Publishable JRP Summary Report for JRP SIB 56 (SoundPwr) "Realisation, dissemination and application of the unit watt in airborne sound"

Background

The airborne sound power is the major descriptor for the total amount of the sound radiated from a source. In contrary to the acoustic field quantities like sound pressure, it is independent of the acoustic environment and of the distance to the source. The acoustic properties of technical products e.g. a sound emission or a sound insulation, are therefore described in terms of sound power or quantities derived thereof. Due to its outstanding importance in noise protection and other fields, several European Directives refer directly to the concept of sound power which are the Outdoor Directive, the Machinery Directive and the Eco-Design Directive.

Need for the project

The experimental determination of sound power and quantities derived thereof is currently based on the measurement of field quantities like sound pressure. Acoustic power can be calculated from the field quantities under restricting assumptions only. This approach is the basic reason why different standardised procedures to determine sound powers give different results for the same measurand and why uncertainties easily reach several dB to date. One exemplary consequence following from this is that it is often impossible to resolve discrepancies between defined legal requirements for noise protection and measurement results. The current situation is thus described by a lack of traceability and an absence of transparent uncertainty budgets for the quantity sound power.

Scientific and technical objectives

To improve the situation, the JRP aims to establish traceability for the measurand sound power. Starting point is a primary standard for the realisation of the unit watt in airborne sound. It will be based on a vibrating baffled solid body. The sound power output of this device can be determined from the vibration velocity of the body's surface and several additional quantities like static pressure and temperature. In particular, measurements in the airborne sound field as well as restricting assumptions on the nature of the sound field are not required. An uncertainty of 0.5 dB for the realisation of the unit watt is thus aimed at.

A further main objective of this JRP is to develop a system for the dissemination of the unit watt using appropriate transfer standards. It will be investigated whether existing aerodynamic reference sound sources may serve as transfer standards. Furthermore, a tonal transfer standard will be developed and tested. The uncertainty of the sound power emitted by the transfer standards will be determined. The aim is that this uncertainty is only slightly larger than the uncertainty of the primary standard.

A final goal of the JRP is the application of the transfer standards in machinery noise. One application to be developed is the qualification of complete measurement setups for sound power determinations. These setups are combinations of the acoustic field properties and the measurement equipment. The determination of the sound power of real sources by comparing them to a transfer standard is another application aimed at. Here, the determination of the uncertainty of the sound power is a major topic.

EMRP European Metrology Research Programme Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

Expected results and potential impact

The major effort of SP, INRIM, TUBITAK and PTB in the reporting period was the establishment of the primary sound power source. All four institutions developed individual technical solutions and successfully tested the devices. One main topic to be addressed turned out to be the friction between the moving piston and the supporting structure. Such a friction was not observed at TUBITAK's source possibly due to an airgap of about 0.1-0.2 mm. At PTB, SP and INRIM, friction processes were observed leading to instabilities and non-linearities. PTB therefore constructed another source where an elastic silicon seal is applied. Even though all existing devices met the major design goals, all primary sources are still in a process of optimisation. A further important part of the project is the scanning apparatus for the measurement of the acoustic field quantities which is developed at LNE, PTB and SP. LNE follows the concept of using one microphone which can be moved automatically in two dimensions on the enveloping hemispherical measurement surface. SP follows the concept to move a microphone on a quarter-circle path and perform the other dimension of the movement manually. PTB will set up an arc with 24 microphones which will be moved so that each of the microphone moves on a vertical hemicircle. All these devices are now in a stage of being realised within the next few months. The numerical results obtained by REG(POLITO) and PTB proved that the codes used are able to produce results for the sound power of a rigid piston within a few tenths of a dB. It is therefore expected that numerical calculations for the real source in the real room will result in sound power levels which can be compared to measured ones and those calculated by Rayleigh's integral. The results from REG2(BAuA) which joined the consortium in the reporting period give insights into the effect of the shape of the enveloping surface on the measured sound power levels and are thus an excellent starting point for work package 3.

The results of this JRP will enable national metrology institutes to set up primary sound power sources. From these sources, the unit watt will be disseminated by transfer standards to the user community which are laboratories from independent testing institutes and from industry. Thereby, a complete metrological infrastructure for the quantity sound power will be set up.

The JRP website [http://www.ptb.de/emrp/soundpwr.html] was set up in July 2013 and will be updated every six months. So far the project has contributed presentations to the committees working in ISO/TC 43/SC 1/WG 28 "Basic machinery noise emission standards" and NA 001-01-04 AA "Geräuschemission von Maschinen und Anlagen, Messung, Minderung, Datensammlung" (German standardisation committee on sound emission of machinery), providing information on the JRP. A presentation entitled “Establishing traceability for the quantity sound power” was also given at Internoise, Innsbruck, Austria, 2013. Two further presentations resulting from the JRP were given at the German national conference on acoustics.

Scientific results will be made available to the public by papers in peer reviewed journals and by presentations at international conferences. A new ISO-standard for primary sound power sources will be drafted and other ISO-standards will be redrafted. Finally, a workshop will be held as a structured session at an international conference to disseminate the results to the stakeholders from industry, authorities, testing institutes and standardisation committees.

JRP start date and duration:	01 June 2013, 36 months
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