Proposed Compressor for Air Cooling Two RICH Detectors

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To remove ~600 W heat generated by the electronics located in the electronics panel, the RICH detector currently in operation requires significantly more air flow for cooling than was originally estimated. This note proposes a new compressor capable of providing more than adequate airflow for simultaneously cooling two such detectors.

The RICH detector, currently in operation, requires more air flow (740 SLPM) for cooling than was originally estimated (300 SLPM) because the FPGA boards dissipate more power than anticipated, and the power and signal cables inside the electronics panel obstruct airflow in some regions.

The Atlas Copco compressor (SF11) in use has a 50% duty cycle, a maximum airflow of 1200 SLPM, and supplies air with a dew point of 38° F (up to 2000 ppm water concentration).

The downside of having a high dew point in the air supply is that if the nitrogen flow, which keeps the humidity in the Aerogel volume below 3%, were to be reduced or were to cease, moisture would enter the Aerogel volume, thereby increasing the humidity and degrading the Aerogel's performance; such an incidence has occurred, despite interlocks, due to operator error. A lower dew point would be advantageous, in that, the humidity rise in the Aerogel volume would take longer, providing more time to address such an incident.

Compressors that provide higher airflow (greater than 1600 SLPM) and lower dew point (less than 38° F) were researched. Of the several compressors with 100% duty cycles that were identified, the Atlas Copco ZT 18-10 unit with the integrated rotary drum dryer meets all requirements.

The ZT 18-10's integrated rotary drum dryer supplies cooling air at a dew point of -22 F; at this dew point the water concentration decreases to 378 ppm. The air flow rate of the unit is 2232 SLPM, more than adequate for air-cooling two detectors. The 10 bar working pressure minimizes air flow fluctuations across the downstream pressure regulator and flow meter when the compressor cycles. Power (three-phase 480 V, 18 kW/25 hp) is required for the unit. ZT 18 series compressor, Fig. 1, measures 70"x 40"x 64", larger than the dimensions of the current location of 64"x 30"x 49". Therefore an alternate location or modification of the current location is required. The cost of the compressor is ~$50,000.

Of the two current air compressors, one will be needed to supply air for testing the next RICH sector in the EEL clean room, the other would be a spare.

In conclusion, the ZT 18-10 unit is strongly recommended to air cool two RICH detectors.

FIG. 1. ZT 18-10 compressor.