Gas Leak Study of Low Threshold Cerenkov Counter

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Because of the need to fill the Low Threshold Cerenkov Counter (LTCC) sectors frequently with gas, a gas leak was suspected, and a study conducted.

Each LTCC sector holds 7200 liter (80 kg) of C_4F_{10} gas. It is important to know the C_4F_{10} gas usage rate for the LTCC detector due to the cost of the gas. For the upcoming engineering run, Hall B plans to use the gas on hand (150 kg) in one sector only. This study was conducted to find the most leak-tight sector.

For the study, the Detector Support Group continuously monitored the controls sensors and transducer of the LTCC sectors from 4/25/17 to 6/12/17. The gas system used only the supply side of the gas panel, all six manual valves to the exhaust manifold were closed, and over and under pressure protections were handled by the bubblers on each sector. The gas used was N_2.

A schematic of the gas controls instrumentation is shown in Fig. 1. From the Hall B supply, gas flows through an MKS GE50a mass flow controller to a normally-closed solenoid. When a Dwyer Magnehelic differential pressure transducer registers a gas pressure <1.2 InWC, it sends a signal to open the solenoid via an Omega DP25a process controller. When the pressure reaches 1.4 InWC, the solenoid is closed. The pressure read by the Magnehelic is continuously recorded by the cRIO system, also via the DP25a.

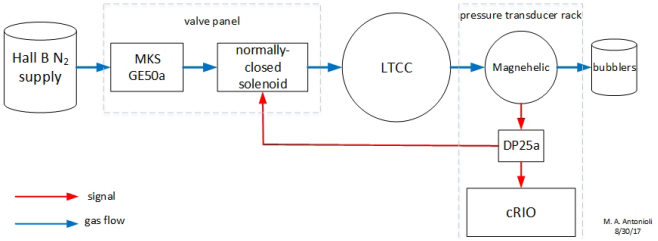

FIG 1. Gas controls instrumentation.

Pressure, flow, and ambient pressure data were recorded, imported into an Excel file, and graphed. Additionally, the mass flow controllers automatically recorded the flow volume.

The study showed that all sectors leak. The sectors which leak less (2, 4, and 5) can maintain pressure while ambient pressure is flat or falling. An increase in ambient pressure results in a higher leakage rate as gas is squeezed out of the detector by the flexible, large, area windows.

During a period of no N_2 flow, the ambient pressure was stable, Fig. 2. Sectors 2, 4, and 5 were able to maintain pressure over a longer period of time, while 1, 3, and 6 decayed at a faster rate. Table I lists the sector order of leakage, best to worst, and their corresponding average daily leak rate.

Sector	Leakage rate [l/m]
2	38.63
5	45.29
4	52.25
1	96.58
3	123.42
6	160.36

TABLE I. Sectors ranked by leakage rate, best to worst.

Based on this study, LTCC sector 2 leaks the least.

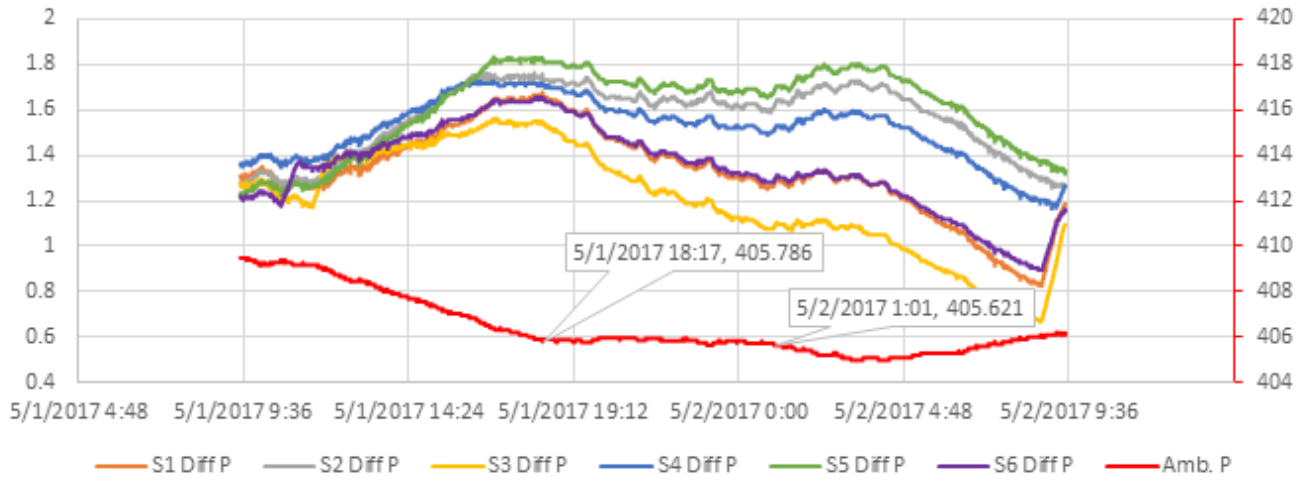

FIG 2. Pressures of six LTCC sectors and ambient pressure, with no gas flow.