

**E2 Test Facility  
at  
NASA Stennis Space Center**

**Liquid Oxygen Pump Skid**

**August 9, 2013  
Revision 0**

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TUBING SYSTEMS FOR FACILITY  
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EQUIPMENT, AND AEROSPACE  
HARDWARE

### 1.3 SUBMITTALS

The following shall be submitted in sufficient detail to show full compliance with the specification:

#### Data

The Contractor shall furnish design calculations covering performance features of the pump skid. Design calculations shall be submitted with the shop drawings. These are due no later than THREE (3) weeks after award of the contract. Design calculations shall include:

Calculations showing how pump speed, discharge pressure, inlet pressure, and flowrate were determined and will be achieved.

#### Drawings

Shop Fabrication Drawings shall be submitted of the pump skid AND of each skid assembly component as needed for the assembly of the skid, due no later than THREE (3) weeks after the award of the contract. Shop drawings shall show the location and details of:

- all dimensions and details of construction
- all interface connection locations and types/sizes
- lifting points
- center of gravity (of complete skid assembly)
- support design requirements (as needed)
- bill of Materials for all parts and components

#### Schedules

A copy of Fabrication time and test and inspection schedules shall be submitted in standard Gantt Chart format no later than THREE (3) weeks after award of contract.

#### Statements

The Contractor shall submit the following items within THREE (3) weeks after award of contract:

- Cleaning Procedures
- Hydrostatic Leak Check Procedures
- Functional and Acceptance Test Procedures

#### Reports

Prior to shipment, the Contractor shall submit a copy of the following items:

- Mill Test Reports and certifications for all metallic parts
- Hydrostatic Test Report including test set-up configuration and log of time versus pressure
- Functional and Acceptance Test Reports
- Cleaning and Sampling Reports
- Complete listing of all materials and certifications for soft goods

#### 1.4 REQUIREMENTS

The pump skid shall be designed, fabricated, tested, cleaned and delivered in accordance with the detailed requirements of this specification and any attached data sheets. The requirements specified herein are minimum requirements. The Contractor shall take whatever additional measures are necessary in his design, fabrication, inspection and testing to produce a pump skid, which will satisfactorily pass the tests specified herein without damage. Where specific requirements are set forth, and where such specific requirements depart from requirements or alternatives contained in any documents referenced herein, the specific requirements contained herein shall govern and take precedence.

The pump skid shall consist of a boost pump, motor, cold end assembly, surge chamber, and all intake and discharge piping necessary to meet the requirements of this specification.

##### 1.4.1 Motor

The main drive motor for the pump skid shall be no larger than 40 horsepower, Total Enclosed Fan Cooled electric motor operating on 60 Hz 480 volt 3 phase power. Protective shrouding shall be installed around moving/rotating parts to protect personnel.

##### 1.4.2 Boost Pump

The boost pump that is installed on the skid between the skid intake and the cold end assembly shall be sized such that the pump will not cavitate under operating conditions listed in the attached data sheet.

#### 1.5 QUALITY ASSURANCE

The Contract Administrator and Government reserve the right to inspect all work at all times during and upon completion of fabrication and to witness any or all tests. The Contractor shall cooperate fully to enable the COTR or Government designated representative to be present at the performance of any or all tests and any other activity as specifically requested. The Contractor shall furnish all equipment and materials for all tests except where specially stated otherwise. The Contractor shall notify the COTR fourteen calendar (14) calendar days prior to performance of any and all tests.

As a minimum, the following hold points shall apply:

Item No.	Surveillance	Type
1	Government review and approval of sizing calculations, drawings, cleaning procedures, and weld radiographs	Verification /Approval
2	Initial Cleaning of Pump Skid	Witness
3	Hydrostatic, Functional, and Acceptance Tests	Witness
4	Final Cleaning Verification Post-Test and Packaging For Shipment	Witness

### 1.6 WELDING PROCEDURE AND WELDING OPERATOR QUALIFICATIONS

Welding procedure and welders qualifications shall be performed in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. All pressure containing welds must be 100% radiographed. Radiographs must be submitted for approval and approval granted before proof pressure tests.

### 1.7 GUARANTEE

All equipment to be furnished under this specification shall be guaranteed against defective materials, design, and workmanship for a period of one year from receipt of the pump skid. Upon receipt of notice of failure of any part of the guaranteed equipment during the guarantee period, new replacement parts shall be furnished and installed promptly by the Contractor at no additional cost. The Contractor shall acknowledge his responsibility under these guarantee provisions by letter, stating the inclusive dates of the guarantee period for which the equipment and materials referred herein are guaranteed.

### 1.8 TESTING

All valves, tubing, and piping shall be hydrostatically tested to 1.5 times the MAWP and held for 10 minutes. The hydrostatic test pressure and test date shall be permanently marked on the valve, tubing, and piping.

Acceptance testing of pump skid using Liquid Nitrogen is required following cleaning procedure. Acceptance test shall successfully demonstrate that flowrate and pressure requirements of the skid have been met.

### 1.9 CLEANING

All pump skid components shall be cleaned NASA RPT STD 8070-0001 Level 1000A before Liquid Nitrogen acceptance testing. A report showing the particulate and NVR sampling results must be kept and submitted at the end of the contract. After acceptance test, pump discharge fluid must be sampled and must meet the above clean level or re-

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cleaning and re-testing will be required. After cleaning and verification of clean level, skid shall be packaged in accordance with NASA RPT STD 8070-0001.

-- End of Section --

APPENDIX A  
PUMP SKID FOR LIQUID OXYGEN SERVICE

**Positive Displacement Liquid Oxygen Pump Skid Data Sheet**

- Equipment Type: 1 Cylinder Positive Displacement Pump Skid
- Nominal Pump Rate: 4 GPM
- Service Fluid: LOX (Liquid Oxygen)
  - Fluid Inlet Temperature Range: -320 to -280 °F
  - Fluid inlet Pressure Range: 10 – 22 psig
- Maximum Allowable Working Pressure of Skid: 6000 psig
- Nominal Working Pressure of Skid: 5000 psig
- Materials of Construction:
  - Cylinder: Monel 400
  - Poppet: Monel 400
  - Softgoods and lubricants must be oxygen compatible per NASA/SSC/DWG 54000-GM30 “Specifications for Materials used in LOX and GOX Service Exempt from Batch Test Requirements.” Non listed materials will require approval before skid construction.
- Inlet End Connection: 1.5” AS5202
- Outlet End Connection: 1” (0.688” ID) Autoclave Engineers medium pressure cone and thread fitting SF1000CX per SSC-SSTD-8070-0126 TUBE.
- The operating environment of the pump skid will be 20°F0 - 100°F, 100% relative humidity
- Pump skid shall be cleaned for oxygen service in accordance with RPT STD-8070-0001 Level 1000A. The manufacturer shall submit a cleaning and verification procedure subject to approval by the Purchaser before any cleaning work is performed.
- Pumps skid shall be acceptance tested at manufacturer using Liquid Nitrogen. At the conclusion of the test, a liquid sample shall be taken from the discharge connection. This sample must meet RPT STD-8070-0001 Level 1000A clean requirements or the test shall be deemed failed.
- Pump skid construction shall meet ASME B31.3. Welds shall be backed with Argon only, no Nitrogen. All pressure containing welds shall be 100% radiographed per ASME B31.3. Radiographs must be submitted for approval and approval granted before hydrostatic test and calibration.
- The Purchaser reserves the right to inspect any or all component piece parts for cleanliness and workmanship prior to assembly with advanced two week notice.
- All pump skid components shall be hydrostatically proof tested in accordance with ASME B31.3, to a pressure of not less than 1.5 times the MAWP for no less than 10 minutes.
- All high pressure tubing shall be Autoclave Engineer’s medium pressure cone and thread tubing per SSC-SSTD-8070-0126 TUBE.
- All low pressure tubing shall be 37 degree FLARED or BOSS, and shall be seamless stainless steel with 0.065” wall minimum per SSC-SSTD-8070-0126 TUBE.
- All relief devices protecting the pump skid shall be manufactured by Autoclave Engineers or Anderson Greenwood.
- Manufacturer shall supply any special tools needed for disassembly or reassembly of pump.
- Along with pump skid assembly, delivery shall include detailed drawings of pump and pump skid assembly, test procedures, test reports and material certifications for all metallic parts.
- All pump skid components shall be permanently marked with the following:
  - Manufacturer
  - Model #
  - Serial #
  - MAWP
  - Pressure Rating and Temperature Rating
  - Proof Test Type / Pressure / Date

APPENDIX B1

NASA RPT-STD-8070-0001

SURFACE CLEANLINESS STANDARD FOR FLUID SYSTEMS  
FOR ROCKET ENGINE TEST FACILITIES  
OF THE NASA ROCKET PROPULSION TEST PROGRAM

APPENDIX B2

SSC-DWG No. 54000-GM30

SPECIFICATION FOR MATERIALS USED IN LOX OR GOX SERVICE EXEMPT  
FROM BATCH TEST REQUIREMENTS

APPENDIX B3

SSC-SSTD-8070-0126 TUBE

TUBING SYSTEMS FOR FACILITY SYSTEMS, SPECIAL TEST EQUIPMENT,  
AND AEROSPACE HARDWARE