

PRODUCT DATA

Two-microphone Impedance Measurement Tube — Type 4206 Impedance Measurement Tube for ASTM — Type 4206 A

Two-microphone Impedance Measurement Tube Type 4206 is used in measuring the acoustic absorption coefficient, acoustic reflection coefficient and normalized impedance of small test samples in the frequency range from 50 Hz to 6.4 kHz. It is supplied with two specially designed ¼" Microphones Type 4187 with preamplifiers, and uses PULSE Material Testing Type 7758 with a PULSE™ Multi-analyzer System Type 3560. Type 7758 contains pre-programmed tasks that control measurement and calibration procedures, post-processing, data file management and reporting for a measurement setup controlled by PULSE.

USES

- Measurement of:
 - acoustic absorption coefficient
 - acoustic reflection coefficient
 - normalized impedance
 - normalized admittance
- Measurements on complex or composite materials
- Measurements on orientation-sensitive materials
- Simulation of measurements on hanging ceilings

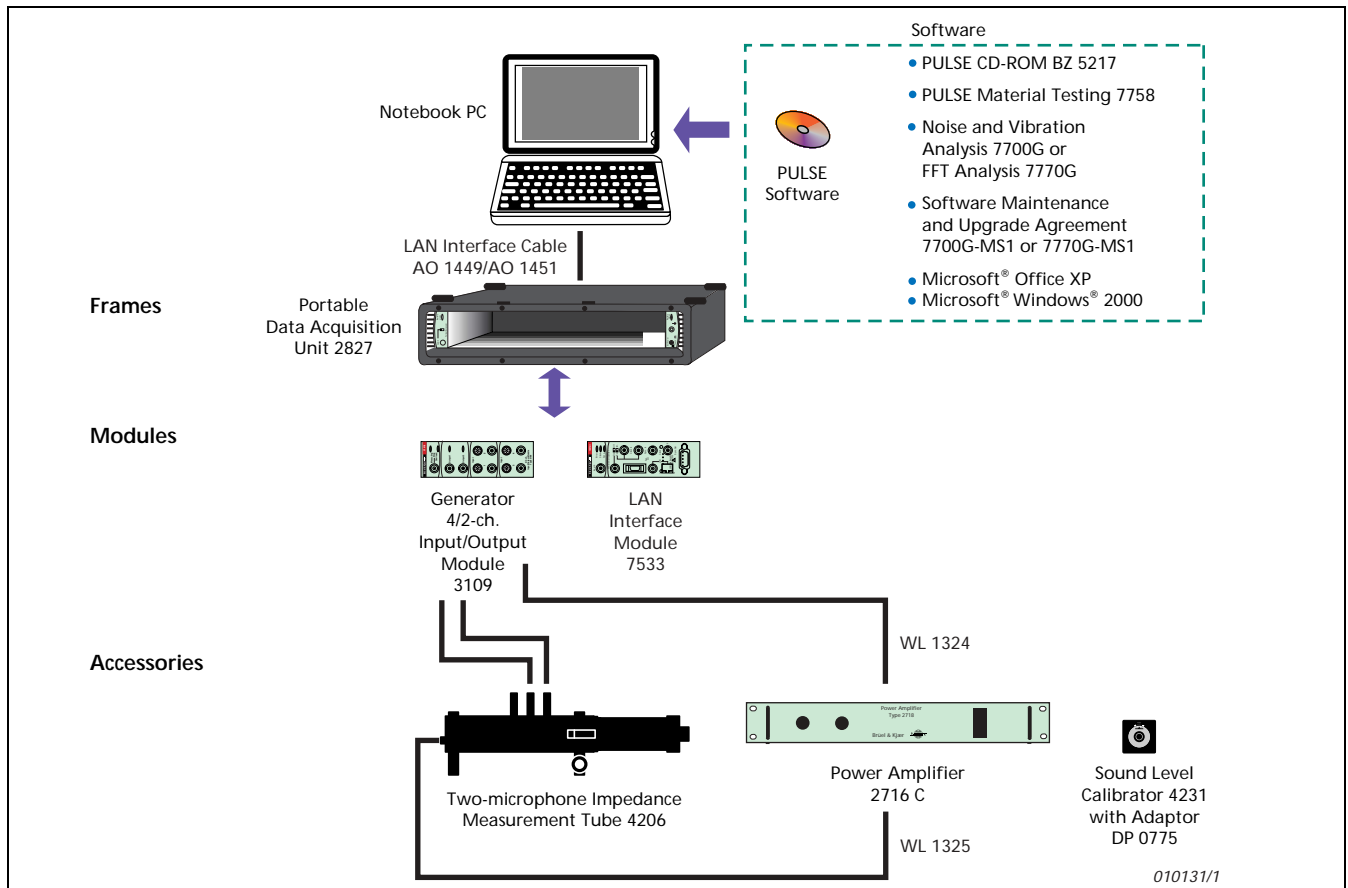
FEATURES

- Quick measurements over a large frequency range
- Software-controlled measurements, data management and reporting facilities
- Measurement procedure and specifications based on ISO 10534–2 and ASTM E1050–98
- Measurement of Noise Reduction Coefficient frequencies derived from ASTM C423–99a measurements (250, 500, 1000, 2000 Hz)
- Low-frequency tube: 50 Hz to 1.6 kHz
- Mid-frequency tube: 100 Hz to 3.2 kHz
- High-frequency tube: 500 Hz to 6.4 kHz
- Horizontal mounting of orientation-sensitive materials
- Wall mountable



4206, 4206 A

Fig. 1 Impedance tube measurement system using PULSE as controller



Description

Type 4206

Two Microphone Impedance Measurement Tube Type 4206 consists of:

- a large (low-frequency) measurement tube which has a frequency-weighting unit and sound source mounted at one end, and three couplers for mounting microphones flush with the inside of the tube
- an optional medium (mid-frequency) measurement tube UA 2033, which has three microphone couplers and is mounted directly onto the open end of the large measurement tube. This tube is designed to meet the ASTM E1050-98 (American Society for Testing and Materials) code in the USA
- a small (high-frequency) measurement tube which has two microphone couplers and is mounted directly onto the open end of the large measurement tube
- large, medium (optional) and small sample holders, each with an acoustically hard backplate attached to a sliding piston
- two large extension tubes which can be fitted between the measurement tube and sample holder to increase the length of either of the measurement setups

These components can be assembled into standard large, medium and small tube setups into which the test samples are mounted. The effective length of each setup can be changed by fitting one or both extension tubes and by changing the position of the sliding piston inside the sample holder.

Type 4206 A

Impedance Measurement Tube for ASTM Type 4206 A consists of:

- a large tube which has a frequency-weighting unit and sound source mounted at one end, and three couplers for mounting microphones flush with the inside of the tube
- a medium (mid-frequency) measurement tube UA 2033, which has three microphone couplers and a medium sample holder, and which is mounted directly onto the open end of the large measurement tube. This tube is designed to meet the ASTM E1050-98 (American Society for Testing and Materials) code in the USA

General

Three types of weighting are selectable with the large tube's frequency weighting unit:

- high-pass, for high frequency measurements in the small tube
- linear, for measurements in the large tube
- low-pass for extra measurement accuracy below 100 Hz

Measurements inside the tube are made with two ¼" Condenser Microphones Type 4187 which are supplied with Types 4206 and 4206 A, and which are specially designed to reduce errors due to pressure leakage at high frequencies.

Calibration Procedure

Before measurements can be made using a particular tube setup, a quick and easy calibration procedure must be used to ensure that the measurements are not affected by phase or amplitude mismatch between the two measurement channels. The measurements involved in this procedure are controlled by software and you only need to switch the positions of the two microphones for the calibration to be completed.

PC-controlled Measurement Setup

A measurement setup using PULSE with Material Testing Software Type 7758 as system controller is shown in Fig.1. The large tube setup is for measurements in the range 50 Hz to 1.6 kHz, the medium tube setup is for measurements in the range 100 Hz to 3.2 kHz and the small tube setup is for measurements in the range 500 Hz to 6.4 kHz

Once the tube setup is calibrated, the test sample is mounted and a measurement can be made. The analyzer generates a random signal which is amplified (by, for example, Power Amplifier Type 2716 C), frequency weighted by the frequency-weighting filter in the large tube unit, and applied to the sound source. The analyzer measures the response of the two microphones and calculates the H1 frequency response function between the two microphone channels. From this frequency response function, all other test sample data are calculated.

For each measurement made on a sample, the following data can be calculated and displayed by the analyzer in the frequency range of interest: acoustic absorption coefficient (magnitude only), acoustic reflection coefficient, normalized impedance, frequency response function or calibration result, each displayed as magnitude, phase, real or imaginary part, or as a Nyquist plot (real versus imaginary) or Nichols plot (phase versus amplitude).



Applications

Types 4206 and 4206 A can be used to measure acoustic properties of almost any test sample, including composite materials (e.g., ceiling tiles), and irregular materials (e.g., fissured acoustic tiling). The piston backplate onto which test samples are mounted inside the sample holders can be withdrawn to produce an air gap behind the test sample. This can be used, for example, to simulate measurements on hanging ceilings.

Types 4206 and 4206 A can also be mounted vertically to make measurements on orientation-sensitive samples (e.g., granular materials) which must be mounted horizontally.

All measurements using Types 4206 and 4206 A are made over all frequencies in a chosen frequency range simultaneously, and in a fraction of the time taken by traditional standing wave methods.

Compliance with Standards

 	CE-mark indicates compliance with: EMC Directive and Low Voltage Directive. C-tick mark indicates compliance with the EMC requirements of Australia and New Zealand.
Safety	EN 61010-1 and IEC 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use. UL3111-1: Standard for Safety – Electrical measuring and test equipment.
EMC Emission	EN 50081-1: Generic emission standard. Part 1: Residential, commercial and light industry. EN 50081-2: Generic emission standard. Part 2: Industrial environment. CISPR 22: Radio disturbance characteristics of information technology equipment. Class B Limits. FCC Rules, Part 15: Complies with the limits for a Class B digital device.
EMC Immunity	EN 50082-1: Generic immunity standard. Part 1: Residential, commercial and light industry. EN 50082-2: Generic immunity standard. Part 2: Industrial environment. Note: The above is guaranteed using accessories listed in this Product Data sheet only.
Temperature	IEC 60068-2-1 & IEC 60068-2-2: Environmental Testing. Cold and Dry Heat. Operating Temperature: +5 to +40 °C (41 to 104 °F) Storage Temperature: -25 to +70 °C (-13 to 158 °F)
Humidity	IEC 60068-2-3: 90% RH (non-condensing at 40°C)
Mechanical	Non-operating: IEC 60068-2-6: Vibration: 0.3 mm, 20 m/s ² , 10-500 Hz IEC 60068-2-27: Shock: 1000 m/s ² IEC 60068-2-29: Bump: 1000 bumps at 250 m/s ²
Reliability	MIL-HDBK 217F, GB (Part-stress): MTBF >10000 hours
Other	ASTM E1050-98, ASTM C423-98a, ISO 10534-2

Specifications – Two Microphone Impedance Tube Type 4206, 4206 A

FREQUENCY RANGE

Large Tube: 50 Hz to 1.6 kHz

Medium Tube: 100 Hz to 3.2 kHz

Small Tube: 500 Hz to 6.4 kHz

ZERO ABSORPTION

(calculated in $1/3$ -octave bands)

50 Hz to 4 kHz: < 4%

5 kHz to 6.3 kHz: < 10%

TUBE DIMENSIONS

	Diameter [mm] (in)	Length [mm] (in)
Small Meas. Tube	29 (1.1)	200 (7.9)
Medium Meas. Tube	63.5 (2.5)	200 (7.9)
Large Meas. Tube	100 (3.9)	440 (17.4)
Small Sample Holder	29 (1.1)	200 (7.9)
Medium Sample Holder	63.5 (2.5)	200 (7.9)
Large Sample Holder	100 (3.9)	200 (7.9)
Small Ext. Tubes	29 (1.1)	200 (7.9)
Large Ext. Tubes	100 (3.9)	200 (7.9)

ASSEMBLED SETUP DIMENSIONS

Large Tube (length)*: 700 mm (27.7")

Medium Tube (length): 910 mm (36")

Small Tube (length)*: 850 mm (33.6")

Total Width: 140 mm (5.5")

Total Height: 240 mm (9.5")

1/4" CONDENSER MICROPHONE CARTRIDGE TYPE 4187

To optimise the measurement accuracy of Type 4206, the microphones have a non-removable protection grid which forms an airtight front cavity. This gives a coupling between Type 4206 and the microphones that is well-defined with respect to phase
Open-circuit Sensitivity (250 Hz): 4 mV/Pa (-48 ± 3 dB re 1 V/Pa)
Capacitance (250 Hz): 6.4 pF, typical
Frequency Response Characteristic (Flush Mounted) ± 1 dB: 1 Hz to 8 kHz

Polarization Voltage: 200 V

LOUDSPEAKER

Max. Average Power: 10 W at 20°C (68°F)

Max. Pulsed Power: 50 W for 2 s (limited by protection circuit)

Impedance: 4 Ω

Diameter: 80 mm (3.2")

WEIGHT (WITH ACCESSORIES)

12 kg (26.5 lb.)

*Add 200 mm for each extension tube used

Ordering Information

Type 4206

Type 4206 Two-microphone Impedance Measurement Tube
Includes the following accessories:

2 × Type 4187	¼" Condenser Microphone Cartridge
2 × Type 2670	¼" Preamplifier
AF 9111	Cable Labels, "A"
AF 9112	Cable Labels, "B"
BC 0200	Calibration Chart
2 × DB 3259	Swivel Nut
2 × DB 3260	Large Extension Tube
DH 0615	Sample Holder Foot
3 × DP 0821	Dummy Microphone
DS 0864	Large Calibration Sample
DS 0865	Small Calibration Sample
UA 1117	Large Measurement Tube
UA 1118	Small Measurement Tube
UA 1119	Large Sample Holder
UA 1120	Small Sample Holder
2 × UA 1168	Small Extension Tube
2 × ZG 0350	LEMO to Brüel & Kjær 7-pin Adaptor

Type 4206 A

Type 4206 A Impedance Measurement Tube for ASTM

Includes the following accessories:

2 × Type 4187	¼" Condenser Microphone Cartridge
2 × Type 2670	¼" Preamplifier

TRADEMARKS

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Brüel & Kjær reserves the right to change specifications and accessories without notice.

AF 9111	Cable Labels, "A"
AF 9112	Cable Labels, "B"
BC 0200	Calibration Chart
3 × DP 0821	Dummy Microphone
UA 1117	Large Measurement Tube
UA 2033	Medium Measurement Tube for Type 4206

Required Accessories

PULSE Multi-analyzer System

Type 7758 PULSE Material Testing

One of the following:

Type 7700 G Noise and Vibration Analysis System

or

Type 7770 G FFT Analysis

Power Amplifier

Type 2716 C Power Amplifier (includes input and output cables WL 1324 and WL 1325)

Optional Accessories

Type 4231 Sound Level Calibrator

UA 2033 Medium Measurement Tube for Type 4206

7700 G-MS1 Software Maintenance and Upgrade Agreement

or

7770 G-MS1 Software Maintenance and Upgrade Agreement