



Contribution ID: 163

Type: Poster

Compressibility measurements of working liquid of the primary absolute pressure standard of Russia

Tuesday 19 June 2018 18:00 (20 minutes)

Primary absolute pressure standard of Russia in the range of 0,1-1000 Pa is a laser interferometric oil manometer. In the higher part of the range the oil's density uncertainty gives the main contribution to the standard's uncertainty. The oil's density is measured at normal conditions (atmospheric pressure), but the real density value at the working pressure is less due to the liquid compressibility.

Laser interferometric piezometer was developed in VNIIM to investigate the liquids compressibility at the working pressures of the absolute pressure standard.

The construction of the piezometer and its operation principal are follows. The steel cylindrical vessel filled with the test liquid is mounted in a vacuum chamber. The flat mirror is installed under the liquid surface at the depth of 2-3 mm. The laser beam from He-Ne laser is directed by the mirror to the center of the liquid surface where it is split in two. One of the beams is reflected from the liquid surface while the other is reflected from the mirror. Then these two beams are directed to the screen. The resulting interference pattern is recorded by the web camera on the computer. The outer vessel filled with the investigating liquid surrounds the measurement vessel to provide the additional temperature stabilization during the measurement process. When the pressure in the chamber raises the oil level decreases and so does the order of interference. The direction of motion of the rings, toward or from the center, depends on the ratio of the curvature radii of the interfering beams. The measurement procedure consists in counting of passed interference rings in the video file.

Received compressibility value for the oil is 5,2-10-10 Pa⁻¹. It was measured with the uncertainty of 2 %.

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Session Classification: Poster Session Tuesday

Track Classification: Vacuum Science & Technology