Metrology for MEMS Sensors

During the next 10 years the U.S. Navy is adopting the procurement strategy that will result in a new and improved Fleet for the next 50-80 years: one that can fight and win battles over a longer deployment period. The initial acquisition cost is only 20%-25% of the total ship cost, life cycle support comprising the rest. The cost savings in the next generation of ships, the DD-21, CG-21, CVX, and NSSN, will come from reduced crew sizes and lowered "total cost of ownership". Operational cost reduction goals for the DD-21 and the CVX are 66% and 50%, respectively, when compared to their current day counter-parts, the DDG-51 and CVN-76.

One major initiative in reducing the daily cost of maintenance is the use of Microelectromechanical systems (MEMS) technology to monitor and control ship functions. Two demonstration programs utilizing

MEMS are the Reduced Ship crew through Virtual Presence (RSVP), an FY 99 Advance Technology Demonstration of wireless MEMS technology, and the Boeing demonstration of MEMS for condition based maintenance on the USS Rushmore.

The Integrated Compartment Assessment System (ICAS) is a deploying system that allows remote evaluation of compartment/machinery status. ICAS is dependent on accurate information from remote sensors to correctly assess ship status. Over a long duration, the availability of accurate information is dependent on calibration of the sensors. The Metrology R&D Program has established a test bed to evaluate the long-term measurement reliability issues for MEMS sensors, and develop both analytical and hardware approaches to extend their useful embedded lifetime. Initial results have shown a wide variation of response from identical transducers, with a larger variation between different company's comparable transducers.

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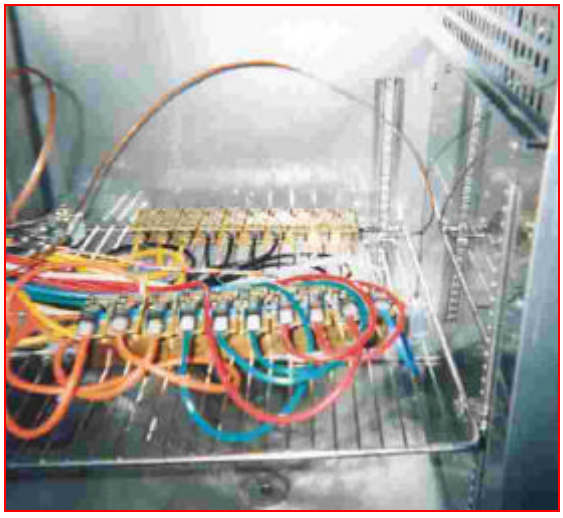

Figure 1

Test bed of MEMS pressure sensors in oven for life cycle testing.