PRODUCT DATA

Human Vibration Analyzer — Type 4447

An increase in the number of hand-arm and whole-body injuries caused by vibration is the consequence of the use of modern appliances that are powered by external power sources.

Hand-tools, machinery, and heavy vehicles cause vibration, the harmfulness of which depends on its intensity and frequency content, and the time of exposure.

Human Vibration Analyzer Type 4447, a portable system for acquisition, measurement and evaluation of human vibration, is designed to meet the requirements of those who wish to monitor and reduce the exposure of human operators to the harmful influences of such vibration.

USES AND FEATURES

USES

- Hand-arm vibration measurements (1 to 1250 Hz)
- Whole-body vibration measurements (1 to 80 Hz)
- Low-frequency whole-body vibration measurements down to 0.4 Hz
- Linear mode (0.4 to 1250 Hz) – for calibration

FEATURES

- Compact, stand-alone instrument with an internal power source
- Versatile graphics display for control of the instrument and analysis of results
- Only four buttons to control the instrument's functions – ideal for field-work
- All the necessary data is displayed for instant assessment of exposure to vibration
- Very few cables (only one cable connection to a transducer in basic setup)
- USB connection to a computer for post-processing and archiving
- Risk assessment following the good practice guide for human vibration

Tentative

Brüel & Kjær

Introduction

This instrument has been designed for those working with human vibration and who require quick and reliable results. Using Type 4447, measurements can be made easily, as only the necessary parameters required by EU Directive 2002/44/EC are calculated.

The instrument was developed and designed on the basis of input from several groups concerned about human vibration:

- Consultants working with measurements of, and risk evaluations caused by, exposure to occupational vibration
- Departments for occupational health
- Manufacturers of building machinery, freight vehicles and other machinery causing vibration
- Manufacturers of anti-vibration pads, seats and personal protection equipment
- Manufacturers of all kinds of hand-tools
- Educational institutions
- Medical institutions

Measurement Options

Type 4447 simultaneously measures and calculates the following parameters[1]:

- Three components of the running RMS vibration, weighted or unweighted, a_x, a_y, a_z
- Three components of the peak vibration, weighted or unweighted, $a_{x,\,peak}$, $a_{y,\,peak}$, $a_{z,\,peak}$,
- The crest factor for each axis
- The frequency-weighted hand-arm vibration a_{Wx}, a_{Wy}, a_{Wz}
- The frequency-weighted whole-body vibration a_{Wx}, a_{Wy}, a_{Wz}
- The combined vibration on all 3 axes as a vector sum a_{Wv}, with implementation of the *k*-factors for whole-body
- MTVV – Maximum Transient Vibration Value
- MSDV – Motion Sickness Dose Value
- VDV – Vibration Dose Value
- Evaluation of results with respect to daily exposure limits and action values for hand-arm and whole-body vibration

Display

- User-friendly graphical interface for set up of measurements and readout of results
- Current measurement results expressed as running rms, peak, crest factor, time averaged vibration, sum, $peak_{max}$, MTVV, MSDV, VDV
- Readings in g, m/s^2, ft/s^2, in/s^2, or dB
- Display of *k*-factors
- Measurement status (Stop, Pause, Run)
- Elapsed time
- Battery status
- Colour input status indication
- Overload indication
- Open-circuit and short-circuit connection warning
- Voltage input
- Memory

1. Only parameters required by EU Directive 2002/44/EC are enabled and displayed.

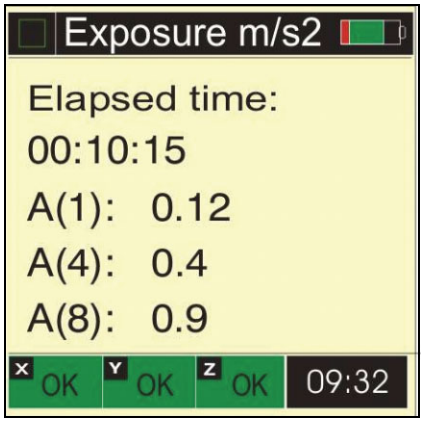
Description

Type 4447 has four analog inputs and one USB digital I/O. The inputs are designed for use with tri-axial or mono-axial accelerometers and are equipped with selectable CCLD (ICP®) power supplies. The sensitivity of the input channels is designed to fit the typical transducers used in human vibration.

The inputs are equipped with the necessary W_x weighting curves for hand-arm and whole-body vibration measurement. The processing power of the instrument is such that it can display all measurement parameters, including the combined vector sum of all three axes, (with added k_i for whole-body), the vibration dose (VDV), the peak values for individual axes, and the crest factor. The crest factor indicates the impulsiveness of the vibration.

Instantaneous and equivalent results for the individual and combined axes are available while the measurement is in progress. After the measurement has stopped, additional parameters are available – the calculated 1, 4, and 8 hour exposure values (Fig. 1), the allowed time exposure and maximum rms values.

Fig. 1
Calculated exposure values



Before a new measurement is started, the current results can be stored or you can choose to overwrite them.

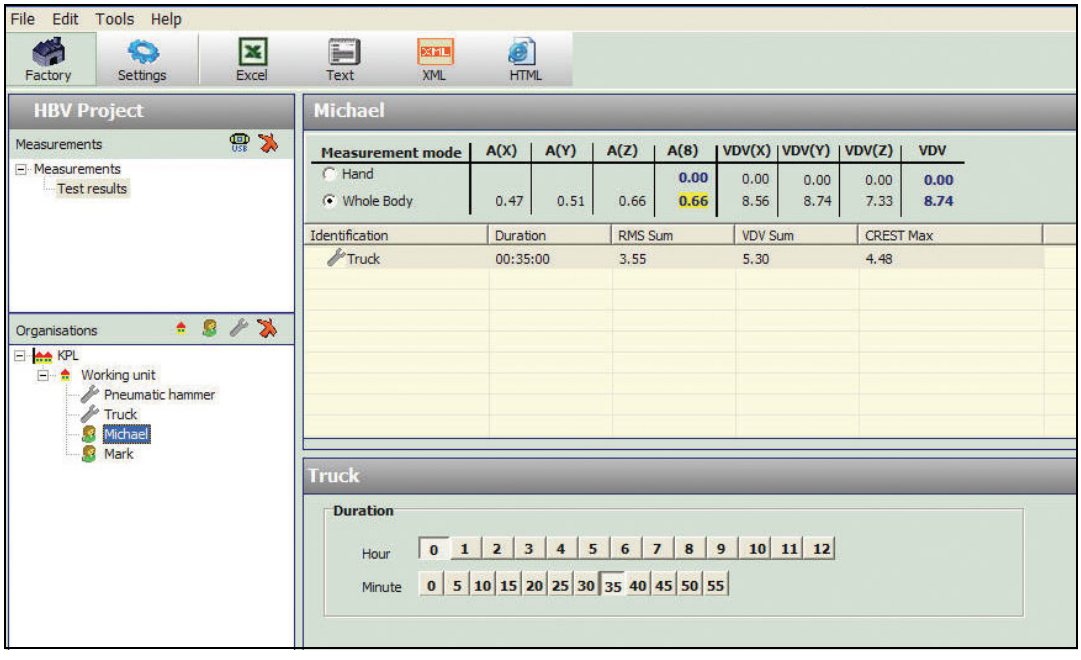
The instrument has space for up to 750 measurements in a non-volatile memory.

Stored results can be recalled to the display or sent over the USB interface to a PC for further processing.

Software is included with the instrument to enable the transfer of results to a PC and their manipulation.

For instance, you can use the software to combine the results from different measurement points and give exposure limits for combined operations, see Fig. 2.

Fig. 2
Calculated exposure values



The commonly used weighting curves for hand-arm and whole-body vibration are stored in the instrument by default. Other weighting curves can be added as required. Multiple weighting filters can also be added to the instrument, with an optional utility tool to meet the requirements of ISO 8041 or other relevant standards.

What is Included?

Human Vibration Measuring Kit

Fig. 3
Human Vibration Measuring Kit

Human Vibration Measuring Kit Type 4447 includes the following items:

- Four-channel Human Vibration Analyzer
- Triaxial Accelerometer Type 4524
- Adaptors for hand, arm, and direct mounting of an accelerometer
- Power supply and charger
- Seatpad adaptor
- USB connection cable
- Software for the download and calculation of daily exposures for 1, 4, and 8 hour periods
- User manual
- Power supply

The following option is also available:

- Calibration Exciter Type 4294

Compliance with Standards

CE, C-Tick	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/IEC 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use. UL 61010–1: Standard for Safety – Electrical measuring and test equipment.
EMC Emission	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.
EMC Immunity	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. **Note:** The above is only guaranteed using accessories listed in this Product Data sheet.

Specifications – Human Vibration Analyzer Type 4447

Type 4447 complies with the following National and International Standards:

- ISO 8041–2005 Technical specification
- ISO 5349–2: 2001 Hand arm
- ISO 2631–1: 1997 Whole body
- EN 1032–2003: Mechanical vibration
- EU Dir. 2002/44/EC

SUPPLIED ACCELEROMETER

Type: 4524-B-001
Sensitivity: 10 mV/g
Frequency: 0.5 Hz to 6.5 kHz

DYNAMIC RANGE

Type 4447 has one measuring range which covers the range of the supplied accelerometer. Useful range is between 0 m/s^2 to approx. 450 m/s^2 (more than 80 dB)

NOISE

Noise Level: < 5 mV or –80 dB of full scale 7 Vp. Depends on the high-pass Filter

High-pass Filter	0.4 Hz	1 Hz	3 Hz
Noise	0.4 mV	0.35 mV	0.3 mV

DETECTOR

Simultaneous measurement of peak and rms vibration value for each channel

FREQUENCY WEIGHTING

Filters for frequency weightings are calculated in time domain to conform ISO 8041–2005, including filters W_h, W_d and W_k. Other frequency curves can be added on request

DISPLAY

Sony® Colour graphical display with the resolution of 124 × 124 pixels:

Basic information regarding the instrument status is shown through icons, including: battery indicator; measurement status; run; pause; stop; input type; 'U' as direct or voltage input or 'OK' as DeltaTron® input; Overload (OVL); Open (OPN); or short (SHT) and real time or elapsed time

MEASURING PARAMETERS

Measured parameters are selected according to the selected setup mode. The following parameters are measured and calculated during measurement: Time Averaged Weighted Acceleration Value (TAWAV); Maximum Transient Vibration (MTVV); Vibration Dose Value (VDV); Motion Sickness Vibration Dose (MSDV); running rms acceleration value
Resolution: 0.01 m/s^2

MEMORY

64 kB or 750 measurements can be stored in non-volatile memory

USB INTERFACE

Conforms to USB 2.0
Connector: Mini B

CLOCK

Real-time clock with calendar

CALIBRATION

Reference Vibration Value: 10 m/s^2
Reference Fequency: 159.4 Hz or 79.7 Hz
Reference Electrical Level: 100 mV
Frequency: 79.7 Hz

BATTERY

Rechargeable Li-ion battery 3.7 V, 2400 mA. More than 3.5 h continuous use at room temperature

PHYSICAL DIMENSIONS

Size: 70 × 135 × 28 mm (2.7 × 5.3 × 1.1″)
Weight: 260 g (9.2 oz), battery included

Ordering Information

Type 4447-A	**Human Vibration Analyzer, including:**
Type 4515-B-001	Triaxial DeltaTron Seat Pad Accelerometer, with built-in Type 4524-B-001, 10 mV/g, TEDS, with 3 m integral cable to 4-pin LEMO
AO-0694-D-012	3×10–32 UNF LEMO female adaptor, 1.2 m, for Type 4447-A and 4447-B
AO-0693-D-025	LEMO to 4-pin 1/4–28 connector cable, 2.5 m, for Type 4447-A and 4447-B
and the following	accessories:
	Hand Adaptor
	Handle Adaptor
	Cube Adaptor for direct fixation
	Basic software for data transfer (utility), organising measurement site and calculation
	USB standard A to USB mini-B interface cable
	Universal Charger
	Screwdriver

Type 4447-B	**Human Vibration Analyzer, including:**
	all components and accessories listed for Type 4447-A, plus:
Type 4294	Calibration Exciter

OPTIONS

Type 4294	Calibration Exciter (included in Type 4447-B)
AO-0694-D-012	3×10–32 UNF LEMO female adaptor, 1.2 m, for Type 4447-A and 4447-B
AO-0693-D-025	LEMO to 4-pin 1/4–28 connector cable, 2.5 m, for Type 4447-A and 4447-B

SERVICE PRODUCTS

	Traceable Calibration, with certificate[1]
	Extended Warranty, 1 year[1]
	Extended Warranty, 3 years[1]

1. Will be available from September 2006

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