	LZ (LUX/ZEPLIN) Vacuum Pumping Station Procurement Specification	Revision: A Author Name: Charles Maupin Responsible Inst: SDSTA Doc #: LZ-CTD-03-004
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APPROVALS REQUIRED

Name	Project Role	Approved
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REVISIONS

Revision	Change Description	Effective Date
A	Initial Release	

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OVERVIEW

This procurement specification outlines the specifications that are to be used to produce the Large Underground Xenon (LUX)-ZEPLIN (LZ) vacuum pumping stations which will be installed at the Sanford Underground Research Facility as sub-assemblies of the LZ Generation Two (G2) Direct Dark Matter Detector.

This procurement specification applies to the four vacuum pumping station assemblies which collectively will provide vacuum pumping capability to the LZ G2 Direct Dark Matter Detector. The vacuum pumping stations will provide vacuum pumping capability to establish and maintain vacuum for the purpose of residual gas removal and insulating vacuum.

This procurement specification applies to all components fabricated by forming, machining and welding operations and covers the specifications for design, welding, cleaning, inspection, testing, documentation, packaging and transportation.

Deviations from this procurement specification, unless otherwise specified, must be approved by the Sanford Underground Research Facility (SURF) technical representative prior to the time of manufacturing. Any exceptions to the specifications outlined in this procurement specification are to be noted on fabrication proposals.

VACUUM PUMPING STATION OVERVIEW

The LZ vacuum pumping stations shall be comprised of four continuous vacuum pumping stations. Each continuous vacuum pumping station shall consist of a turbomolecular vacuum pump, a scroll-type vacuum pump, a turbomolecular vacuum pump power supply/controller, a wide-range vacuum pressure transducer, two low vacuum pressure transducers and all required cables (power and signal). The required quantity of each component are as follows.

Description	Quantity
Turbomolecular Vacuum Pump	4
Scroll-Type Vacuum Pump	4
Turbomolecular Vacuum Pump Power Supply/Controller	4
Wide-Range Vacuum Pressure Transducer	4
Low Vacuum Pressure Transducer	8

Each vacuum pumping station shall provide at the inlet of the turbomolecular vacuum pump a vacuum pumping speed equal to or greater than 60 Liters per second (L/s) of Nitrogen (N2) and an ultimate pressure of 1 x 10-8 Torr. The details of the vacuum space which the continuous vacuum pumping stations will be installed on are as follows:

Vacuum Space	Volume	Notes:
Outer Cryostat Vessel	2246L	Vacuum Space to be pumped by two continuous vacuum pumping stations. Vacuum pumping conduit equivalent diameter and length, 2.37in (60.2mm) and 33.8in (0.9m) respectively.
PMT Standpipe	213L	Vacuum pumping conduit equivalent diameter and length, 2.37in (60.2mm) and 33.8in (0.9m) respectively.
Liquid Xenon Tower	1085L	Vacuum pumping conduit equivalent diameter and length, 2.37in (60.2mm) and 33.8in (0.9m) respectively.
Inner Cryostat Vessel	4883L	Vacuum Space to be pumped by continuous vacuum pumping station sourced from Outer Cryostat Vessel. Vacuum Space contains approximately 171L of Polytetrafluoroethylene (PTFE), 36L of Fluorinated Ethylene Propylene (FEP) and 1L of Polyethylene. Vacuum pumping conduit equivalent diameter and length, 2.81in (71.4mm) and 173.2in (4.4m) respectively.

Component Specifications

TURBOMOLECULAR VACUUM PUMP

All turbomolecular vacuum pumps shall conform to the following specifications.

- Turbomolecular vacuum pump shall be of an oil-free design.
- Turbomolecular vacuum pump shall have an ISO63 inlet flange.
- Turbomolecular vacuum pump shall be capable of being controlled by the vacuum pump power supply/ controller.
- Turbomolecular vacuum pump shall be cooled through natural convection or by a forced convection fan which is powered and controlled by the vacuum pump power supply/controller.

SCROLL-TYPE VACUUM PUMP

All scroll-type vacuum pumps shall conform to the following specifications.

- Scroll vacuum pump shall be of an oil-free design.
- Scroll vacuum pump shall be sized to provide vacuum backing for the turbomolecular vacuum pump.
- Scroll vacuum pump shall be capable of being controlled by the vacuum pump power supply/controller.
- Scroll vacuum pump shall be capable of operating on an electrical supply of 120VAC, 60Hz.
- Scroll vacuum pump shall have an integral inlet vacuum isolation valve (preferred) or be capable of having an inlet vacuum isolation valve hardwired in parallel with the electric motor.
- Scroll vacuum pump shall be cooled through natural convection.

TURBOMOLECULAR VACUUM PUMP POWER SUPPLY/CONTROLLER

All turbomolecular vacuum pump power supply/controller shall conform to the following specifications.

- Turbomolecular vacuum pump power supply/controller shall be capable of powering and controlling the turbomolecular vacuum pump.
- Turbomolecular vacuum pump power supply/controller shall be capable of controlling the scroll-type vacuum pump.
- Turbomolecular vacuum pump power supply/controller shall be capable of controlling the wide-range vacuum pressure transducer.
- Turbomolecular vacuum pump power supply/controller shall be capable of controlling the low vacuum pressure gauge.
- Turbomolecular vacuum pump power supply/controller shall be capable of operating on an electrical supply of 120VAC, 60Hz.
- Turbomolecular vacuum pump power supply/controller shall be capable of being remotely operated/monitored over a Profibus network.
- Turbomolecular vacuum pump power supply/controller shall be capable of controlling a pneumatic solenoid valve (0.35W at 24VDC).
- Turbomolecular vacuum pump power supply/controller shall be capable of receiving/providing the following inputs/outputs to a remote programmable logic controller through a configurable Profibus connection:
  - Turbomolecular Vacuum Pump
    - Start/Stop
    - At Normal Speed
    - Fault/Alarm Status
  - Scroll Vacuum Pump
    - Start/Stop
    - Fault/Alarm Status
  - Pneumatic Solenoid Valve
    - Open/Close
- Turbomolecular vacuum pump power supply/controller shall be UL Listed.

WIDE-RANGE VACUUM PRESSURE TRANSDUCER

All wide-range vacuum pressure transducers shall conform to the following specifications.

- Wide-range vacuum pressure transducers shall be capable of being controlled by the turbomolecular vacuum pump power supply/controller.
- Wide-range vacuum pressure transducers shall be capable of measuring pressures from atmospheric to $1x10^{-8}$ Torr.
- Wide-range vacuum pressure transducers shall have a NW25 inlet flange.

Low Vacuum Pressure Transducer

All low vacuum pressure transducers shall conform to the following specifications.

- Low vacuum pressure transducers shall be capable of being controlled by the turbomolecular vacuum pump power supply/controller.
- Low vacuum pressure transducers shall be capable of measuring pressures from atmospheric to $1x10^{-3}$ Torr.
- Low vacuum pressure transducers shall have a NW25 inlet flange.

Packaging/Shipping

Packaging/Shipping shall conform to the following specifications.

- Packaging/Shipping shall be arranged by supplier and all components shall ship to SURF at the following address.
  Sanford Underground Research Facility – Ross Warehouse
  100 Ross St.
  Lead, SD 57754
- Packaging shall be developed to prevent damage incurred during shipping.
- Packaging shall be developed to be handled with a forklift if the weight of components and packaging is over 40 pounds.