting four (4) banks of high pressure gas cylinders to the compressor. The nitrogen charging piping shall serve a high

pressure pump and evaporator unit. Transmitting nitrogen gas to the high pressure gas cylinder banks adjacent to the southeast corner of the Test Cell Building. The cylinder bank distribution manifold shall include selector valves, burst heads and filter elements and shall connect 280 (two hundred and eighty) high pressure gas storage cylinders for helium and nitrogen gas pressurizing systems. Pressurizing piping shall connect between the distribution manifold and the propellant tanks in the fuel and oxidant pits in the Test Cell Building. The vent and purge piping shall serve the propellant tank piping and related piping in the fuel and oxidant pits and shall connect to the exhaust duct, collector basin, and detention tank. Safety-head vents are included in this piping.

- (e) Service piping includes pilot pressure system, helium service and carbon-dioxide systems and will serve the fuel and oxidant pits and the test cell. The pilot pressure system will use helium and nitrogen gas from the pressurizing system and will serve the remote-actuated valves and pressure regulators in the fuel and oxidant pits and the test cell. The helium service system will provide high pressure helium gas for the test cell from the oxidant pit and the carbon dioxide system will provide spray nozzles and flow lines in the test cell feeding from storage cylinders located in the Test Cell basement.

1-02. Scope:

- (a) The work to be performed under this specification consists of furnishing all services, labor, equipment and materials (except those specified herein to be furnished by the Government) necessary for placing and installing equipment and accessories, the fabrication and connection of piping and tubing, the fabrication and installation of supports and hangers, the hydrostatic pressure testing cleaning and leak checking of the piping systems, the fabrication and placing of necessary cover plates and all other work not specifically excepted herein, for the installation of the aforementioned piping and tubing systems as shown on the drawings and as specified herein, in a complete and satisfactory manner, ready for operation for the National Advisory Committee for Aeronautics, Lewis Flight Propulsion Laboratory, 21000 Brookpark Road, Cleveland 11, Ohio.
- (b) Foundations and other structures required for placement of equipment under this specification are expected to be completed by another contractor by April 1, 1956. The rack mounting of 280 high pressure gas bottles which require piping installations under this specification is expected to be completed by another contractor by May 15, 1956. In order to allow completion of structure by another contractor, the 2 fuel and 2 oxidant tank assemblies are to be mounted in the pits of the test cell building under this specification by May 15, 1956.

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- (c) The following items of material will be furnished by the Government at a place of storage on the Laboratory site and shall be picked up, hauled and incorporated, in the quantities needed, by the contractor as partial material requirements of the piping systems under this contract. Any materials in excess of the quantities required for completion of the contract shall be returned to the Government by the contractor.

Pipe and Tubing:

- (1) 4" Schedule 40 welded stainless pipe (Type 304) - 428 feet.
- (2) 4" Schedule 40 welded stainless pipe (Type 347) - 148 feet.
- (3) 3" Schedule 40 seamless stainless pipe (Type 304) - 362 feet.
- (4) 2" Schedule 40 seamless stainless pipe (Type 304) - 155 feet.
- (5) 2" Schedule 40 welded stainless pipe (Type 304) - 2000 feet.
- (6) 1" Schedule 40 seamless stainless pipe (Type 304) - 290 feet.
- (7) 3/4" Schedule 40 seamless stainless pipe (Type 304) - 360 feet.
- (8) 3/4" O.D. by 17 gage wall stainless steel tubing (Type 316) - 2832 feet.
- (9) 1/2" O.D. by .065" wall stainless steel tubing (Type 347) - 2062 feet.
- (10) 1/4" O.D. by .035" wall stainless steel tubing (Type 347) - 1541 feet.

Miscellaneous Pipe Fittings:

- (11) 3" Schedule 40 stub ends - butt weld stainless steel (Type 347) - (15 available).
- (12) 2" Schedule 40 stub ends - butt weld stainless steel (Type 347) - (10 available).
- (13) 4" x 4" x 2" standard weight tee - butt weld - stainless steel (Type 347) - (15 available).
- (14) 3" x 3" x 2" standard weight tee - butt weld - stainless steel (Type 347) - (15 available).
- (15) 2" x 2" x 2" standard weight tee - butt weld - stainless steel (Type 347) - (15 available).

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- (16) 2" x 2" x 1" standard weight tee - butt weld - stainless steel (Type 304) - (15 available).
- (17) 1-1/2" x 1-1/2" x 1-1/2" standard weight tee - butt weld - stainless steel (Type 304) - (48 available).
- (18) 1" x 1" x 1" standard weight tee - butt weld - stainless steel (Type 304) - (44 available).
- (19) 3/4" x 3/4" x 3/4" standard weight tee - butt weld - stainless steel (Type 304) - (17 available).
- (20) 4" - 90° standard weight els - butt weld - stainless steel (Type 347) - (16 available).
- (21) 3" - 90° standard weight els - butt weld - stainless steel (Type 347) - (13 available).
- (22) 2" - 90° standard weight els - butt weld - stainless steel (Type 347) - (8 available).
- (23) 1-1/2" - 90° standard weight els - butt weld - stainless steel (Type 347) - (60 available).
- (24) 1-1/2" - 90° standard weight els - butt weld - stainless steel (Type 304) - (60 available).
- (25) 1" - 90° standard weight els - butt weld - stainless steel (Type 304) - (12 available).
- (26) 1" - 90° standard weight els - butt weld - stainless steel (Type 347) - (7 available).
- (27) 3/4" - 90° standard weight els - butt weld - stainless steel (Type 347) - (251 available).
- (28) 1/2" - 90° standard weight els - butt weld - stainless steel (Type 347) - (6 available).
- (29) 1/2" - 90° standard weight els - butt weld - stainless steel (Type 304) - (10 available).
- (30) 1" - 45° standard weight els - butt weld - stainless steel (Type 304) - (50 available).
- (31) 3/4" - 45° standard weight els - butt weld - stainless steel (Type 347) - (35 available).

SECTION I

- (d) The following items of equipment will be furnished by the Government at a place of storage on the Laboratory site and shall be picked up, hauled, installed, securely anchored to ground supports, floors, walls, or other structures, as indicated, and connected by the contractor who shall provide and install necessary supports, expansion bolts, levelling shims, welding and other required equipment, materials and services:
- (1) Two (2) liquid nitrogen storage tanks. Each tank, skid mounted, weighs approximately 12,000 pounds, is 20 (twenty) feet long, 8 (eight) feet wide by 9 (nine) feet high. Concrete support pads at the proper locations are provided by the Government.
 - (2) Two (2) liquid oxygen storage tanks. Identical to liquid nitrogen storage tanks. Concrete support pads at the proper locations are provided by the Government.
 - (3) Liquid nitrogen pump and evaporator unit. Unit weighs approximately 3000 pounds, is 6-1/2 (six and one-half) feet long by 6 (six) feet wide by 8 (eight) feet high. A concrete support pad is provided by the Government at the proper location.
 - (4) Helium compressor - Diesel engine driven, complete unit is mounted on four (4) wheels and equipped with tow bar.
 - (5) Three (3) hydrocarbon fuel storage tanks. Each tank, equipped with support legs, weighs 2200 (twenty-two hundred) pounds, is 18-1/2 (eighteen and one half) feet long by 4 (four) feet wide by 5-1/2 (five and one-half) feet high. Concrete support piers are provided by the Government at the proper location.
 - (6) Ammonia storage tank and transfer compressor. The compressor shall be mounted atop tank on steel shelf furnished by the Government. Total weight is 8600 (eighty-six) hundred pounds. Tank is approximately 27-1/2 (twenty-seven and one-half) feet long by 4 (four) feet wide by 5-1/2 (five and one-half) feet high and provided with support legs. Concrete support piers are provided by the Government at the proper location.
 - (7) Two (2) oxidant propellant tanks, immersion cylinders, tank supports and calibration yokes. These items shall be assembled as shown on drawing CE-101601 and mounted in oxidant pit of the Test Stand Building.
 - (8) Two (2) fuel propellant tanks, immersion cylinders, tank supports and calibration yokes. These items shall be assembled as shown on drawing CE-101602, and mounted in fuel pit of the Test Stand Building.

SECTION I

- (9) First and second stage oil separators for helium compressor. These items are described in drawings CD-101628 and CD-101629.
- (10) Fuel transfer pump approximately 3 (three) feet long by 1 (one) foot wide by 1 (one) foot high and weighing 180 (one hundred eighty) pounds. A concrete support pad is provided by the Government at the proper location.
- (e) The following drawings describe the piping systems specified herein and are hereby made a part of the specifications:

<u>Drawing No.</u>	<u>Date</u>	<u>Title</u>
CD-101575	1-6-56	Propellant & Hi-Pressure Gas Piping Plan Layout and Details
CD-101576	1-6-56	Propellant & Hi-Pressure Gas Piping, Isometric
CD-101577	1-6-56	Hi-Pressure Gas Piping, Manifold at Storage Racks
CB-101578	1-6-56	Hi-Pressure Gas Piping, Outlet Filter, Hi-Pressure Gas Cylinders
CE-101601	1-6-56	Oxidant Tank General Assembly
CE-101602	1-6-56	Fuel Tank General Assembly
CD-101603	1-6-56	Tank Supports
CD-101611	1-6-56	Piping Support Details
CD-101612	1-6-56	Piping Support Details
CD-101613	1-6-56	Piping Support Details
CB-101641	1-6-56	Flange - 1500 Lb. Lap Joint
CC-101642	1-6-56	Valve Schedule - Propellant Pilot Control Piping
CC-101643	1-6-56	Valve Schedule - Carbon Dioxide & Helium Test Cell Service Systems
CE-101644	1-6-56	Oxidant Pit Propellant Piping
CE-101645	1-6-56	Fuel Pit Propellant Piping
CE-101646	1-6-56	Propellant Pipe Supports

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<u>Drawing No.</u>	<u>Date</u>	<u>Title</u>
CE-101647	1-6-56	Fuel Tank Pressurizing Piping
CE-101648	1-6-56	Oxidant Tank Pressurizing Piping
CE-101649	1-6-56	CO ₂ & Helium Service Piping
CE-101650	1-6-56	Propellant Pilot Control Piping
CE-101651	1-6-56	Propellant Pilot Regulator Panels
CD-101652	1-6-56	Hi-Pressure Gas Flexible Hose Assembly
CD-101653	1-6-56	Oxidant Vent System Auxiliary Scrubber
CE-101654	1-6-56	Oxidant Vent & Purge Piping
CE-101655	1-6-56	Fuel Vent & Purge Piping
CE-101656	1-6-56	Safety Head & Vent Piping
CE-101657	1-6-56	Oxidant & Fuel Immersion Tank Drain Piping
CC-101658	1-6-56	Valve Schedule - Liquid Oxygen & Nitrogen Storage & Supply Systems - Sheet #1
CC-101659	1-6-56	Valve Schedule - Liquid Oxygen & Nitrogen Storage & Supply Systems - Sheet #2
CC-101660	1-6-56	Valve Schedule - Hydrocarbon & Ammonia Storage & Supply Systems
CC-101661	1-6-56	Valve Schedule - Oxidant Propellant System - Sheet #1
CC-101662	1-6-56	Valve Schedule - Oxidant Propellant System - Sheet #2
CC-101663	1-6-56	Valve Schedule - Fuel Propellant System
CC-101664	1-6-56	Valve Schedule - Hi-Pressure Helium & Nitrogen Storage & Charging System

(f) The following drawings are furnished for reference purposes only and are not a part of this specification:

<u>Drawing No.</u>	<u>Change and Date</u>	<u>Title</u>
CE-101113	B-1 8-30-55	Civil - Roadway, Intersections & Storage Areas Grades & Details

<u>Drawing No.</u>	<u>Change and Date</u>	<u>Title</u>
CE-101130	C-4 11-28-55	Mechanical - Extention of Utilities & Electrical Services Utilities - General Plan
CE-101150	D-1 9-15-55	Electrical - Extention of Utilities & Electrical Services - Plot Plan
CE-101311	D-1 11-28-55	Struct. - Test Cell Building - Foundation & Pit Wall Sections & Details
CE-101360	B-8 8-30-55	Mechanical -- Test Cell Building - Piping Plan
CE-101556	A-2 8-30-55	Structural - Fuel Storage Areas and Facilities Trenches & Stairways
CE-101615	B 8-30-55	Structural - Water Reservoir - Foundation & Valve Pit
CD-101628	- 1-6-56	Helium Compressor - First Stage Oil Separator
CD-101629	- 1-6-56	Helium Compressor - Second Stage Oil Separator
CD-101632	8-16-55	Oxidant Tank Details
CD-101633	9-23-55	Oxidant-Immersion Cylinder
CD-101635	8-16-55	Fuel Tank Details
CD-101636	9-13-55	Fuel Immersion Cylinder
CD-101637	8-16-55	Calibration Yoke

(g) Drawings of existing buildings, structures and piping and/or catalog cuts of equipment furnished by the Government under this contract will be available to the contractor for reference at the Laboratory site.

(h) The following sections are hereby made a part of the specifications:

<u>Section No.</u>	<u>Title</u>
I	Description, Scope, Etc.
II	Wage Rates
III	Standard General Provisions (Long Form)
IV	Technical Provisions

SECTION I

1-03. Renegotiation:

- (a) This contract is subject to the Renegotiation Act of 1951 (P.L. 9, 82nd Congress) and shall be deemed to contain all the provisions required by Section 104 of said Act.
- (b) The contractor (which term as used in this clause means the party contracting to furnish the materials or perform the work required by this contract) agrees to insert the provisions of this clause, including this paragraph (b) in all subcontracts as required by Section 104 of the Renegotiation Act of 1951; provided, that the contractor shall not be required to insert the provisions of this clause in any subcontract of a class or type described in Section 106 (a) of the Renegotiation Act of 1951.

1-04. Exceptions From Domestic Articles:

Because the materials listed below, or the materials from which they are manufactured are not mined, produced or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, their use in the work herein specified (subject to the requirements of the specifications) is authorized without regard to the country of origin:

Antimony	Copper	Mica
Asbestos	Cork	Nickel
Balsa	Mahogany	Rubber
Chrome Ore or Chromite	Mercury	Tin
		Tungsten

1-05. Priority:

- (a) DO Rating C2, certified under DMS Regulation No. 2 and allotment of controlled materials will be issued to the bidder to whom award is made.
- (b) The contractor agrees, in the procurement and use of materials required for the performance of this contract, to comply with the provisions of all applicable rules and regulations of the Business and Defense Services Administration, including Defense Materials Systems Regulations.

1-06. Nondiscrimination:

Article 19 of Standard Form 23A is hereby deleted in its entirety and the following substituted:

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"In connection with the performance of work under this contract, the contractor agrees not to discriminate against any employee or applicant for employment because of race, religion, color, or national origin. The aforesaid provision shall include, but not be limited to, the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; lay-off or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post hereafter in conspicuous places, available for employees and applicants for employment, notices to be provided by the Contracting Officer setting forth the provisions of the nondiscrimination clause.

The contractor further agrees to insert the foregoing provisions in all subcontracts hereunder, except subcontracts for standard commercial supplies or raw materials."

1-07. Liquidated Damages:

All of the work specified herein shall be completed within 240 (two hundred and forty) calendar days after the date of receipt of notice to proceed. Proposals offering completion in excess of 240 calendar days after the date of receipt of notice to proceed will not be considered. For each calendar day completion of the work is delayed beyond 240 calendar days from date of receipt of notice to proceed, liquidated damages will be assessed in the amount of \$100.00.

SECTION II - WAGE RATES

2-01. Minimum Wage Rates:

(a) In accordance with the provisions of the Davis-Bacon Act, as amended, the Secretary of Labor has issued Decision P-7263 dated December 2, 1955, determining the minimum wage rates for laborers and mechanics employed or working on contracts for construction work at Lewis Flight Propulsion Laboratory, Cuyahoga County, 21000 Brookpark Road, Cleveland 11, Ohio. The minimum wage rates for the classification of laborers and mechanics to be employed on this contract are as follows:

<u>Craft</u>	<u>Per Hour</u>
Asbestos Workers	\$3.375
" " improvers:	
1st year	1.825
2nd year	1.995
3rd year	2.36
4th year	2.70
Boilermakers	3.35
" helpers	2.975
Ironworkers, structural	3.325
" ornamental	3.325
" apprentices	2.575
Laborers:	
Laborers, construction	2.65
Painters:	
" Brush	3.075
" Spray	3.20
" Structural Steel	3.325
" Apprentices:	
1st 6 mos. 45% of journeymen's rate	
2nd 6 mos. 50% " "	
3rd 6 mos. 55% " "	
4th 6 mos. 60% " "	
5th 6 mos. 65% " "	
6th 6 mos. 70% " "	
Pipe fitters	3.30
Plumbers	3.30
" apprentices:	
1st year 35% of journeymen's rate	
2nd year 45% " "	
3rd year 55% " "	
4th year 65% " "	
5th year 75% " "	
Sprinkler fitters	3.225
Steam fitters	3.30
" " apprentices:	
1st year 35% of journeymen's rate	
2nd year 45% " "	
3rd year 55% " "	
4th year 65% " "	
5th year 75% " "	

<u>Craft</u>	<u>Per Hour</u>
Truck drivers, Building Materials:	
Building supply	\$2.10
Welders - receive rate prescribed for craft performing operation to which welding is incidental	
<u>Building, Heavy and Highway</u>	
Cranes (all types)	3.40
Welders on gas or electric machines	3.15

- (b) Any class of laborers or mechanics, including apprentices, not listed in the preceding paragraph, which will be employed on this contract, shall be classified or reclassified conformably to the foregoing schedule. In the event the interested parties cannot agree on the proper classification of a particular class of laborers and mechanics to be used, the question, accompanied by the recommendation of the Contracting Officer, shall be referred to the Secretary of Labor for final determination.
- (c) While the wage rates shown are the minimum hourly rates required by the specifications to be paid during the life of the contract, it is the responsibility of bidders to inform themselves as to the local labor conditions such as the length of workday and workweek, over-time compensation, health and welfare contribution, labor supply and prospective changes or adjustment of wage rates. The contractor shall abide by and conform to all applicable laws, executive orders, rules, regulations and orders of Federal agencies authorized to pass upon and determine wage rates. No increase in contract price shall be allowed or authorized on account of payment of wage rates in excess of those listed herein.

SECTION III - STANDARD GENERAL PROVISIONS (LONG FORM)

3-01. Scope:

- (a) Under this Section is included an outline of the powers and duties of the Contracting Officer and of the Contractor and a brief description of Government regulations and other general requirements concerning this construction contract.
- (b) The Contractor shall acquaint himself with all rules, regulations and general orders of the United States Government, its official agencies or departments, if the work is on or near United States Government Properties, Reservations, acquired or leased properties.
- (c) The Contractor shall comply strictly with all applicable governing laws, ordinances and regulations with regard to labor or methods employed on his work.
- (d) The requirements of this Section apply only insofar as they fall within the scope of the work to be done under this contract. Requirements of this Section not applicable to this work shall be disregarded.

3-02. Authority of the Contracting Officer:

- (a) The Contracting Officer shall decide all questions which may arise as to the performance, quantity, quality, acceptability, fitness and rate of progress of the several kinds of work to be done or materials to be furnished under this contract. He shall decide all questions which may arise as to the interpretation of the specifications and of drawings used and as to the fulfillment of this contract on the part of the Contractor and as to defects in the Contractor's work, subject to appeal under the provisions of Article 6 of Standard Form 23A General Provisions (Construction Contracts).
- (b) Wherever in this contract, or in the specifications, or upon the drawings the words "directed", "required", "permitted", "ordered", "designated", "prescribed", or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation, or prescription of the Contracting Officer or his duly authorized representative is intended and similarly the words "approved", "acceptable", "satisfactory", or words of like import, shall mean approved by, or acceptable or satisfactory to, the Contracting Officer or his representative.

3-03. Cooperation - Plan and Program of Construction and Stop Orders:

- (a) Attention is directed to Articles 5, 10 and 12 of Standard Form 23A, General Provisions (Construction Contracts).
- (b) The Contracting Officer will advise and cooperate with the Contractor in every way possible to the end that the progress of the work may be expedited and that the work as a whole may be satisfactorily completed; it is expected that the Contractor will facilitate and reciprocate such advise and cooperation.

SECTION III

- (c) The Contractor shall arrange his work so that it will not interrupt or interfere with any work being done on the premises by the Government or others. In case such interruption or interference is unavoidable, or in the event of the necessity to cut into, connect to, or alter in any way, existing utilities or equipment, the Contractor shall obtain the approval of the Contracting Officer before proceeding with such work, in accordance with the requirements of this Section, Item 3-12. It may be impossible to coordinate the work so that each contractor may proceed without interruption. It may be necessary, therefore, to issue stop orders of reasonable duration in order to coordinate the work properly. The time during which such stop order is in effect will not apply on the contract time.
- (d) Except as otherwise specified, the Contractor's procedure and methods of construction may be of his own selection, provided that, in the judgment of the Contracting Officer, they are calculated to secure results that satisfy all the requirements of the contract, accompanying drawings and specifications, however, the Contracting Officer shall have the right to control the order in which the various parts of the work are constructed or installed, to such extent as he may deem necessary to protect the best interests of the Government.
- (e) The Contractor shall prepare and submit to the Contracting Officer promptly after award of the contract, a complete construction schedule showing the sequence of operations of the work as a whole, as well as of each of the several portions of the work, with dates on which they will be started and completed. This construction schedule shall be in the form of a progress chart, indicating with symbols the percentages completed at any time. It shall be kept up to date and current copies, revised up to date of partial payments then due, shall be attached to each requisition for partial payment.
- (f) Promptly after award of the contract, the Contractor shall submit to the Contracting Officer for his approval, a list of subcontractors proposed for the principal parts of the work.

3-04. Drawings Accompanying Specifications:

- (a) Attention is directed to Article 2 Standard Form No. 23A, General Provisions (Construction Contracts).
- (b) All drawings, specifications and memoranda relating to this contract are the property of the Government and shall be carefully used and returned to the Contracting Officer on completion of the contract. Anyone in possession of information covered by the drawings, specifications or memoranda is prohibited from using same for any purpose other than performance of this contract, unless prior approval and permission are obtained in writing from the Government.
- (c) Wherever "as shown", "as indicated" or words of similar import are used, it shall be understood that reference is made to the drawings enumerated herein unless otherwise specified.

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- (d) All dimensions and elevations shown and indicated on the drawings shall be checked for accuracy by the Contractor before he proceeds with construction and the ordering of materials. The Government does not guarantee the accuracy of dimensions given on the drawings. The Contractor shall be fully responsible for the proper connections, tying or fitting of all work. He shall promptly inform the Contracting Officer of any errors he may discover in the drawings and specifications, in order that the proper corrections may be made.
- (e) The drawings forming a part of these specifications show typical details of the construction, but the Government will allow minor modifications, provided the resulting structure meets the essential requirements and provided the modifications meet the specific approval of the Contracting Officer, in accordance with the requirements of this Section, Item 3-05.

3-05. Design and Drawings Required From Contractor:

- (a) The Contractor shall prepare all working drawings, shop drawings and details that are necessary to enable him to fabricate and erect all parts of the work in conformance with the contract drawings and specifications. For all steel work and general construction, the drawings shall illustrate methods of construction which are left to the Contractor's choice or which are not shown on the contract drawings.
- (b) All connections necessary to complete properly the work under this contract, shall be designed and completed in a satisfactory manner by the Contractor. This shall apply with equal force to details not shown or specified but necessary to alter or to add to any existing structure or to provide connection for any future building. All parts designed by the Contractor shall be amply strong to withstand, without excessive deflection, any load or pressure to which they are likely to be subjected. In no case shall the Contractor use construction inferior in any way to that shown on the drawings. All designs and details made by the Contractor shall be in accordance with the best standard practice, as approved by the Contracting Officer.
- (c) All drawings submitted to the Contracting Officer shall be in quintuplicate (5 copies), shall be marked with the names of the contract and of the Contractor, shall be numbered consecutively and shall be accompanied by a letter of transmittal listing the numbers of the drawings submitted. One copy of each drawing will be returned by the Government, approved or marked to indicate the corrections required. Quintuplicate copies shall be submitted after each correction until approval is given. Work for which drawings are required, if commenced prior to the approval of the Contracting Officer, shall be at the Contractor's risk.
- (d) If the Contractor's drawings show variation from the contract requirements because of standard shop practices or other reasons, the Contractor shall make specific mention of such variation in his letter of transmittal, in order that, if acceptable, suitable action may be taken for proper adjustment of the contract; otherwise the Contractor will not be relieved of the

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responsibility for executing the work in accordance with the contract, even though the drawings have been approved.

- (e) Contractor's drawings returned marked as indicated in (c) above and data approved shall not be construed as a complete check, but will indicate that the general design and proposed method of construction are satisfactory. This approval will not relieve the Contractor of his responsibility for the correctness of dimensions, for the proper design of details, for the proper functioning of the finished work in accordance with the contract requirements, or for furnishing any materials and/or work required by the Contract which may not be indicated on the drawings when approved.

3-06. Materials:

- (a) Attention is directed to Article 8 of Standard Form No. 23A, General Provisions (Construction Contracts).
- (b) All materials furnished under this contract shall be new, shall meet the requirements of an approved recognized standard and shall be of kind, composition and physical properties best adapted to their several purposes, in accordance with best engineering practices.
- (c) Where two or more varieties of materials are specified for any purpose, it shall be optional with the Contractor which one is used, but the same material shall be used throughout.
- (d) Materials shall at all times be kept clean and protected from the weather and all steel and iron shall be free from excessive scale and rust.
- (e) Materials shall conform to Federal Specifications where they apply including revisions and addenda in effect on the date of this specification.

3-07. Materials or Installations Furnished by the Government:

- (a) Unless otherwise specifically noted, when the Government is to supply any material to the Contractor for the performance of this contract, the Government will make such material available to the Contractor at a place of storage or on a carrier's truck within the laboratory premises. The Contractor shall provide all labor and equipment necessary for removal of the material from storage or its unloading from the carrier's truck and for its hauling to and unloading at the site of the Contractor's work. Unused portions of such material shall be returned to Government storage as directed.
- (b) Unless otherwise stated, the Government cannot guarantee when it will make available to the Contractor, or install, such material or installations as it is to furnish, as this is usually dependent upon other contractors or suppliers.

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3-08. Government Specifications:

Copies of Federal Specifications referred to herein may be obtained from Business Service Center, General Services Administration, Regional Office Building, Seventh and D Streets, S.W., Washington 25, D.C. Single copies for bidding purposes are available at no charge, and additional copies at prices ranging from \$0.05 up. Naval Stores and Material Specifications and U.S. Army Specifications can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C., free or within the approximate price ranges as above.

3-09. Inspection and Acceptance:

- (a) Attention is directed to Article 9 of Standard Form No. 23A, General Provisions (Construction Contracts).
- (b) Upon completion of the work, the Contractor shall give written notice to the Contracting Officer of his readiness for final inspection and tests specified to be made by the Contracting Officer.

3-10. Site:

- (a) The extent and limits of the work shall be as located and shown on the drawings herein specified or as described in the bid invitation. The site will be made available "AS IS", and the Contractor shall be responsible for clearing the site, unless otherwise specified. All permanent and temporary building operations and work shall be strictly confined to the limits as shown, described and designated by the Contracting Officer.
- (b) It is assumed that the Contractor has visited the site of work and acquainted himself with all available information concerning the nature of materials involved, local conditions bearing on transportation, disposal, handling and storage of materials and concerning other work, if any, which is being performed. Failure to have done so will in no way relieve the Contractor from the responsibility for having properly estimated the difficulties and cost of successfully performing the work and in no event will the Government assume any responsibility whatever for any interpretation, deduction or conclusion drawn from the Contractor's examination of the site.

3-11. Materials on the Site:

- (a) When and if materials of value are found on the site, such materials shall remain the property of the Government. Such materials shall be stored on the premises, or when conforming with the contract requirements and considered suitable for reuse in the opinion of the Contracting Officer, they may be reused in the work as directed by him. If in the opinion of the Contracting Officer, the material has no value, it shall be removed from the premises by the Contractor and deposited for reuse at another location, such location will be designated by the Contracting Officer, shown on the drawings, or specified herein.

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- (b) The contractor, on removing his own material and equipment from the site, shall present at the exit a material pass, NACA Form C-702, covering material and equipment being removed and such pass shall be signed by the inspector on the job or other duly authorized representatives of the Government.

3-12. Protection and Safety Measures:

- (a) The Contractor shall take particular care not to damage any existing work. Any or all existing work damaged by the Contractor's operations shall be the full responsibility of the Contractor and he shall replace or repair all such damaged work without cost to the Government.
- (b) The Contractor shall protect all sidewalks, curbs, curb drains and road surfaces liable to damage from operations under this contract. If any such installations are damaged or removed by the Contractor, he shall install replacements fully equal to the existing work. Trenches across roadways, parking areas, walks and gutters shall be backfilled with slag or gravel well tamped in layers not exceeding 3 (eight) inches in depth.
- (c) On contracts involving connections to the existing process-systems lines, tanks, buildings and equipment, the Contractor shall secure written permission on forms supplied by the Contracting Officer and specific approval at beginnings of operation as to absence of flammable vapors, materials or conditions.
- (d) The Contractor shall be responsible for the protection of Government-owned and privately-owned property from damage resulting from his operations. Any such damage shall be made good without delay. The Contractor shall erect and maintain at his own expense warning lights, signals, signs, barriers, passageways, detours, suitable temporary bracing and shoring for structures and equipment and all other devices required by the Government, and in accordance with best construction practices, for construction work under, on or above ground level. The Contractor shall operate in strict adherence to all applicable Governmental rules and regulations, including those of the State of Ohio Industrial Commission and the Department of Industrial Relations "Specific Safety Requirements Relating to Building and Construction Work", for the area or areas wherein the work is being done.
- (e) The Contractor shall be responsible for conducting his operations and those of his subcontractors, in such a manner as to prevent the creation or existence of fire hazards and to this end shall take all necessary measures to prevent fire-breeding conditions from arising or existing. He shall familiarize himself with NACA's existing fire-protection systems by checking with the Contracting Officer and shall provide additional fire extinguishers with his name thereon, as may be required and/or specified elsewhere. Tarpaulins used for protection purposes shall be made of fire-resisting materials complying with Federal Specification CCC-D-746.
- (f) The contractor must secure, in advance, written permission from the contracting Officer or his duly authorized representative to bring onto the laboratory reservation any tank or container for the storage and dispensation of flammable liquids, (gasoline, kerosene, diesel fuel, solvents etc.) except that he may possess and use, without permission, not more than five "Safety Cans" of not more than five gallons capacity each and having flame arresters, spring closing lids and spout covers. No permission will be granted to bring onto the laboratory

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reservation any flammable-liquid tank or container having a capacity in excess of 550 gallons. The aggregate capacity of all such tanks and containers which the Contractors may possess and use on the laboratory reservation, shall not exceed 550 gallons. The Storage and use of flammable liquids on the laboratory reservation by the Contractor shall at all times be subject to the control of the laboratory Safety Engineer. Detailed regulations which must be observed may be secured from the Contracting Officer or his representative.

- (g) On contracts involving alterations to existing structures, the Contractor shall, to the best of his ability, protect machinery and equipment from injurious dirt and dust from the building operations at all times. Where it is possible, the space where the work is to be done shall be enclosed by temporary dust-proof enclosures and precautions shall be taken to keep down the dust by frequent wetting and sweeping of the concrete floors. Debris shall be wet down and removed from the building immediately. Rubbish and inflammable material shall be removed at once.
- (h) Welding is a hazard to the Government's operations and installations and special precautions are a contract requirement. The Contractor must see that such safety precautions as are required are in effect before welding starts and that they are maintained at all times until welding operations are completed. The contractor shall see that each welder is thoroughly conversant with all safety requirements and that a copy of the following instructions is posted in the welder's construction quarters.

INSTRUCTIONS TO WELDERS

- (1) The operation of all welding equipment shall be checked and approved by the job inspector. Any defective equipment shall be put in safe operating condition immediately or removed from the site.
 - (2) Tarpaulins MUST BE FIRE RESISTANT.
 - (3) Shields must be used wherever possible. Where shields cannot be used, the area must be approved by the inspector. Personnel and property must be protected from flash burns and sparks.
 - (4) A fire extinguisher, with the contractor's name or label on it, is a MUST requirement with each welding operation. Operation is defined as one or more welding outfits operating in the same confined area.
 - (5) Special precautions must be taken to prevent sparks falling or being blown through gratings, partitions, pipe openings, etc. If this condition cannot be avoided, a safety man with fire extinguisher must be maintained as a standby and the setup approved by the job inspector.
- (1) Attention is directed to Item 3-17 - Temporary Buildings, Material Storage and Sanitation and Item 3-18 - Temporary Heating. The following regulations shall apply to the operation of salamanders and heating devices:
- (1) Heating stoves shall be set in a sand base approximately 3-1/2 inches thick extending about six (6) inches beyond the largest dimensions of the stove.

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- (2) No fires shall be left burning after working hours unless attended.
- (3) Oil stoves shall be of an approved variety.
- (4) Chimneys shall be provided with approved thimbles where they pass through walls or roofs.
- (5) Chimneys shall be located a minimum distance of 18 inches from the rafters and shall be substantially supported.
- (6) Top of chimneys shall be provided with flame arrestors.
- (7) No open fires will be permitted without specific approval of the NACA Safety Department.

3-13. Protection and Replacement Of Landscape Work:

- (a) The Contractor shall exercise special precautions not to damage existing trees, shrubs, evergreens, lawns and other landscaping. It shall be the responsibility of the contractor to provide adequate protection for all landscape items in the vicinity of his operations and to replace or restore all damaged items, in a complete and satisfactory manner as directed at no cost to the Government.
- (b) Trees, shrubs, evergreens and plant beds shall be protected by wooden barriers, set not less than 2 (two) feet away. Tree trunks shall be protected from injury by burlap wrappings.
- (c) Materials shall not be stored within five (5) feet of any tree, shrub or evergreen..
- (d) Where earth must be placed on existing lawns, the grass shall first be protected by tarpaulins; both earth and tarpaulins shall be removed as soon as practicable.
- (e) If the movement of heavy vehicles or equipment over lawn areas is necessary, lawns shall be protected by means of wide planks, such planking shall be removed as soon as possible.
- (f) Plant material liable to damage by operations of the contractor may be removed, with the approval of the Contracting Officer and heeled in temporarily as directed until such time as it is to be replanted. Moving and replanting shall be done in such a manner as to avoid injury to the plants; cutting and bruising of roots shall be avoided as far as possible and roots shall not be exposed to drying or freezing conditions. Plant and shrub beds shall be restored to their original shape and size and plants and shrubs shall be replanted in their original locations.

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- (g) Trenches or other excavations dug in existing lawns shall be back-filled with the excavated earth well tamped with pneumatic tamper in layers not exceeding eight (8) inches in depth. Lawns shall be reseeded or resodded as required. Sod temporarily removed for later replacement shall be cut with a sod-cutter or sharp flat spade into rectangular sections of uniform width and a depth of not less than two inches, placed in layers with grass to grass and roots to roots, covered with moist burlap and kept damp by spraying as needed.
- (h) All trees, shrubs and evergreens supplied to replace damaged items shall be best quality nursery stock, approved as fully equivalent to the material being replaced and shall be handled and planted in accordance with the best practice for this work, as directed by the Contracting Officer. Topsoil, fertilizer and other necessary materials shall be provided by the contractor.
- (i) Damaged lawn areas to be reseeded shall have topsoil added as required to replace lawn in original condition and twenty (20) pounds of "10-6-4" fertilizer and five (5) pounds of grass seed, of an approved mixture, per one thousand (1,000) square feet. New seeding shall be rolled in with a lawn roller.
- (j) Transplanting and seeding shall not be done between June 1 and September 1.

3-14. Roadways:

- (a) The Contractor shall use only the established roadways and such temporary roadways on the premises as may be authorized by the Contracting Officer. When it is necessary to cross curbing or sidewalks, secure bridges must be constructed over same and at completion of all work bridges must be removed; damaged roads, curbing, sidewalks repaired; and all left in original state and condition.
- (b) The Contractor shall keep clear for traffic at least one-half of any roadway involved in his operations, and any such road clearance shall be adequate for not less than one-way traffic.
- (c) Trenches less than five (5) feet in width dug across eight (8) inch asphaltic concrete roads, shall be repaired by the contractor by placing upon the finished subgrade four (4) inches of No. 12 slag choked with screenings, six (6) inches of concrete and two (2) inches of T-35 hot mix with surface edges sealed with asphalt emulsion. Trenches over five (5) feet in width dug across eight (8) inches of asphaltic concrete roads shall be repaired by the contractor by placing upon finished subgrade four (4) inches of No. 12 slag choked with screenings and eight (8) inches of hot mix laid in three (3) courses, base course three (3) inches, binder course three (3) inches, and surface course two (2) inches, with each course rolled with an asphalt road roller. Edges shall be sealed with asphalt emulsion.

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3-15. Use of Space:

The Contractor shall be permitted to use the necessary unoccupied space and facilities which are owned or controlled by the Government and which the Contracting Officer is able to place at his disposal. However, nothing in this paragraph shall be construed as restricting the Contracting Officer from requiring the Contractor to vacate such Government-owned space as in his opinion may have been occupied without authority or as may be necessary for Governmental purposes.

3-16. Water, Electricity and Compressed Air:

- (a) Water, in such quantities as may be actually required for the work, will be furnished by the Government without charge. The Contractor, however, shall make all necessary connections to the existing water main, furnish all equipment and run the water lines required by him. Connections shall be made and lines run as directed by the Contracting Officer. Water shall not be wasted and the Contractor's water lines shall contain no leaks; otherwise, the Contracting Officer may require water to the Contractor to be metered at its cost to the Government.
- (b) On work under progress during the winter months, the Contractor shall install drainage and cut-off valves at the point where his piping connects to the supply main and shall cut off and drain the temporary piping each night. The Contractor shall be held responsible for all damage to the water-supply system due to his operation.
- (c) There will also be available, without charge to the Contractor such electricity as may be necessary for lighting and for operating the tools and equipment ordinarily used by the Contractor in the prosecution of his work. All connections to existing utilities shall be made at the expense of the Contractor and at the convenience of and in a manner and location as directed by the Contracting Officer. At the time the Contractor is ready to connect his temporary electrical wiring to the existing utilities, clearance shall be obtained from the Contracting Officer and the Electrical Power Dispatcher.
- (d) The Government will not furnish compressed air to the Contractor unless specifically noted otherwise under SECTION I in the scope of the work.

3-17. Temporary Buildings, Material Storage and Sanitation:

- (a) The Contractor shall provide office, storage and toilet buildings set on posts eighteen (18) inches clear of the ground, with wire mesh screens to close the openings against vermin harboring under the buildings. If the building is to be used for storage immediately on the ground and no floor is installed therein, the siding may be brought down to the ground surface. Sketches or descriptions of such

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buildings shall be submitted to the Contracting Officer for approval before erection and locations shall be as directed by the Contracting Officer. The buildings shall be maintained in a clean, sanitary condition at all times. Covered metal containers shall be provided for the collection of garbage and other rubbish.

- (b) Lumber and other materials in exterior storage shall be stacked at least four (4) inches clear of the ground and the Contractor shall exercise precautions at all times to prevent the spread and harboring of vermin in, under or near the buildings.
- (c) Temporary wood structures, erected on the site by the Contractor, used for offices and storage and open storage of inflammable materials, shall be fully protected from fire at all times. Inflammable rubbish or debris shall not be allowed to collect at or near the site of the temporary structure or material storage and the Contractor shall be responsible for any damage caused by such neglect.

3-18. Temporary Heating:

- (a) The Contractor shall provide temporary heat, when necessary, to protect any or all work and materials against injury from dampness and cold weather, to the satisfaction of the Contracting Officer. Salamanders shall not be used for this purpose after the building is enclosed, without the specific approval of the Contracting Officer.
- (b) When the building is completely enclosed, the Contractor will be permitted to make connections to steam or gas mains, but the Government does not guarantee that the supply of steam or fuel gas will be adequate to provide the amount of heat required. The Contractor shall be responsible for keeping informed at all times about the quantity of steam or gas available for the temporary heating and he shall provide any additional heat that may be required for protection of the work or materials.
- (c) The Contractor shall be responsible for the installation and operation of the temporary heating system until the contract is completed and accepted by the Contracting Officer. Radiators, duct outlets or gas heaters for temporary heating shall be installed in proper locations to maintain a temperature of 50 (fifty) degrees Fahrenheit for plastering and 70 (seventy) degrees Fahrenheit where other finish work is to be installed.

3-19. Off-The-Road Storage and Parking:

- (a) The Contractor shall provide off-the-road areas adjacent to the construction site, as approved by the Government, for parking and storage of equipment, workmen's cars and/or supplies as may be required during the progress of construction; preliminary grading required and maintenance of the area for this purpose shall be by and at the expense of the Contractor.

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3-20. Lines and Grades:

The Contractor shall lay out the work and be responsible for the correctness of dimensions and levels.

3-21. Removal of Debris and Cleaning:

- (a) The Contractor shall, at all times, keep the premises free from waste and rubbish caused by his employees or work and shall remove all debris away from the laboratory reservation at his own expense. At no time shall debris be allowed to accumulate in such a manner as to constitute an unsightly condition or a fire or other hazard.
- (b) The Contractor shall, at all times, keep the roads and sidewalks free from dirt and debris and caused by hauling or grading. At no time shall dirt or debris be allowed to accumulate in the road gutters.
- (c) On completion of the work, the Contractor shall leave the building broom clean, unless otherwise specified.
- (d) Failure to comply with the requirements of Item 3-21. Removal of Debris and Cleaning, promptly, as directed, shall give the Government the right to perform the work necessary for such compliance by contract or otherwise and charge the Contractor the cost thereof.

3-22. Identification Badges:

- (a) Contractors and subcontractors shall report to the Badge Clerk in the Administrative Services Building upon their arrival at the site for the purpose of arranging for the issuance of badges to their employees.
- (b) All contractors, subcontractors and their employees shall be required, while on the Government Reservation, to wear official laboratory badges so as to be visible at all times.
- (c) A daily telephonic report must be made to the Badge Clerk identifying the employees on the reservation for each contractor or subcontractor in compliance with laboratory security regulations.
- (d) No alien may be employed without first obtaining clearance from the Laboratory Security Officer.

3-23. Hours of Work:

The hours during which work may be done at the site will be subject to control by the Contracting Officer and may be changed without notice. This shall not be construed as requiring the performance of work during premium time periods unless specifically provided for elsewhere in the contract.

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3-24. Taxes:

- (a) Federal Taxes - Except as may be otherwise provided in this contract, the contract price includes all applicable Federal Taxes in effect on the contract date.
- (b) State or Local Taxes - Except as may be otherwise provided in this contract, the contract price does not include any State or local direct tax in effect on the contract date.
- (c) Evidence of Exemption - The Government agrees, upon request of the Contractor, to furnish a tax exemption certificate or other similar evidence of exemption with respect to any direct tax not included in the contract price pursuant to this clause; and the Contractor agrees, in the event of the refusal of the applicable taxing authority to accept such evidence of exemption, (i) promptly to notify the Contracting Officer of such refusal, (ii) to cause the tax in question to be paid in such manner as to preserve all rights to refund thereof and (iii) if so directed by the Contracting Officer, to take all necessary action, in cooperation with and for the benefit of the Government, to secure a refund of such tax (in which event the Government agrees to reimburse the Contractor for any and all reasonable expenses incurred at its direction).

3-25. Payments to Contractor:

Prior to the submission of the first estimate of partial payment the contractor shall prepare and submit a segregation of the contract price into items of labor and materials with representative amounts and this segregation shall be subject to the approval of the Contracting Officer. Partial payments will be made only on material delivered and work completed at the site. The Contractor shall, when payments are made to him, either partial or final and as a prerequisite thereto, execute and deliver such affidavits, receipts, waivers and other documents as the Contracting Officer may require.

3-26. National Defense Clause:

- (a) The contractor shall immediately submit a confidential report to the contracting officer of information concerning existing or threatened espionage, sabotage or subversive activity at any plant, factory or site at which work under this contract is being performed or at which material acquired, fabricated or manufactured in connection with the performance of this contract is stored. The report shall contain a complete statement of such information. The contractor shall instruct its personnel to submit any information which they may have with respect to the foregoing.
- (b) The contractor shall, whenever directed by the head of the department or his duly authorized representative, submit such information as it may have concerning any of its employees engaged in work at any plant, factory or site at which work under this contract is being performed.

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- (c) The contractor shall exclude (this does not imply the dismissal or separation of any employee) from any part of its plant, factories or sites at which work on this contract is being performed, any person or persons whom the head of the department or his duly authorized representative, in the interest of security, may designate in writing. The contractor shall exclude such person or persons from access to information relating to the work contracted for hereunder.
- (d) The contractor shall insert provisions similar to paragraphs (a), (b) and (c) of this article in all subcontracts or purchase orders placed under this contract unless the contracting officer shall consent to the omission thereof; PROVIDED, that such provisions need not be inserted in any subcontract or purchase order for standard or commercial items procured under specifications which will not disclose any information which has been identified by the Government as Top Secret, Secret, Confidential or Restricted Security Information.

3-27. Correspondence:

All correspondence in connection with this contract and all work hereunder shall be furnished in quadruplicate and addressed to:

Representative of the Contracting Officer
National Advisory Committee for Aeronautics
Lewis Flight Propulsion Laboratory
21000 Brookpark Road
Cleveland 11, Ohio

3-28. Termination for Convenience of the Government:

- (a) The performance of work under this contract may be terminated by the Government in accordance with this clause in whole, or from time to time in part, whenever the Contracting Officer shall determine that such termination is in the best interests of the Government. Any such termination shall be effected by delivery to the contractor of a Notice of Termination specifying the extent to which performance of work under the contract is terminated and the date upon which such termination becomes effective.
- (b) After receipt of Notice of Termination and except as otherwise directed by the Contracting Officer, the Contractor shall (1) stop work under the contract on the date and to the extent specified in the Notice of Termination; (2) place no further orders or subcontracts for materials, services or facilities except as may be necessary for completion of such portion of the work under the contract as is not terminated; (3) terminate all orders and subcontracts to the extent that they relate to the performance of work terminated by the Notice of Termination; (4) assign to the Government, in the manner, at the times and to the extent directed by the Contracting Officer, all of the right, title and interest of the

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contractor under the orders and subcontracts so terminated; (5) settle all claims arising out of such termination of orders and subcontracts subject to the approval or ratification of the Contracting Officer, which approval or ratification shall be final for all the purposes of this clause; (6) transfer title and deliver to the Government, in the manner, at the times and to the extent, if any, directed by the Contracting Officer, (i) the fabricated or unfabricated parts, work in process, completed work, supplies and other material produced as a part of or acquired in connection with the performance of, the work terminated by the Notice of Termination and (ii) the completed or partially completed plans, drawings, information and other property which, if the contract had been completed, would have been required to be furnished to the Government; (7) use his best efforts to sell, in the manner, at the times, to the extent and at the price or prices directed or authorized by the Contracting Officer, any property of the types referred to in provision (6) of this paragraph. Provided, however, that the Contractor (i) shall not be required to extend credit to any purchaser and (ii) may retain any such property at a price or prices approved by the Contracting Officer; (8) complete performance of such part of the work as shall not have been terminated by the Notice of Termination; and (9) take such action as may be necessary, or as the Contracting Officer may direct, for the protection and preservation of the property related to this contract which is in the possession of the Contractor and in which the Government has or may acquire an interest.

- (c) After receipt of a Notice of Termination, the Contractor shall submit to the Contracting Officer its termination claim. Such claim shall be submitted not later than 1 year from the effective date of termination unless one or more extensions, in writing, are granted by the Contracting Officer upon request of the Contractor made within such 1 year period or authorized extension thereof. Upon failure of the Contractor to submit its termination claim within the time allowed, the Contracting Officer shall determine, on the basis of information available to him, the amount, if any, due to the Contractor by reason of the termination.
- (d) Subject to the provisions of paragraph (c) the contractor and the Contracting Officer may agree upon the whole or any part of the amount of amounts to be paid to the Contractor by reason of the total or partial termination of work pursuant to this clause, which amount or amounts may include a reasonable allowance for profit on work done in connection with the terminated portion of the contract and the contract shall be amended accordingly. Such amendment shall be final and conclusive upon the Contractor and the Government. Nothing in paragraph (e) of this clause prescribing the amount to be paid to the Contractor in the event of failure of the Contractor and the Contracting Officer to agree upon the whole amount to be paid to the Contractor by reason of the termination of work pursuant to this clause, shall be deemed to limit, restrict or otherwise determine or affect the amount of amounts which may be agreed upon to be paid to the Contractor pursuant to this paragraph (d).

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- (e) In the event of the failure of the Contractor and the Contracting Officer to agree as provided in paragraph (d) upon the whole amount to be paid to the contractor by reason of the termination of work pursuant to this clause, the Government, but without duplication of any amounts agreed upon in accordance with paragraph (d), shall pay to the contractor the amounts determined as follows: (1) For completed supplies accepted by the Government and not theretofore paid for, a sum equivalent to the aggregate price for such supplies computed in accordance with the price or prices specified in the contract; (2) The total of (1) the cost incurred in the performance of the work terminated, exclusive of any costs attributable to supplies paid or to be paid for under paragraph (e) (1) hereof; (ii) the cost (which may include a reasonable allowance for profit to the subcontractors or vendors on work done in connection with the terminated portion of any subcontract or order) of settling and paying claims arising out of termination of work under subcontracts or orders as provided in paragraph (b) (5) above, exclusive of the amounts paid or payable on account of supplies or materials delivered or services furnished by subcontractors or vendors prior to the effective date of the Notice of Termination, which amounts shall be included in the cost payable under (1) above; and (iii) a sum equal to 2% of that part of the amount determined under (1) which represents the cost of articles and materials not processed by the Contractor, plus a sum equal to 8% of the remainder of such amount, but the aggregate of such sums shall not exceed 6% of the whole amount determined under (1) above, which amount, for all purposes of this subdivision (iii) shall exclude any charges for interest on borrowings; (3) The reasonable cost of the protection and preservation or property incurred pursuant to paragraph (b) (9) hereof; and any other reasonable cost incident to termination of work hereunder, including expense incident to the determination of the amounts due to the Contractor as the result of such termination. The total sum to be paid to the Contractor under (1) and (2) of this paragraph (e) shall not exceed the total contract price reduced by the amount of payments otherwise made and also reduced by the contract price of work not terminated. Except for normal spoilage and to the extent that the Government shall have otherwise expressly assumed the risk of loss, there shall be excluded from the amounts payable to the Contractor as provided in paragraph (e) (1) and paragraph (e) (2) (i), any amounts allocable to or payable in connection with property which is destroyed, lost, stolen or damaged so as to become undeliverable to the Government, or to a buyer pursuant to paragraph (b) (7).
- (f) The Contractor shall have the right of appeal, under the clause of this contract entitled "Disputes", from any determination of the amount due to the Contractor made by the Contracting Officer under paragraph (c) or (e) above, except that if the Contractor has failed to submit its claim within the time provided in paragraph (c) above and has failed to request extension of such time, he shall have no right of appeal. In any case where the Contracting Officer has made a determination of any amount due under paragraph (c) or (e) above, the Government shall pay to the contractor the following: (i) if no appeal has been taken the amount so determined by the Contracting Officer, of (ii) if an appeal has been taken,

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the amount finally determined on such appeal, such determination being final and conclusive upon the Contractor and the Government.

- (g) The obligation of the Government to make any payments under this clause shall be subject to deductions for (1) all unliquidated advance or other unliquidated payments on account theretofore made to the Contractor, (2) any claim which the Government may have against the Contractor and (3) the agreed price for, or the proceeds of sale of, any materials, supplies or other things retained by the Contractor or sold, pursuant to the provisions of this clause and not otherwise recovered by or credited to the Government.
- (h) Prior to the settlement of the terminated portion of this contract, the contractor may file with the Contracting Officer a request, in writing, for an equitable adjustment of the price or prices specified in the contract relating to that portion of the contract not terminated by the Notice of Termination and such equitable adjustment as may be agreed upon shall be made in such price or prices.
- (i) The Government may from time to time, under such terms and conditions as it may prescribe, make partial payments and payments on account against costs incurred by the Contractor in connection with the terminated portion of this contract whenever in the opinion of the Contracting Officer the aggregate of such payments shall be within the amount to which the Contractor will be entitled hereunder. If the total of such payments is in excess of the amount finally determined to be due under this clause, such excess shall be payable by the Contractor to the Government upon demand, together with interest computed at the rate of 6% per annum, for the period from the date such excess payment is received by the Contractor to the date on which such excess is repaid to the Government.
- (j) The Contractor, for a period of 3 years after final settlement under this contract, shall make available to the Government at all reasonable times at the office of the Contractor all its books, records, documents or other evidence bearing on the cost and expenses of the Contractor under this contract and relating to the work terminated hereunder.

SECTION IV - TECHNICAL PROVISIONS

4-01. General Piping Requirements:

In general the installation and testing of the specified piping systems shall conform to the minimum requirements and recommended practices as prescribed in Sections 3 and 6 of the ASA Code for Pressure Piping B31.1-1951. However, it should be noted that the piping systems will be handling corrosive, toxic, high pressure, extremely low temperature liquids and gases, making it imperative that workmanship be of the highest quality to insure sound leak-proof systems. Particular care should be paid to the cleanliness of all components before installation to aid the final cleaning of the completely assembled systems.

(a) Pipe -

- (1) Unless otherwise noted, all stainless steel pipe shall be seamless austenitic conforming dimensionally to ASA Standard B36.19 - 1952. Material shall conform to ASTM Specification A312. Refer to Items 4-02 through 4-05 for pipe weight schedules and approved types of austenitic stainless steels.
- (2) All steel pipe shall be black seamless carbon steel conforming dimensionally to ASA Standard B36.10-1950. Material shall conform to ASTM Specification A-106, Grade B.
- (3) All brass pipe shall be seamless red brass conforming to ASTM Specification B-43.

(b) Weld Fittings -

Unless otherwise specified, all steel and stainless steel pipe fittings shall be seamless forged butt weld type, conforming dimensionally to ASA Standard B16.9-1951. Steel pipe fittings shall conform to ASTM Specification A-105. Stainless steel pipe fittings shall conform to ASTM Specification A-182. Refer to Items 4-02 through 4-05 for pipe fitting schedule and approved type of austenitic stainless steels.

(c) Screwed Joints -

- (1) All screwed pipe joints shall be assembled and sealed with a litharge and glycerine compound or approved commercial equivalent. Sealing compound shall be applied by brush to the pipe only and not to the fitting, valve, or accessory, and shall not be permitted to enter the piping system. Pipe ends shall be reamed to remove internal burrs and shall be threaded in accordance with ASA dimensional standard B2.1-1945. After assembly with specified sealing compound joints shall be completely leak tight with no more than 3 (three) threads remaining exposed. If normal tightening of any joint does not develop a leakproof seal the pipe and/or fitting, valve, or accessory shall be replaced as necessary; caulking of threads to stop leakage will not be permitted.

- (2) All take-offs shown on drawings as made with threaded half couplings shall be made with forged stainless steel (Type 347),, 3000 pound WOG service-rated half couplings, accurately centered and welded over drilled holes no smaller than the inside diameter of the coupling. All drill chips shall be removed from inside of pipe before welding is performed.

(d) Flanged Joints -

Unless otherwise noted all flanged joints shall be of the lap joint type conforming dimensionally to ASA standard B16.5-1953. Material for carbon steel flanges shall conform to ASTM Specification A-105, and stainless steel to ASTM Specification A-182. All pipe stub ends shall be of austenitic stainless steel with concentrically serrated gasketing faces, conforming dimensionally to ASA standard B16.9-1951. Serrations shall consist of concentric triangular grooves 90 (ninety) degrees included angle, 1/64 (one sixty-fourth) inch deep and spaced 1/32 (one thirty-second) inch apart. Material shall conform to ASTM Specification A-182. Refer to Items 4-02 through 4-05 for flange and stub end series schedules, boltings, gasketing and approved grades of austenitic stainless steel.

(e) Tubing and Tube Fittings -

- (1) All copper tubing shall be seamless hard temper copper water tube, Type K, conforming to ASA H23.1 ASTM Specification B88. Sizes shown on drawings are nominal tube sizes, (actual outside diameter is 1/8 (one-eighth) inch larger).
- (2) Unless otherwise specified all copper tube fittings shall be wrought copper solder-joint type conforming to ASA Standard B16.22-1951.
- (3) All stainless steel tubing shall be seamless austenitic conforming to ASTM Specification A-269. Sizes shown on drawings are actual outside diameters.
- (4) All stainless steel tube fittings shall be forged austenitic stainless steel AFCC flareless fittings manufactured by the Aircraft Fitting Company, Cleveland, Ohio.

4-02. Supply Piping:

(a) Hydrocarbon - Alcohol -

All welded except for threaded connections for equipment, valving, or unions.

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- (1) Pipe: - 2 (two) inch, Schedule 40, 304 stainless steel, welded pipe and fittings.

Type 304, or 347 stainless steel, single-braid, 2 (two) inch inside diameter, spiral flexible hose.

- (2) Thread joints - see Item 4-01 (c).
- (3) Working pressure - 60 (sixty) pounds per square inch gage.
- (4) Test pressure - 90 (ninety) pounds per square inch gage hydraulic.

(b) Ammonia

All welded except for threaded connections for equipment, valving or unions.

- (1) Pipe: - 2 (two) inch, Schedule 40, 304 stainless steel, welded pipe and fittings.

Type 304 or 347 stainless steel, single braid, 2 (two) inch inside diameter spiral flexible hose.

- (2) Thread joints - see Item 4-01 (c).
- (3) Working pressure - 300 (three hundred) pounds per square inch gage.
- (4) Test pressure - 450 (four hundred fifty) pounds per square inch, hydraulic.
- (5) Materials of, or plated with copper, brass, zinc or cadmium are not to be used in this system.

(c) Liquid Oxygen and Liquid Nitrogen

To be silver soldered throughout with All-State 23 except for threaded valve or accessory connections.

- (1) Tubing and fittings - 2 (two) inch copper water tube, see Item 4-01 (c); also, 2 (two) inch inside diameter seamless bronze single braid spiral flexible hose.
- (2) Thread joints - see Item 4-01 (c).
- (3) Working pressure - 60 (sixty) pounds per square inch gage.
- (4) Test pressure - 90 (ninety) pounds per square inch gage, hydraulic.

4-03. Propellant Piping:(a) Propellant flow and return piping

(1) Oxidant system (Drawing CE-101644)

(aa) Pipe - 3 (three) inch, Schedule 80, 347 stainless steel fittings and stub ends.

2 (two) inch, Schedule 80, 347 stainless steel fittings and stub ends.

2 (two) inch Type "K", copper water tube and wrought copper solder fittings.

(bb) Flanges - 3 (three) inch, 600 pound, forged Type 303 or 304 stainless steel.

2 (two) inch, 600 pound, forged Type 303 or 304, stainless steel.

(cc) Gaskets - Flat copper jacketed asbestos filled, full double seal type: Akron Metallic Gasket Company, Akron, Ohio, Type FDS, or approved equal.

3 (three) inch pipe - Catalog No. 412 (3 x 4-7/8).

2 (two) inch pipe - Catalog No. 314 (2 x 3-5/8).

1-1/2 (one and one-half) inch pipe - Catalog No. 271 (1-5/8 x 2-7/8).

(dd) Bolts and Nuts - Bolts shall be austenitic stainless steel conforming to ASTM Specification A320-52T grade L8F. Nuts shall be austenitic stainless steel conforming to ASTM Specification A-194, Grade 8F. A molybdenum disulphide type of lubricant shall be used on bolt threads and on the load bearing surface of the nut to prevent galling of the threads and nut surface.

(ee) Working pressure - 1000 (one thousand) pounds per square inch gage.

(ff) Test pressure - 1500 (fifteen hundred) pounds per square inch gage, at 70 (seventy) degrees Fahrenheit hydraulic.

(2) Fuel system (drawing CE-101645)

(aa) Pipe, fittings and stub ends -

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3 (three) inch, Schedule 80, extra low carbon 304 stainless steel.

2 (two) inch, Schedule 80, extra low carbon 304 stainless steel.

2 (two) inch, Schedule 40, extra low carbon 304 stainless steel.

(bb) Flanges - 3 (three) inch, 900 (nine hundred) pound, forged carbon steel.

(cc) Gaskets - Flat type of unfilled teflon 3/32 (three thirty-seconds) inch thick.

3 (three) inch Schedule 80 pipe - 5 (five) inch outside diameter by 3 (three) inch inside diameter.

2 (two) inch Schedule 80 pipe - 3-5/8 (three and five-eighths) inch outside diameter by 2 (two) inch inside diameter.

2 (two) inch Schedule 40 pipe - 3-5/8 (three and five-eighths) inch outside diameter by 2-1/8 (two and one-eighth) inch inside diameter.

1-1/2 (one and one-half) inch Schedule 40 pipe - 2-7/8 (two and seven-eighths) inch outside diameter by 1-5/8 (one and five-eighths) inch inside diameter.

(dd) Bolts and Nuts - Shall be carbon steel conforming to ASTM Specification A307-52T, Grade B.

(ee) Working pressure - 1500 (fifteen hundred) pounds per square inch gage, at 70 (seventy) degrees Fahrenheit.

(ff) Test pressure - 2250 (two thousand two hundred fifty) pounds per square inch at 70 (seventy) degrees Fahrenheit hydraulic

(b) Rocket Starting

Fuel and Oxidant

(1) Pipe, fittings - 3/4 (three-fourths) inch, Schedule 40, 304 stainless steel.

(2) Tubing - 1/2 (one-half) inch outside diameter by .065 (sixty-five thousandths) inch wall, 304 stainless steel.

(3) Thread joints - see Item 4-01 (c).

- (4) Working pressure - 250 pounds per square inch gage, fuel -
1800 pounds per square inch gage, oxidant.
- (5) Test pressure - 375 pounds per square inch gage, hydraulic,
fuel.
- 2700 pounds per square inch gage hydraulic,
oxidant.

(c) Immersion Tank DrainsFuel and Oxidant

- (1) Tubing - 1-1/2 (one and one-half) inch type "K" copper water-tube and wrought copper solder fittings.
- (2) Thread joints - See Item 4-01 (c).

4-04. High Pressure Gas Piping:(a) Helium

- (1) Charging, including helium tube trailer
 - (aa) Piping and weld fittings - 1 (one) inch, 3/4 (three-fourths) inch, Schedule 40, 304 stainless steel.
 - (bb) Flexible hose - 1 (one) inch, 3/4 (three-fourths) inch, neoprene, wire reinforced.
 - (cc) Thread joints - see Item 4-01 (c).
 - (dd) Working pressure - 2400 (twenty-four hundred) pounds per square inch gage.
 - (ee) Test pressure - 3600 (thirty-six hundred) pounds per square inch gage hydraulic.
- (2) Return
 - (aa) Piping - 1 (one) inch, 2 (two) inch, Schedule 40, 304 stainless steel.
 - (bb) Thread joints - See Item 4-01 (c).
 - (cc) Flexible hose - 2 (two) inch neoprene, wire reinforced.
 - (dd) Working pressure -
 - (1a) From Grove pressure regulator (501) to high pressure cylinder manifold - 2400 (twenty-four hundred) pounds per square inch gage.

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(2a) From Grove (501) to helium compressor - 300
(three hundred) pounds per square inch gage.

(ee) Test pressure, hydraulic -

(1a) 3600 (thirty-six hundred) pounds per square inch
gage (See (dd) (1a) above).

(2a) 450 (four hundred fifty) pounds per square inch
gage (See (dd) (2a) above).

(b) Nitrogen Charging

(1) Piping and weld fittings - 1 (one) inch, Schedule 40, 304
stainless steel.

(2) Thread joints - See Item 4-01 (c).

(3) Working pressure - 2400 (twenty-four hundred) pounds per
square inch gage.

(4) Test pressure - 3600 (thirty-six hundred) pounds per square
inch gage.

(c) Distribution Manifold

(1) Piping and fittings - 4 (four), 3 (three), 2 (two) inch
Schedule 80, 304 stainless steel; 1 (one), 3/4 (three-fourths)
inch, Schedule 40, 304 stainless steel; 3/4 (three-fourths)
inch outside diameter by 17 (seventeen) gage, 316 stainless
steel tubing.

(2) Welding - 1 (one) inch return header to use 3000 (three
thousand) pound 304 stainless steel socket weld crosses and
socket-weld valves; 2 (two) inch manifolds to use socket-weld
valves.

(3) Thread joints - See Item 4-01 (c).

(4) Working pressure - 2400 (twenty-four hundred) pounds per
square inch gage.

(5) Test pressure - 3600 (thirty-six hundred) pounds per square
inch gage.

(d) Propellant Pressurizing Piping

(1) Fuel system (drawing CE-101647) from distribution manifold to,
and including fuel pit.

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- (aa) Piping and weld fittings - 4 (four) inch, 3 (three) inch, 2 (two) inch, Schedule 80, and 1-1/2 (one and one-half) inch Schedule 40, extra-low carbon 304 stainless steel.
 - (bb) Flexible hose - 1-1/4 (one and one-fourth) inch inside diameter, 316 stainless steel, flexible hose, double braided, with 316 stainless steel stub ends. (See drawing No. CD-101652).
 - (cc) Gaskets - Flat type of unfilled teflon 3/32 (three thirty-seconds) inch thick.
 - 3 (three) inch Schedule 80 pipe - five (5) inch outside diameter by 3 (three) inch inside diameter.
 - 2 (two) inch Schedule 80 pipe - 3-5/8 (three and five-eighths) inch outside diameter by 2 (two) inch inside diameter.
 - 2 (two) inch Schedule 40 pipe - 3-5/8 (three and five-eighths) inch outside diameter by 2-1/8 (two and one-eighth) inch inside diameter
 - 1-1/2 (one and one-half) inch Schedule 40 pipe - 2-7/8 (two and seven eighths) inch outside diameter by 1-5/8 (one and five eighths) inside diameter.
 - (dd) Bolts and Nuts - Shall be carbon steel conforming to ASTM Specification A307-52T, Grade B.
 - (ee) Threaded joints - See Item 4-01 (c).
 - (ff) Working pressure - 2400 (twenty-four hundred) pounds per square inch gage.
 - (gg) Test pressure - 3600 (thirty-six hundred) pounds per square inch gage hydraulic.
- (2) Oxidant system (Drawing CE-101648) from distribution manifold to, and including oxidant pit.
- (aa) Piping and weld fittings - 3 (three) inch, 2 (two) inch, Schedule 80, and 1-1/2 (one and one-half) inch Schedule 40, extra-low carbon 304 stainless steel.
 - (bb) Flexible hose - 1-1/4 (one and one-fourth) inch inside diameter, 316 stainless steel flexible hose, double-braided, with 316 stainless steel stub ends. (See drawing CE-101652).

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- (cc) Gaskets - Flat copper jacketed asbestos filled, full double seal type: Akron Metallic Gasket Company, Akron, Ohio, Type FDS, or approved equal.
 - 3 (three) inch pipe - Catalog No. 412 (3 x 4-7/8)
 - 2 (two) inch pipe - Catalog No. 314 (2 x 3-5/8)
 - 1-1/2 (one and one-half) inch pipe - Catalog No. 271 (1-5/8 x 2-7/8)
- (dd) Bolts and Nuts - Bolts shall be austenitic stainless steel conforming to ASTM Specification A320-52T, Grade L8F. Nuts shall be austenitic stainless steel conforming to ASTM Specification A-194, Grade 8F. A molybdenum disulphide type of lubricant shall be used on bolt threads and on the load bearing surface of the nut to prevent galling of the threads and nut surface.
- (ee) Thread joints - See Item 4-01 (c).
- (ff) Working pressure - 2400 (twenty-four hundred) pounds per square inch gage.
- (gg) Test pressure - 3600 (thirty-six hundred) pounds per square inch gage hydraulic.

(c) Vent and Purge Piping

- (1) Fuel (Drawings CE-101655 and CE-101656)
 - (aa) Piping and fittings - 4 (four), 3 (three), 2 (two) and 1 (one) inch Schedule 40, 304 welded or seamless stainless steel.
 - (bb) Tubing - 1/4 (one-fourth) inch by .031 (thirty-one thousandths) wall stainless steel.
 - (cc) Tubing fittings - AFCC flareless stainless steel.
 - (dd) Thread joints - See Item 4-01 (c).
 - (ee) Working pressure - 500 (five hundred) pounds per square inch gage.
 - (ff) Test pressure - 750 (seven hundred fifty) pounds per square inch, hydraulic.

- (2) Oxidant (Drawings CD-101653, CE-101654 and CE-101656)
- (aa) Piping and fittings - 3 (three), 2 (two) and 1 (one) inch Schedule 40, 304 welded or seamless stainless steel.
 - (bb) Tubing - 2 (two), 1-1/4 (one and one-fourth) and 3/4 (three-fourths) inch type "K" copper water tube.
 - (cc) Fittings - wrought copper solder and AFCO flareless stainless steel.
 - (dd) Thread joints - See Item 4-01 (c).
 - (ee) Flexible hose - in oxidant system, 1 (one) inch nominal, single braid, stainless steel flexible hose.
 - (ff) Working pressure -
 - (1a) Purge lines - 500 (five hundred) pounds per square inch.
 - (2a) Vent lines - 500 (five hundred) pounds per square inch.
 - (3a) Isolation pressure relief lines - same as line in which upstream connection is made.
 - (gg) Test pressure - 1-1/2 (one and one-half) times working pressure, hydraulically.

4-05. Service Piping:

- (a) Pilot pressure (Drawings CE-101650 and CE-101651)
- (1) Piping and fittings - 1 (one) and 1/4 (one-fourth) inch Schedule 40, 304 stainless steel.
 - (2) Tubing - 1/2 (one-half) and 3/8 (three-eighths) inch.
 - (3) Tubing fittings - AFCO flareless stainless steel.
 - (4) Thread joints - See Item 4-01 (c).
 - (5) Working pressure -
 - (aa) to pressure regulators in all branches - 2400 psig.
 - (bb) from regulator (600) - 15 psig.

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- (cc) from regulators (601) and (602) - 1500 psig.
 - (dd) from regulator (605) - 150 psig.
 - (ee) from regulator (614) - 35 psig.
 - (ff) from regulator (650) - 1500 psig.
 - (gg) from regulator (651) - 15 psig.
 - (hh) from regulator (652) - 150 psig.
 - (ii) from regulator (657) - 35 psig.
- (6) Test pressure - hydraulic 1-1/2 (one and one-half) times working pressure.
- (b) Helium Service (Drawing CE-101649)
- (1) Piping and fittings - 1 (one) inch, 3/4 (three-fourths) inch, Schedule 40, 304 stainless steel; 3/8 (three-eighths) brass, or stainless (304) nipples.
 - (2) Thread joints - See Item 4-01 (c).
 - (3) Working pressure - 2400 (twenty-four hundred) pounds per square inch gage.
 - (4) Test pressure - 3600 (thirty-six hundred) pounds per square inch gage, hydraulic.
- (c) Carbon Dioxide (Drawing CE-101649)
- (1) Piping - 1 (one) inch, 3/4 (three-fourths) inch Schedule 80 black iron.
 - (2) Fittings - 2000 (two thousand) pound, malleable black iron.
 - (3) Thread joints - See Item 4-01 (c).
 - (4) Working pressure - 1000 (one thousand) pounds per square inch gage.
 - (5) Test pressure - 1500 (fifteen hundred) pounds per square inch gage, hydraulic.
- 4-06. Welding:
- (a) All welding of austenitic stainless steel and carbon steel pipe joints shall be performed by the inert gas (helium or argon) metal arc welding process in strict accordance with the ASA Code for Pressure Piping B31.1-1951, Section 6, Chapters 4 and 5.

- (b) All butt-welded pipe joints of austenitic stainless steel and carbon steel shall be made with the "EB weld insert process" Arcos Corporation, 1500 S. 50th Street, Philadelphia 43, Pennsylvania, in strict accordance with manufacturers instructions.
- (c) Each welding procedure that is followed in construction shall be qualified in accordance with ASME Boiler and Pressure Vessel Code - Section IX, 1952, and this procedure shall be recorded in detail by the contractor.
- (d) In addition to the above welding procedure tests Charpy impact tests at minus 320 (three hundred twenty) degrees Fahrenheit of samples of type 347 welded pipe joints made with the proposed welding procedure shall be performed and certified by an independent laboratory in strict accordance with the ASME Boiler and Pressure Vessel Code, 1952 Edition, Section VIII, paragraph UG-84. Tests shall cover the weld zone, heat affected zone adjacent to weld and parent metal. The minimum value of Charpy impact strength at minus 320 (three hundred twenty) degrees Fahrenheit shall be 15 (fifteen) foot-pounds.
- (e) All welders shall be required to pass the operator qualification tests prescribed in the ASME Boiler and Pressure Vessel Code, Section IX, 1952.
- (f) No stress-relief heat treatment shall be used on stainless steel welded pipe joints.
- (g) All pipe, fittings, valves and other accessories to be welded into the piping systems shall be cleaned free of all paint, oil, hydrocarbon solvents, rust, dirt, slag and scale on all surfaces before being aligned in position for welding.
- (h) No welding of any kind shall be done when base metal temperature is below 0 (zero) degrees Fahrenheit at temperatures between 0 (zero) degrees Fahrenheit and 32 (thirty-two) degrees Fahrenheit the surface of all areas within 3 (three) inches of the point where a weld is to be started, shall be heated to a temperature of at least 60 (sixty) degrees Fahrenheit before welding is started. No welding shall be done when surfaces adjacent to welds are covered with ice. Welding shall not be carried on in inclement weather unless adequate protection is provided.
- (i) The Contracting Officer reserves the right to use any and all tools of inspection to insure that quality, including soundness and strength of welds is in accordance with these specifications. Radiographic inspection will be used by the Contracting Officer to the extent considered necessary. Porosity in excess of that shown on the porosity charts of the ASME Boiler and Pressure Vessel Code, 1952 Edition, Section VIII, Pages 133 through 137 inclusive, will be cause for rejection. Rejected work shall be removed and replaced as directed.

4-07. Silver Soldering:

- (a) All solder joints on copper water tube and brass pipe shall be made without the use of flux. Except as noted "All state No. 23 silver brazing rod", All State Welding Alloy Company, White Plains, New York, shall be used in strict accordance with manufacturer's instructions.
- (b) Copper water tube ends and wrought copper fitting sockets shall be polished with fine steel wool, degreased with trichlorethylene, and wiped dry with clean cotton waste. The joint should then be made up immediately.
- (c) All copper water tube, fittings, valves and accessories shall be cleaned free of foreign matter, oil and grease prior to joint preparations.

4-08. Valves and Miscellaneous Accessories:

- (a) All valves and accessories procured by the contractor shall be ordered from the manufacturer to be free of all machinery lubricants, rust preventative, coatings, greases and oils. Such equipment shall be subject to inspection by the Contracting Officer prior to installation and shall be degreased and cleaned, if necessary, by the contractor, at the option of the Contracting Officer.
- (b) Annin Valve - Item 343, See Valve Schedule, Drawing CC-101661.
 - (1) Body - Type 347 stainless steel.
 - (2) Seat - Annealed electrolytic copper, sealed with tin plated dead soft chemical lead facing gaskets for bubble tight shut off.
 - (3) Plug and stem - quick opening plug for on-off service of Type 347 stainless steel, stem of type 347 stainless steel, stem guide of brass.
 - (4) Operator - Annin pneumatic cylinder complete with solenoid valve item (611).
- (c) Annin valves - Items (410), (422) and (423) - See Valve Schedule CC-101663.
 - (1) Body - Type 304 or 316 stainless steel (all items).
 - (2) Seat - Type 316 stainless steel (all items).
 - (3) Plug and stem - Items (422) and (423) quick opening double plugs for on-off-vent service. Type 316 stainless steel plug, stem and stem guides. Item 410 percentage type plug with a flow coefficient of approximately 46.0 (forty-six). Plug, stem and stem guide shall be of type 316 stainless steel.

- (4) Operator - Items (422) and (423) - Annin pneumatic cylinder with solenoid valve items (662) and (663). Shall be spring closed, air to open, capable of opening with full 1500 (fifteen hundred) pounds per square inch differential across valve. The maximum pressure required to actuate the valve shall not exceed 150 (one hundred fifty) pounds per square inch gage. The time required to full stroke the valve shall not exceed 3 (three) seconds using dry nitrogen as the actuating fluid. Item (410) valve shall be capable of operating through the first half of the left range with full 1500 (fifteen hundred) pounds per square inch gage differential across the valve seat. It shall be furnished with valve positioner mounted, adjusted, and complete with gages. Valve positioning pressure shall be approximately 3 (three) to 15 (fifteen) pounds per square inch gage for zero to full stroke of the valve. Under slight vibrating conditions, a pressure reversal of .005 (five-thousandths) pounds per square inch loading pressure shall cause valve travel reversal. The maximum pressure required to actuate the valve shall not exceed 120 (one hundred twenty) pounds per square inch gage. The time required to full stroke the valve shall not exceed 5 (five) seconds using dry nitrogen as actuating fluid.
- (d) All stainless steel valves and safety heads in item 300 series except items (333), (334), (338) and (339) shall be of type 347 stainless steel. Items (333), (334), (338) and (339) shall be of type 304 or 347 stainless steel.
- (e) All stainless steel valves and safety heads in item 400 series shall be of type 304 or 347 stainless steel.

4-09. Pressure Testing, Cleaning and Leak Checking:

(a) General

These operations shall be performed by the contractor, using his own personnel, materials and equipment. Qualified Government personnel will be present to observe, advise and inspect all three operations. The liquid oxygen and liquid nitrogen storage tanks shall be omitted from the three operations and the fuel and oxidant immersion tanks shall be omitted from the pressure testing and cleaning. The fuel immersion tank shall be tested for leaks with water and the Government will leak test the oxidant immersion tank.

(b) Pressure Testing

All piping, tubing, tankage, equipment and their joints or connections described in these specifications are to be hydraulically

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pressure tested for mechanical strength and nominal leaks. The test pressures for various sections of the piping systems are described herein. Suitable care is to be taken to isolate each section requiring a different test pressure and to eliminate all air in the section being tested prior to applying hydraulic pressure. A minimum of 5 (five) minutes must be used to gradually apply the test pressure, which shall then be held for a minimum of 5 (five) minutes. While the test pressure is maintained, the contractor shall visually inspect each tested section for weakness or leaks; the contractor shall be responsible for proper steps to correct faults of fabrication or installation.

(c) Cleaning

All traces of dirt, grease, scale, rust and slag are to be removed from the interior of all tankage, piping and equipment described in these specifications. Trichlorethylene shall be recirculated through all piping systems described. Flushing shall be continued until a sample of the flushing fluid can be evaporated on a clean white cloth or filter paper without leaving a trace of moisture, grease or sediment. After flushing, all systems are to be purged with dry nitrogen gas (using the Government liquid nitrogen vaporizer and liquid nitrogen storage tanks with the contractor's liquid nitrogen). Purging is to continue until no odor can be detected in the effluent gas anywhere in the rocket piping. The fuel pit propellant piping, the fuel supply piping, the fuel pit pressurizing piping, the fuel vent and purge piping shall be omitted from the following step. The systems are then to be evacuated to a pressure below that of the vapor pressure of trichlorethylene (3.94 inches mercury, absolute at 88 (eighty-eight) degrees Fahrenheit, 1.5 inches mercury, absolute, at 53 (fifty-three) degrees Fahrenheit) until the exhaust of a vacuum pump (furnished by the Government) can be passed through a liquid nitrogen cold trap leaving no trace of moisture, grease, or solvent. The contractor is expected to take proper precautions regarding protective clothing, ventilation, etc., when using the trichlorethylene solvent.

(d) Leak Checking

Each section of all rocket piping described in these specifications shall be pressurized, using the contractor's helium to one-half (1/2) the stated working pressure and all flanged, welded, soldered and threaded joints and sealed openings, flexible hose and other sources of leaks shall be swabbed or squirted with Leak-Tec solution available from American Gas and Chemical, Inc., 45 Rockefeller Plaza, New York 20, New York. The contractor shall be responsible for repairs of leaks resulting from faulty fabrication or installation.

- (c) All pipe, fittings, or accessories furnished by the contractor, which show leaks or other defects during tests, shall be replaced or repaired promptly at the contractor's expense.

4-10. Supports and Hangers:

- (a) Except as noted in the specifications and drawings, the contractor shall provide all necessary supports and hangers for equipment, piping and accessories as detailed on the drawings.
- (b) All steel pipe supports and hangers shall be painted with one (1) primer coat of Rust-Oleum No. 769 Dampproof Primer or fully equal, and one (1) finish coat of Rust-Oleum No. 740 Ready Mixed Aluminum LC, or fully equal.