Development and Characterization of a Diaphragm-Shaped Force Transducer for Static Force Measurement

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Abstract: There are different types of force transducers, used over the years, comprising of different principles and have different grades of uncertainty. Force transducers may be analog or digital and may be strain gauged, tuning fork type, piezoresistive type, Hall Effect based etc. Though different types of force transducers have been developed in last few decades, still strain gauged force transducers are used over the larger scale due to practical viability and reliability for force measurement. The paper describes low-cost indigenous development of a force transducer, which has been developed for a nominal capacity of 5 kN with ease of design and manufacturing. It has strain gauges applied at suitable locations to form a Wheatstone bridge. The force transducer has been calibrated according to the standard calibration procedures based on ISO 376 and IS 4169 standards. Measurement results and an uncertainty analysis have been presented. The uncertainty of measurement of the force transducer is found up to 0.06%. The paper also discusses the implications of applying multiple strain gauges at a single location in series to enhance the sensitivity of the force transducer. Two strain gauges are arranged in series for the given location and the sensitivity of the force transducer is enhanced. It also indicates that the uncertainty of measurement of the force transducer in such case is enhanced up to 0.05% or better to make force transducer suitable for most of metrological and industrial applications.

Keywords: Force transducer; Diaphragm; Uncertainty of measurement; Metrological characteristics