

## Research and Design on a Portable Intravehicular Ultrasonic Leak Detector for Manned Spacecraft

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**Abstract :** Based on the acoustics cascade sound theory, the mechanism of air leak sound producing, transmitting and signal detecting has been analyzed. A formula of the sound power, leak size and air pressure in the spacecraft has been built, and the relationship between leak sound pressure and receiving direction and distance has been studied. The center frequency in millimeter diameter leak is more than 20 kHz. The situation of air leaking from spacecraft to space has been simulated and an experiment of different leak size and testing distance and direction has been done. The sound pressure is in direct proportion to the cosine of the angle of leak to sensor. The portable ultrasonic leak detector has been developed, whose minimal leak rate is  $10^{-1}$  Pa $\cdot$ m<sup>3</sup>/s, the testing radius is longer than 20 mm, the mass is less than 1.0 kg, and the electric power is less than 2.2 W.

**Keywords :** leak testing, manned spacecraft, sound transmitting, ultrasonic

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