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Abstract

A hydrostatic weighing system has been designed and developed to measure the density of stainless steel weight. This system has been designed to load four sample weights with nominal mass 20 g to 1 kg. Distilled water is used as reference liquid in this system. The correction of mass value due to gravitational ratio was significant in nominal mass 500 g and 1 kg. The density measurement results at 20 °C have an expanded uncertainty of 3,6 $kg \cdot m^{-3}$ for a nominal mass of 20 g and 0,24 $kg \cdot m^{-3}$ for a nominal mass of 1 kg. The largest component of this uncertainty is due to different balance indication. The results obtained are in accordance with a limit of density value for E1 class weight which is required in OIML R111.

Keywords: density, hydrostatic weighing, weight, OIML

1.Background

Mass is a property of a physical body that is the measure of an object's resistance to acceleration when a net force applied which determines the magnitude of the gravitational force acting on an object. In practice, the mass measurement is done by measuring the magnitude of the force acting on the sensor element in balance, so that the value of the mass that is displayed in the balance essentially represents the magnitude of the gravitational force acting on the object minus the buoyancy force which arises in accordance with Archimedes' law. From these principles, true mass values can only be measured when the value of buoyancy force can be known. Measuring the buoyancy force can only be done when the density of the measured object is known. The primary mass standard is a platinum-iridium cylinder with a density of 21 000 $kg \cdot m^{-3}$, while the weight standards used for various purposes of dissemination of mass values is made of stainless steel with a density of about 8 000 $kg \cdot m^{-3}$. The density difference is large enough to cause a