

Leakage test of straw tube detector modules

1 Equipment

Gas leaks in the detector module box allow impurities to enter the counting gas of the straw tube detectors. These impurities may lead to a degradation of the detector performance during operation. To keep impurities at an acceptable level the detector leak rate must not exceed a certain level. The test procedure for detector modules is described below: The test set-up is shown in figure 1. The components used are:

- The gas used should be Argon, CO₂ or a mixture of these two gases.
- As flow meter a rotameter with a full range of approximately 1l/min should be used.
- A differential pressure gauge with a maximum range of ≈ 100 mbar is used. Recommended is model 223B by the company MKS. See <http://www.mksinst.com/cgi-bin/product.exe?pid=223B>
- The valves can be simple mechanical valves.
- To search for gas leaks, a sniffer to the gas used is needed. Recommended is the model Q196 by Ai Qualitek, see <http://www.ai-leaktest.com/frame-meltron.htm>. It is sensitive to Argon and CO₂.

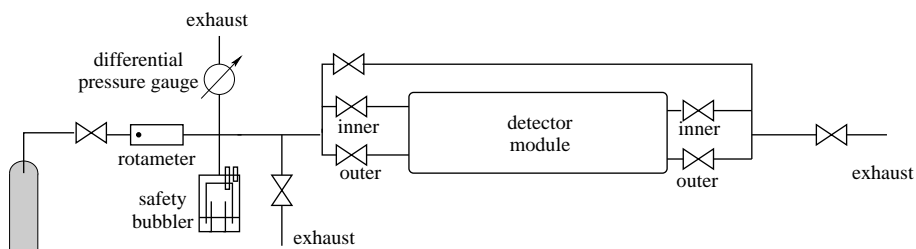


Figure 1: Set-up to measure leak rates of straw tubes.

2 Procedure of the leakage test

Step 1: Blind test

Before starting the leak rate measurement for the detector module, a blind test is mandatory to make sure that the measurement is not spoiled by gas leaks in the set-up:

- Adjust the settings of the valves as shown in figure 2.
- Fill the set-up with gas up to an overpressure of $10\text{mbar} \pm 2\text{mbar}$.
- Close inlet valve.
- Wait about one minute.
- Log overpressure.
- Wait for two minutes.
- Log overpressure.
- If the pressure difference does exceed 1 mbar gas leaks in the set-up have to be fixed. In that case:
- Search for gas leaks by means of the sniffer.
- Fix the gas leaks.
- Repeat the blind test until the pressure drop over two minutes does not exceed 1 mbar.

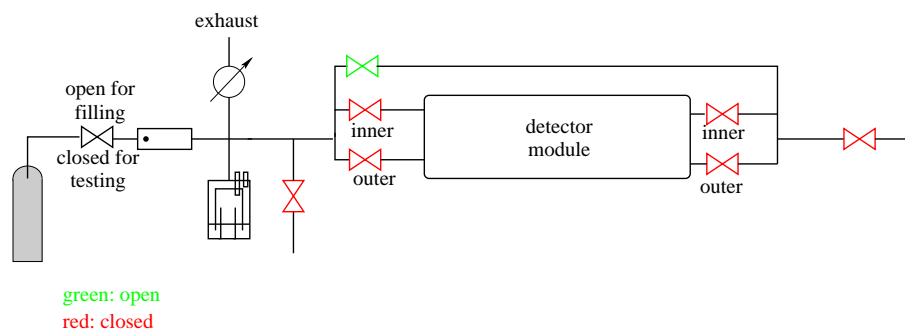


Figure 2: Settings of valves for blind test.

Step 2: Leak rate measurement

- Adjust the settings of the valves as shown in figure 3.
- Fill the set-up with gas up to an overpressure of $5\text{mbar} \pm 1\text{mbar}$.
THE FILLING OF THE DETECTOR MODULE SHOULD BE DONE SLOWLY ($\approx 0.5\text{mbar/s}$) TO AVOID DAMAGE OF THE DETECTOR MODULE!
- Close inlet valve.
- Wait about one minute.
- Log overpressure.
- Wait for one minute.
- Log overpressure.
- If the pressure difference does exceed 1 mbar gas leaks in the set-up have to be fixed. This pressure drop corresponds to a loss of 1.2% of the detector volume per hour under LHCb running conditions¹. In that case:
 - Search for gas leaks by means of the sniffer.
 - Repair the gas leaks as described under step 3.
 - Repeat the leak test for the detector module (step 2) until the pressure drop over one minute does not exceed 1mbar.

¹assuming an overpressure of 1 mbar in the detector, as foreseen for the OT gas system.

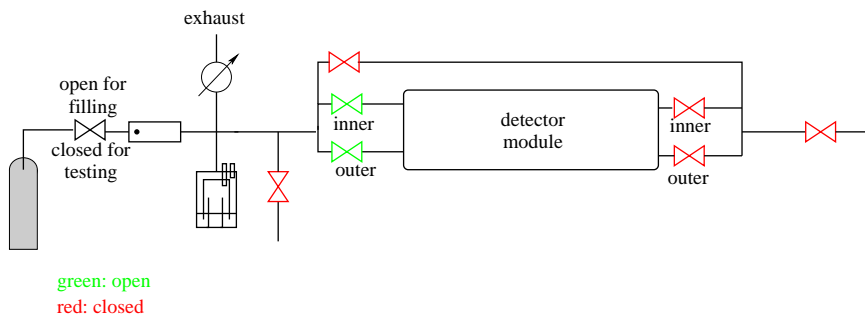


Figure 3: Settings of valves for leak rate measurements.

Step 3: Sealing of leaks

Leaks found in the detector module have to be sealed by means of *Araldite AY103 + HY991* or Torr Seal. For the mixing of Araldite see instruction note *Preparation of Araldite AY103*. The curing time of the Araldite is 12 hours at room temperature.

DURING CURING OF THE GLUE ANY MOVEMENTS OF THE DETECTOR MODULE MUST BE AVOIDED!