

BONuS Target Gas System Manual

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Introduction

The Bonus target consists of a Kapton straw filled with pressurized gas.

The target parameters are:

Straw Length	50 cm
Straw diameter	6 mm
Straw wall thickness	55 microns
Target pressure	86 psig
Beam energy	11 GeV
Beam current	200 nA
Target gas	D2, H2, He4
Target flush gas	N2

The target straw is connected to the target gas panel on the SVT cart; a transfer line connects the target gas panel to the supply gas panel in the gas pad. Four gas bottles will be stored in the gas pad that can be connected to the gas panel; H2, D2, N2, and He4.

The target straw can only be connected to the gas system at one end; therefore, the gas cannot be changed by flowing gas through the straw. Therefore, the gas will be changed by emptying and refilling the straw. When a different type of gas is used, the target will be filled and emptied 3 times to remove the first gas and replace it with the second gas.

Installation

The flammable gas regulator is installed on the D2 or H2 bottle, and a hose is connected to the supply gas panel.

The non-flammable gas regulator is installed on the N2 or He4 bottle, and a hose is connected to the supply gas panel.

Both regulators are set at 86 psig. A 0.050 inch orifice is installed upstream of the regulators to limit gas flow during a regulator failure. 100 psig relief valves are installed on the gas panel, before the solenoid valves. A flashback arrestor is installed after the flammable gas regulator to prevent flames from reaching the flammable gas bottles during an unexpected event.

A pressure transducer is also installed on the supply gas panel, as well as a mass flow meter.

The transfer line is a ¼" SST line that goes from the gas pad to the level 1 space frame, beam left, near the target. A ¼" SST hose will connect the gas line to the target gas panel mounted on the SVT cart. A 1/8" SST hose will connect the target gas panel to the target straw.

A 0.010 inch orifice is installed at the entrance of the target gas panel to reduce the flow during system flushing. A 0.001 inch orifice is installed before the straw to reduce the flow into and out of the straw to reduce stress on the straw and windows.

The vent line from the target gas panel will discharge outside of the Hall near the gas pad.

Controls

The control system will control 4 solenoid valves

- SVBT100, flammable gas supply
- SVBT102, non-flammable gas supply
- SVBT108, straw supply
- SVTB112, exhaust

The control system will read out 2 pressure transducers and 1 mass flow meter

- PT104, gas supply pressure
- PT110, straw pressure
- MFC104, gas supply flow

The control system will operate solenoid valves based on user commands and interlocks, and a purge command.

Control System Modes of Operation

1. Manual
 - a. All solenoid valves can be opened or closed by the operator
 - b. Used to clean and flush the system
2. Auto Flammable
 - a. Solenoid valves are open from the flammable gas bottle to the target straw
3. Auto Non-Flammable
 - a. Solenoid valves are open from the non-flammable gas bottle to the target straw
4. Empty Target
 - a. Close SVBT100
 - b. Close SVBT102
 - c. Close SVBT108
 - d. Open SVBT112

5. Purge

- a. Control system operates SVBT108 and SVBT112 and monitors PT110 to empty and fill the target straw
 - i. Initial condition is PT110 at full pressure
 - ii. Close SVBT108 to stop the supply of gas to the target straw
 - iii. Open SVBT112 to exhaust gas from target straw
 - iv. PT110 down to 5 psi
 - v. Close SVBT112
 - vi. Open SVBT108 to charge target straw

Interlocks

System in manual, auto, or purge mode

- Flammable gas detector senses flammable gas:
 - Close SVBT100
 - Close SVBT102
 - Close SVBT108
 - Open SVBT112
 - Secure HV
 - These actions stop the supply of gas and open the exhaust to reduce the gas pressure

- PT104 or PT110 read greater than 95 psi
 - Pressure regulator failure indicated
 - Close SVBT100
 - Close SVBT102
 - Close SVBT108
 - Open SVBT112
 - Secure HV
 - These actions stop the supply of gas and open the exhaust to reduce the gas pressure

- System may be left in manual mode and left unattended with bottles open and supplying pressure to the system
 - Flammable gas detector senses flammable gas, system must close the valves to stop the flow of flammable gas.

System in manual mode:

- No additional interlocks

System in auto mode:

- PT104 or PT110 fall below 75 psig, or MFC reads higher than 100 ccm
 - Leak indicated
 - Close SVBT100
 - Close SVBT102
 - Close SVBT108
 - Open SVBT112
 - Secure HV
 - These actions stop the supply of gas and open the exhaust to reduce the gas pressure

System in purge mode:

- If PT104 or PT110 do not reach 80 psi after 30 seconds when filling, leak or open exhaust solenoid valve indicated
 - Close SVBT100
 - Close SVBT102
 - Close SVBT108
 - Open SVBT112
 - Secure HV
 - These actions stop the supply of gas and open the exhaust to reduce the gas pressure

Failure Mode Analysis

Failure	Action
Pressure regulator fails open	Pressure increases to 100 psi and relief valve opens PT104 and or PT110 read higher than 95 psi, Solenoid valves are operated to stop supply flow and reduce pressure
PT104 fails	If out of range, solenoid valves are operated to stop supply flow and reduce pressure Check PI104 to compare
PT110 fails	If out of range, solenoid valves are operated to stop supply flow and reduce pressure Check PI110 to compare
SVBT100 or SVBT102 fail open	SVBT108 will control the flow
SVBT108 fails open	SVBT100 or SVBT102 will control the flow
SVBT112 fails open	Exhaust will be open all the time, PT110 will indicate low pressure and solenoid valves are operated to stop supply flow and reduce pressure
SVBT100, 102, or 108 solenoid valve fails closed Supply manual valves closed	System will not build pressure, operator to correct issue
SVBT112 exhaust solenoid fails closed Exhaust manual valves closed	System will not reduce pressure, operator to correct issue

Procedures

Flushing the Target with N2

1. Connect the non-flammable regulator to the N2 bottle
2. Open:
 - a. N2 bottle valve
 - b. MVBT102
 - c. SVBT102
 - d. MVBT104
 - e. MVBT106
 - f. MVBT108
 - g. SVBT108
 - h. MVBT110
 - i. SVBT112
 - j. MVBT112
 - k. MVBT114
3. Flush the system with N2 for 10 minutes
4. Close exhaust solenoid valve SVBT112 to pressurize the target with N2
5. When straw pressure reaches 80 psig, close supply solenoid valve SVBT108 and open exhaust solenoid valve SVBT112 to reduce pressure
6. When straw pressure reaches 0 psig, close exhaust solenoid valve SVBT112 and open supply solenoid valve SVBT108 to increase pressure
7. Repeat steps 5 and 6 two times
8. Close non-flammable solenoid valve SVBT102
9. Open exhaust solenoid valve SVBT112 to reduce pressure
10. Close:
 - a. N2 bottle valve
 - b. MVBT102

Filling the Target

1. Connect the flammable gas regulator to the H2 or D2 bottle
2. Open:
 - a. H2 or D2 bottle valve
 - b. MVBT100
 - c. SVBT100
3. Flush the system with the target gas for 3 minutes
4. Close exhaust solenoid valve SVBT112 to pressurize the target with H2 or D2
5. When straw pressure reaches 80 psig, PURGE the Target 3 times
6. Now the target is clean and pressurized with the target gas

Purging the Target

This is required to remove helium from the target straw on a regular basis

1. Click on the PURGE button on the Bonus target gas screen
2. The controls will:
 - a. Close the supply solenoid valve SVBT108
 - b. Open the exhaust solenoid valve SVBT112
 - c. When the straw pressure reaches 5 psi, the exhaust solenoid valve SVBT112 is closed, and the supply solenoid valve SVBT108 is opened
 - d. The straw pressure will increase back to 86 psig
3. This process is done 3 number of times when the PURGE button is pressed to remove the helium from the target straw.

Questions

1. PT406 - what alarm or interlock
 - a. EPICs alarm to engineering on-call
2. How to secure high voltage due to gas system failure
 - a. Email to Sebastian Nov 15
3. Test entire system in the Hall? January 2-4
 - a. Email to Sebastian Nov 15