TELEDYNE
INSTRUMENTS
Analytical Instruments
A Teledyne Technologies Company

DATE: 7-7-03

FROM: Michael Gonzalez

CONTROL NOs.: 32579, 33927

SUBJECT: Failure Analysis Report of Returned R22-2BUD Sensors

INTRODUCTION:

The purpose was to evaluate and then determine root cause of failure on returned R22-2BUD sensors. Sensors were returned by Vandagraph due to various reasons from no and low outputs to erratic behavior under pressure (Control Nos. 32579 and 33927).

METHOD:

The first batch of sensors (48) were tested on the ATS unit, 12 of 48 sensors gave 0.0 mV or very low output readings. After removing from the ATS unit, the air outputs of these 12 sensors were taken. Two (2) sensors read 9.7 & 11.0 mV and these readings were within specification. The other 10 sensors still gave 0.0 mV or very low (1.7 mV) outputs. Before removing the pcb assemblies from all sensors, plus (+) and negative (-) solder connections to the pcb assemblies were inspected. The solder connections on 10 sensors were sub-standard - not to IPC 610 standard.

Next, the side wire welds to the 2 side sealing cylinders were checked. The wires on 3 of the 12 sensors had being reattached after breaking off. Here, the wires were reconnected by re-soldering back onto the cylinders. Cylinders on the 3 sensors were tested to see if there was current flow. Here, the meter leads were connected directly on the cylinders - all 3 sensors had current flowing at this point (all were >100 uA). Finally, the front Zytex and clamp rings were removed to inspect condition of the sensing membrane and heat-seals. Ten (10) of the 12 sensors has bad seals – wrinkles on the membrane were seen (on the heat-sealed area around the cathode OD). In most cases, the cathodes were lifted on one side above the cell body groove. Here, the cathodes were seated in place inside the front cell body groove (Evaluation data in summarized in Table 1).

In the second batch, 8 sensors that were returned due erratic behavior during pressure testing were selected. These sensors were insert inside a pressure bomb where the pressure was increased from 1.0 to 1.3 atm (sample gas was 100% oxygen). Six (6) sensors generated an occasion spike at 1.3 atm pressure. The pressure bomb was tapped on the outside to see if the spike increased. On all occasions the spiking increased. After removing sensors from the bomb, the pcb assemblies, side weld wires and sensing membrane were inspected. Six (6) of the 8 solder connections on 10 sensors were sub-standard - not to IPC 610 standard. The side welds on all sealing cylinders were good (no re-soldering seen). Three (3) sensing membrane were leaking electrolyte and 5 of the 8 cathodes were lifted on once side. Again, the cathodes were seated in place inside the front cell body groove thus lifting was seen (Evaluation data in summarized in Table 2).

In the third batch, 2 recently date sensors, which were returned due to outputs, were selected (Date Code D3). These sensors were not pressure tested but the pcb assemblies; side weld wires and sensing membrane were thoroughly inspected. Here, in both cases, cathode were lifted on once side. Again, the cathodes were seated in place inside the front cell body groove thus lifting was seen (Evaluation data in summarized in Table 1).

EQUIPMENT AND MATERIAL:

- Automatic Testing System, ATS (SEN 99)
- Fluke digital multimeter (2), Model 8020A (CC06808 & CC23741)
- Linseis recorder, Model L6514B (SN 2015/92)
- Digital pressure gauge, Druck Inc. Model DPI 282
- 100% Oxygen gas

RESULTS: