

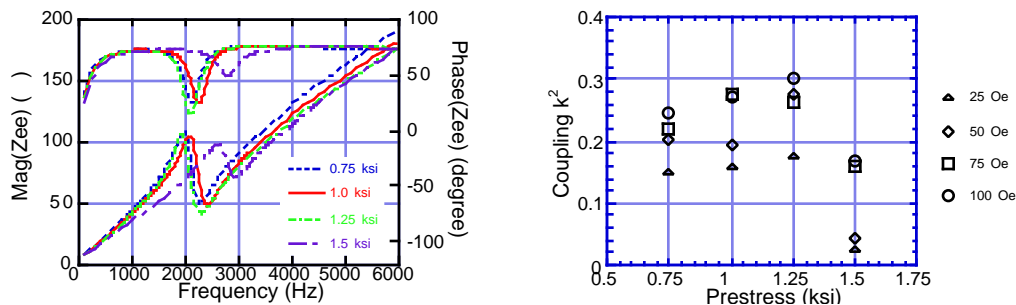
TRANSDUCER BASED TERFENOL-D PROPERTY MEASUREMENT

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Modeling of magnetostrictive Terfenol-D transducer performance requires reliable data on the magnetostrictive element's properties under various operating conditions. Experimental procedures have been developed for characterizing functional trends in properties with varied mechanical prestress, mass load, magnetic bias, and low level AC applied magnetic field. The experimental approach used to determine properties is based on the magnetostrictive constitutive equations, transduction equations, and a lumped parameter mechanical model of the test transducer [Hall, D.L., "Dynamics and vibrations of magnetostrictive transducers," PhD. dissertation, Iowa State University, 1994]. Swept sine measurement of complex electrical impedance and admittance functions and acceleration per unit current at frequencies to above first transducer resonance as loaded are used to evaluate properties of the test transducer and its Terfenol-D element. The presented properties include magnetomechanical coupling factor, elastic modulus, axial strain coefficients, damping, and permeability. These results can be used as input to analytical models and finite element codes for performance prediction under similar *dynamic* operating conditions instead of material property information based on quasi-static Terfenol-D behavior. Additionally, the results provide an empirical guide for use in development and verification of nonlinear models of Terfenol-D performance under varied operating conditions.

Properties are presented from tests of 0.25" (6.35 mm) diameter, 2.02" (51.3 mm) long cylindrical laminated and solid Terfenol-D ($Tb_{0.3}Dy_{0.7}Fe_{1.9}$) samples produced via the free stand zone melt technique. Typical mass loads are eight times the mass of the Terfenol-D element (120 gm). Prestresses vary between 0.5 and 1.75 ksi (3.4 to 12.08 MPa). AC applied magnetic field levels vary from 5 to 100 Oe (0-peak) (0.3 to 8.0 kA/m). A near constant temperature of 20-30°C was maintained during test. Typical electrical impedance function results (below left) illustrate trends with varied prestress for a laminated sample driven at 50 Oe. Magnetomechanical coupling factor is used as an example of typical results, showing trends in Terfenol-D sample properties as both prestress and applied field vary (below right).

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I prefer a poster presentation.