SEA-BIRD SCIENTIFIC

Advisory on a problem with Kistler Pressure Sensors

10 November 2016

Dear Argo Scientists, float manufacturers, and program managers,

We want to inform you of a problem with Kistler pressure sensors that developed in the spring of this year. As of 10 November Sea-Bird has received no reports of Kistler sensor defects in the field. We would expect extremely few defect occurrences in the field based on the root-cause findings that we summarize below. A sensor defect will have identifiable signatures in field CTD data. This notification is prompted by follow-up questions from float manufacturers and the EuroArgo community.

In June of 2016 we noticed a defect mode in Kistler pressure sensors – a sudden jump shift in the pressure span (the calibration slope of pressure.) In early July we halted shipments of Kistler pressure sensors in CTDs and began an investigation with the collaboration of Kistler. Across our Argo CTD products manufactured between January and July 2016 a total of 19 Kistler sensors out of a total of 195 were discovered to have failed – a 10% rate. None of these identified sensors had left the factory.

Screening of the archived calibration data of 305 CTDs with Kistler sensors manufactured between December 2015 and July 2016 identified an additional two suspect sensors in SBE 41 CTDs shipped to NKE and NOTC. Subsequently, NKE found a third confirmed failure. None of these CTDs had been deployed and we asked that they be returned to Sea-Bird for investigation and sensor replacement. In July Kistler implemented an extensive temperature cycling and screening process to their production line and since that time Sea-Bird's independent screening and calibration process has found no additional occurrences of span defect in 302 sensors tested.

The root-cause of the defect, identified by Kistler, is an electrical component in the pressure bridge circuit that becomes disconnected from the circuit board. Temperature cycling of the pressure sensor caused a mechanical separation of materials in the component and electrical disconnection. This was borne out by a separate analysis at Sea-Bird. We believe that the temperature cycling performed by Kistler and inherent in the repeat CTD calibrations at Sea-Bird is sufficient to make vulnerable parts fail.

The magnitude of the pressure span shift, from the component disconnection, is 1-30 %, pivoting at 0 pressure, and always one sign – resulting in higher reported pressure than actual pressure. For example a defective sensor reporting 1200 dbars at 1000 dbars depth, reports +2 dbars at the ocean surface.

The pressure sensor defect will not cause a float to sink. We believe that float control algorithms will gracefully re-adjust the float profiling range to a shallower depth interval. The effect of pressure error is that all variables will plot incorrectly in pressure space, and calculations involving pressure will be wrong. CTD temperature is correct but computed salinity values will be systematically low of correct (+200 dbar error results in about -0.100 psu salinity error). On-shore calculations of potential temperature and density values will be similarly wrong. The strongest evidence of a Kistler sensor defect in the field will likely be in T-S, Theta-S plots or shifts of plotted variables in pressure or density space.

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We encourage Argo scientists and data managers to review their data from CTDs with Kistler pressure sensors. While we believe we kept affected sensor out of the field by provoking their failure during the routine manufacturing process, there is the possibility that some slipped through this screen. That small possibility is the purpose of this notice,

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