CCIW

HYDRAULICS RESEARCH DIVISION

Technical Note

DATE: 3 October 1977

REPORT NO: 77-14
(Study No. H77 049)

TITLE: "Temperature Stress Test and Evaluation of an OTT Potentiometric Punch Paper Tape Recorder."

AUTHOR: W. Moody

TESTING ASSISTANCE: F. Dunnett, G. Voros, D. Fekyt and A. Roncari

REASON FOR REPORT: To comply with a request from W.S.C., Water Resources Branch, P. O. Box 365, Halifax, Nova Scotia B3J 2P8.

CORRESPONDENCE FILE NO: 1324-2

PURPOSE

To evaluate the capability of an OTT Punched-Tape Water Level Recorder to operate in a cold environment.

SPECIFICATIONS

1. OTT Punched-Tape Water Level Recorder Model IMS 117, Serial No. 002.
2. Stainless steel encased, silicone fluid filled, neoprene diaphragm pressure transducer.
3. Thirty-Five meters of three conductor CGE Type S 600V 14/3 signal cable c/w one three pin male Bronco 66 waterproof connector and one three pin male Cannon connector.

PROCEDURE

1. The recorder and associated equipment was received at CCIW where a visual inspection produced the following notes:
   - the punched-paper chad tray had been knocked of its hanger and was rattling around loose inside the recorder.
   - the signal cable was not assembled and would require splicing connectors onto each end.
   - no operating instructions, schematic diagrams or manuals were included.
   - one signal lead on the clock had broken loose.
   - the rear door, when closed over the gearbox, pressed against the servomotor terminals causing them to bend and become loose.
   - the nicad batteries which were installed were dated 1970 and were discharged.
2. Assembly and operating instructions were obtained from W.S.C. Halifax.
3. The chad tray was replaced on its hanger and secured.
4. The broken signal wire on the clock was repaired.
5. The recorder to sensor signal cable was assembled. This involved sorting out inconsistent colour coding of the cable and connectors as related to the instructions given in the manual and then splicing connectors onto the cable.
6. On May 19, 1977 an unsuccessful attempt was made to recharge the existing nicad batteries. A second set of nicad batteries was obtained in June 1977 from W.S.C. This set, also dated 1970, could not be charged to a large enough capacity to properly operate the recorder. A third battery, dated 1973, was obtained the following week on loan from a local source but was also inadequate. A carbon zinc battery unit was put together in our own laboratory to produce enough power to operate this recorder.
7. All connectors, the waterproof end of the signal cable, sensor diaphragm and the silicone fluid were checked and the sensor lowered into a tank of water.
8. The recorder was turned on and a test run made with the transducer being moved to different levels in the tank. Punched-tape recordings and intense visual observations were made during this test.
9. A modification was made to the servomotor mount to eliminate its excess motion and to retain its alignment with the gearbox.

10. The gearbox/motor unit was removed from the recorder, placed in waterproof plastic bags and immersed in dry ice, water and 10% methanol where a -3°C temperature was obtained. The unit was run under these conditions for one hour.

11. The equipment was then reassembled and the following tests run using the environmental chamber:

Note: The punched-tape recording interval is 15 minutes.

(a) Complete recorder unit and third nicad battery set was placed in the chamber at approximately 24°C and the chamber temperature reduced gradually to -5°C while a punched-tape recording was taken over an eight hour period.

(b) Complete recorder unit and nicad battery set was left in the chamber at +7°C for approximately 24 hours with a recording being made.

(c) The nicad battery set was placed outside the chamber at approximately 24°C and the rest of the recorder unit left inside the chamber at −5°C while a recording was made over a 24 hour period.

(d) The carbon zinc battery set was placed outside the chamber at approximately 24°C and the rest of the recorder unit left inside the chamber at -5°C for 24 hours while a recording was being made.

RESULTS

1. The recorder, which was received in an inoperable condition, has been repaired to an operable condition.
2. The effective depth of the threaded servomotor mounting screws was increased from 0.5 mm to 1.5 mm resulting in the elimination of motor misalignment and excess motion.
3. The test described in "10" of the "Procedures" section of this report showed that the gearbox/motor unit would operate with no sluggishness or other malfunction in a sub-freezing environment.
4. Some intermittent action by the clock was noted during the tests. This resulted in a loss of data with no means of determining when the loss occurred.
5. The tests performed in the environmental chamber as described in "11" of the "Procedures" section of this report, plus test runs at room temperature, produced the following results:

   Room Temperature - the recorder showed no loss of data and was sensitive to changes in water levels as the manufacturer specifies.

   11 (a) - the recorder began to fail at approximately +10°C.

   11 (b) - the recorder produced only 76% of the possible data in this 24 hour test.

   11 (c) - the recorder produced less than 25% of the possible data in this 24 hour test.

   11 (d) - the recorder produced 50% of the possible data in this 24 hour test. At the conclusion of this test it was found that the recorder was producing no data whatsoever in its automatic mode and only occasional data when the manual test trigger was activated.

CONCLUSIONS

1. The design of this punch paper tape recorder is not suitable for use in any harsh environment or where rapid response to changes is required.
2. The following suggested changes would improve the capability of this recorder. However, the time and costs to make such changes are not known and the resulting improved performance would have to be tested.
   - replace existing drive belts with belts made of a material not sensitive to temperature changes.
   - secure the battery housing.
   - make a more positive connection between shafts and gears to prevent slippage, to increase the reliability of calibrations and data collection.
   - replace door gaskets to obtain a waterproof and airtight seal.
   - insulate the instrument case and install a heater element to maintain a constant temperature inside the recorder.
   - install some type of protection for the transducer diaphragm to reduce the possibility of damage from external sources.
   - replace all open circuitry, relays etc. with environment proof items to avoid contamination from moisture, dirt, ice,salt, etc.
   - change the layout of components to prevent damage caused by tight confinement e.g. door closing on servomotor terminals.