**PRODUCT DATA**

**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

<table>
<thead>
<tr>
<th>Type of Tube</th>
<th>Properties</th>
<th>Frequency Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impedance Tube (Type 4206)</td>
<td>Absorption, Impedance, Reflection</td>
<td>50 Hz – 6.4 kHz</td>
</tr>
<tr>
<td>Medium Tube (Type 4206-A)</td>
<td>Absorption, Impedance, Reflection</td>
<td>100 Hz – 3.2 kHz</td>
</tr>
<tr>
<td>TL Tube (Type 4206-T)</td>
<td>Transmission Loss</td>
<td>50 Hz – 6.4 kHz</td>
</tr>
<tr>
<td>Medium TL Tube (UA-2033)</td>
<td>Transmission Loss</td>
<td>100 Hz – 3.2 kHz</td>
</tr>
<tr>
<td>High-frequency Tube (WA-1599)</td>
<td>Absorption, Impedance, Reflection, Transmission Loss</td>
<td>1 kHz – 12.8 kHz</td>
</tr>
<tr>
<td>Road Surface Absorption Tube (Type 9740, WA-1599-W-003)</td>
<td>Absorption, Impedance, Reflection</td>
<td>220 Hz – 1.8 kHz</td>
</tr>
</tbody>
</table>

See **BN 1212** for more information
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

PULSE templates are provided for normal incidence sound absorption and normal incidence transmission loss. This section explains features and functionalities that are specific to these templates.

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

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 outlet 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.
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® SQL Server® 2014 (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

Normal Incidence Absorption

STANDARDS

SUITABLE APPARATUS
- Impedance Tube Kit (50 Hz – 6.4 kHz) Type 4206-T.

MEASUREMENT
- 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 sound pressure reflection coefficient for hard backing case
- Normal incidence transmission loss, $TL_n$
- 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 (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.

MEASUREMENT
- Autospectrum of reference signal
- Frequency response function between the complex sound pressure at a microphone position and the complex reference signal
- Sound pressure level at each microphone position with generator off
- 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
## Ordering Information*

<table>
<thead>
<tr>
<th>Type 7758-X</th>
<th>PULSE Acoustic Material Testing</th>
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<tbody>
<tr>
<td>ACCESSORIES</td>
<td></td>
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<tr>
<td>Type 3160-A-042</td>
<td>LAN-XI Generator, 4/2-ch. Input/Output Module 51.2 kHz (Mic, CCLD, V)</td>
</tr>
<tr>
<td>UA-3102-042</td>
<td>LAN-XI Front Panel, Generator, for 200 V Microphone</td>
</tr>
<tr>
<td>Type 2735</td>
<td>2 × 35 Watt Measurement Power Amplifier</td>
</tr>
<tr>
<td>Type 4206†</td>
<td>Impedance Tube Kit (50 Hz – 6.4 kHz)</td>
</tr>
<tr>
<td>Type 4206-A</td>
<td>Impedance Tube Kit (100 Hz – 3.2 kHz)</td>
</tr>
<tr>
<td>Type 4206-T</td>
<td>Transmission Loss Tube Kit (50 Hz – 6.4 kHz)</td>
</tr>
<tr>
<td>Type 4231</td>
<td>Sound Calibrator</td>
</tr>
<tr>
<td>DP-0775</td>
<td>Adapter for ¼” Microphones (for Type 4231)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>OPTIONAL SOFTWARE</th>
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<tr>
<td>Type 8400-X</td>
<td>BK Connect Data Viewer</td>
</tr>
<tr>
<td>Type 8400-A-X</td>
<td>BK Connect Data Viewer (advanced), for statistics calculations in the Normal Incidence Transmission Loss template</td>
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<tr>
<td>Type 8401-X</td>
<td>BK Connect Hardware Setup</td>
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<tr>
<td>Type 8403-X</td>
<td>BK Connect Data Processing</td>
</tr>
<tr>
<td>Type 8404-X</td>
<td>BK Connect Data Processing Specialist (can be used instead of Type 8403)</td>
</tr>
</tbody>
</table>

## 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 |
| M1-8404-X | Agreement for Type 8404 |

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* 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