FEA-Based Design Studies for Development of Diaphragm Force Transducers

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Abstract: This paper discussed the finite element analysis (FEA)-based design considerations and its role in finding optimum location of sensing element in diaphragm-based force transducers. The design studies of two diaphragms made of two different materials steel (EN 24) and silicon are discussed as per the analytical expressions available and further validated using FEA for values of deflection, stress and strain of the spring element with appropriate location for fixing of strain gauges so as to get the optimum output in electrical units in mV/V against the applied force. The proposed analytical study in conjunction with finite element analysis shall be indispensable in design and development of diaphragm-based force transducers of optimum electrical output for different industrial applications and also could be used as force transfer standard to disseminate the measurement traceability chain in force measurements throughout the country. The metrological investigation revealed that the measurement uncertainty is 0.06% for steel force transducer and 0.22% for silicon diaphragm force transducer.

Keywords: Strain gauges; FEA; Stress; Strain; Deflection; Traceability; Transducer