

PRODUCT DATA

Reference Sound Source Type 4204

Reference Sound Source Type 4204 is a calibrated source of sound power with very well defined operating characteristics and predictable performance. It is rugged, compact and stable, and is therefore suitable for both field and laboratory use.

Type 4204 is intended for use as a reference source for determination of the sound power output of equipment by the various comparison methods including the method described in ISO 3741, and by the survey methods described in ISO 3747. Type 4204 is also used for measuring environmental correction K_2 when determining sound power according to ISO 3744. It is also useful in the field of building acoustics to determine the sound absorption and the sound insulation of a room.



Uses and Features

Uses

- Comparison method for determination of sound power of noise sources according to ISO 3741
- Measurement of environmental correction, K_2 according to ISO 3744
- Sound absorption measurements
- Sound insulation measurements

Features

- Fulfils ISO 3741, ISO 3744, ISO 3745, ISO 3747 and ISO 6926 for calibrated sound power sources
- Frequency range from 50 Hz to 20 kHz
- Sound power output 91 dB re 1 pW (A-weighted, 50 Hz line frequency) and 95 dB re 1 pW (A-weighted, 60 Hz line frequency)
- Temperature range -10°C to $+50^{\circ}\text{C}$
- 50 and 60 Hz operation
- Long-term stability
- Individual calibration chart supplied
- Compact and rugged
- Fitted with safety grid

Characteristics

The reference sound source consists essentially of a specially designed centrifugal fan driven by a powerful asynchronous motor. The motor is an external rotor type, and due to its high moment of inertia, it has a very stable speed of rotation. The motor is mounted on a cast aluminium base, shaped to minimize reflections. The complete assembly of motor and fan is within a cylindrical safety grid fitted with two carrying handles.

The directional characteristic of the reference sound source in the vertical plane varies less than 6 dB for any frequency in the range 100 Hz to 10 kHz (measured in 1/3-octaves). In the horizontal plane, the variation is less than 0.2 dB for frequencies up to 10 kHz (measured in 1/3-octaves). Fig. 1 shows some typical vertical directional characteristics. The reference sound source fulfils the requirements for reference sound sources as stated in ISO 3741, ISO 3747, ISO 6926 and ANSI S1.3 1. The use of a reference sound source in noise and sound power measurements on machines is also described in DIN 45635.

The reference sound source has a frequency range of 100 Hz to 20 kHz. In the range from 100 Hz to 10 kHz, the acoustic power output is greater than 70 dB re 1 pW in any 1/3-octave frequency band. The A-weighted output is typically 91 dB (50 Hz line frequency) and 95 dB (60 Hz line frequency). Fig. 2 shows a typical 1/3-octave frequency response curve of Type 4204.

Fig. 1 Directivity index measured vertically above Type 4204 in 1/3-octave bands

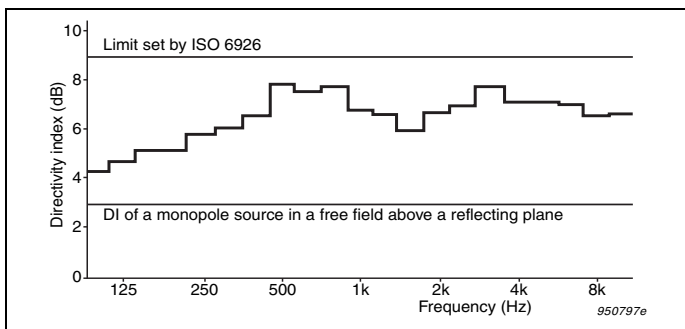
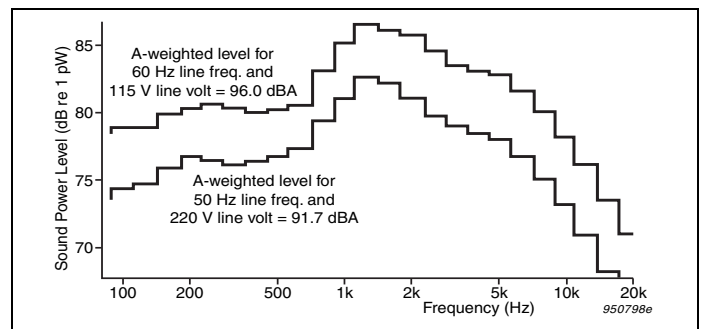


Fig. 2 Typical sound power spectrum of Type 4204



Each reference sound source is individually calibrated and, as standard, a calibration table is supplied showing the sound power output from 100 Hz to 20 kHz at 230 V/50 Hz and 115 V/60 Hz operating voltages. Temperature, barometric pressure, humidity and rotational speed are all given on the calibration table. The maximum interval between successive calibration is 24 months. If there are signs of physical damage to Type 4204, then a recalibration is recommended.

In the field, the sound power produced may differ from the calibrated value. Changes in mains supply line voltage and frequency, ambient pressure, and temperature all affect the rotational speed of Type 4204. In addition, changes in ambient pressure and temperature alter the specific acoustic impedance of the air, also changing the sound power. Once the values are measured, however, simple formulae can be used to calculate the correct sound power levels from the values given on the calibration table.

Carrying Case WE-0268

Fig. 3
WE-0268 is a tough, padded carrying case. It is an optional accessory for use with Type 4204 and especially useful for protection during shipment to and from calibrations, as well as for relocation generally. It has a fold-away handle on one of the top edges and pivoted rollers attached to its base for safe, easy transportation



Accredited Calibration Services at Brüel & Kjær

To ensure traceable measurement history from day one, you can order accredited calibration with your new Type 4204.

If there are signs of physical damage to Type 4204 then a recalibration is recommended. We recommend that your Type 4204 is calibrated at a Brüel & Kjær ISO 17025 certified laboratory annually or biennially. If any errors are detected by the technician during calibration, repair will be performed prior to returning the instrument to you.

Fig. 4 Typical calibration certificate issued by an accredited calibration laboratory

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 ISO 17025:2005
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Brüel & Kjær Calibration Laboratory
 Skudsborgvej 307
 DK-2650 Nærum
 DENMARK

Initial calibration of a reference sound source

Identification
 Object: Reference sound source Brüel & Kjær type 4204 ser.no. 2798017
 Object state: Upon arrival the object had no visual damage.
 Arrival date: April 4, 2012
 Calibration date: April 11, 2012

Measurement methods and procedures
 The calibration has been performed according to ISO 6926:1999 and ANSI S12.5-2006/ISO 6926:1999, the free field method, and the sound power level for the actual meteorological conditions is calculated according to ISO 3745:2000 by adding the following correction:

$$-10 \lg \left(\frac{\beta}{1013.2} \sqrt{\frac{273.15}{273.15+\theta}} \right)$$

where
 β = barometric pressure during calibration (hPa)
 θ = air temperature during calibration (°C)

The result is finally normalized to reference meteorological conditions, 23°C and 1013.2 hPa, using corrections given in the BAK 4204 manual, by adding the following correction:

$$-10 \lg \left(\frac{\beta}{1013.2} \sqrt{\frac{273.15}{273.15+\theta}} \right)$$

The free-field method with 3 meridional paths and a radius of 2 m is used. Each path has an integration time of 300 s. The microphone is mounted with its normal at 90° to the centre radius vector of the measurement hemisphere. The measurements have been corrected for air absorption according to ISO 9613-1:1993.

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Measurement conditions

Room temperature	22 ± 1°C	230 V / 50 Hz
Relative humidity	25 ± 5 %	22 ± 1°C
Air pressure	972 ± 3 hPa	972 ± 3 hPa
Rotation speed	2251 ± 10 rpm	2387 ± 10 rpm
Main voltage	115 ± 0.5 V	230 ± 2 V
Main frequency	60 ± 0.5 Hz	50 ± 0.2 Hz

The mains voltage switch was set to 115 V and 240 V respectively.

Results
 The sound power level of the reference source, normalized to 23°C and 1013.2 hPa, is given in the table below.

Frequency (Hz)	L_{w} (dB m ² pW)		Uncertainty (2σ) (dB)
	115 V / 60 Hz	230 V / 50 Hz	
50	79.8	77.2	1.0
63	80.7	77.1	1.0
80	79.8	76.7	1.0
100	81.2	77.2	0.9
125	79.8	76.1	0.8
160	79.8	76.3	0.8
200	80.3	76.0	0.8
250	80.1	76.5	0.8
315	79.9	76.4	0.8
400	79.9	76.7	0.8
500	80.0	76.3	0.8
630	80.3	77.2	0.8
800	82.3	78.6	0.8
1 k	81.2	78.7	0.8
1.25 k	84.4	81.4	0.8
1.6 k	83.0	81.8	0.8
2 k	83.5	81.8	0.8
2.5 k	84.1	80.0	0.8
3.15 k	83.0	79.4	0.8
4 k	82.9	79.2	0.8
5 k	82.3	79.2	0.8
6.3 k	81.5	77.4	0.8
8 k	79.8	75.5	0.7
10 k	77.0	73.4	0.8
12.5 k	76.1	71.5	1.0
16 k	74.4	69.7	1.2
20 k	72.4	67.7	1.2
25 k	69.9	65.3	0.8
A-weighted	84.0	81.2	0.4

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The reported results are within the limits specified by ISO 6926:1999 and ANSI S12.5-2006/ISO 6926:1999, which are:

- Max. difference in L_{w} in two adjacent 1/3 octave bands is:
 - 3 dB from 100 Hz to 10 kHz
 - 4 dB from 50 Hz to 20 kHz
- Max. deviation in L_{w} over the total frequency range:
 - 12 dB from 100 Hz to 10 kHz
 - 16 dB from 50 Hz to 20 kHz

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with IFA Publication EA-402. The long term stability of the calibrated object is not included in the reported expanded uncertainty of measurement.

Traceability
 The result is traceable to Swedish national and international sound pressure standards.

Equipment

- Microphone: Brüel & Kjær type 4180 ser.no. 15157818
- Preamplifier: Brüel & Kjær type 2469 ser.no. 2221477
- Sound analyser: Brüel & Kjær type 3050-A-960 ser.no. 100552, PULSI ver. 14.1.1
- Sound calibrator: Brüel & Kjær type 4231 ser.no. 1790609
- Tachometer: Luton type DT-232A ser.no. 502529



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 Energiteknik - Akustik

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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/IEC 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use. ANSI/UL 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use.
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. This ISM device complies with Canadian ICES-001 (interference causing equipment standard).
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.
Temperature	IEC 60068-2-1 & IEC 60068-2-2: Environmental Testing. Cold and Dry Heat. Operating Temperature: -10 to +55°C (14 to 131°F). Storage Temperature: -25 to +70°C (13 to 158°F).
Humidity	IEC 68-2-3: Damp Heat: 90% RH (non-condensing at 30°C).
Mechanical	Non-operating: IEC 66-2-6: Vibration: 0.3mm, 20m/s ² , 10-500Hz. IEC 68-2-27: Shock: 750m/s ² .

Specifications – Reference Sound Source Type 4204

POWER SUPPLY

Supply Voltage: 110, 115, 127, 230 or 240 V AC, 50 or 60 Hz

Power Consumption: 50 Hz: 500 VA; 60 Hz: 700 VA

SOUND POWER OUTPUT

Measured in 1/3-octaves from 100 Hz to 20 kHz: >70 dB re 1 pW

A-WEIGHTED SOUND POWER OUTPUT (NOMINAL)

91 dB re 1 pW @ 50 Hz line frequency

95dB re 1 pW @ 60 Hz line frequency

A-WEIGHTED SOUND PRESSURE LEVEL

Nominal; diffuse field in a room with an equivalent absorption area of 10 m²

87 dB(A) @ 50 Hz line frequency

91 dB(A) @ 60 Hz line frequency

VARIATION OF SOUND INTENSITY WITH DIRECTION:

(10 Hz to 10 kHz measured in 1/3-octaves under free-field conditions)

Vertical Plane: <6 dB

Horizontal Plane: <0.2 dB

VARIATION OF SOUND POWER OUTPUT

With Supply Voltage: ($\pm 10\%$ (50 Hz) and $\pm 5\%$ (60 Hz) of nominal voltage): $< \pm 0.2$ dB @ 50 Hz line frequency

$< \pm 0.3$ dB @ 60 Hz line frequency

With Barometric Pressure: Sound power output is proportional to barometric pressure at a constant speed of rotation

FREQUENCY OF ROTATION

Nominal

48 Hz @ 50 Hz line frequency

56 Hz @ 60 Hz line frequency

The frequency of rotation during calibration is given on the calibration chart

DIMENSIONS

Height: 300 mm (11.8")

Diameter: 300 mm (11.8")

Weight: 21 kg (46 lb)

CALIBRATION

Maximum time between calibrations: 24 months

Ordering Information

Type 4204 Reference Sound Source

Includes the following accessories:

- VF-0044: 6.3 Amp fuse
- 2xVF 0043: 12.5 Amp fuses

OPTIONAL ACCESSORIES

WE-0268 Carrying case for protection during shipment to and from calibrations and during relocation generally

Service Products

ACCREDITED CALIBRATION

4204-CA1	Accredited Calibration of Sound Source Type 4204, at power 100 V, 50 Hz
4204-CA2	Accredited Calibration of Sound Source Type 4204, at power 100 V, 60 Hz
4204-CA3	Accredited Calibration of Sound Source Type 4204, at power 115 V, 50 Hz
4204-CA4	Accredited Calibration of Sound Source Type 4204, at power 115 V, 60 Hz
4204-CA5	Accredited Calibration of Sound Source Type 4204, at power 230 V, 50 Hz

INITIAL ACCREDITED CALIBRATION

4204-CI1	Initial Accredited Calibration of Sound Source Type 4204, at power 100 V, 50 Hz
4204-CI2	Initial Accredited Calibration of Sound Source Type 4204, at power 100 V, 60 Hz
4204-CI3	Initial Accredited Calibration of Sound Source Type 4204, at power 115 V, 50 Hz

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Brüel & Kjær 

