Note on Vertical Test Results of Cavity TE1ACC002-3

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Cavity TE1ACC002, a single-cell Tesla-shape cavity manufactured by ACCEL was initially tested at the Fermilab VCTF on 2/4/09 and 2/24/09. Results from these tests indicated that the cavity was limited at first (2/4/09) by strong field emission, beginning at about 21.5MV/m, only reaching 33 MV/m, and then (2/24/09) was limited by strong Q-drop at essentially the same gradient (though it was FE-free as a consequence of additional HPR). It was felt, therefore, that this cavity would be a good candidate for a 120º C bake, which would likely reduce or eliminate the Q-drop, and potentially lead to improved cavity performance.

After the 2/24/09 vertical test at FNAL, the cavity was removed from the test stand, and baked out a 120° C for 48hours at the A0 facility, with active vacuum pumping maintained throughout the bakeout cycle. The cavity was then transported back to the VCTF at IB1, where it was mounted on the test stand (w/o connection to the pumping system, which was being used on cavity TE1ACC001) and instrumented with 2 8-sensor bands of Cernox sensors as part of the Fast Thermometry System.

The cavity was cooled down to 2.00K and CW measurements of Q_0 vs E were performed Since this cavity was part of a two-single-cell test configuration along with cavity TE1ACC001, Q_0 vs T data were not taken in order to take advantage of the efficiency provided by testing two cavities in a single cooldown. Low field Q_0 was found to be about 1.9×10^{10}, decreasing gradually as field increased. No radiation due to field emission or multipacting was observed, and the cavity reached a maximum gradient of 37.1 MV/m where it was limited by quench (see Figure 1).

From field levels of about 30MV/m (corresponding to an input power of about 11-12W) and higher, the cavity field was unstable due to suspected He discharge/breakdown in the input cable connector at the cavity. This is most likely due to the lack of venting holes in the 7/16 right-angle adapter used to couple the second RF input cable of the test stand (previously unused) to the cavity input coupler. This can be easily remedied before the next tandem single-cell test (based on the low power levels present (P_{input} never exceeded 41W) cable damage is not expected). Due to this instability, measurement of Q_0 at the highest gradients showed significant scatter; however by allowing the input cable connectors to cool, and then taking a single measurement at high gradient (> 33MV/m), reasonable measurements of Q_0 were obtained in this region (only these measurements are shown in Figure 1). The cavity Q_0 at maximum gradient appeared to still be ~1.1×10^{10}. As a result of the 120°C bake, the previously observed Q-drop was eliminated (see Figure 2), and the cavity easily met the ILC specification.

It was difficult to stably operate the cavity at the quench field, due to the connector heating; however a few scans using the FTS were performed. Initial results indicated that heating could be observed on sensors #2 and #5 on band #2. These sensors are located

~135° apart azimuthally. Sensor #2 exhibited a “typical” quench spike without any pre-quench heating, while sensor #5 showed significant heating (related to increasing cavity field) without a quench spike. The cause of the difference in behaviour between these two sensors is not clear. It has been suggested that the full diode thermometry array be installed on this cavity during its next test, in order to more fully map its thermal behaviour at high fields[1].

(1) D. Sergatskov, private communication

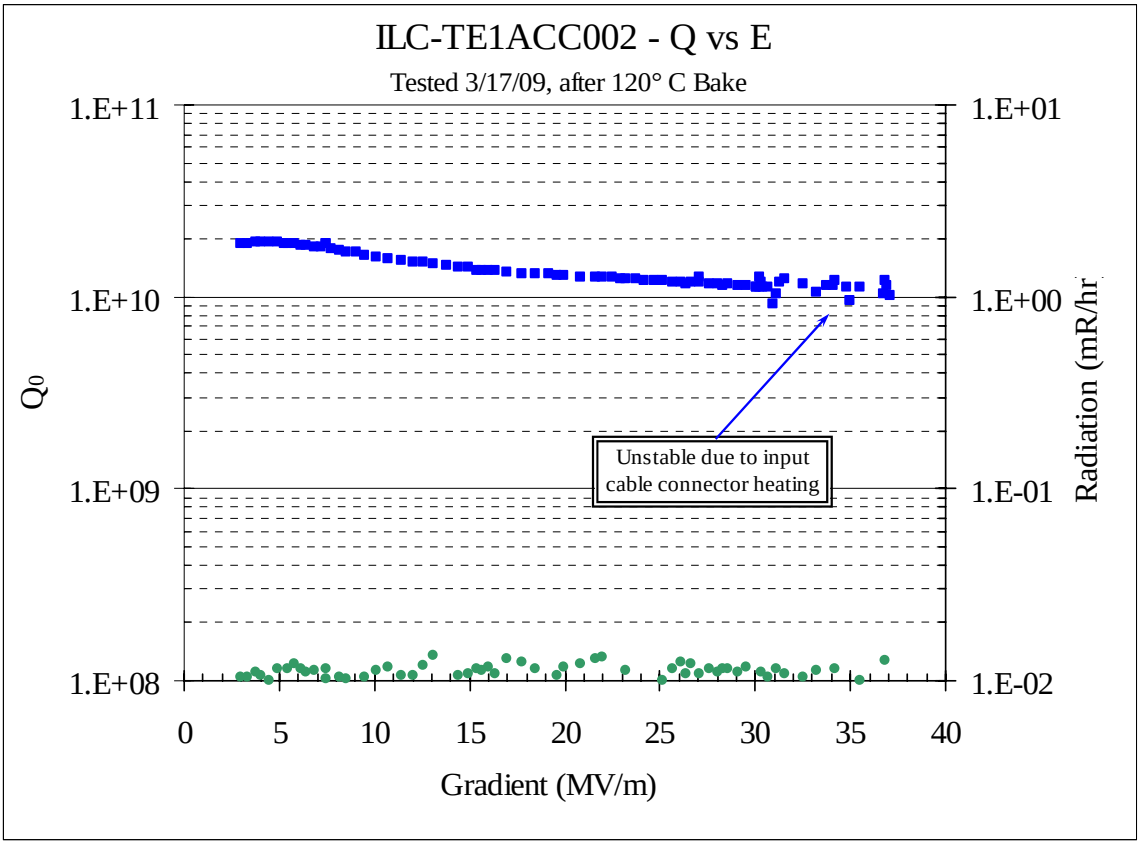

Figure 1.) Q_0 vs E run at 2K

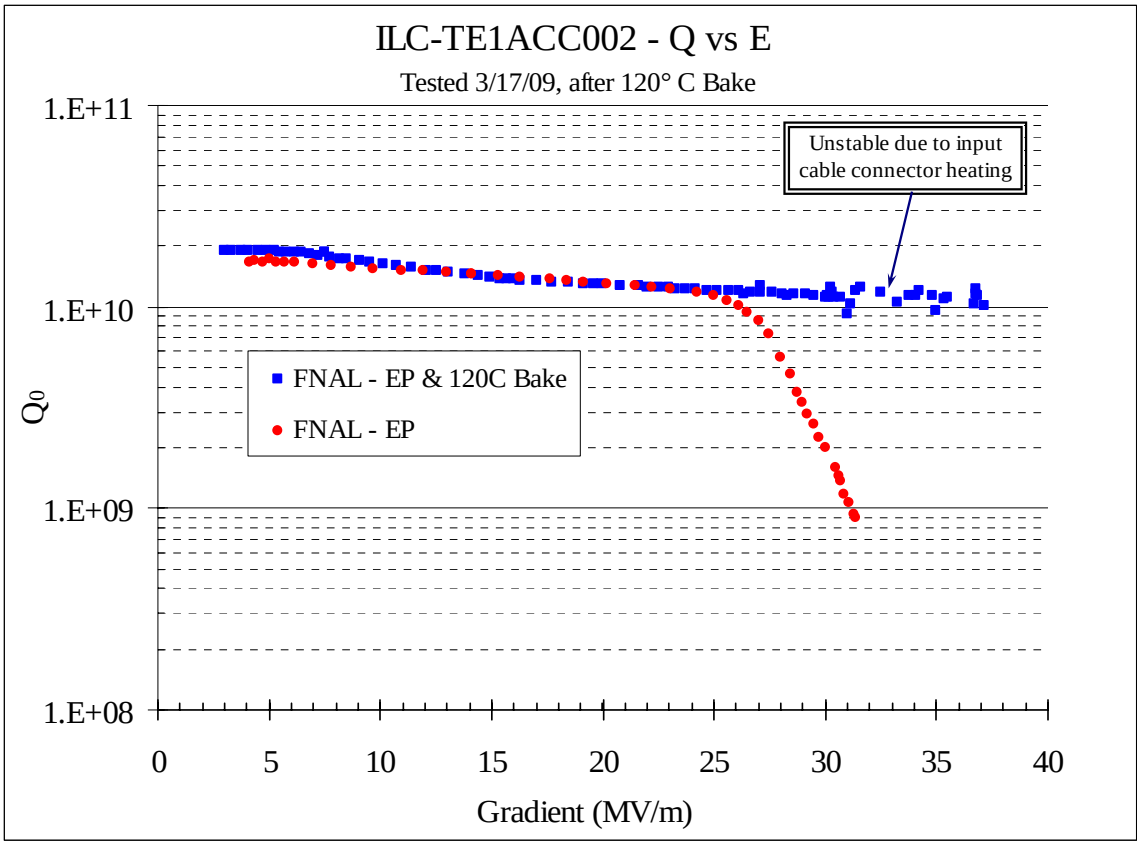

Figure 2.) Comparison of latest and previous Q_0 vs E runs at 2K, after the 120° C bake.