D-ZERO LIQUID LEVEL GAUGE SENSOR INVESTIGATION

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D-ZERO ENGINEERING NOTE 3740.000-EN-137

APPROVED: G. T. Mulholland 5/19/88

INTRODUCTION: This report describes the efforts and results of finding the most practical sensing element for use in a liquid argon level gauge. The following criteria will be weighed and a choice made on that basis :

A. Most notable liquid to gas and gas to liquid voltage changes at constant current.
B. Long-term reliability -ie. least % change in voltage indication.
C. Speed of response between the two phases in both directions.
D. Cost to the extent significant.

SENSORS CONSIDERED: Various sensing elements were considered for the job of LAr level sensing. In no order, they are:

1) LN914 Signal Diodes
2) Green L.E.D.s (HPLM 1500)
3) Red L.E.D.s (HPLM 1300)
4) 100KΩ Thermistor
5) 30KΩ Thermistor
6) Alpha 13L240 Thermistor

SENSOR TESTING PROCEDURE:

All of the above sensors were tested by the setup shown in appendix 1. A H.P. model 6920B was used as a constant current source and a Fluke 8060A Digital Voltage Meter was used for voltage measurements. Liquid Argon was used for all testing.

A. Initially, room temperature voltage/resistance measurements were taken on each sensor.

B. The voltage of each sensor was then measured while submerged in the liquid and recorded on a chart recorder.

C. The sensor was then raised into the gas above the liquid, and the chart recorder was allowed to record the voltage vs. time. (liquid to gas

response)

SENSOR TESTING PROCEDURE (CON'T):

D. After the curve leveled out, the sensor was lowered back into the liquid and the chart recorder then measured the gas to liquid response.

E. The value of the current was then changed, and steps B, C, and D. above were repeated.

F. Final room temperature resistance information was taken for each sensor to detect any permanent change.

The results of this testing are shown in the attached appendix. Note that all testing was done by Mike Hentges group and the original data can be found there.

CONCLUSION: At the time of this report, speed of response testing was still in progress. Appendix 1 will include the test results, a diagram of the setup, and the finished version of the attached V(liquid)/V(gas) vs. I(drive) graph. Also, specifications for each sensor where possible will be attached. If cost becomes an important criteria it will be appended.

D-0
Liquid Level Gauge
Sensor
Investigation
Appendix-A

R.T. Krasa

3/24/88

D-Zero Engineering Note 3470.000-EN-137-A

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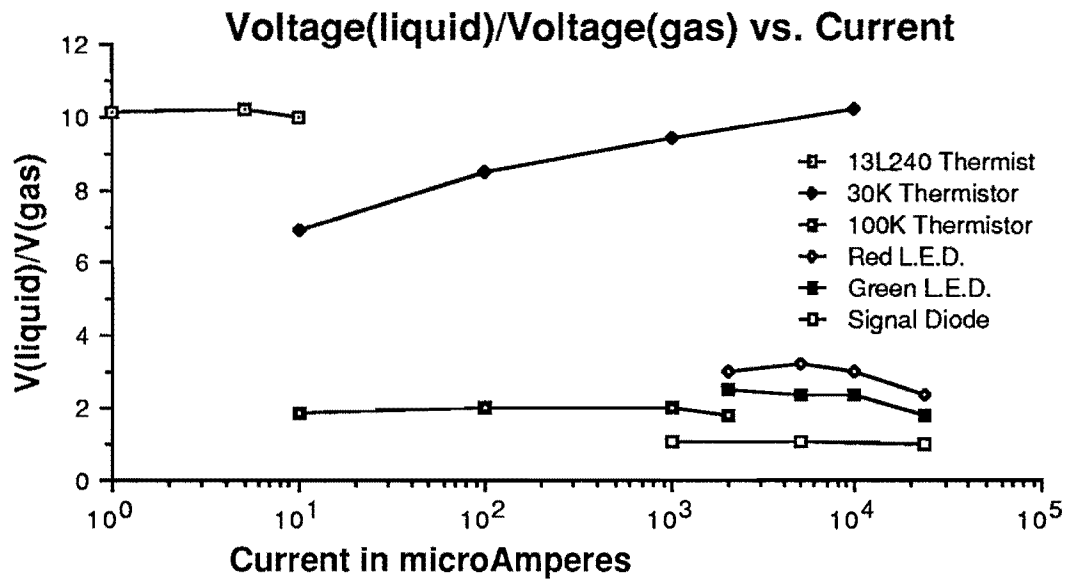
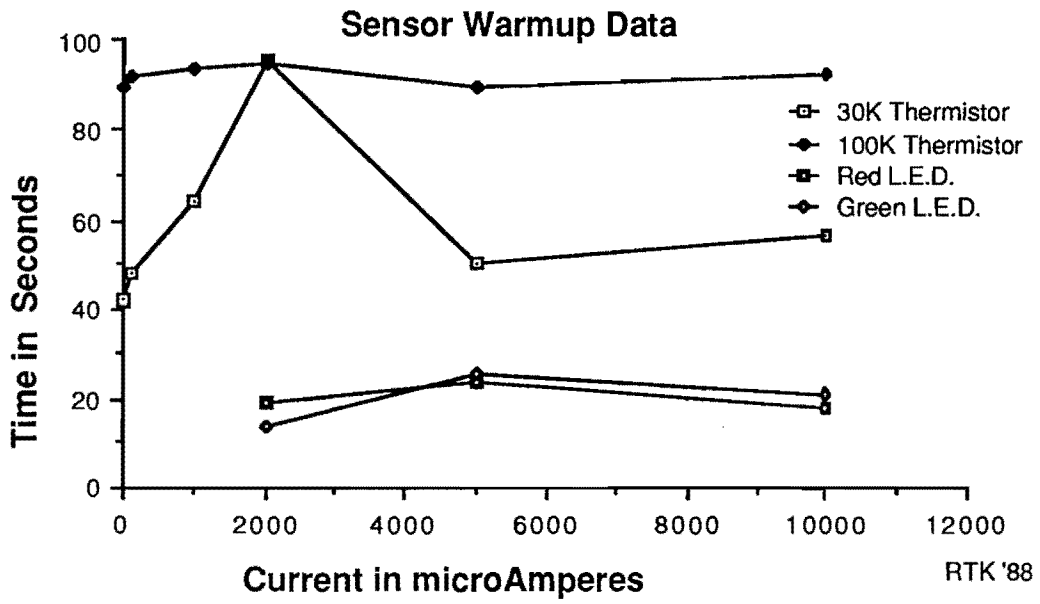
Preface:

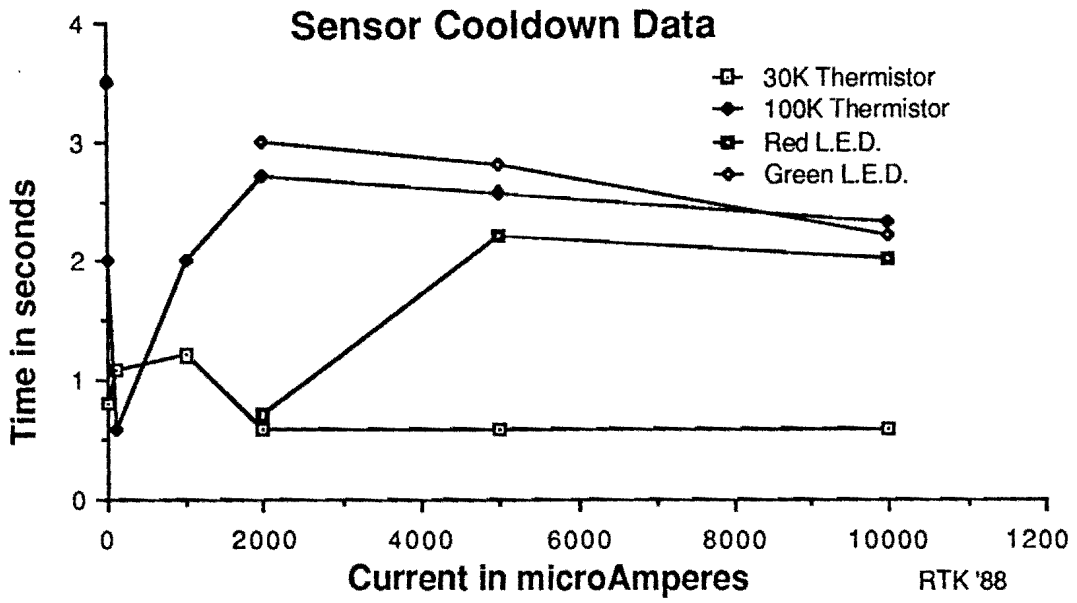
The following contains test results of tests described in EN-137 as well as a synopsis of conclusions made throughout the sensor selection process.

Preliminary Test Results:

The forestated sensing elements were tested for Voltage(liquid)/Voltage (gas) vs. Current(constant), as well as warmup and cool down time response. Test results appear below.



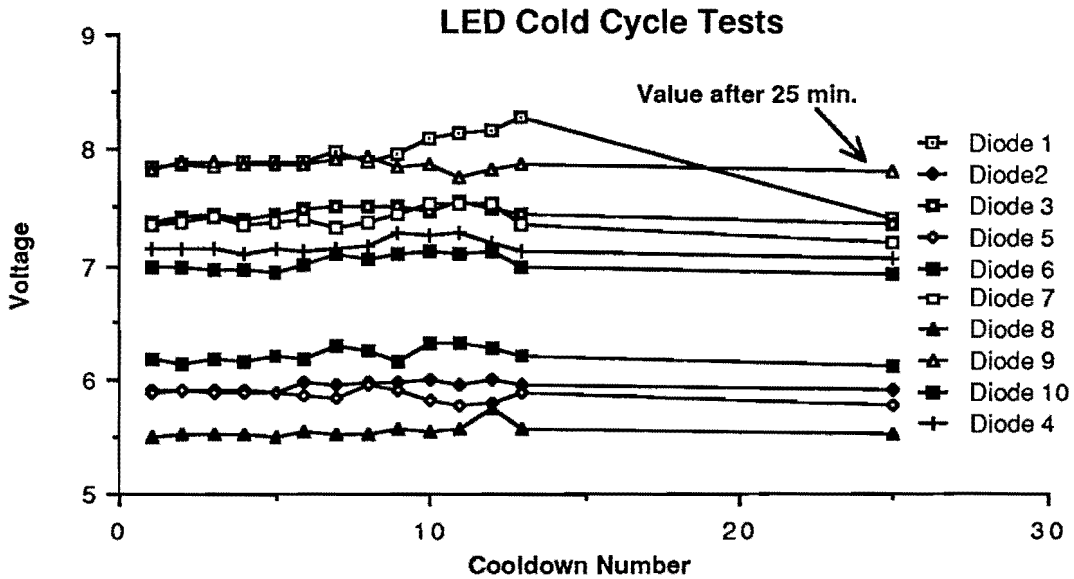




The above graphs aided in the qualifying or disqualifying of the various sensors for further test.

Preliminary Status	Sensor Type	Reasoning
Disqualified	134L240 Thermistor	too fragile
Disqualified	30K Thermistor	long response time
Disqualified	100K Thermistor	long response time
Qualified	Red L.E.D.	best response time,good voltage ratio
Qualified	Green L.E.D.	2nd best response time,good voltage ratio
Disqualified	Signal Diode	smaller voltage ratio

Due to a large difference in warmup time, only the two L.E.D.'s qualified for further testing. Ten randomly selected L.E.D.'s tested for Voltage(liquid) and Voltage(gas) gave the following results.



Initially, voltage appeared to increase with the number of cycles. However, further tests revealed that after immersion, if the sensor was allowed to stablize for a period of time, the voltage settles to a closer to average value. Subsequent longevity tests in liquid Nitrogen revealed no negative ageing affects.

Conclusions:

Red L.E.D.'s possess a notable gas/liquid liquid/gas voltage change, relatively fast response, and have demonstrated reliable behavior in testing. They have the highest overall level gauge performance of the sensors tested. Therefore, red L.E.D.'s will be used as the sensing elements for the fill level and operating level gages in the cryostats. Sensors for the final probes will be selected carefully after cold cycling, since sensor working voltages at constant current differ from batch to batch as is evident in the above graph.