BRÜEL & KJÆR® Acoustic Analysis Software

PULSE Sound Power in Reverberation Rooms Type 7884

PULSE™ Sound Power in Reverberation Rooms Type 7884 is software for determining sound power based on the standards ISO 3741, ISO 3743-1, ISO 3743-2 and ISO 9295.

Laboratory reverberation rooms as described in ISO 3741 are particularly suitable when performing precision grade tests on comparatively small machines when the sound emitted is predominantly steady in character.

Special reverberation rooms constructed to fulfil the requirements of ISO 3743-2 are less expensive than the laboratory reverberation rooms described in ISO 3741. The methods described in ISO 3743-2 provide measurements of engineering grade, particularly suitable for direct measurement of A-weighted sound power levels of a series of small noise sources.

The hard-walled test rooms as described in ISO 3743-1, are used for engineering grade measurements. Most ordinary, unfurnished rooms without special acoustical treatment comply with the requirements of this standard.

Uses and Features

Uses

- To declare the sound power emitted under defined conditions
- To verify the declared values (legislation, voluntary awards)
- To compare the noise emitted by machinery and equipment of various types and sizes (for example, when benchmarking, or in engineering work, when developing quieter products)

Features

- Comprehensive solutions for determining sound power levels according to ISO 3741, ISO 3743-1 and ISO 3743-2
- Solution for determining sound power levels according to ISO 9295 (complementing the ISO 3741 method)
- Interactive measurement setup and information windows to guide you through the measurement process
- Measurement data and results can be conveniently saved to familiar Microsoft® Excel® workbooks for customized reporting and further post-processing
- Scalable solution

PULSE template for reverberation rooms

Type 7884 includes a dedicated PULSE LabShop template that enables the determination, storage and reporting of the sound power of noise sources operating in reverberant test environments, using measurement and calculation procedures based on ISO 3741, 3743-1 and 3743-2. The similarities between the standards are reflected in the template and all results can be exported to Microsoft® Excel® for report generation.

Table 1 *Overview of the ISO reverberation room standards*

PARAMETER	ISO 3741 PRECISION	ISO 3743-1 ENGINEERING	ISO 3743-2 ENGINEERING
Test environment	Reverberation room	Hard-walled room	Special reverberation room
Criterion for suitability of test environment	Room volume and reverberation time to be qualified	Volume > 40 m^3 Absorption coeff. < 0.20	70 m^3 < Volume < 300 m^3 0.5 s < T_{nom} < 1 s
Volume of sound source	Preferably: <2% of test room volume	Preferably: <1% of test room volume	Preferably: <1% of test room volume
Character of noise from source	Steady, broadband, narrowband or discrete frequency	Any, but no isolated bursts	Any, but no isolated bursts

PULSE template for high-frequency sound power

Type 7884 also includes a PULSE LabShop template that manages the measurement of high-frequency noise using measurement methods described in ISO 9295 and calculates the guaranteed sound power level for each item tested. The template supports the four measurement methods used to measure sound power at high frequencies that are described in ISO 9295: reverberation time method, air absorption method, reference sound source method and free-field method. These methods complement the method described in ISO 3741.

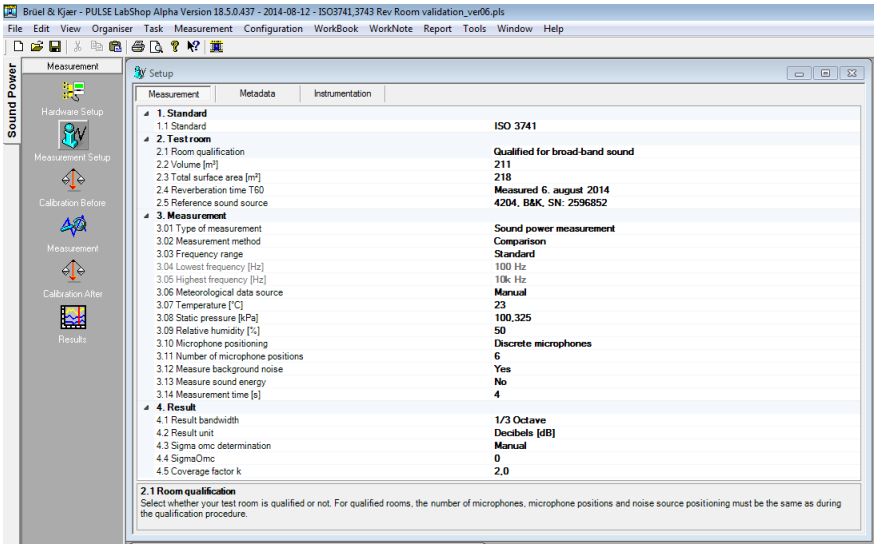
You can export results to Microsoft® Excel® for report generation. When you combine these results with results from the Sound Power in Reverberation Rooms template, you will have a report that covers both high and low frequency ranges.

Software user interface

When you select the desired measurement method in the Setup task, the template automatically adjusts to show only the applicable setup parameters. The software then leads you through all the steps necessary to fulfil the requirements of the chosen standard by means of a task list. The tasks are arranged logically to provide an intuitive user interface.

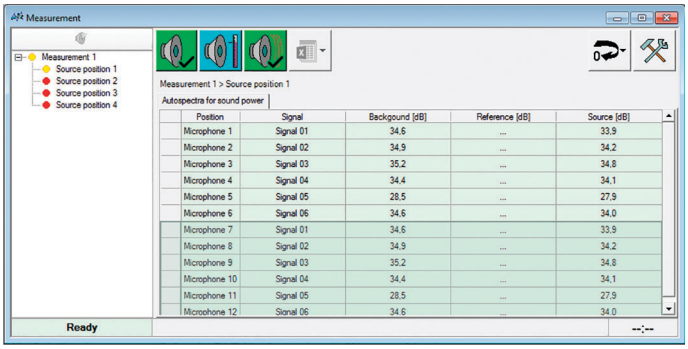
Graphical features, such as pop-up text, colour coding and warnings, allow quick updates on measurement status, determination of pending actions, and validation of specific parameters within the standard. The flexibility of the program allows you to skip repetitive tasks.

Fig. 1 *Interactive reverberation room template: use Measurement Setup to select the required standard, configure the measurement, select calculation parameters and determine measurement uncertainty*



Method

Fig. 2 *The bookkeeping of the various measurements is clearly shown by means of colour codes, icons and tabulated values*



Sound power is determined from sound pressure measurements obtained from a distributed set of microphones in the test environment. Depending on the actual situation, sometimes multiple microphone positions as well as multiple source positions have to be measured. To correct for the influence of the test environment, multiple measurements may have to be made with several positions of a reference sound source. Another possibility is that the reverberation time can be measured and stored in the measurement project. Type 7884 provides you with a clear indication of the status of the measurement by means of a colour-coded user interface.

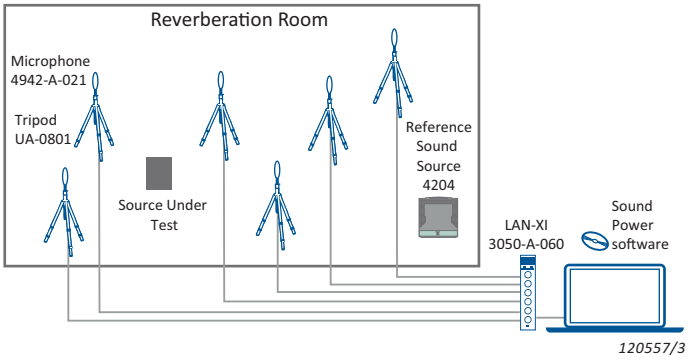
Req-X during high-frequency sound power determination

It is recommended that the microphone you use for measurements of high-frequency sound power has a flat frequency response over the range in which you are measuring. To ensure this, use the Req-X task of Type 7888 to apply a correction to your microphone's frequency response.

Typical setup

To measure the sound pressure levels, either a set of microphones or a single rotating microphone may be used.

Fig. 3 Typical setup for determination of sound power in reverberation rooms according to ISO 3741



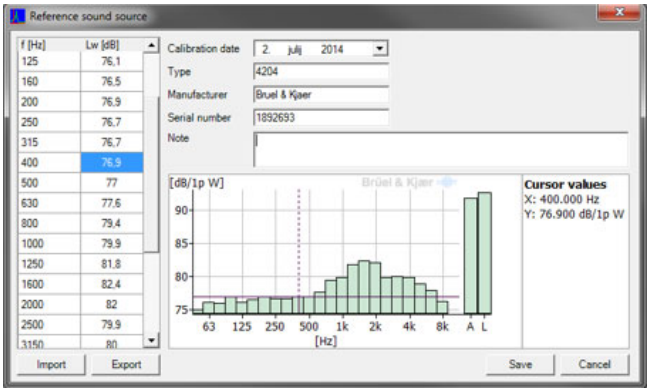
Setup with high-frequency sound power determination

½″ Diffuse-field TEDS Microphone Type 4942-A-021 is recommended for making measurements using Type 7888 because of its flat frequency response over the desired frequency range. The microphone can be used with Input Module LAN-XI 51.2 kHz Type 3050 which includes Front Panel UA-2100.

Type 7884 supports configurations that use, for example, more microphones, other measurement surfaces, booms, or a reference sound source.

Measurements of discrete tones are performed in the 1/12-octave. If a reference sound source is used, it requires calibration in the 1/12-octave.

Fig. 4 Calibration data for Reference Sound Source Type 4204 used to measure environmental corrections (left), are imported into Type 7884 (right)



Specifications – PULSE Sound Power in Reverberation Rooms Type 7884

A Windows®-based application for use with PULSE LabShop. The software is delivered via DVD or USB

System

SYSTEM REQUIREMENTS

- Microsoft® Windows® 10 Pro or Enterprise (x64) with either Current Branch (CB) or Current Branch for Business (CBB) servicing model
- Microsoft® Office 2016 (x32 or x64) or Office 2019 (x32 or x64)
- Microsoft® SQL Server® 2017

NOTE: Microsoft SQL Server 2017 Express is included in the installation

RECOMMENDED SYSTEM CONFIGURATION

- Intel® Core™ i9, 3 GHz processor or better
- 32 GB RAM
- 1 TB Solid State Drive (SSD) with 100 GB free space, or better
- 1 Gbit Ethernet network*
- Microsoft® Windows® 10 Pro or Enterprise (x64) with CB
- Microsoft® Office 2019 (x32)
- Microsoft® SQL Server® 2017
- Screen resolution of 1920 × 1080 pixels (full HD)

FRONT END

The software automatically detects the front-end hardware connected and configures the system. If IEEE 1451.4 capable transducers (with standardized TEDS) are being used, these are also detected and attached automatically to the correct channel of the input module. For information about LAN-XI hardware, see product data BP 2215

* A dedicated data acquisition network (LAN or WAN) is recommended. A network that only handles data from the front end improves the stability of the data

OPTIONAL SOFTWARE FOR ADDITIONAL CAPABILITIES

- BK Connect® Data Viewer Type 8400
- BK Connect Hardware Setup Type 8401
- BK Connect Data Processing Type 8403

Calibration

Use PULSE LabShop's integrated Calibration Master, which initiates microphone calibration while you move the calibrator from one microphone to the next. The full calibration history for a transducer can be retained in the Transducer Database, which allows monitoring calibration data variations over a period of time

SPW Reverberation Room (PULSE Template)

Provides measurement and calculation procedures for the determination of the sound power of noise sources using sound pressure, as described in the following international standards

STANDARDS

ISO 3741: 2010 Determination of sound power levels and sound energy levels of noise sources using sound pressure. Precision methods for reverberation test rooms
ISO 3743-1: 2010 Determination of sound power levels of noise sources using sound pressure. Engineering methods for small, movable sources in reverberant fields. Part 1: Comparison method for a hard-walled test room
ISO 3743-2: 2018 Determination of sound power levels of noise sources using sound pressure. Engineering methods for small, movable sources in reverberant fields. Part 2: Methods for special reverberation test rooms

SUITABLE TEST ENVIRONMENTS
- Reverberation rooms as specified in ISO 3741
- Reverberant fields as specified in ISO 3743-1 or ISO 3743-2

MEASUREMENT

$L'_{p(B)\,ij}$	time-averaged sound pressure level produced by the background noise
$L'_{p(R)\,ij}$	time-averaged sound pressure level from the reference sound source
$L'_{p(S)\,ij}$	time-averaged sound pressure level from the noise source under test

- All quantities are measured in 1/3-octave band for any range with nominal mid-band frequencies from 50 Hz to 10 kHz or in 1/1-octave band for any range with nominal mid-band frequencies from 125 Hz to 8 kHz
- A-weighted values calculated from 1/1-octave or 1/3-octave values as specified in Annex C of ISO 3745: 2012

CALCULATION

K_1	background noise corrections
$\bar{L}_{p(R)\,j}$	mean corrected time-averaged sound pressure level from the reference sound source ovesr all source positions
$\bar{L}_{p(S)\,j}$	mean corrected time-averaged sound pressure level from the noise source under test over all source positions
N_M	number of necessary microphone positions or separate microphone traverses for each source position
N_S	number of necessary source positions
L_W	sound power level in dB under the meteorological conditions at the time and place of the test
C_2	radiation impedance correction to change the actual sound power relevant for the meteorological conditions at the time and place of the measurement into the sound power under reference meteorological conditions.

VALIDATION
Criterion for background noise
Requirement evaluation for additional microphone positions
Requirement evaluation for additional source positions

SPW High-frequency Sound Power (PULSE Template)

SUITABLE TEST ENVIRONMENTS
Reverberation rooms as specified in ISO 3741

MEASUREMENTS
Time-averaged sound pressure levels:
- Produced by the background noise
- From the reference sound source
- From the noise source under test

All quantities are measured in one of the following:
- 1/3-octave band for any range with nominal mid-band frequencies from 50 Hz to 20 kHz
- 1/1-octave band for any range with nominal mid-band frequencies from 63 Hz to 16 kHz
- 1/12-octave band for any range with nominal mid-band frequencies from 50 Hz to 22.4 kHz

A-weighted values calculated from 1/1-octave or 1/3-octave values as specified in Annex C of ISO 3745: 2012

CALCULATIONS
- Background noise corrections
- Mean corrected time-averaged sound pressure level from the reference sound source over all source positions
- Mean corrected time-averaged sound pressure level from the noise source under test over all source positions
- Sound power level

Ordering Information

Type 7884-X* **PULSE Sound Power in Reverberation Rooms**

SOFTWARE MAINTENANCE AND SUPPORT AGREEMENTS

M1-7884-X	Agreement for Type 7884

RECOMMENDED HARDWARE

Type 4942-A-021	½" Diffuse-field Microphone, incl. Preamp. Type 2671
Type 4231	Sound Calibrator
Type 3050-A-060	LAN-XI 6-ch. Input Module 51.2 kHz (Mic, CCLD, V)
UA-2101-060	LAN-XI Front Panel, 200 V Microphone

OTHER SOFTWARE AND ACCESSORIES

Type 8400-X	BK Connect Data Viewer
Type 8400-A-X	BK Connect Data Viewer (advanced)
Type 8401-X	BK Connect Hardware Setup
Type 8403-X	BK Connect Data Processing
Type 8403-A-X	BK Connect Data Processing Specialist
Type 4204	Reference Sound Source
Type 3923	Rotating Boom
UA-0801	Lightweight Tripod

* X is the licence type. X = N, where the licence is node-locked to PC host ID or dongle; or X = F, where the licence is floating, that is, shared via a licence server

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