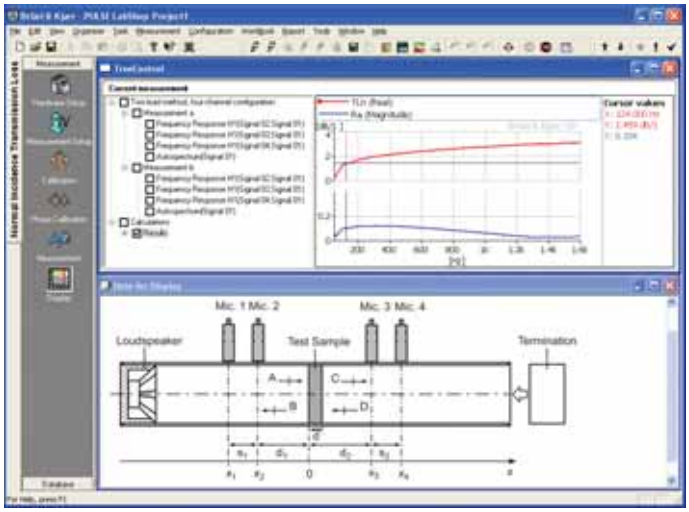
PULSE Acoustic Material Testing in a Tube Type 7758

PULSE™ Acoustic Material Testing in a Tube Type 7758 is software for determining the acoustical properties of noise control materials whether used to absorb airborne sound or to reduce airborne sound transmission.

It works in conjunction with Impedance Tube Kits Type 4206 and Type 4206-A, Transmission Loss Tube Kit Type 4206-T and any other custom measurement tube.



Uses and Features

Uses

- To develop noise control products
- To verify compliance with specifications
- To benchmark competitive products
- To help select the most adequate treatment
- To provide materials' acoustic properties for validating and calibrating computational methods

Features

- Comprehensive solution for evaluating both normal incidence sound absorption and sound transmission properties
- Determination of normal incidence sound absorption coefficient and normal surface impedance based on ASTM E1050–12, ISO 10534–2 and ISO 13472–2
- Determination of normal incidence transmission loss based on ASTM E2611–17
- PULSE platform ensures exceptional measurement accuracy
- Scalable solution

Table 1 *Types of impedance tube supported depending on the application*

Type of Tube	Properties	Frequency Range
Impedance Tube (Type 4206)	Absorption, Impedance, Reflection	50 Hz – 6.4 kHz
Medium Tube (Type 4206-A)	Absorption, Impedance, Reflection	100 Hz – 3.2 kHz
TL Tube (Type 4206-T)	Transmission Loss	50 Hz – 6.4 kHz
Medium TL Tube (UA-2033)	Transmission Loss	100 Hz – 3.2 kHz
High-frequency Tube (WA-1599)	Absorption, Impedance, Reflection, Transmission Loss	1 kHz – 12.8 kHz
Road Surface Absorption Tube (Type 9740, WA-1599-W-003) See BN 1212 for more information	Absorption, Impedance, Reflection	220 Hz – 1.8 kHz

Brüel & Kjær

Description

Acoustic Material Testing Type 7758 is used to measure the acoustic properties of materials according to the requirements of international standards (ISO 10534–2, ASTM E1050–12 and ASTM E2611–17). Absorption, impedance, reflection and transmission loss can be measured using various types of impedance tube depending on the application.

Fig. 1 *Acoustic material testing configurations*

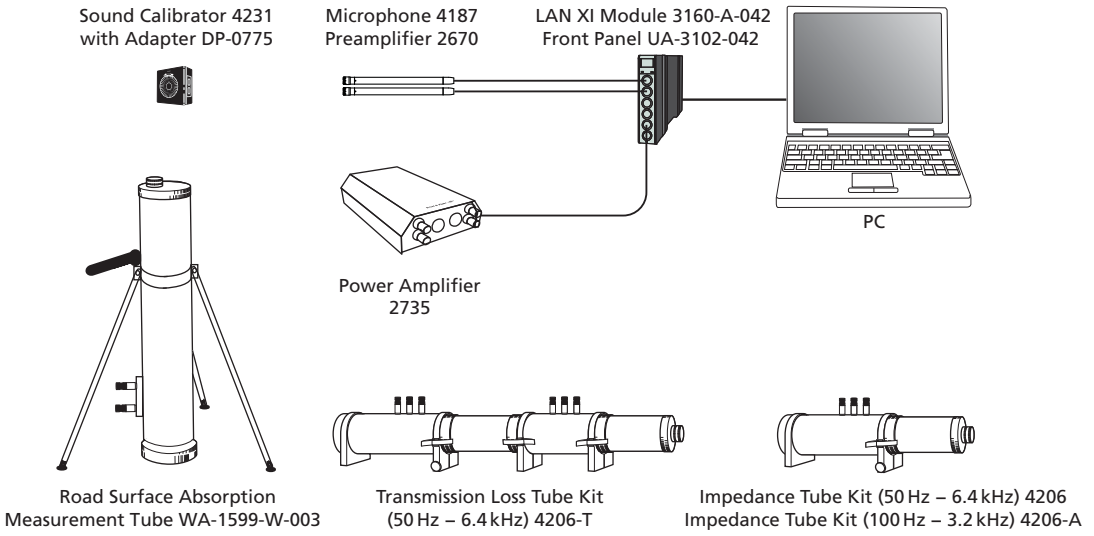


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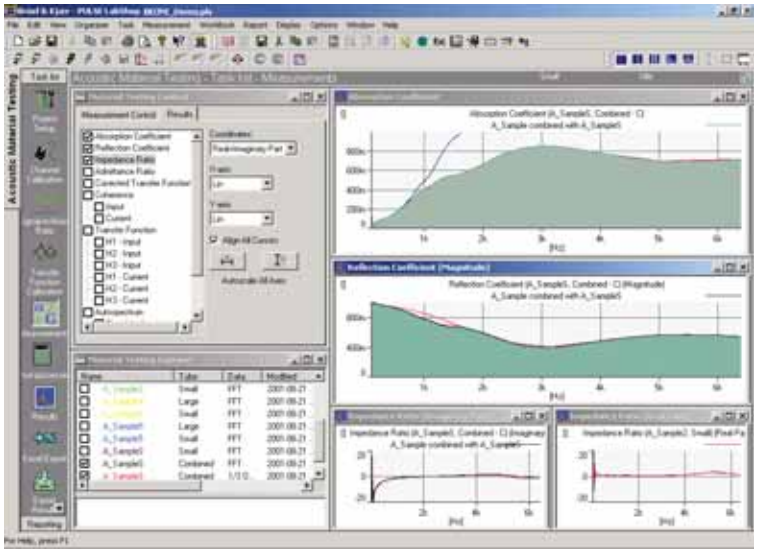
Fig. 2 *PULSE Acoustic Material Testing's task-oriented user interface provides step-by-step guidance through all stages of the measurement process*



PULSE templates are provided for normal incidence sound absorption and normal incidence transmission loss. The following sections explain the features and functionalities that are specific to these templates.

Normal Incidence Sound Absorption

This PULSE template provides measurement and calculation procedures for the determination of the normal incidence sound absorption coefficient and related acoustic properties of a sample using a two-microphone impedance tube (for example, Type 4206 or Type 4206-A). It is based on ASTM E1050−12, ISO 10534–2 and ISO 13472−2 and includes transfer function calibration to eliminate the effects of phase and amplitude mismatches between the two measurement channels.

Prior to testing, the signal-to-noise ratio (SNR) can be determined at each microphone position to ensure accurate results. The measured SNR values are automatically compared to a user-defined threshold (for example, background noise) and, if this is exceeded, a warning is shown.

Intermediate results can be examined to validate your data thoroughly before accepting it. In addition, the program issues automatic warnings during measurement if parameter levels fall out of compliance with predefined settings, for example, if there is too large a difference between the maximum and minimum sound pressure level inside the tube.

Powerful batch measurement functionality allows you to configure up to 250 items prior to measurement. Measurement results can be averaged to compensate for variations in the test samples. You can combine measurements from different tube types to cover a broader frequency range and extract 1/n-octave frequency information.

Measurement data and results are saved in the project in which they were originally generated. However, the Export/Import Results task lets you save data in dedicated files and load it into another project based on the Normal Incidence Absorption project template. A convenient tool (Material Testing Explorer) is provided for keeping track of measurement data. All measurements that have been executed, post-processed or imported are displayed in table format.

Normal Incidence Transmission Loss

This solution provides the determination of the normal incidence sound transmission loss and related acoustic properties of a sample using a four-microphone standing wave tube (for example, Type 4206-T). An example of a measurement with normal incidence transmission loss and normal incidence anechoic reflection coefficient is shown in the figure on the front page.

A transfer matrix representation, which has been widely used in the past in scientific literature, is adopted. Its elements are used to determine the normal incidence transmission loss of the sample as well as a variety of other acoustical properties: for example, the normal incidence absorption coefficient for the case of an anechoic termination, the ratio of dissipated energy within the sample to the incident energy, and the surface normal impedance of the sample for the case of anechoic termination.

Although the sound power transmitted through the sample generally depends on both its properties and the tube termination conditions, the method provides the normal incidence transmission loss as if the sample were backed by a perfectly anechoic termination independent of the actual tube termination conditions used during the measurements. That is, the solution does not require a perfectly anechoic termination, which would be difficult to realize and very expensive. The transfer matrix is estimated from two measurements with two different tube termination (or loading) conditions, which typically are open and approximately anechoic terminations. When the sample under test is symmetric front-to-back, a procedure that requires only a single measurement is implemented (one-load method).

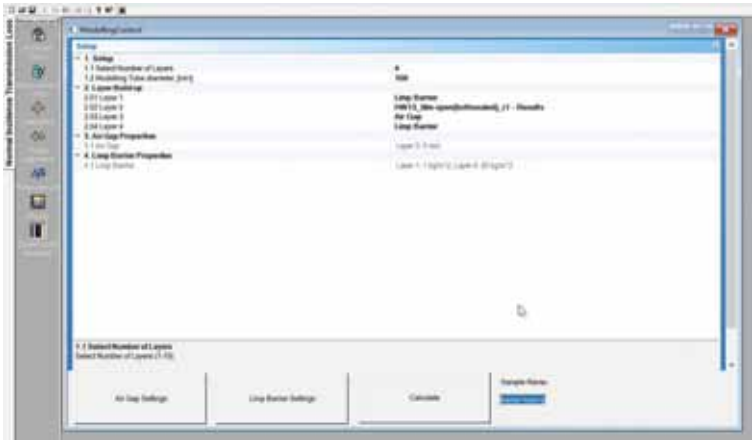
When the sample is a porous material that can be modelled as an effective fluid (like glass fibres and fibrous materials), the material's characteristic impedance and the complex wave number can also be determined along with associated quantities such as the complex density and complex sound speed. These quantities are most often required when validating and calibrating computational methods. Data can be stored in a dedicated database, increasing the efficiency of browsing and comparing data. Using BK Connect Data Viewer (advanced) Type 8400-A, statistical quantities can be calculated on batch measurements stored in the database.

When using a user-defined tube, you can account for the use of conical adapter sections upstream and downstream. To use this, you need to enter the inlet and out diameter for the test sample and the length of the adapter section. The conical adapter sections need to mate properly to the standard large or small tubes for Type 4206-T. The effect of the conical section is accounted for in the transmission loss calculations so the final result is only for the test sample.

Use with Multi-Layer Panels

The Experimental Modeling task in the Normal Incidence Transmission Loss template enables you to predict the sound transmission loss (STL) performance of multi-layer panel constructions using a measurement-based transfer matrix method. This method is unique because the characterization of the poro-elastic material is strictly measurement-based and does not require modeling the material.

Fig. 1 *The Experimental Modeling task*



Specifications – PULSE Acoustic Material Testing Type 7758

Type 7758 is a PULSE LabShop software application for use with LAN-XI data acquisition hardware

System

SYSTEM PC REQUIREMENTS

- Microsoft® Windows® 10 Pro or Enterprise (x64) with either Current Branch (CB) or Current Branch for Business (CBB) servicing model; or Windows® 7 Pro, Enterprise or Ultimate (SP1) (x64) operating systems
- Microsoft® Office 2016 (x32 or x64) or Office 2013 (x32 or x64)
- Microsoft® SQL Server® 2014 Express (SP2) (included in installation), SQL Server® 2014 (SP2), SQL Server® 2012 R2, SQL Server® 2008 or 2008 R2 Express Edition SP1

HARDWARE REQUIREMENTS – SINGLE MODULE ONLY SUPPORTED

- LAN-XI data acquisition hardware with one generator output channel (full generator functionality)

RECOMMENDED PC CONFIGURATION

- Intel® Core™ i7, 3 GHz processor or better
- 32 GB RAM
- 480 GB Solid State Drive (SSD) with 20 GB free space, or better
- 1 Gbit Ethernet network*
- Microsoft® Windows® 10 Pro or Enterprise (x64), CB
- Microsoft® Office 2016 (x32)
- Microsoft® SQL Server® 2014 (SP2)
- Screen resolution of 1920 × 1080 pixels (full HD)

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 automatically initiates 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 to allow for monitoring of calibration data variations over a period of time

* 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

Normal Incidence Absorption

STANDARDS

ISO 10534-2: Determination of sound absorption coefficient and impedance in impedance tubes – Part 2: Transfer-function method.
ISO 13472-2: 2010, Acoustics – Measurement of sound absorption properties of road surfaces in situ – Part 2: Spot method for reflective surfaces.
ASTM E1050-12: Standard test method for impedance and absorption of acoustical materials using a tube, two microphones and a digital frequency analysis system

SUITABLE APPARATUS

- Impedance Tube Kit (50 Hz – 6.4 kHz) Type 4206
- Impedance Tube Kit (100 Hz – 3.2 kHz) Type 4206-A
- Any other custom two-microphone impedance tube. Up to three different user-defined tube set-ups can be used in a single project

MEASUREMENT

- Transfer function of the two microphone signals
- Sound pressure level at each microphone position with generator off (background noise) and on

A group or batch of measurements can be made in a project and measurements from previous projects can be imported into the current project

CALCULATION

- Normal incidence absorption coefficient
- Normal incidence sound pressure reflection coefficient
- Normal surface impedance ratio
- Normal surface admittance ratio
- Transfer function of two microphone signals corrected for channel mismatch
- Characteristic impedance
- Propagation constant

VALIDATION

- Signal-to-noise ratio (SNR) at each microphone position
- User-defined SNR threshold level
- Coherence

STATISTICS
Mean of any measured or calculated quantity on batch measurements (max. 250 items)

ADDITIONAL POST-PROCESSING ANALYSIS
- Combination of measurements from two different tubes
- Extraction of 1/n-octave frequency information

Normal Incidence Transmission Loss

STANDARDS
ASTM E2611-17: 2017, Standard test method for normal incidence determination of porous material acoustical properties based on the transfer matrix method

SUITABLE APPARATUS
Transmission Loss Tube Kit (50 Hz – 6.4 kHz) Type 4206-T.
Any other custom four-microphone transmission loss tube

MEASUREMENT
- Autospectrum of reference signal
- Frequency response function between the complex sound pressure at a microphone position and the complex reference signal

CALCULATION
- Complex amplitudes of plane progressive waves travelling in opposite directions in both the up- and downstream tube sections, whose phases are defined relative to reference signal
- Sound pressure on the upstream and downstream face of the sample
- Normal acoustic particle velocity on the upstream and downstream face of the sample
- Transfer matrix elements
- Normal incidence pressure transmission/reflection coefficient for the case of an anechoic termination
- Normal incidence, power transmission/reflection coefficient for the anechoically terminated sample
- Normal incidence absorption/dissipation coefficient for the case of an anechoic termination
- Surface normal incidence impedance for the case of an anechoic termination
- Normal incidence pressure reflection coefficient for hard backing case
- Normal incidence transmission loss, *TLn*
- Complex wave number of the material under test
- Complex characteristic impedance of the material under test
- Normalized complex sound speed of the material under test
- Normalized phase speed of the material under test
- Normalized complex density of the material under test

VALIDATION
- Coherence of the frequency response functions as a function of source level

STATISTICS*
Mean and standard deviation of any measured or calculated quantity on batch measurements

* BK Connect Data Viewer (advanced) Type 8400-A licence required

Ordering Information†

Type 7758-X **PULSE Acoustic Material Testing**

ACCESSORIES

Type 3160-A-042	LAN-XI Generator, 4/2-ch. Input/Output Module 51.2 kHz (Mic, CCLD, V)
UA-3102-042	LAN-XI Front Panel, Generator, for 200 V Microphone
Type 2735	2 × 35 Watt Measurement Power Amplifier
Type 4206†	Impedance Tube Kit (50 Hz – 6.4 kHz)
Type 4206-A	Impedance Tube Kit (100 Hz – 3.2 kHz)
Type 4206-T	Transmission Loss Tube Kit (50 Hz – 6.4 kHz)
Type 4231	Sound Calibrator
DP-0775	Adapter for ¼″ Microphones (for Type 4231)

OPTIONAL SOFTWARE

Type 8400-X	BK Connect Data Viewer
Type 8400-A-X	BK Connect Data Viewer (advanced), for statistics calculations in the Normal Incidence Transmission Loss template
Type 8401-X	BK Connect Hardware Setup
Type 8403-X	BK Connect Data Processing

SOFTWARE MAINTENANCE AND SUPPORT AGREEMENTS

M1-7758-X	Agreement for Type 7758 (required)
M1-8400-X	Agreement for Type 8400
M1-8400-A-X	Agreement for Type 8400-A
M1-8401-X	Agreement for Type 8401
M1-8403-X	Agreement for Type 8403

† X = license model either N for node-locked or F for floating.

† For a complete specification of the Impedance Measurement Tubes, see Product Data BP1039

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