



Pressure drop calculation for the straw tube module of the LHCb outer tracking system

1 Description of the problem

In the LHCb outer tracking system the straw tube modules are supplied by two separate gas lines. One gas line distributes the straw tubes itself by the counting gas, the second line flushes the envelope volume. The pressure drop across the module will be determined by gas pipes at the module entrance and exit.

Based on the calculator available

http://lhcxp.web.cern.ch/LHCExp/GasWG/standard/p_drop.htm

the pressure drop for various scenarios of the gas supply is calculated. The calculations are based on the following parameters:

The total module dimensions are 50 cm length, 34 cm width and 1.07 cm height, resulting in a volume of 18.19 l. Out of this volume the straw tube volume is 12.56 l ($256 \text{ straws} \times 2.5 \text{ m} \times \pi \times 2.5 \text{ mm}^2$). The envelope volume is therefore equal to 5.63 l. The pressure drop depends on the number of input/output gas pipes, their length and their diameter, as well as the number of gas exchanges. The length is subsequently assumed to be 10 cm. Table 1 and Table 2 show the pressure drop expected for different numbers and diameters of the input/output gas pipes for the straw tube volume and the envelope volume. As exchange rate one volume exchange per hour and one volume exchange every two hours are assumed.

# pipes	diameter [mm]	Volume [l]	# exchanges / hour	Δp [mbar]
1	1	5.63	1	2.52
2	1	5.63	1	1.26
3	1	5.63	1	0.84
4	1	5.63	1	0.63
1	2	5.63	1	0.16
2	2	5.63	1	0.08
3	2	5.63	1	0.05
4	2	5.63	1	0.04
1	1	5.63	0.5	1.26
2	1	5.63	0.5	0.63
3	1	5.63	0.5	0.42
4	1	5.63	0.5	0.31
1	2	5.63	0.5	0.08
2	2	5.63	0.5	0.04
3	2	5.63	0.5	0.03
4	2	5.63	0.5	0.02

Table 1: Pressure drop for envelope volume.

# pipes	diameter [mm]	Volume [l]	# exchanges / hour	Δp [mbar]
1	1	12.56	1	5.61
2	1	12.56	1	2.81
3	1	12.56	1	1.87
4	1	12.56	1	1.40
1	2	12.56	1	0.35
2	2	12.56	1	0.18
3	2	12.56	1	0.12
4	2	12.56	1	0.09
1	1	12.56	0.5	2.81
2	1	12.56	0.5	1.40
3	1	12.56	0.5	0.93
4	1	12.56	0.5	0.70
1	2	12.56	0.5	0.18
2	2	12.56	0.5	0.09
3	2	12.56	0.5	0.06
4	2	12.56	0.5	0.04

Table 2: Pressure drop for straw tube volume.