

# PRODUCT DATA

## Noise Dose Meter — Type 4444 Logging Noise Dose Meter — Type 4445 Intrinsically Safe Logging Noise Dose Meter — Type 4445E

Noise Dose Meter Type 4444, Logging Noise Dose Meter Type 4445 and Intrinsically Safe Logging Noise Dose Meter Type 4445E are small, lightweight and robust instruments for the assessment of personal noise exposure. The meters perform all of the essential functions for making dose measurements. In addition, Types 4445 and 4445E include statistical analysis of measurement data and the ability to log user-selected values.

The instruments have been designed for daily use – a simple matter of switching on, calibrating and starting the measurement. Definition of setups and handling of data can be done from a PC connected to the instrument.

The instruments can also be connected directly to printers, or to PCs, for further data processing.



## USES AND FEATURES

### USES

- Evaluation of personal noise exposure
- Noise surveys in the workplace

### FEATURES

- Simple operation, including direct read-out of results
- Compact and lightweight
- Rugged design
- Seven built-in setups cover national and international noise at work standards
- Thirteen user-defined measurement setups
- Post-processing of data using Noise Explorer Type 7815 and Protector Type 7825 PC software
- Download of setups from your PC to the Noise Dose Meter
- Keypad lock protects instrument against accidental operation
- The statistical analysis function and logging of values provide insights into the causes of noise exposure dose problems, pointing the way to possible solutions (Types 4445 and 4445E only)
- Timers support pre-selection of measurement time and duration (Types 4445 and 4445E only)
- An intrinsically safe model is also available (Type 4445E) for use in hazardous atmospheres, and for hand-held measurements (with optional stalk microphone fitted)

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## Prevent Noise-induced Hearing Loss in the Workplace

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The noise dose meter is a useful tool in the fight against noise-induced hearing loss on the job. Long-term exposure to a high average noise level is the number one cause of occupational hearing loss, yet many people cannot feel the damage occurring. Type 4444, 4445 and 4445 E noise dose meters are rugged, easy to use and comfortable to wear for an entire working day. They provide a simple, effective solution for evaluating noise exposure and preventing hearing loss in the workplace.

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## Noise Dose Defined

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### Criterion Level

A noise dose meter is typically used to measure the amount of noise an individual is exposed to throughout the working day. The person wears the meter with the microphone fastened close to the ear. During the course of the day, the meter continuously measures the sound pressure level and calculates the so-called noise “dose” received by the individual during the day. The noise dose is expressed as the equivalent average sound level for an 8 hour period (reference duration) and this level must be below the limit (or Criterion Level) specified in the relevant occupational health regulation (often an 85 dB limit is used). The noise dose may also be expressed as a percentage of the maximum allowed.

The equivalent level for an 8 hour period may be calculated from a measurement duration of less than 8 hours, assuming sound levels for the remaining time stay the same. The result is called the Projected Dose.

### Exchange Rate

If the limit is 85 dB and a person is exposed to a constant sound pressure level of 85 dB for eight hours, the result is a 100% noise dose. A constant level of 88 dB results in a 200% dose according to the ISO standard. ISO uses an energy-based average for the noise dose calculation, which means that the “exchange rate” or amount of increase that corresponds to a doubling of the noise dose is 3 dB. Using the 3 dB exchange rate, the 8 hour average level is known as  $L_{EP,d}$  (also known as  $L_{EX,8h}$  in some standards). The Sound Exposure (in physical units) for the measurement duration is known as  $E$  ( $Pa^2h$ ).

By contrast, the exchange rate defined in the OSHA standard is 5 dB (that is, the level must be raised to 90 dB to double the noise dose). Using the 5 dB exchange rate, the 8 hour average level is known as TWA (Time Weighted Average), while for exchange rates of 4, 5 or 6 the average level for the measurement duration is known as  $L_{avg}$ .

### Threshold

Most regulations specify that for the measurement of noise at work, sound levels below a certain limit (the threshold) should be disregarded. The noise dose meter, therefore, sums up the contributions from the levels above the threshold only, and uses these values to calculate the noise dose parameters.

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## Making Dose Measurements

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Before gathering any data, the first priority is to make sure your measurement is set up in accordance with the applicable regulation providing definitions and procedures to ensure that measurements are valid. Types 4444 and 4445 come with seven built-in setups, including OSHA, MSHA, DOD, ACGIH (USA Standards) and ISO 85<sup>a</sup>, ISO 90<sup>a</sup> (International Standards) which correspond to today's most widely used standards, ensuring simple compliance checks

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a. ISO procedures using 85 dB and 90 dB Criterion Levels

and valid data. Included with these setups are two sound level meter setups: METER, which can store data to memory; and SLM, which gives on-screen results only, and cannot store data to memory.

Furthermore, it's possible to define thirteen additional setups and download them to your meter with Noise Explorer Type 7815 software and Protector Type 7825 software.

Types 4444 and 4445 are specifically designed for making noise dose measurements. The measurement process consists of these simple steps (see Fig. 1):

- Attach the instrument and microphone
- Start the measurement
- Stop the measurement at the end of the day
- Check the results – they are saved to printout in the future, or for download to post-processing software

**Fig. 1**

*The microphone can be conveniently clipped to a collar and the noise dose meter inserted in a breast pocket*



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## **Additional Analytical Capabilities**

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Logging Noise Dose Meters Type 4445 and Type 4445 E include all of the functionality of the Type 4444, plus some powerful extras that make it much more effective in the struggle against hearing loss on the job. The added features are:

- Statistical analysis of noise levels
- Logging of data (i.e., recording of time histories)
- Timers for setting up automatic start and stop of measurements

The statistical and logging features are very useful for evaluating the validity of measurements. By looking at statistical data, for example, it is possible to establish a general picture of the noise situation in a given work area. You can find out how much the noise level varies, and whether excessive doses stem from a generally high noise level or a few isolated noise incidents. If a worker taps the microphone directly, for example, the resulting noise event will stand out clearly as anomalous compared to the general noise level, and you'll know to disregard the data. The ability to log values also provides greatly improved insight into the measurement situation. Data logging consists of making a large number of measurements over an extended period of time and attaching a time stamp to each data point. The resulting time history data set reveals a variety of facts, including how often noise levels are excessive and when. This makes it possible to link noise problems to specific processes or periods and to evaluate whether excessive readings should be eliminated from the measurement, or whether further investigation is necessary.

Timers are a convenient and time-saving way to automate daily dose measurements. The timer feature allows you to set up an entire week's worth of measurements, for example. You can

set up the meter to automatically start measuring every day when a worker arrives on the job, and to stop at his appointed finishing time. This eliminates the need to personally attend to each worker in connection with his or her daily measurement program, except for turning the noise dose meter on and off.

All these extra functions on Type 4445 build on the (already) strong basic measurement capabilities of Type 4444, making Type 4444/4445 an excellent choice for dealing effectively with noise control issues in the workplace.

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### **Intrinsically Safe Model (Type 4445 E)**

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An ‘intrinsically safe’ version of Type 4445 is also available. This model was designed to meet the requirements associated with ATEX certification code EEx ia I M1 and EEx ia IIC T4 II 1 G, which makes it particularly suitable for use in hazardous areas such as mines, printing works, petrochemical plants and other areas that require the use of Ex-rated instruments.

With the optional Stalk Microphone (MM-0274) fitted, it becomes a hand-held, Type 2 sound level meter.

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### **Post-processing – PC Software Type 7825 Protector™ (for Calculating Personal Noise Exposure)**

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Protector is a Windows®-based software package for post-processing, simulating and archiving noise exposure data. Designed to work with the family of Brüel & Kjær sound level meters, noise dose meters and sound level analyzers, Protector allows you to quickly download sample noise profiles for specific locations or persons. Protector can use this data to calculate noise exposure for people or positions under investigation.

Protector calculates noise exposure according to ISO 9612.2. For situations where only work point noise measurements are available, and workers move about, Protector can combine work point measurements with a profile of a persons movements, to simulate their personal noise exposure.

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### **PC Software Type 7815 Noise Explorer™ (for Reporting)**

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Noise Explorer is a Windows®-based software package for the downloading and reporting of noise and vibration data measured with Brüel & Kjær sound level meters and noise dose meters. Data can be exchanged between Noise Explorer and Type 7825 Protector.

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### **Compliance with Standards**

	<p>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.</p>
<p><b>EMC Emission</b></p>	<p>EN/IEC 61000–6–3: Generic emission standard for residential, commercial and light industrial environments. EN/IEC 61000–6–4: Generic emission standard for industrial environments. 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.</p>
<p><b>EMC Immunity</b></p>	<p>EN/IEC 61000–6–1: Generic standards – Immunity for residential, commercial and light industrial environments. EN/IEC 61000–6–2: Generic standards – Immunity for industrial environments. EN/IEC 61326: Electrical equipment for measurement, control and laboratory use – EMC requirements.</p>
 <p><b>Type 4445 E Only</b></p>	<p>EN 50014: Electrical apparatus for potentially explosive atmospheres. General requirements. EN 50020: Electrical apparatus for potentially explosive atmospheres. Intrinsic safety “i” (2002).</p>

## Specifications – Noise Dose Meter Type 4444, Logging Noise Dose Meter Type 4445 and Intrinsically Safe Logging Noise Dose Meter Type 4445 E

Specifications apply to all types unless otherwise stated. All types conform with the following National and International Standards:

- IEC 61252, ANSIS1.25
- IEC 60651–1979 Type 2<sup>a</sup>
- IEC 60804–2000 Type 2<sup>a</sup>
- ANSIS1.4–1983 Type S(1)
- ANSIS1.43–1997

### SUPPLIED MICROPHONE

**Type:** 1/4" Microphone with Integral Cable

**Connector:** 5-pin LEMO

### MEASUREMENT CONTROL

**Manual Control:** using keys for Start/Pause/Continue and Stop. After the Start key is pressed, measurement will start when the clock reaches 00 seconds

### MEASURING RANGES

**Linearity and Indicator Ranges at 4 kHz (IEC 60804):**

30–100: 43<sup>b</sup>–100 dB (A and C)

50–120: 50–120 dB (A and C)

70–140: 70–140 dB (A and C)

**Peak Range:**

C-weighted or Linear Peak over the top 40 dB of each measurement range

30–100: 63–103 dB Peak

50–120: 83–123 dB Peak

70–140: 103–143 dB Peak

### FREQUENCY WEIGHTINGS

**RMS Detector:** A or C

**Peak Detector:** C or L (Linear)

### TIME WEIGHTINGS

Fast, Slow and Impulse (RMS detector)

### EXCHANGE RATE

3 dB (always), plus one additional exchange rate of 4, 5 or 6 dB

### STABILISATION TIME

10 seconds from power on

### CALIBRATION

Done before and after measurement using Sound Calibrator Type 4231 (optional). Adaptor for calibrator supplied with Noise Dose Meter

### SETUP

Seven built-in (predefined) default setups are included – see Table 1. Thirteen additional user-defined setups can be stored

### MEASUREMENT PARAMETERS

Measured parameters are selected according to the selected setup and mode. For example, parameters based on an exchange rate different from 3 dB are not calculated or displayed when using the ISO setting.

Measured parameters, as applicable, are:

- a. Operating temperature range: 0–40°C for an accuracy of  $\pm 0.5$  dB.
- b. 10 dB above noise floor.

- Dose Percentage (Dose%)<sup>c</sup>
- 8 Hour Projected (Projected Dose%)<sup>c</sup>
- Sound Exposure (Pa<sup>2</sup>h)
- Time Weighted Average (TWA)<sup>c</sup> uses 8 hours reference duration
- Time Weighted Average (TWA<sub>v</sub>)<sup>c</sup> uses a user-defined reference duration
- Sound Pressure Level (SPL)
- Minimum Sound Pressure Level (L<sub>min</sub>)
- Maximum Sound Pressure Level (L<sub>max</sub>)
- Sound Exposure Level (L<sub>EP,d</sub>) uses 8 hours reference duration
- Sound Exposure Level (L<sub>EP,v</sub>) uses a user-defined reference duration
- Maximum Peak (L<sub>Cpk</sub> or L<sub>Lpk</sub>)
- Equivalent Continuous Sound Level (L<sub>eq</sub>), exchange rate 3 dB
- Impulse Weighted Average Sound Level (L<sub>leq</sub>), exchange rate 3 dB
- Average Sound Level (L<sub>avg</sub>), exchange rate 4, 5 or 6 dB (as applicable, according to set-up)
- Single Event Noise Exposure Level (L<sub>E</sub> or SEL)

### THRESHOLD AND CRITERION LEVELS

From the setup, predefined in the built-in setup according to applicable standards. User-defined setups in the following ranges:

- Threshold Level: 70–90 dB in 1 dB steps
- Criterion Level: 80–90 dB in 1 dB steps

### OVERLOAD INDICATIONS

At 0.1 dB above the top of the selected measurement range. Shown on the display and saved with the data

### UNDER-RANGE INDICATIONS

At 1 dB below the bottom of the selected measurement range. Shown on the display and saved with the data

### KEYPAD LOCK

Lock and unlock by pressing key combinations: up and right arrows to Lock; left and down arrows to Unlock

### CLOCK

Real-time clock with calendar

### MEMORY

Results from 50 measurements can be stored for later viewing, download and printing. Measurements can be erased using the instrument keypad or via Type 7815 and Type 7825 software

### OUTPUT

Data can be downloaded to a PC (with cable supplied)

Pre-formatted report can be printed on parallel interface printer (Centronics) (requires cable AO-0576, not supplied)

### MICROPHONE TEMPERATURE

For service use only, displayed at 0.1°C resolution

### BATTERY

Single 9V alkaline (IEC 6LF22)

(Type 4445 E requires Duracell MN1604 PP3 or Duracell 'Procell')

c. Threshold applied.

**Table 1** Summary of Default Setups

Setup	OSHA	MSHA	DOD	ACGIH	ISO 85	ISO 90	METER	SLM
Measurement Range (dB)	70–140	70–140	70–140	70–140	70–140	70–140	50–120	70–140
Time Weighting	Slow	Slow	Slow	Slow	Fast	Fast	Fast	Slow
Frequency Weighting	A	A	A	A	A	A	A	A
Peak Frequency Weighting	Lin	Lin	Lin	Lin	C	C	C	Lin
Exchange Rate	3 and 5	3 and 5	3 and 4	3	3	3	3	3
Threshold (dB)	80	80	80	80	70	70	N/A	N/A
Criterion Level (dB)	90	90	85	85	85	90	N/A	N/A
Allow User to Change Setup	No	No	No	No	No	No	Yes	Yes

**Battery Lifetime:** Typically >35 hours at room temperature. (Type 4445E: >30 hours)

The instrument will automatically stop the measurement and store the data before the battery voltage gets too low.

**Battery Indicator:** Symbol indicating battery voltage level in 8 steps. BATT FAIL indicated when voltage is insufficient for operation

**Battery Backup:** A super-capacitor is incorporated, with at least 15 minutes life, which gives you enough time to change the battery

#### OPERATING ENVIRONMENT

##### Operating Temperature:

-0 to +40°C (32 to 104°F) for an accuracy of <±0.5 dB

-10 to +50°C (14 to 122°F) for an accuracy of <±0.8 dB

Type 4445E has a maximum operating range of +40°C (104°F)

**Storage Temperature:** -10 to +50°C (14 to 122°F)

**Humidity ± 0.5 dB:** 30% – 90% (non-condensing)

**Influence of Magnetic Fields:** Negligible

**Influence of Vibration:** Negligible

#### DIMENSIONS AND WEIGHT

**Dimensions:** 120 × 65 × 30 mm (4.8 × 2.6 × 1.2 in.), excluding microphone

**Weight:** 280 g (9 oz.) including battery.

(Type 4445E: 380g (12 oz.))

### Additional Specifications for Type 4445 (including Type 4445 E)

#### OPTIONAL MICROPHONE MM 0274 (TYPE 4445 E ONLY)

**Type:** 1/4" Stalk Microphone

**Connector:** 5-pin LEMO

#### MEASUREMENT CONTROL

**Measurement Duration:** may be set to 5, 10, 15 or 30 minutes or 1, 2, 4, 8, 12 or 24 hours

#### TIMERS

Up to 16 timers (automatic start and stop) can be set (maximum up to one month ahead of measurement time)

**Timer Controlled Start/Stop:** set up from the PC software, enabled or disabled using menus on the instrument. For the timer to operate, the instrument must be turned on

#### SYNC

Timer available which synchronises the logging period to the real-time clock. For example, if activated, and the logging period is set to 1 hour, the logging will begin exactly on the next full hour

#### MEASUREMENT PARAMETERS

Statistical noise levels ( $L_N$ ), five values selected by the user in 1 dB steps (default:  $L_{10}$ ,  $L_{50}$ ,  $L_{90}$ ,  $L_{95}$ ,  $L_{99}$ )

A statistical distribution with 0.5 dB resolution is stored

#### LOGGING

Up to ten values can be logged, selected from these parameters (if the Logging Period is  $\geq 1$  minute):  $L_{eq}$ ,  $L_{leq}$ ,  $L_{avg}$ ,  $L_{min}$ ,  $L_{max}$ ,  $L_{pkmax}$ ,  $L_N$

**Logging Period:** 1 s, 2 s, 5 s, 10 s, 15 s, 20 s, 30 s, 1 min, 2 min, 5 min, 10 min, 15 min, 20 min, 30 min or 60 min

**Logging Capacity:** More than 220000 values can be stored at any one time

### Ordering Information

Type 4444 Noise Dose Meter

Type 4445 Logging Noise Dose Meter

Type 4445 E Intrinsically Safe Logging Noise Dose Meter

AO-0576

Adaptor Cable for Interface to Parallel Interface Printer

MM-0111

1/4" Microphone with Integral Cable, Type 4444 and Type 4445 only

MM-0275

1/4" Microphone with Integral Cable, Type 4445 E only

#### INCLUDE THE FOLLOWING ACCESSORIES

MM0111 1/4" Microphone with Integral Cable, Type 4444 and Type 4445 only

MM-0275 1/4" Microphone with Integral Cable, Type 4445 E only

KE-0428 Carrying Case with Inlay

DP-0952 1/4" adaptor for Sound Calibrator Type 4231

AO-0577 Serial Interface Cable

2 × QB-0016 9 V Alkaline Batteries

#### SERVICE PRODUCTS

4444-CAI Accredited Initial Calibration of Type 4444

4444-CAF Accredited Calibration of Type 4444

4444-CTF Traceable Calibration of Type 4444

4444-EW1 Extended Warranty, one year extension

4445-CAI Accredited Initial Calibration of Type 4445

4445-CAF Accredited Calibration of Type 4445

4445-CTF Traceable Calibration of Type 4445

4445-EW1 Extended Warranty, one year extension

4445-E-CAI Accredited Initial Calibration of Type 4445 E

4445-E-CAF Accredited Calibration of Type 4445 E

4445-E-CTF Traceable Calibration of Type 4445 E

4445-E-EW1 Extended Warranty, one year extension

#### Accessories Available

Type 4231 Sound Calibrator

MM-0274 Stalk Microphone, Type 4445 E only

Type 7815 Noise Explorer Software

Type 7825 Protector Software

#### TRADEMARKS

Windows is a registered trademark of Microsoft Corporation in the United States and/or other countries

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

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