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Relative calibration and characterization of 1/4" condenser microphones under different environmental conditions

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Measurement condenser microphones are commonly used in air at ambient temperature and pressure. However, several applications require to use such microphones in environments which are significantly different. In particular, for the determination of the Boltzmann constant by an acoustic method, measurements take place in a cavity filled with pure argon or helium over a wide pressure range at the temperature of the triple point of water. For this application, it is important to determine the microphone frequency response and acoustic input impedance with a low uncertainty in these gas conditions.
A few previous works have examined the influence of static pressure, temperature and gas composition on microphone sensitivity. In one case, these results were supported by a theoretical investigation using a lumped-element model. The aim of the present work is to compare theoretical results from different lumped-element models with experimental relative calibration results obtained using an electrostatic actuator technique. Measurements are performed on 1/4" condenser microphones maintained in argon and helium environments, at 273.16 K, in the pressure range between 50 kPa and 700 kPa. The results are used to test the existing theoretical models and to compare the microphone properties with the manufacturer's data.