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Gas System Monitoring Instructions – Version 3

In this document , two levels of alarm are defined. The lower level of alarm "of interest" is one for which there is no immediate danger to the detector chambers, and will have negligable effect on the quality of data. For the lower level of alarm an email or page on site for a gas system expert is appropriate. The higher level is one for which "action " needs to be taken, such as turning the Voltage to the Chambers off. For the "action" level of alarm Robert Openshaw or Marielle Goyette should be contacted.

1) **<u>Twice Per Shift– Check Histories from Midas Status</u>**

To look at the Histories, click on History from the Midas status page. The histories relevant to the gas system are then labeled as Pres, Flow1–Flow8, MFC, and Gas Shack. In general when looking at the histories, looking at 12h or 24h will give you a good idea of how the system should be behaving.

i) Check the pressure histories (Pres). There are seven pressures shown on this chart.

a) DC_Diff and PC_Diff are measured in mTorr. Note that there could be short spikes on these due to people activity on the rack platform. If there is a 150 mTorr change in these pressures, solenoid valves will automatically isolate the chambers (stopping the flows). If this happens, slow controls pops up a red alarm indicating you should TURN OFF HV and CALL EXPERT.

	Nominal Value	"of interest"	"action"
DC_diff	110 mTorr	± 5 mTorr	± 50 mTorr (foil movement of 200µm)
PC_diff	205 mTorr	± 5 mTorr	± 50 mTorr

b) He_diff is measured in mTorr. Changes to He_diff are quite benign, and are likely to happen since the pressure is controlled by a mechanical pressure regulator, a manual rotameter, and the output impedance of the cradle exhaust tube. If the helium bubbler is bubbling, then turn off HV.

	Nominal Value	"of interest"	"action"
He_diff	109 mTorr	± 20 mTorr	± 100 mTorr

c) Atm is measured in Torr. No level of alarm here, just mother nature at work.

d) DC_pump, and PC_pump are measured in Torr. They respond to flow changes, atmospheric pressure changes, and PC_Mix fills, so are quite variable. Any dangerous level in these would be seen as dangerous changes in output flow from the chambers, DC_diff, and PC_diff. The level of "action" for these is only if the pump stops (checked on the gas system walkaround.)

e) PC_Mix_pressure is measured in Torr. This reports basically the same info as the CF4_Mix flow and the Iso_Mix flow. The level "of interest" is if the cycle time changes by > 20% from the ~3−4 hour fill cycle. This gas supply is shared with another experimental group, so the fill cycle is approximately every three hours while they are runing, and approximately every four hours when they are not.

ii) Check DC and PC chamber flow histories. Click on each of Flow1 to Flow8 to view the different chambers. The flow histories should be reasonably stable, with small temperature related drifts. The PC flows will have bumps on them which correlate with the PC fill cycle. Nominal flow rates are ~ 18−20 cc/min per chamber. If the flow rate changes by > 5cc/min this is "of interest", and the level of "action" is if a chamber flow drops to < 3 cc/min then HV TO THAT CHAMBER MUST BE TURNED OFF. If other chamber flows are OK then there is no need to turn those chambers off.

iii) Check that there is a return gas flow rate. Check this by clicking on History, then MFC. Nominal values are DC_Return ~ 0.75 L/min, PC_Return ~ 0.21L/min, PC_Recycle ~ 0.18 L/min, PC_Exhaust ~ 0.04 L/min. These values are approximate, and will change depending on the gas system settings. There should be a return flow (>0.1 for DC and >0.03 PC), otherwise there will be other alarms going off anyways.

iv) Check the flow rates from the Gas Shack. These flows can be checked by clicking on History then Gas Shack. Since the PC's are on a discontinous fill cycle click on 12h so that you can see that they are being filled approximately every three or four hours. Nominal flows for He ~ 1 L/min, and N2 ~ 0.03 L/min. If the ratio of He flow to N2 flow varies from 97.3:2.7 by more than 10% this is "of interest", and if it varies by >40% this is "call in an expert. The PC flow during a fill will have CF4 ~ 0.96 L/min and Isobutane ~ 0.24 L/min so that the ratio of CF4:Isobutane is 80:20. If the mix ratio is off by > 5% this is "of interest", and if the mix is off by > 10% then there is need for "action". The rate of fills is about once every four hours, if the rate changes by > 20% email Robert (make sure you just didn't lose the history for DAQ reasons though).

v) Check the cital compressor Helium line pressure. This can be found by clicking on History then Cital Compress (Psi). The cital compression gage pressure should be about 48−49 psi. At pressures above about 40 psi the cital columns are fully compressed and we are just see the deflection of the end plates. Above 40 psi the end plates compress by about 2.5 μm/psi.

<u>2) Once Per Eight Hour Shift – Do Gas System Walk Around</u>

Keep your nose and ears alert during the walk around. The first indication of something going wrong could be the smell of a gas leak, or the sound of a gas leak or malfunctioning pump.

i) Go to the gas shack to check flow rates and cylinder masses (DME, and Isobutane) or pressures (He, N2, CF4, and eventually C02). The input and output flow rates for each gas can be read from the black Pyrex balls. These flow measurements are pressure dependent, so will only tell you whether the input and output flows are approximately equal. In general it looks like the return flow is greater than the input flow because of the pressure differences. If the return flow drops below half the input flow, then there is reason to call for extra help. The flow rate of the CF4/Isobutane can change dramatically, depending on whether a fill is being done at the moment. In general there are two cylinders for each gas, the "in use" or primary cylinder, and the "backup" or secondary cylinder. The primary cylinder will usually be labelled as "in use". If it is not labelled, assume that the "front" cylinder is the primary. The mass of the cylinders is found by adding the readings from the two scales in pounds.

ii) Go to the gas shack alarm box. Be careful not to toggle any of the metal switches, it could be easy to catch a sleeve on one of the switches. Do not check the flows from here anymore, this could cause excessive wear on the controller. Instead you can check the flows from history, and here just check that the relevant gases have green or yellow lights. A yellow light is not critical, it just means that gas is coming from the backup cylinder. If we are down to just one bottle (yellow) for one non–weekend day, then notify a gas system expert. If there is a red light then there is need for "action".

iii) Go down to the Meson hall beam floor. Smell around on either end of the gas racks for any gas leaks. Check that the gas bubblers are not bubbling. Listen to hear that the pumps are operating at a normal rate and are not struggling. If one of the bubblers is bubbling, then turn off the HV, and call in a gas system expert.