NPOI Nitrogen Distribution

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User Manual

Document

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Chapter 1. Prototype Function

1.1 Prototype Description

This system is designed to provide gaseous nitrogen to the siderostat mirror purges, vacuum tube gate valves, and imaging station pneumatic actuators at the Navy Precision Optical Interferometer. Nitrogen is supplied through copper tubing at a line pressure set above the required pressure for any device, to account for pressure drop. Since mirror purges require a different pressure input than the other devices, one regulator is designated for each device.

1.2 Part List

		Quantity
1/2in Copper tubing	50ft	4
1/4in Polyvinyl hose	30ft	
1/2in Solder tee		3
1/2in Solder coupling		1
1/2in tube adapter	1/4in female NPT	3
1/4in male NPT	1/4in hose barb	3
Stainless hose clamps	7/32in-5/8in	27
Reservoir tank	3 gallon	1
Brass ball valve	1/4in	4
Harris regulator	0-15PSI	2
Harris regulator	0-60PSI	2

Chapter 2. Assembly and Operation

2.1 Tee Assembly and Coil Construction

In an effort to reduce the time spent on site, and to prevent cold solder joints (improper heating of the solder in the joint that can cause leaks) the tee assemblies were soldered indoors. This process involved cutting and prepping a small section of tube to attach to the branch of the tee. This was soldered into the tee and a female tube to female

NPT fitting was soldered to the end. All of the soldering was performed using a handheld Benzomatic torch with MAPP gas fuel and plumbing solder. MAPP gas burns hotter than propane (3730ºF vs. 3600ºF [12]), which makes it more suitable for soldering tubing of this size. The coil was also constructed at this time by simply soldering two 50ft rolls together using a coupling

2.2 Supply Line Installation

The 50ft rolls of copper tubing is easily rolled out straight by applying pressure onto the roll and rolling it along a smooth, flat concrete surface. The covers of the cable tray are removed using a flathead screwdriver and 9/16in wrench. Due to the curves in the cable tray, the ends of the tubing are secured while two people carefully bend the tubing to match the curvature of the tray. After the tubing is properly located, the tee assemblies can be soldered into place using the MAPP gas torch and solder. Upon completion of the solder joints, the covers may be reinstalled.

2.3 Attachment of Devices

The first object to be connected to the system is the mirror purge setup in the astrometric hut. This is done by attaching one ball valve and one double-precision regulator to the first tee in the system. These objects are attached using ¼in polyvinyl hose cut to length, and secured using hose clamps on each barb fitting. Hose menders can then be used to attach the hose to the already installed hose that is attached to the mirror covers. Upon securing all of the fittings, the regulator is then set to 9PSI to properly supply the purge system.

Figure 2.1- Astrometric hut distribution system.

Following the completion of the astrometric hut, the gate valves and reservoir tank can be attached. The ball valve attaches shortly off of the tee fitting using 1/4in polyvinyl hose and hose clamps. Several feet of polyvinyl hose attach the reservoir tank to the outlet of the valve. On the outlet side of the tank, the regulator is installed and feeds into the gate valve enclosure. Upon securing all of the fittings, the regulator can be set to 9PSI.

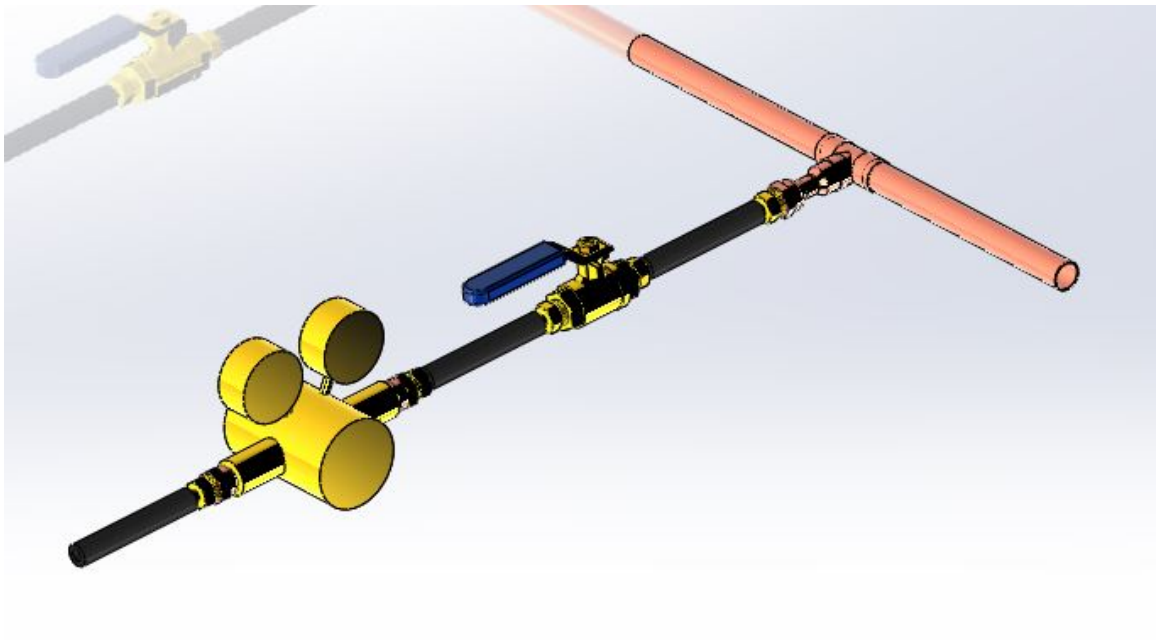

Figure 1.2- Gate valve distribution system.

Lastly, the imaging station distribution can be attached to the supply line. Rather than using a tee, this is done by soldering a tube to NPT adapter directly to the end of the tube. ¼in polyvinyl hose then feeds the barb tee that splits the flow into two separate regulators. Hose clamps are to be installed at each attachment point, and firmly secured using a flathead screwdriver. One regulator is to be set to 9PSI for the mirror purges, while the other should be set to 40PSI for the pneumatic actuators. The manual shutoff valve is to be installed for any instance where maintenance is required on the actuators or the mirror purges. Due to the low frequency of maintenance required on the objects with the current system, there was no need to install one valve per device.

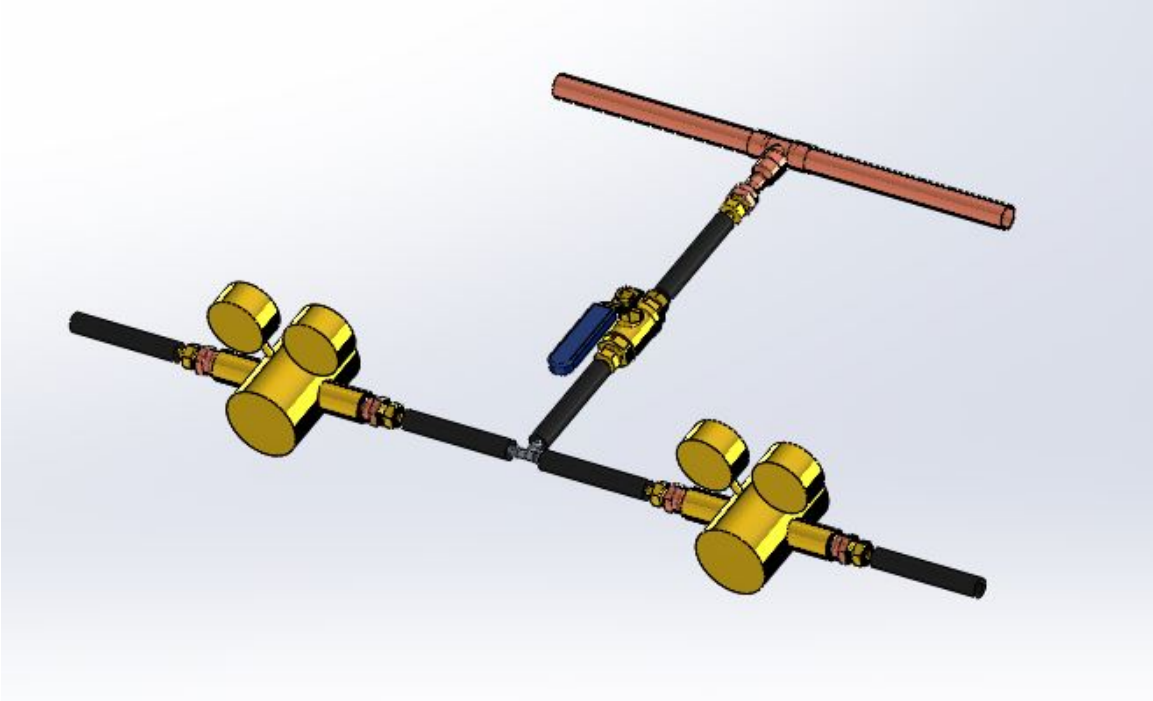

Figure 2.3- Imaging station distribution system.

Although the final system is designed around a 1000L liquid nitrogen Dewar, the extreme cost of renting the tank far exceeded the expected budget and made rental of such a tank a far unreasonable cost. For this reason, a simple gaseous nitrogen tank was used that is currently on site. Pressure off of this regulator is set to 50PSI to account for the predicted pressure drop in the line using the gaseous regulator attached to the tank. The following plot shows a general view of the design layout:

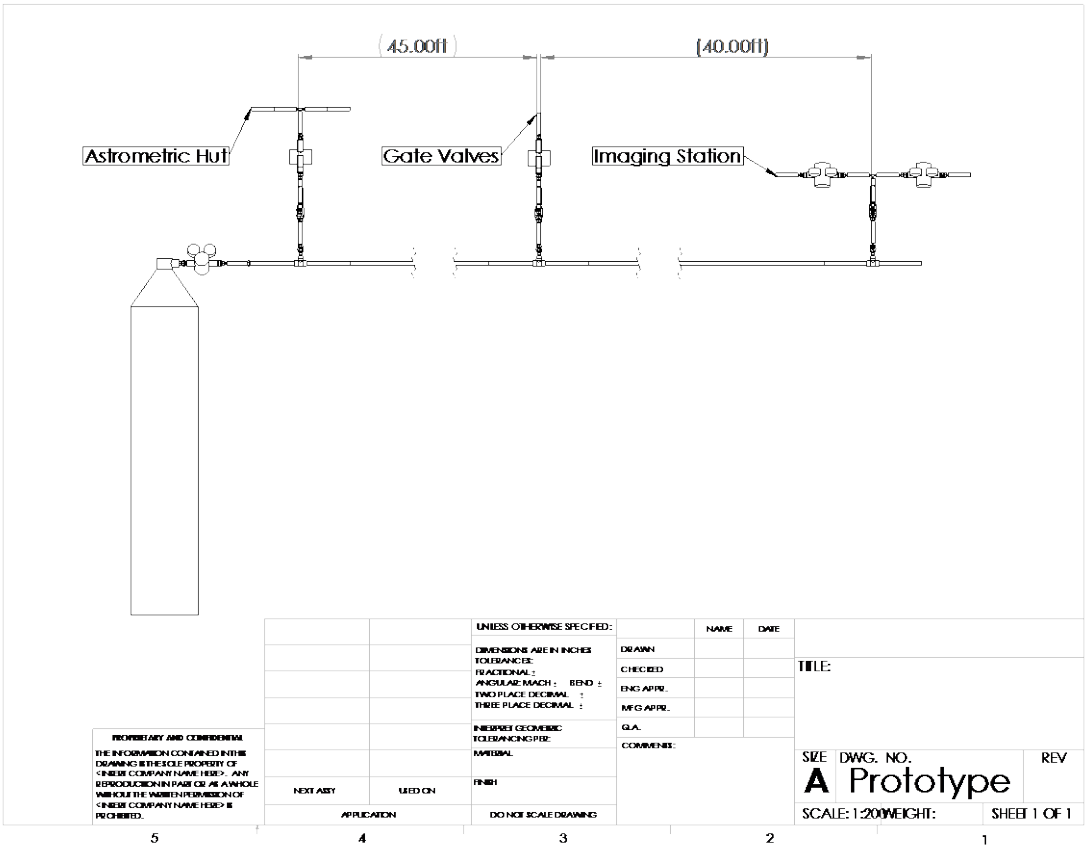

Figure 2.4- Prototype overview

2.4 Pressure Setting

For proper operation, it is required to properly set the input pressure for all devices using the supplied regulators. The gate valves and the imaging station actuators require 40PSI, while the siderostat mirror purges require 9PSI, respectively. This is performed by rotating the large knob on the center of the regulator clockwise to increase pressure, and counter clockwise to reduce pressure. However, since this is a sealed system, simply rotating the knob will not reduce pressure in the line. Reducing the pressure requires bleeding off the pressure at some point in the line. This is done by disconnecting a nearby valve connection (downstream), and releasing small amounts of pressure until the desired pressure is reached.

Chapter 3. Operation and Safety Instructions

3.1 Prototype Operation

The prototype system, as well as the final design that has been proposed for this system, are quite self-sustainable. Once the liquid nitrogen Dewar tank has been installed, the nitrogen supplier, Praxair has a system that will be implemented to prevent the tank

from running dry. This system will send a data package to the local Praxair facility to notify the employees of a low nitrogen situation. Therefore, the only maintenance required by NPOI staff is to periodically check the outlet pressure at each device to ensure it is supplying the appropriate pressure.

3.2 Safety Instructions

The maximum pressure in the system is designed to be 50PSI, which quite small compared to the maximum allowable pressure of the copper tubing, solder joints, and even polyvinyl hose. Since a manual shutoff valve will be installed at each location, if a device requires maintenance, only a small amount of nitrogen will escape when the polyvinyl hose is removed. As long as the tubing is safely restrained in the cable tray, there should be chance of holes forming in the tubing, so there will be no risk of nitrogen rapidly escaping and causing harm to an employee.