Czech Metrology Institute
Okružní 31, 638 00 Brno

1. ------IND- 2018 0577 CZ- EN- ------ 20181224 --- --- PROJET

Executive summary for the EC (not part of this legislation)

'Sound-measuring instruments of classes 1 and 2, bandwidth filters, measurement microphones' may be placed on the market and put into use in the Czech Republic as specified measuring instruments pursuant to Act No 505/1990 on metrology, as amended. Pursuant to this act, the specified measuring instruments are measuring instruments in the List of Specified Measuring Device Types (Decree No 345/2002) and specified (by the manufacturer/importer) for measurement important for the protection of public interests in the following areas: consumer protection; contractual relations; stipulation of sanctions, fees, tariffs and duties; health protection; environmental protection; occupational safety or protection of other public interests protected by separate legislation. This is therefore a similar purpose to that which is used to identify stipulated products – non-automatic measuring and weighing instruments pursuant to Directives 2014/31/EU and 2014/32/EU. The requirements of this General Measure do not apply to measuring instruments not placed on the market in the Czech Republic for the above purposes, identified by Act No 505/1990 on metrology.

The purpose of this notified legislation is to lay down metrological and technical requirements for these specified measuring instruments. This legislation also stipulates tests for type approval and verification of specified measuring instruments of this type.

(End of executive summary)

Author: Mgr. Tomáš Hendrych
Telephone: 545 555 414

P U B L I C N O T I C E

As the authority with substantive and territorial jurisdiction in the matter of laying down metrological and technical requirements for specified measuring instruments and stipulating the testing methods for type approval and verification of specified measuring instruments pursuant to § 14(1) of Act No 505/1990, on metrology, as amended (hereinafter the 'Metrology Act'), and in accordance with the provisions of § 172 et seq. of Act No 500/2004, the Code of Administrative Procedure (hereinafter the 'CAP'), the Czech Metrology Institute (hereinafter the 'CMI') commenced ex officio proceedings on 2 March 2016 pursuant to § 46 of the CAP, and, based on supporting documents, issues the following:

I.

D R A F T G E N E R A L M E A S U R E

number: 0111-OOP-C087-18

laying down the metrological and technical requirements for legally controlled measuring instruments, including testing methods for verification of the following legally controlled measuring instruments:

'Sound-measuring instruments of classes 1 and 2, bandwidth filters, measurement microphones'

This General Measure introduces electroacoustic operating requirements for the following types of sound-measuring instruments:

- conventional sound level meters which exponentially measure time-weighted sound pressure levels;
- integrating-averaging sound level meters which measure the equivalent sound pressure levels;
- integrating sound level meters which measure sound exposure levels;
- intensity sound level meters which measure acoustic energy or intensity in a sound field;
- measurement condenser microphones, single or in pairs, or microphone fields;
- octave and third-octave filters (as well as software filters and analysers).

An individual sound level meter must ensure any or all types of measurement. All sound level meters specified in this Measure must be equipped with frequency function A. They may also be equipped with additional octave and third-octave filters. However, they must always be capable of working with measurement microphones which have properties pursuant to the technical conditions specified in this Measure.

1 Basic definitions

For the purposes of this General Measure, the terms and definitions according to VIM and VIML[1], ČSN IEC 50(801)[2] shall apply.

2.1 Operating conditions

2.1.1 Operating conditions for use of the measuring instrument

The operating conditions for sound measurement instruments shall be specified by the manufacturer for the particular type of measuring instrument. If not specified, the following requirements shall apply to class 1 sound level meters:

- the ambient operating temperature range must be at least −10 °C to +50 °C;
- the relative air humidity limits must be at least 30 % to 70 %;
- atmospheric pressure must at least be within the limits 85 kPa to 108 kPa.

---

[1] TNI 01 0115 International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (VIM) and International Vocabulary of Terms in Legal Metrology (VIML) are part of the technical harmonisation compendium 'Terminology in the Area of Metrology', which is publicly accessible at www.unmz.cz.

[2] ČSN IEC 50(801) International Electrotechnical Vocabulary – Chapter 801: Acoustics and electroacoustics

2.1.2 Reference operating conditions

The reference ambient conditions are:

- air temperature 23 °C;
- static pressure 101.325 kPa;
- relative air humidity 50 %.

2.1.3 Temperature stabilisation period

The times needed for temperature stabilisation of the measuring instrument must be clearly indicated on the measuring instrument and stated in the manufacturer's documentation.

3 Technical requirements

3.1 General technical requirements

3.1.1 This Measure specifies two operating categories of sound level meters, class 1 and class 2. An additional class 0 having the lowest permissible error values is established for filters.

3.1.2 Sound level meters (except intensity meters) must have specified frequency characteristics for sound impacting the microphone in a single main direction in a free sound field or in random directions.

3.1.3 Sound level meters are intended for measuring sounds within the range of human hearing, but if ultrasound is present within the audible sound, then the frequency function AU may be used. If the sound level meter is equipped with a frequency function AU, the measurement result will be measured as a sound pressure level AU. The nominal characteristics of the frequency function AU and associated maximum permissible error values are in the frequency range of 10 Hz to 20 kHz in accordance with the nominal characteristics and maximum permissible error values specified in Table 3 of this Measure for frequency function A. Sound pressure level measurement with an AU weighting function is also the sound pressure level measurement with an A weighting function.

3.1.4 This Measure applies to the design of a sound level meter within the specified range. A sound level meter may be an individual manual instrument with a connected microphone (or multiple microphones) and a built-in display device. A sound level meter may be made up of separate components located in one or more units and may be capable of displaying multiple levels of an acoustic signal. Sound level meters may include extensive processing of an analogue or digital signal, be it individually or in combination with multiple analogue or digital outputs. Sound level meter components may include multi-purpose computers, data loggers, printers and other devices which constitute an essential component of the complete instrument.

3.1.5 Sound level meters may be designed for use with an operator present (or without, using remote control), or for automatic or continuous measurement of sound pressure levels without an operator present. The technical requirements specified in this Measure for response to sound waves apply to sound fields without an operator present.

3.2 Technical requirements for measurement microphones

3.2.1 The body diameter of measurement microphones must be:

- for a 1" microphone: (23.77 ± 0.05) mm;
- for a 1/2" microphone: (13.20 ± 0.05) mm;
- for a 1/4" microphone: (7.00 ± 0.05) mm;
- for a 1/8" microphone: (3.50 ± 0.05) mm.

Microphones must have a screw-on protective screen so that an electrostatic actuator (which must be specified and supplied by the manufacturer) can still be placed on the microphone. In case of a design with a fixed screen, this screen must be galvanically separated into two parts and structurally prepared so that the front part of the screen can still be used as an electrostatic actuator. The technical parameters of this actuator as well as the external actuator must be specified in the operating instructions.

3.2.2 A measurement microphone must be removable from the sound level meter so that it can be tested separately. It must be marked with a type and serial number. This also applies to microphone systems (such as an intensity sensor).

3.2.3 Every measurement microphone must include the following information, which must be in printed form or in a known electronic format (readily readable):

- manufacturer's name, microphone type, serial number, year of manufacture;
- characteristics of use (for the free field, angle of incidence, pressure microphone, intensity probe);
- nominal microphone size (its diameter specified in millimetres and in fractions of an inch);
- specifications for the microphone insert threads and microphone cover screen;
- microphone sensitivity measured in an open circuit (specified in mV/Pa and in dB re 1V/Pa) at reference conditions as well as with specified measurement uncertainty;
- magnitude of condenser microphone's polarisation voltage (in V);
- resonance frequency (in kHz or Hz);
- frequency characteristics in tolerance field of ±2 dB;
- maximum permissible SPL value (sound pressure level) which may be applied to the microphone at 3 % signal distortion (in dB re 20 μPa);
- microphone's internal noise (specified in dB(A));
- microphone's electrical capacity (in pF);
- equivalent volume (in mm^3);
- types of pre-amplifiers which the microphone can work with;
- types of usable acoustic calibrators with essential data needed to verify or calibrate the microphone (such as correction for standard pistonphones), while the type of acoustic calibrator must be capable of calibration itself;
- influence of static pressure on the microphone's sensitivity level (in dB/hP) at 250 Hz;
- influence of air humidity on the microphone's sensitivity level (in dB/%RH) at 250 Hz;
- influence of temperature on the microphone's sensitivity level (in dB/degree Celsius) at 250 Hz;
- influence of the magnetic field with an intensity of 80 A/m at a frequency of 50 Hz (in dB re 20 μPa);
- influence of axial vibration 1 m/s^2 (in dB per 20 μPa);
- estimated long-term stability value at specified temperature (time/dB);
- type of electrical actuator for measuring frequency characteristics and applied electrical voltage (in V);
- graph of frequency characteristics for excitation via electrical actuator;
- graphs of frequency characteristics in a free field for various angles of acoustic wave incidence;
- correction of actuator frequency characteristics for a free field (for entire usable frequency range);
- for intensity microphones, information must be specified for proper functioning and measurement via intensity probe, including the verification or calibration process.

3.3 Technical requirements for filters

3.3.1 Ambient reference conditions

The reference conditions for the surrounding area which apply to hardware filters include an ambient air temperature of 20 °C, relative air humidity of 65 % and atmospheric pressure of 101.3 kPa.

3.3.2 General

The electrical properties and frequency characteristics specified in this Measure for octave and fractional octave filters apply under the reference ambient conditions pursuant to Article 3.3.1. As long as the resulting instrument meets all applicable requirements of this Measure, any desired filter design can be used, be it as a base ten system or a base two system. The technical requirements specified in this Measure also apply to software filters which are used as basic or supplementary equipment in sound level meters.

3.3.3 Nominal mean band frequencies

Octave and fractional octave filters must be identified or marked with the nominal mean band frequencies which are suitable rounded values of exact mean frequency bands. The exact and nominal mean frequency bands for octave and third-octave filters are specified in the following Table 1.

Table 1 – Mean frequency band for octave and third-octave filters in sound frequency range

Value X	**Base ten exact f_m $(10^{x/10})(1\ 000)$ Hz**	**Base two exact f_m $(2^{x/3})(1\ 000)$ Hz**	**Nominal mean frequency Hz**	**Third octave**	**Octave**
−16	25.119	24.803	25	°	
−15	31.623	31.250†	31.5	°	°
−14	39.811	39.373	40	°	
−13	50.119	49.373	50	°	
−12	63.096	62.500†	63	°	°
−11	79.433	78.745	80	°	
−10	100.00	99.913	100	°	
−9	125.89	125.00†	125	°	°
−8	158.49	157.49	160	°	
−7	199.53	198.43	200	°	
−6	251.19	250.00†	250	°	°
−5	316.23	314.98	315	°	
−4	398.11	396.85	400	°	
−3	501.19	500.00†	500	°	°
−2	630.96	629.96	630	°	
−1	794.33	793.70	800	°	
0	1 000.0†	1 000.0†	1 000	°	°
1	1 258.9	1 259.9	1 250	°	
2	1 584.9	1 587.4	1 600	°	
3	1 995.3	2 000.0†	2 000	°	°
4	2 511.9	2 519.8	2 500	°	

5	3 162.3	3 174.8	3 150	°	
6	3 981.1	4 000.0†	4 000	°	°
7	5 011.9	5 039.7	5 000	°	
8	6 309.6	6 349.7	6 300	°	
9	7 943.3	8 000.0†	8 000	°	°
10	10 000†	10 079	10,000	°	
11	12 589	12 699	12 500	°	
12	15 849	16 000†	16 000	°	°
13	19 653	20 159	20 000	°	

NOTE The exact mean frequency bands (except for the exact values marked with a †) are calculated to five decimal places from the equation

$$f_m = (G^{(2x+1)/(2b)})\, f_r \quad (1)$$

in which x is an arbitrary whole number, positive, negative, or zero and f_r is the reference frequency 1 000 Hz.

3.3.4 Reference attenuation

With all filters, the manufacturer must specify the reference attenuation in the permeable band, which must be identical for all filters from the set of filters.

3.3.5 Relative attenuation measurement

3.3.5.1 The relative attenuation at the reference range must be tested with the same three filters with which the linearity was measured.

3.3.5.2 The relative attenuation measurement is conducted as a measurement of the response to sinusoidal signals with a constant amplitude of various frequencies. The level of the signals must be (1 ± 0.1) dB below the specified upper limit of the linearity range.

3.3.5.3 The standardised frequency of the test sinusoidal signal $\Omega_k = f_k / f_m$ must be determined in each filter with the mean frequency f_m according to the relation:

$$\Omega_k = 1 + [(G^{1/(2b)} - 1)\,(R_k - 1)] / (G^{1/2} - 1) \quad (2)$$

where: G ..... is the octave ratio of the frequencies;

b ..... reciprocal of the numerical designation of the bandwidth;

R_k ..... frequency parameter defined in Table 2;

K ..... whole number in a range of 0 to 7.

The index of standardised frequencies during the test must be expanded according to the relation:

$$\Omega_k = 1/\Omega_{-k} \quad (3)$$

in which Ω_k and Ω_{-k} have the same relative attenuation acceptance limits.

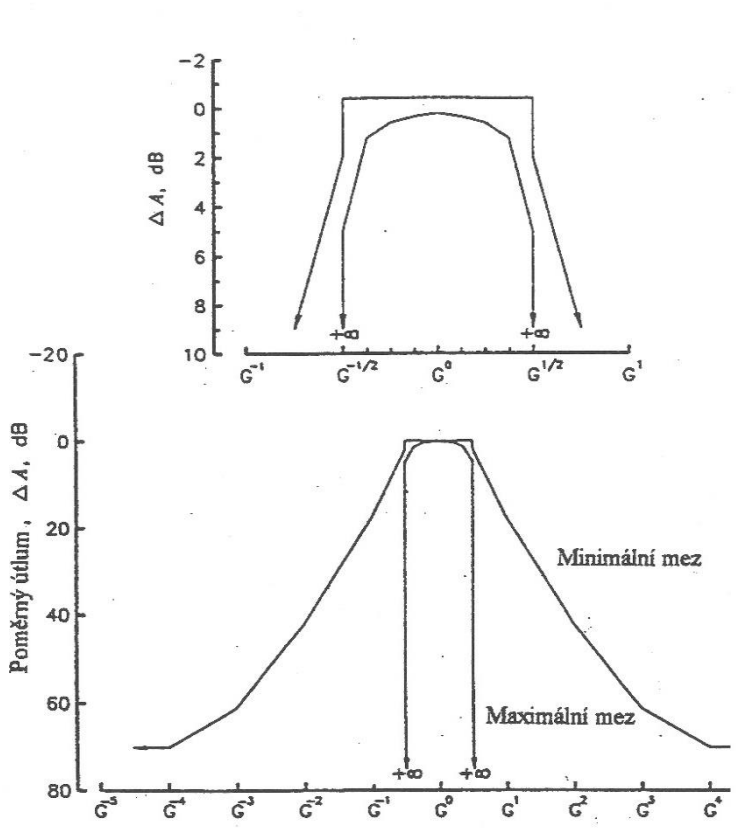
The technical requirements specified in this chapter constitute the abbreviated general requirements specified in the applicable standard.

In the case of octave filters, $\Omega_k = R_k$.

Table 2 – Relative attenuation limits for octave filters

Index k	**Frequency parameter**	**Minimum; maximum relative attenuation acceptance limits** dB	
	R_k	**Class 1**	**Class 2**
0	$G^{\circ}=1$	−0.4; +0.4	-0.6; +0.6
1	$G^{1/8}$	-0.4; +0.5	-0.6; +0.7
2	$G^{1/4}$	-0.4; +0.7	-0.6; +0.9
3	$G^{3/8}$	-0.4; +1.4	-0.65; +1.7
4	G	+16.6; +∞	+15.6; +∞
5	G^2	+40.5; +∞	+39.5; +∞
6	G^3	+60; +∞	+54; +∞
7	G^4	+70; +∞	+60; +∞

3.3.5.4 Figure 1 shows the limits of the minimum and maximum relative attenuation of the octave filter. The figure also shows discontinuous changes in the minimum and maximum relative attenuation at the limit frequencies of the band and the linear change in the limits of relative attenuation between normalised frequencies with the fraction points specified in Table 2.



Poměrný utlum, Δλ, dB	Relative attenuation, Δλ, dB
Minimální mez	Minimum limit
Maximální mez	Maximum limit

Normalised frequency (logarithmic scale)

Figure 1 – Maximum and minimum relative attenuation limits for class 1 octave filters

3.3.6 Integrated filter characteristics

3.3.6.1 Integrated filter characteristic ΔB: in decibels, must be determined for the bandpass filter according to the equation:

$$\Delta B = 10 \log (B_e/B_r) \quad (4)$$

where: B_e ..... is the normalised effective bandwidth;

B_r ..... normalised reference bandwidth determined from equation (5) for the same mean band frequency:

$$B_r = (f_2 - f_2) / f_m = [G^{+1/(2b)} - G^{-1/(2b)}] \quad (5)$$

3.3.6.2 For an arbitrary filter, the normalised effective bandwidth with exact mean band frequency f_m represented by the equation:

$$B_e = \int_0^{\infty} 10^{-0,1\Delta A\left(\frac{f}{f_m}\right)} \times d\left(\frac{f}{f_m}\right) \quad (6)$$

3.3.6.3 The integrated filter characteristic must not exceed ±0.4 dB for any bandpass filter integrated into the instrument for class 1 instruments or ±0.6 dB for class 2 instruments.

3.3.7 Pre-filters for interference

The manufacturer must prepend interference filters to a device with digital filters or sampled data filters in either analogue or digital form as needed. Pre-filters for interference must minimise interference between the input signal and the sampling process, which could create disruptive frequency components in the input signal and cause the filter's relative attenuation frequency characteristics to exceed the maximum value of the permissible minimum limits specified in Table 2.

3.3.8 Operation in real time

The manufacturer must numerically mark bandwidths and corresponding frequency ranges in which the output signal level in the response to the sinusoidal input signal with constant amplitude, whose frequency logarithm changes at a constant speed, is the theoretical level of the output signal for class 1 instruments with an accuracy of ±0.3 dB for class 2 instruments with an accuracy of ±0.5 dB.

3.3.9 Linearity range

3.3.9.1 At each accessible measurement range and for all bandwidths of a filter for flat frequency characteristics, if integrated, it holds true that errors in the amplitude characteristic linearity must not exceed the following in the linearity range:

±0.4 dB in linearity ranges of at least 50 dB for class 1 filters;

±0.5 dB in linearity ranges of at least 40 dB for class 2 filters.

3.3.9.2 Overlapping of measurement ranges (if there are more than one) must be conducted so that the linearity range overlaps by at least 40 dB for class 1 filters and by at least 30 dB for class 2 filters.

3.3.9.3 In case of filters with more than one measurement range, the permissible tapering of the linearity range is on the most sensitive measurement range, assuming that the range is not a reference range.

3.3.9.4 In filters which have a display as an inseparable component or if the filter's output is transmitted to an external display or other device with a greater range than the linearity range, the manufacturer must specify the amplitude characteristic linearity tolerances, which are complied with outside of the linearity range.

3.3.10 Flat frequency characteristics

The manufacturer must specify the range of frequencies in which the relative attenuation is in an accuracy range of ±0.4 dB and ±0.6 dB with respect to the relative attenuation at the reference frequency for instruments of class 1 and class 2, respectively. In measurements of the relative attenuation of flat frequency characteristics, the reference attenuation is the same as with measurements of the relative attenuation of a bandpass filter if the instrument is equipped with a frequency-independent transmission range (i.e. flat frequency characteristics).

3.3.11 Total of output signals

The difference between

a) the input signal level minus the reference attenuation and
b) the level of the sum of average values of the squares of the output signals from various filters with a specified bandwidth

must not exceed

+1.0 dB; −2.0 dB (class 1 instruments) and

+2.0 dB; –4.0 dB (class 2 instruments)

for a sinusoidal input signal of a random frequency between two sequential mean frequencies of an octave or fractional octave band.

3.3.12 Maximum input signal

The manufacturer must specify the maximum effective voltage value of the input sinusoidal signal at which all filters integrated into the instrument at each measurement range meet the requirements of this Measure.

3.3.13 Terminating impedance

If relevant, the manufacturer must specify the input and output terminating impedance necessary to ensure proper operation of the instrument.

3.3.14 Sensitivity to various environments

3.3.14.1 Ambient temperature

At the nominal mean band frequency, the relative attenuation of a random filter integrated into the device must not deviate from the relative attenuation at the same frequency under reference ambient conditions by more than ±0.4 dB for class 1 instruments and ±0.6 dB for class 2 instruments in an ambient temperature range of at least 0 °C to +50 °C.

3.3.14.2 Relative air humidity

The relative humidity range and corresponding air temperature at which the device may continuously operate must be established by the manufacturer and specified in the user manual. After 24 hours of exposure to a damp atmosphere with a relative humidity of 75 % and an ambient temperature of +40 °C and without condensation on the internal components of the test device, the relative attenuation at the nominal mean band frequency of a random filter integrated into the device must not deviate from the

relative attenuation at the same frequency under reference ambient conditions by more than ±0.15 dB for class 0 instruments and ±0.3 dB for class 1 instruments and ±0.5 dB for class 2 instruments.

3.3.15 Power supply check

For instruments which are powered by a battery or rechargeable battery, the manufacturer must ensure a suitable means of checking the power supply which, at the moment of the check, must have sufficient capacity to operate the instrument in accordance with all requirements of this Measure.

3.4 Technical requirements for sound level meters

3.4.1 General

3.4.1.1 A regular digital sound level meter is made up of a microphone, pre-amplifier, signal processing device (filters, amplifier, attenuator), A/D converter, processor, indication unit, memory, D/A converter, power supply unit and control elements – this is generally a combination of microphone, signal processor and display device. Sound level meters must be capable of either indicating measured values directly on the display or store the measurement results into a memory and then display them on a device specified by the manufacturer.

3.4.1.2 The operating requirements specified in this chapter apply under reference ambient conditions specified in Part 2.1.2.

3.4.1.3 A sound level meter which is specified as a class 1 sound level meter in the user manual must meet all binding requirements for class 1 which are specified in this Measure. A sound level meter which does not meet all requirements for class 1 (but meets the remaining requirements for class 2) must be allocated to class 2. A class 2 sound level meter may have certain properties of a class 1 meter, but if some of the properties only meet the requirements for class 2, then the instrument is a class 2 sound level meter. The sound level meter may be specified as a class 1 instrument in one configuration and as a class 2 instrument in another configuration (for example, with a different microphone or pre-amplifier).

3.4.1.4 The configuration for a complete sound level meter and its normal operating mode must be specified in the user manual. If appropriate, the sound level meter configuration includes a wind protection cover and other devices which are installed around the microphone as an inseparable component in normal operating mode.

3.4.1.5 For specifying high-frequency emissions and immunity to high-frequency fields, sound level meters are divided into the three following groups:

- group X: individual instruments which encompass a sound pressure level measurement device in accordance with this Measure and for which a power supply from an internal battery is specified in normal operating mode, not requiring external connection with an additional instrument for measuring sound pressure levels;
- group Y: individual instruments which encompass a sound pressure level measurement device in accordance with this Measure and for which a connection to the public electrical grid is specified in normal operating mode, not requiring external connection with an additional instrument for measuring sound pressure levels;
- group Z: individual instruments which encompass a sound pressure level measurement device in accordance with this Measure requiring two or more components of a device which forms a basic part of the sound level meter to be connected together in normal operating mode. Individual components may be powered by internal batteries or the public electrical grid.

3.4.1.6 If necessary, the user manual must specify how the microphone is to be fastened in order to meet the requirements for directional characteristics and frequency weighting. A microphone stand or cable may be necessary to meet the requirements. In such case, the user manual must specify that the sound

level meter only meets the applicable requirements for directional characteristics and frequency weighting if the specified devices are installed. This primarily pertains to sound level meters composed of a microphone with a pre-amplifier connected to other instruments by a cable.

3.4.1.7 The minimum possibility of a conventional sound level meter is to indicate sound pressure level A with time characteristic F. An integrating-averaging sound level meter must at least provide a means of indicating the equivalent of sound pressure level A. An integrating sound level meter must at least provide a means of indicating sound exposure level A. Sound level meters may include any or all design models for which operating requirements are specified in this Measure. The sound level meter must meet the applicable operating requirements for these design models according to which they were built.

3.4.1.8 A sound level meter which has more than one measurement range must be equipped with a suitable range switch. The measurement range(s) must be described in the user manual with the nominal sound pressure level at a frequency of 1 kHz. The function of measurement range switches must be described in the user manual together with recommendations for selecting the optimum measurement range to display the measurement results for sound pressure level or sound exposure level.

3.4.1.9 The user manual must also specify the reference sound pressure level, reference measurement range and reference orientation. The user manual must specify the reference direction for each type of microphone intended for use with the sound level meter; the position of the reference point microphone must also be specified. The reference sound pressure level is 94 dB. Alternatively, a reference sound pressure level of 74 dB, 84 dB, 104 dB, 114 dB or 124 dB may be specified. A sound pressure level of 94 dB closely corresponds to the effective acoustic pressure value of 1 Pa.

3.4.1.10 Frequency function A must be included in every sound level meter. Sound level meters in compliance with the maximum permissible errors for class 1 must have a frequency function C at least for the purposes of type tests. Sound level meters which measure sound pressure level C in intermittent sounds must also measure sound pressure level C in continuous sounds, at least for type-testing purposes. Frequency function ZERO (weighting function Z) is selectable. The user manual must describe all available frequency weighting functions. The sound level meter may be equipped with octave or third-octave filters. Analogue filters may be connected to a measurement chain as a self-standing instrument or may be part of a sound level meter. Digital filters may be special programmes according to which the processor processes digital sound (in digital sound level meters).

3.4.1.11 A sound level meter may have more than one display device, whereas the connection of a direct, alternating or digital output on its own is not deemed to be a display device.

3.4.1.12 It must be possible to transmit electrical signals to the input of the sound level meter in order to ensure that the sound level meter's parameters are in accordance with the requirements of this Measure. These signals should be equivalent to signals from the microphone. The user manual for each respective type of microphone must specify the nominal impedance and valid tolerance of the electrical properties of the device or means with which the signals can be transmitted to the sound level meter's electrical input. Electrical properties include the resistance and reactance component of electrical impedance at the output of the device. The nominal impedance value must be specified for a frequency of 1 kHz.

3.4.1.13 The user manual must also specify the maximum sound pressure level at the microphone's location and the maximum peak-to-peak voltage which can be connected to an electrical input without damaging the sound level meter.

3.4.1.14 If the sound level meter is to be capable of measuring the maximum time-weighted sound pressure level and the peak sound pressure level C, a 'hold' function must be available while measuring these quantities. The user manual must also describe the operation of a device with a 'hold' function and means of zeroing the display, which is blocked for this function.

3.4.1.15 A computer software program may be an inseparable part of a sound level meter. The user manual must specify a unique identification of all such programs, including location in the directory structure of the computer being used, or must note that certain other programs which could interfere with the proper operation of the sound level meter may not be used at the same time.

3.4.1.16 The operating requirements specified in this Measure apply (where applicable) to any time or frequency weighting working at the same time and to any independent channel in a multi-channel sound level meter. The user manual must describe the properties and functions of each independent channel. Multi-channel sound level meters may have two or more microphone inputs.

3.4.1.17 Once the initial time interval has elapsed after switching on a power supply and whose length must be specified in the manual and must not exceed 2 minutes, the sound level meter must reach a state of equilibrium and all requirements for the sound level meter's electroacoustic response as per this Measure must apply.

3.4.2 Indicated levels and their settings

3.4.2.1 The user manual must specify at least one type of acoustic (or electrostatic) calibrator for calibrating the sound level meter.

3.4.2.2 A calibrator of the same or more accurate class must be used for verifying or calibrating a sound level meter of a particular class.

3.4.2.3 The procedure and indication for setting the sound pressure level displayed in the response to the application of an acoustic calibrator must be specified in the user manual for the reference sound pressure level in the reference measurement range and for the calibration frequency. The result of the use of the indication setting procedure must be a sound pressure level or sound exposure level which would be indicated in the response to plane progressive sinusoidal sound waves impacting from the reference direction or, as the case may be, in the response to sounds with an impact in a random direction. The procedure and indications for settings must at least relate to the ambient conditions in the usable ranges which are specified in this Measure, including the reference ambient conditions. The settings must apply to all microphone types specified in the type-approval certificate with which the sound level meter is used, and to all associated devices provided by the sound level meter manufacturer to fasten the microphone to the sound level meter.

If the wind protection cover is type-approved as an inseparable component of the sound level meter, the user manual must contain information on corrections for the average effects of the wind protection cover on the microphone's frequency characteristics.

3.4.2.4 Information on corrections for deviation in the microphone's mean frequency characteristics from stable frequency characteristics and average effects of reflections for the sound level meter's cover and deflection around the microphone must be specified in the user manual for all types of microphones which are type-approved together the sound level meter. Average effects of reflections and sound deflection relate to the sound pressure level at the microphone's location and without a sound level meter present.

In order for a sound level meter to meet the technical requirements of this Measure with the wind protection cover installed around the microphone and without it, the information described above must be specified for both configurations. In the case of the configuration with the wind protection cover, the information must include corrections for the average effects of the wind protection cover on the microphone's frequency characteristics. If the wind protection cover is an inseparable part of the sound level meter in normal operating mode, the information on corrections for the wind protection cover need only be specified for this configuration.

Corrections for the microphone's average frequency characteristics and average effects of reflections, deflections and a potential wind protection cover must apply to plane progressive sinusoidal sound waves impacting in the reference direction and under wind-free conditions. The information must include the associated values for expanded measurement uncertainties. The expanded measurement

uncertainties and basic information must be specified separately in the user manual in tabular form, whereas the correction for the microphone's average frequency characteristics and average effects of reflections and deflection may be provided as two separate corrections or as one combined correction.

3.4.2.5 The data required in Article 3.4.2.4 must be provided in the following formats:

- for class 1 sound level meters, the information must be specified in tabular form in nominal third-octave intervals from 63 Hz to 1 kHz and then in nominal intervals of one-twelfth of an octave at frequencies higher than 1 kHz up to at least 16 kHz;
- for class 2 sound level meters, the information must be specified in tabular form in nominal third-octave intervals from 63 Hz to at least 8 kHz;
- corrections for average effects of the wind protection cover on frequency characteristics of the microphone must be specified in tabular form in nominal third-octave intervals from 1 kHz to 16 kHz for class 1 sound level meters and from 1 kHz to 8 kHz for class 2 sound level meters.

3.4.2.6 Deviations in measured effects of reflection, deflection and the wind protection cover (if any) on the frequency characteristics of the microphone from the effects specified in the user manual, expanded by the expanded measurement uncertainty, must not exceed two-thirds of the maximum permissible errors specified in Table 3.

3.4.2.7 The user manual must specify data on the types of calibrators suitable for verification purposes. It must also specify data for their settings in order to obtain an equivalent sound pressure level *A* which would be displayed under reference ambient conditions in the response to plane progressive sinusoidal sound waves impacting in the reference direction. These data for settings must apply to the sound pressure level *A* displayed in the response to sound pressure created by the acoustic calibrator or in the response to acoustic pressure simulated by the electrostatic calibrator.

3.4.2.8 The data for settings must be provided for at least the frequencies of 125 Hz, 1 kHz and either 4 kHz or 8 kHz and must apply to the specified combination of microphone, sound level meter and type of acoustic or electrostatic calibrator. The data for settings must be provided for all types of microphones or microphone-wind protection cover configurations for which it is determined that the sound level meter meets the requirements of this Measure. Deviations in the data for settings obtained by measurement from the data specified in the user manual must not exceed ± 0.4 dB or half of the size of the applicable data for the settings depending on which value is greater.

3.4.3 Directional characteristics

3.4.3.1 For the configuration of the sound level meter which is specified in the user manual for the normal operating mode, or for those parts of the sound level meter which are located in the sound field, Table 3 specifies the requirements for directional characteristics which apply to plane progressive sound waves with an arbitrary angle of sound incidence in the specified ranges, including the reference direction. The nominal characteristics are equal to the response to sound from all directions of sound incidence at a random frequency.

3.4.3.2 The requirements specified in Table 3 apply to any frequency in the specified ranges for any orientation of the sound level meter or the applicable components around the reference direction.

Table 3 – Maximum permissible errors in directional characteristics (including maximum permissible expanded measurement uncertainty)

Frequency kHz	**Maximum absolute difference in displayed sound pressure levels for any two angles of sound incidence in a range of ±Θ degrees with respect to the reference direction** dB					
	Θ = 30°		**Θ = 90°**		**Θ = 150°**	
	Class					
	1	**2**	**1**	**2**	**1**	**2**

0.25 to 1	1.0	2.0	1.5	3.0	2.0	5.0
> 1 to 2	1.0	2.0	2.0	4.0	4.0	7.0
> 2 to 4	1.5	4.0	4.0	7.0	6.0	12.0
> 4 to 8	2.5	6.0	7.0	12.0	10.0	16.0
> 8 to 12.5	4.0	...	10.0	...	14.0	...
NOTE To demonstrate conformity with the specified limits, maximum absolute differences are expanded by the expanded measurement uncertainty in the sound pressure levels displayed.						

3.4.4 Frequency weighting function

3.4.4.1 In the sound level meter configuration specified in the user manual for the normal operating mode, the frequency weighting function for the maximum permissible error specified in Table 4 applies to the response to plane progressive sound waves impacting the sound level meter in the reference direction or in a random direction, or potentially in the case of impact by means of the first and second.

3.4.4.2 The frequency function values *A, C* and *Z* rounded to a tenth of a decibel and corresponding to the maximum permissible error for class 1 and class 2 sound level meters are specified in Table 4. The maximum permissible errors specified in Table 4 apply to the given operating class in all measurement ranges and after the setting described in Article 3.4.2 for responses to the acoustic calibrator at calibration frequency and under reference ambient conditions.

3.4.4.3 The nominal value 0 dB with corresponding maximum permissible error ±1.1 dB for class 1 sound level meters and ±1.4 dB for class 2 sound level meters is specified for all frequency weighting functions at frequency 1 kHz.

3.4.4.4 At frequencies between the sequential frequencies specified in Table 4, the frequency function *C* or *A* must be calculated from equations (7) or (8) and rounded to the tenth of a decibel. The maximum permissible errors are the greater of the values specified in Table 4 for two sequential frequencies.

3.4.4.5 The deviation of the sound pressure level displayed from the sound pressure level which is at the microphone's location without the sound level meter present, expanded by the expanded measurement uncertainty, must not exceed the maximum permissible error values at any frequency specified in Table 4. The sound pressure levels measured without the sound level meter present must be weighted with a valid frequency weighting function according to equations (7), (8) or (9).

3.4.4.6 The frequency characteristics of the weighting function *C* is realised with the use of two fields at low frequency f_1, two fields at high frequency f_4 and two zeroes at 0 Hz. With these fields and zeroes, the response of the transmission power of the weighting function *C* falls to $f_L = 101.5$ Hz and $f_H = 103.9$ Hz with respect to the response at the reference frequency $f_1 = 1$ kHz by $D^2 = 1/2$ (approximately −3 dB). The frequency characteristics of the weighting function *A* are realised by supplementing the frequency characteristics of the weighting function *C* by adding two linked high-frequency first-order passes. The limit frequency for both high-frequency passes is given by $f_A = 102.45$ Hz.

3.4.4.7 The practical realisations of frequency functions *C, A* and *Z* specified in Table 4 may be derived as a frequency function from analytical expressions according to equations (7), (8), or (9).

Table 4 – Frequency weighting functions and maximum permissible errors (including maximum permissible expanded measurement uncertainty)

Nominal frequency Hz	**Frequency weighting function*** dB			**Maximum permissible errors** (dB)	
				Class	
	A	**C**	**Z**	**1**	**2**
10	-70.4	-14.3	0.0	+3.0; –∞	+5.0; –∞
12.5	−63.4	−11.2	0.0	+2.5; –∞	+5.0; –∞
16	−56.7	−8.5	0.0	+2; –4	+5.0; –∞
20	−50.5	−6.2	0.0	±2.0	±3.0
25	−44.7	−4.4	0.0	+2.0; −1.5	±3.0
31.5	−39.4	−3.0	0.0	±1.5	±3.0
40	−34.6	−2.0	0.0	±1.0	±2.0
50	−30.2	−1.3	0.0	±1.0	±2.0
63	−26.2	−0.8	0.0	±1.0	±2.0
80	−22.5	−0.5	0.0	±1.0	±2.0
100	−19.1	−0.3	0.0	±1.0	±1.5
125	−16.1	−0.2	0.0	±1.0	±1.5
160	−13.4	−0.1	0.0	±1.0	±1.5
200	−10.9	0.0	0.0	±1.0	±1.5
250	−8.6	0.0	0.0	±1.0	±1.5
315	−6.6	0.0	0.0	±1.0	±1.5
400	−4.8	0.0	0.0	±1.0	±1.5
500	−3.2	0.0	0.0	±1.0	±1.5
630	−1.9	0.0	0.0	±1.0	±1.5
800	−0.8	0.0	0.0	±1.0	±1.5
1 000	0	0.0	0.0	±0.7	±1.0
1 250	+0.6	0.0	0.0	±1.0	±1.5
1 600	+1.0	−0.1	0.0	±1.0	±2.0
2 000	+1.2	−0.2	0.0	±1.0	±2.0
2 500	+1.3	−0.3	0.0	±1.0	±2.5
3 150	+1.2	−0.5	0.0	±1.0	±2.5
4 000	+1.0	−0.8	0.0	±1.0	±3.0
5 000	+0.5	−1.3	0.0	±1.5	±3.5
6 300	−0.1	−2.0	0.0	+1.5; −2.0	±4.5
8 000	−1.1	−3.0	0.0	+1.5; −2.5	±5.0
10,000	−2.5	−4.4	0.0	+2.0; −3.0	+5.0; –∞
12 500	−4.3	−6.2	0.0	+2.0; −5.0	+5.0; –∞
16 000	−6.6	−8.5	0.0	+2.5; −16.0	+5.0; –∞
20 000	−9.3	−11.2	0.0	+3.0; –∞	+5.0; –∞

*Frequency functions C and F were calculated with equations (8) and (9) with frequency f calculated from the equation:

$$f = (f_r)\,[10^{0.1(n-30)}], \qquad (7)$$

in which f_r = 1 kHz and n is a natural number between 10 and 43. The results were rounded to the nearest tenth of a decibel.

3.4.4.8 At any frequency *f* in hertz, the weighting function C(*f*) in decibels must be calculated from the equation:

$$C(f) = 20\log\left[\frac{f_4^2 f^2}{(f^2+f_1^2)(f^2+f_4^2)}\right] - C_{1000} \quad (8)$$

Weighting function A(*f*) must be calculated from the equation:

$$A(f) = 20\log\left[\frac{f_4^2 f^2}{(f^2+f_1^2)\,(f^2+f_2^2\,)^{1/2}\,(f^2+f_3^2\,)^{1/2}\,(f^2+f_4^2\,)}\right] - A_{1000} \quad (9)$$

in which $C_{1\,000}$ and $A_{1\,000}$ are standardising constants in decibels representing the electrical gain needed for the frequency weighting functions to have a gain of zero decibels at 1 kHz.

Weighting function Z(*f*) must be calculated from the equation:

$$Z(f) = 0 \quad (10)$$

3.4.4.9 The frequencies of fields f_1 and f_4 must be determined in units of Hz by solving a quadratic equation in which:

$$f_1 = [\{-b - (b^2 - 4c)^{1/2}\}/2\,]^{1/2} \quad (11)$$

and $$f_4 = [\{-b + (b^2 - 4c)^{1/2}\}/2\,]^{1/2} \quad (12)$$

The constants *b* and *c* must be derived from the equations:

$$b = \{1/(1 - D)\}\{f_r^{\,2} + (\,f_L^{\,2} f_H^{\,2})/f_r^{\,2} - D(f_L^{\,2} + f_H^{\,2})\} \quad (13)$$

and $$c = f_L^{\,2} f_H^{\,2} \quad (14)$$

3.4.4.10 At limit frequency f_A specified in Article 3.4.4.6, the characteristic fields at frequencies f_2 and f_3, which are necessary to introduce the additional high-frequency passes, must be determined in Hz according to the equations:

$$f_2 = [\{3 - (5)^{1/2}\}/2]\, f_A \quad (15)$$

and $$f_3 = [\{3 + (5)^{1/2}\}/2]\, f_A \quad (16)$$

NOTE The addition of the linked high-frequency passes to the frequency characteristics of weighting function C is equivalent to adding two zeroes at 0 Hz and fields at frequencies f_2 and f_3; see 3.4.4.6.

3.4.4.11 The approximated values of frequencies f_1 to f_4 in equations (8) and (9) are:

f_1 = 20.60 Hz, f_2 = 107.7 Hz, f_3 =737.9 Hz and f_4 = 12 194 Hz.

The standardising constants $C_{1\,000}$ and $A_{1\,000}$ rounded to 0.001 dB are −0.062 dB and −2.000 dB, respectively.

3.4.4.12 The user manual must specify the nominal frequency characteristics and maximum permissible errors which are complied with around the nominal values, if the sound level meter is equipped with them. The maximum permissible errors must include the applicable maximum expanded measurement uncertainty for the frequency weighting functions.

3.4.4.13 The frequency weighting filter FLAT must have a transmission of 0 dB from less than 31.5 Hz to more than 8 kHz during acoustic excitation. For the applicable operating classes, the maximum permissible errors at the individual frequencies around the nominal value must not be greater than those indicated in Table 4. Different maximum permissible errors may be specified for the excitation of the

sound level meter by acoustic and electrical input. However, these tolerances must include the applicable maximum permissible expanded measurement uncertainties.

3.4.4.14 The differences in transmission between weighting filters C, Z or FLAT and the transmission values in the use of weighting filter A during excitation via sinusoidal electrical signal 1 kHz must not exceed ±0.4 dB. This requirement applies at reference sound pressure level in the reference measurement range. It does not apply to indications of peak sound pressure level C.

3.4.5 Amplitude characteristic linearity

3.4.5.1 The measured signal level must be the linear function of the sound pressure level at the microphone's location in the entire dynamic range. The amplitude characteristic linearity must apply to the measurement of time-weighted sound pressure levels, equivalent sound pressure levels and sound exposure levels.

3.4.5.2 The maximum permissible errors of the amplitude characteristic linearity apply to electrical signals supplied by the applicable device.

3.4.5.3 The assumed signal level in any measurement range and at any given frequency must be given by the starting point specified in the user manual in the reference measurement range plus the change in input signal level with respect to the input signal level which caused the starting point to be displayed. The reference sound pressure level must be indicated at the starting point at the frequency of 1 kHz, where the tests to determine the amplitude characteristic linearity are initiated.

3.4.5.4 The linearity range spread at the reference measurement range at a frequency of 1 kHz must be at least 60 dB.

3.4.5.5 With class 1 sound level meters, the maximum permissible error of the amplitude characteristic linearity must not exceed ±1.1 dB, and ±1.4 dB for class 2 sound level meters.

3.4.5.6 Deviations from the nominal values increased by the expanded measurement uncertainty for any change in the input signal level from 1 dB to 10 dB must not exceed ±0.6 dB in class 1 sound level meters and ±0.8 dB in class 2 sound level meters.

3.4.5.7 The requirements specified in the previous two articles apply to the entire dynamic range at any frequency in the sound level meter's frequency range and to any frequency weighting function or frequency characteristic available.

NOTE In principle, the requirements for the amplitude characteristic linearity error apply at minimum to any frequency from 16 Hz to 16 kHz in class 1 sound level meters and from 20 Hz to 8 kHz in class 2 sound level meters. If the amplitude characteristic linearity error is measured at low frequencies, the assessment of the test results should explain the cause of the ripple which results during the measurement of the sinusoidal signals with time characteristic F. The ripple reaches approximately 0.2 dB at a frequency of 16 Hz.

3.4.5.8 In sound level meters which measure the time-weighted sound pressure level, the linearity ranges at a frequency of 1 kHz must overlap by at least 30 dB in adjacent measurement ranges. If the sound level meter measures the equivalent sound pressure level or sound exposure level, they must overlap by at least 40 dB.

3.4.5.9 The user manual must specify the nominal sound pressure level A and, if available, the nominal sound pressure levels C and Z for each measurement range and for the lower and upper linearity range limits at which the sound pressure level can be measured without a low signal level or overexcitation arising. The user manual must specify the linearity ranges at frequencies 31.5 Hz, 1 kHz, 4 kHz, 8 kHz and 12.5 kHz for class 1 sound level meters and at 31.5 Hz, 1 kHz, 4 kHz and 8 kHz for class 2 sound level meters.

3.4.5.10 The user manual must, at the frequencies specified in Article 3.4.5.9, specify the starting point initiating the tests for amplitude characteristic linearity errors in a specified measurement range.

3.4.5.11 If certain sound level meters use display devices with a range smaller than the linearity range, then the user manual must describe the means for testing the amplitude characteristic linearity error outside of the limits of the display range.

3.4.6 Internally generated noise

3.4.6.1 For the most sensitive measurement ranges, the user manual must specify the sound pressure levels which would be indicated when the sound level meter is placed in a sound field with a sound pressure level of zero. Such sound pressure levels must correspond to the assumed maximum internally generated noise level for each type of microphone which is specified for use with the sound level meter.

3.4.6.2 The user manual must specify the internally generated noise levels as time-weighted sound pressure levels or, as the case may be, as equivalent sound pressure levels.

3.4.6.3 If the microphone is substituted by an electrical input device and the input is terminated by the means specified in the user manual, then the noise generated must not exceed the level declared in the user manual.

3.4.6.4 The sound pressure levels specified in the user manual for internally generated noise must be specified for all available weighting functions under reference ambient conditions.

3.4.6.5 The user manual must describe the method of measuring low sound pressure levels while taking the internally generated noise into account.

3.4.7 Time-weighted characteristics F and S

3.4.7.1 For time characteristic F (fast), the nominal time constant is 0.125 s and for time characteristic S (slow), the constant has a value of 1 s. The available time-weighted characteristics must be described in the user manual.

3.4.7.2 The time constant of a decrease is determined by the response to a sudden interruption in a continuous sinusoidal electrical input signal with a frequency of 4 kHz. After the signal interruption, the speed of the decrease of the sound pressure level displayed increased by the expanded measurement uncertainty must be at least 25 dB/s at time characteristic F and between 3.4 dB/s and 5.3 dB/s at time characteristic S. This requirement applies to any measurement range.

3.4.7.3 The deviation in the indication of sound pressure level A with time characteristic S and potentially of the installed equivalent sound pressure level A from the indication of the sound pressure level with time characteristic F, increased by the expanded measurement uncertainty, must not exceed ±0.3 dB at an input continuous sinusoidal electrical signal with a frequency of 1 kHz. This requirement applies to the reference sound pressure level in the reference measurement range.

3.4.8 Response to a tone impulse

3.4.8.1 The specification for the sound pressure level measurement of a transitional signal is given in the form of tone impulses with a frequency of 4 kHz. The specification of the impulse tone response applies to electrical input signals.

3.4.8.2 The response to a tone impulse in the case of an individual tone impulse with a frequency of 4 kHz for frequency function A and selectable frequency functions C and Z must be in conformity with the indications specified in the second column of Table 5 for a maximum sound pressure level with time characteristic F or S and in the third column for sound exposure levels. The deviation of the measured response to the tone impulse from the corresponding reference response to a tone impulse, increased by

the expanded measurement uncertainty, must be within the maximum permissible error limits of the valid tolerances in the entire range of duration times of the tone impulse.

3.4.8.3 For the tone impulse durations between two consecutive tone impulse duration times specified in Table 5, the reference response to the tone impulse must be determined from the applicable equation (16) or (17). The maximum permissible errors correspond to the maximum permissible errors specified for the shorter of the tone impulse duration times.

3.4.8.4 The reference responses to tone impulses and maximum permissible errors specified in Table 5 also apply to integrating-averaging sound level meters which do not display the sound exposure level. In such instruments, the sound exposure level of a tone impulse must be converted. The averaging time T must correspond to the time displayed on the sound level meter and must include the tone impulse.

Table 5 – Reference responses to a tone impulse with a frequency of 4 kHz and maximum permissible errors (including maximum permissible expanded measurement uncertainty)

Tone impulse duration T_b ms	**Reference tone impulse response with a frequency of 4 Hz δ_{ref} with respect to a continuous sound pressure level** dB		**Maximum permissible errors** dB	
			Class	
	$L_{AF\,max} - L_A$ $L_{CF\,max} - L_C$ a $L_{ZF\,max} - L_Z$; R.(17)	$L_{AE\,max} - L_A$ $L_{CE\,max} - L_C$ a $L_{ZE} - L_Z$; R.(18)	1	2
1000	0.0	0.0	±0.5	±1.0
500	−0.1	−3.0	±0.5	±1.0
200	–1.0	–7.0	±0.5	±1.0
100	–2.6	−10.0	±1.0	±1.0
50	−4.8	−13.0	±1.0	+1.0; −1.5
20	–8.3	−17.0	±1.0	+1.0; −2.0
10	−11.1	−20.0	±1.0	+1.0; −2.0
5	−14.1	−23.0	±1.0	+1.0; −2.5
2	−18.0	−27.0	+1.0; −1.5	+1.0; −2.5
1	−21.0	−30.0	+1.0; −2.0	+1.0; −3.0
0.5	−24.0	−33.0	+1.0; −2.5	+1.0; −4.0
0.25	−27.0	−36.0	+1.0; −3.0	+1.5; −5.0
	$L_{AS\,max} - L_A$ $L_{CS\,max} - L_C$ a $L_{ZS\,max} - L_Z$; R.(17)			
1 000	−2.0		±0.5	±1.0
500	−4.1		±0.5	±1.0
200	−7.4		±0.5	±1.0
100	−10.2		±1.0	±1.0
50	−13.1		±1.0	+1.0; −1.5
20	−17.0		+1.0; −1.5	+1.0; −2.0
10	−20.0		+1.0; −2.0	+1.0; −3.0
5	−23.0		+1.0; −2.5	+1.0; −4.0
2	−27.0		+1.0; −3.0	+1.0; −5.0

NOTE 1 For the purposes of this measure, the reference response to the tone impulse with a frequency of 4 kHz δ_{ref} is determined for the maximum sound pressure level of conventional sound level meters with the help of the following approximation:

$$\boldsymbol{\delta_{ref}} = 10 \lg \left(\mathbf{1} - \boldsymbol{e}^{-T_b/\tau}\right) \qquad (19)$$

where

T_b is the specified tone impulse duration in seconds, such as from column 1

τ is the standard exponential time constant specified in 3.4.7.1 and

e is the basis of the natural logarithms.

Equation (19) applies to isolated tone impulses with a frequency of 4 kHz.

NOTE 2 For the purposes of this measure, the reference response to a tone impulse with a frequency of 4 kHz δ_{ref} is determined for the maximum sound pressure level of integrating and integrating/averaging sound level meters with the help of the following approximation:

$$\delta_{ref} = 10 \lg(T_b / T_0) \qquad (20)$$

where

T_b is the specified tone impulse duration in seconds,

$T_0 = 1$ s is the reference sound exposure duration.

NOTE 3 The reference responses to a tone impulse with a frequency of 4 kHz specified in Table 5 apply to frequency functions A, C and Z. The other frequency weighting functions may result in different reference responses to the tone impulse.

3.4.8.5 The reference responses to the tone impulse and corresponding maximum permissible error values apply to any tone impulse duration in the ranges specified in Table 5 and to in the reference measurement range in the entire range of continuous input signals. The range of continuous input signals with a frequency of 4 kHz from which the tone impulses are derived, extends from the input equivalent to an indication of 3 dB lower than the specified upper limit of the linearity range downwards to the input equivalent to the indication of 10 dB higher than the specified lower limit. As soon as the response to the tone impulse can be monitored on the display device and an indication is produced which is at least 10 dB higher than the specified noise level created by the actual noise of the microphone and the electronic elements in the sound level meter, the responses to the tone impulse must be within the maximum permissible error limits.

3.4.8.6 An overexcitation indication must not appear during any measurement of the response to a tone impulse in the range of the signal levels specified in Article 3.4.8.5.

3.4.9 Response to repeated tone impulses

3.4.9.1 The specification of the response to repeated tone impulses applies to frequency function A and, if available, for frequency functions C and Z and to any succession of tone impulses with a frequency of 4 kHz, corresponding to amplitude and to duration. In the case of sound exposure levels, the deviation in the equivalent sound pressure level from the equivalent sound pressure level calculated for a succession of tone impulses increased by the expanded measurement uncertainty must be within the maximum permissible error limits specified in Table 5 for responses to tone impulses. These specifications apply to the reference measurement range for tone impulse duration times between 0.25 ms and 1 s and an indication of 3 dB lower than the specified upper limit of the linearity range downwards to the input equivalent to the indication of 10 dB higher than the specified lower limit.

3.4.9.2 For any total measurement duration, the difference δ_{ref} in decibels between the theoretical equivalent sound pressure level of a succession of N tone impulses derived from a continuous sinusoidal signal and equivalent sound pressure level corresponding to the sinusoidal signal is given by the equation:

$$\delta_{ref} = 10 \lg(NT_b/T_m) \quad (21)$$

where T_b ..... is the tone impulse duration (s);

T_m ..... is the total duration of measurement (s).

The corresponding continuous sinusoidal signal must be averaged over the entire duration of measurement.

3.4.10 Overexcitation indication

3.4.10.1 Every sound level meter must be equipped with an overexcitation indicator. An overexcitation indicator of this kind must work in connection with any usable display device. The user manual must describe the function and interpretation of the overexcitation indication.

3.4.10.2 Overexcitation at sound pressure levels above the upper limit of the linearity range must be displayed prior to exceeding the maximum permissible error limits for linear amplitude characteristics in continuous mode or prior to exceeding the maximum permissible errors for responses to tone impulses. This requirement applies to all measurement ranges and at any frequency from 31.5 Hz to 12.5 kHz for class 1 sound level meters or from 31.5 Hz to 8 kHz for class 2 sound level meters.

3.4.10.3 The signals from the positive and negative half period derived from a continuous sinusoidal electrical signal must activate the overexcitation indicator. The response signals must begin and end at the zero transition points. With signals with a positive and negative half period, the difference between the input signal levels which first trigger an overexcitation indication, increased by the expanded measurement uncertainty, must not exceed 1.8 dB.

3.4.10.4 The overexcitation indication must last for the duration of overexcitation or 1 s, depending on which is longer, if the sound level meter uses time characteristics F or S to measure the sound pressure levels.

3.4.10.5 The overexcitation indication must also appear if it is being measured and the condition for overexcitation is present. The overexcitation indication must remain blocked until the measurement results are zeroed. These requirements also apply to measurements of the maximum time-weighted sound pressure levels, peak sound pressure level C and other quantities which are calculated during the measurement interval or are displayed once it has elapsed.

3.4.11 Low signal level indication

3.4.11.1 If, during any measurement situation, it happens that the time-weighted sound pressure level, equivalent sound pressure level or sound exposure level is lower than the specified lower linearity range limit at the given frequency, then a low signal level indication must be displayed before the maximum permissible error limit for the amplitude characteristic linearity error is exceeded. The low signal level indication must last at least as long as the low signal level appears, or 1 s, whichever is longer. The interpretation of the low signal level indication and the functioning of this indicator must be described in the user manual.

3.4.11.2 The display of the low signal level indication at the most sensitive measurement ranges need not be activated as long as the lower limit for the maximum permissible error of amplitude characteristic linearity is reached due to the internal noise of the microphone and electronic elements inside the sound level meter.

3.4.12 Peak sound pressure level C

3.4.12.1 If it is possible to display peak sound pressure levels C on any class 1 or 2 sound level meter, then the user manual must specify the nominal range of peak sound pressure levels C for each measurement range. The spread of the peak level range at peak sound pressure levels C indications must

be at least 40 dB in at least the reference measurement range. Peak sound pressure levels C must be within the specified ranges indicated without the overexcitation condition being displayed.

3.4.12.2 Indications of peak sound pressure levels C must be specified in the form of a response to one period and to the positive and negative half periods of the electrical signals. Signals with one period and a half period must be derived from continuous sinusoidal electrical signals and must be supplied to the specified electrical input device. The entire periods and half periods must begin and end at the zero transition point.

3.4.12.3 A deviation in the indication of the peak sound pressure level C (L_{cpeak}) minus the corresponding indication of the sound pressure level of a continuous signal (L_c) from the corresponding difference specified in Table 6, increased by the expanded measurement uncertainty, must not exceed the maximum permissible error limits specified in Table 6.

Table 6 – Peak sound pressure levels C and tolerances (including maximum permissible expanded measurement uncertainty)

Number of test signal periods	**Test signal frequency** Hz	$L_{Cpeak} - L_C$ dB	**Maximum permissible errors** dB	
			Class	
			1	**2**
One	31.5	2.5	±2.0	±3.0
	500	3.5	±1.0	±2.0
	8 000	3.4	±2.0	±3.0
Positive half period	500	2.4	±1.0	±2.0
Negative half period	500	2.4	±1.0	±2.0

3.4.13 Zeroing

3.4.13.1 If the sound level meter can measure equivalent sound pressure levels, sound exposure levels, maximum time-weighted sound pressure levels and peak sound pressure levels C, it must contain a device for zeroing the loaded data and resuming measurement.

3.4.13.2 The use of the zeroing device must not cause false indications on the display device and from the loaded data.

3.4.14 Measurement thresholds

3.4.14.1 If the user of integrating-averaging sound level meters or integrating sound level meters can select the measurement thresholds, then their functioning and method of operation must be specified in the user manual at the measured equivalent sound pressure levels or sound exposure levels.

3.4.15 Data display

3.4.15.1 Sound level meters which display more than one measurement quantity must be equipped with a means of indicating the quantity which is being presently displayed.

3.4.15.2 The acoustic quantity presently measured must be clearly marked on the display or by means of control elements. The indication must be displayed in the user manual and must contain the frequency and time weighting or, if applicable, the averaging time. The indication must be given using suitable symbols or abbreviations.

3.4.15.3 The display device(s) must be described in the user manual and must enable measurement with a resolution of 0.1 dB within a display range of at least 60 dB. Sound level meters with an analogue display device may have a display range of 60 dB divided into two parts.

3.4.15.4 If, in the case of digital display devices, the data are refreshed in the display at periodic intervals, then the value of the quantity selected by the user at the moment the data are refreshed on the display must be indicated after each time the display is refreshed. Further quantities may be indicated at the time the data on the display are refreshed, and if this is the case, must be explained in the user manual.

3.4.15.5 If a digital indicator is used in the sound level meter, then the user manual must specify the speed of refreshing the data on the display and the conditions for when the first indication will be displayed after measurement has been initiated.

3.4.15.6 For sound level meters which enable integrating and averaging, the user manual must specify the time it takes to display data after integration has ended.

3.4.15.7 If the sound level meter is equipped with a digital output, the manual must specify the interface and data transfer format. If a computer is connected to the sound level meter, then the software enabling mutual communication must be specified, and the computer's interface technical equipment must also be specified.

3.4.15.8 Any alternative device for displaying signal levels which is type-approved constitutes an inseparable component of the sound level meter. Each such alternative device must be included among the components which must meet the operating requirements of this chapter and the associated requirements for ambient conditions specified above.

3.4.16 Analogue or digital output

3.4.16.1 If the sound level meter contains an analogue output, the user manual must describe the characteristics of the output signals. The characteristics must include frequency weighting, output signal range, internal electrical impedance at the output and the recommended range of load impedances.

3.4.16.2 If passive impedance (including zero – i.e. short-circuit) is connected to the analogue output without accumulated electrical energy, this must not influence any ongoing measurement by more than 0.2 dB.

3.4.16.3 If the sound level meter does not have an analogue or digital output for purposes of general application, an output must be integrated for testing the properties of a class 1 sound level meter. A class 2 sound level meter may be equipped with such an output. Changes in signal level at an analogue or digital output in response to changes in sound pressure at the microphone or to changes in the electrical input signal must be identical within one decimal to the changes in signal level indicated on the display devices.

3.4.17 Timing devices

3.4.17.1 A class 1 sound level meter which indicates an equivalent sound pressure level or sound exposure level must enable the display of the time elapsed at the end of the integration time or equivalent indication of the integration time interval. It may also have a function which allows the integration time interval to be set in advance. The time of day may also be displayed. The user manual must describe the procedure with which the integration time is set in advance and the procedure for setting the time of day. If a real-time clock is part of the sound level meter, then the user manual must describe how to set it and must specify the nominal deviation of the displayed time for a period of 24 hours.

3.4.17.2 The user manual must specify the minimum and maximum averaging and integration time during measurement of equivalent sound pressure levels or sound exposure levels for signal levels within the range of the display device.

3.4.18 High-frequency emissions and interference from the public electrical grid

3.4.18.1 If the sound level meter requires the use of cables in connecting its parts, then these cables must be specified in the user manual.

3.4.19 Crosstalk

3.4.19.1 If one input channel of the sound level meter is supplied with a continuous electrical signal with a level at the upper limit of the linearity range and the other input channels are terminated by the relevant electrical impedance (which must be specified in the user manual), then the crosstalk between the channels may reach a maximum of 70 dB in the difference between the measured levels.

3.4.20 Software

Software which is essential for the metrological properties must be identified and secured. Easy identification of software must be possible. Proof of every intervention must be available.

3.4.20.1 If computer programs are part of the sound level meter, the type-approval certificate must specify their version and must also describe what hardware configuration (measuring device as well as evaluation and display device) they are intended for. The possibility of unauthorised tampering changing the software so that the sound level meter would measure and display incorrect values must be prevented.

3.4.21 Power supply

3.4.21.1 The sound level meter's display must show an indication during operation that the power supply is sufficient to operate the sound level meter according to the specifications of this Measure.

3.4.21.2 In case of a change in supply voltage from the maximum to the minimum permissible value, the change in measured and displayed sound pressure level increased by the expanded measurement uncertainty must not exceed ±0.3 dB in class 1 sound level meters and ±0.4 dB in class 2 sound level meters.

3.4.21.3 The batteries or rechargeable batteries which are used to power the sound level meter must be specified in the user manual. The user manual must also specify the sound level meter's time of operation under reference conditions which can be expected during the specified normal operating mode after fully charged batteries or rechargeable batteries have been installed.

3.4.21.4 Battery-powered sound level meters which enable indication and processing of measured values for a time which exceeds the nominal service life of the batteries or rechargeable batteries must have the recommended means of operating the sound level meter from an external power source described in their user manual.

3.4.21.5 If the sound level meter can be powered from a public electrical grid of alternating frequency, the user manual must specify the nominal voltage and supply frequency, as well as the associated tolerance. If the sound level meter or parts thereof can be powered from a common DC voltage source, the user manual must specify the maximum current drawn, the supply voltage value and its permissible ripple and must determine which pole is connected to the body of the sound level meter or to the earthing conductor of its inputs and outputs.

3.5 Environmental criteria and electrostatic and high-frequency criteria

3.5.1 General

3.5.1.1 The sound level meter must meet all technical requirements specified in Chapter 6 which apply to the use of the sound level meter under consideration.

3.5.1.2 The user manual must specify the typical time interval which the sound level meter needs to stabilise after a change in ambient conditions. Any technical requirement influencing the operating environment applies to a sound level meter which is switched on and set up for a typical method of measurement.

3.5.1.3 The technical requirements with regard to the influence of fluctuations in static pressure, air temperature and relative humidity apply to the sound pressure level indicated in the response to the use of an acoustic calibrator which operates at a frequency range of 125 Hz to 1 250 Hz. The influence of fluctuations in static pressure, air temperature and relative humidity on the sound pressure level created by the acoustic calibrator must be known.

3.5.1.4 In accordance with these requirements, no testing may be done at combinations of air temperature and relative humidity which result in a condensation point at temperatures higher than +39 °C and lower than −15 °C.

The sound level meter must still maintain the required technical properties in cases where air humidity condensation occurs in a temperature range from −15 °C to +39 °C.

3.5.2 Static pressure

3.5.2.1 If the static pressure changes within a range of 85 kPa to 108 kPa, then the deviation of the displayed sound pressure level from the sound pressure level displayed at reference static pressure, increased by the expanded measurement uncertainty, must not exceed ±0.4 dB in class 1 sound level meters and ±0.7 dB in class 2 sound level meters.

3.5.2.2 The maximum permissible value by which the measured and displayed quantity may change from the quantity measured and displayed at reference static pressure, increased by the expanded measurement uncertainty, if the static pressure changes from 65 kPa to less than 85 kPa, is:

±0.9 dB in class 1 sound level meters;

±1.6 dB in class 2 sound level meters.

3.5.3 Air temperature

3.5.3.1 The influence of a fluctuation in air temperature at the measured signal level is specified in a temperature range of −10 °C to +50 °C for class 1 sound level meters and for temperatures of 0 °C to +40 °C for class 2 sound level meters. The temperature ranges apply to the entire sound level meter.

3.5.3.2 In components of the sound level meter (such as a computer) which the user manual designates as components only intended for use in areas with controlled ambient conditions (such as inside buildings), the temperature range may be limited to +5 °C to +35 °C. The limited temperature range does not apply to microphones with pre-amplifiers and connecting cables or microphones with integrated pre-amplifiers and A/D converters.

3.5.3.3 The deviation in the sound pressure level displayed at any temperature from the sound pressure level displayed at reference air temperature, increased by the expanded measurement uncertainty, must not exceed ±0.5 dB in class 1 sound level meters and ±1.0 dB in class 2 sound level meters. This requirement applies within the applicable air temperature ranges specified in Article 3.5.3.1 or Article 3.5.3.2 and to any relative humidity within a range specified in Article 3.5.4.

3.5.3.4 The error in amplitude characteristic linearity at a frequency of 1 kHz in the specified linearity range of the reference measurement range must remain within the maximum permissible error limits specified in Article 3.4.5. This amplitude characteristic linearity specification applies to the air temperature ranges specified in Article 3.5.3.1 or Article 3.5.3.2 and to a relative humidity within a range of ±20 % with respect to reference air humidity.

3.5.4 Air humidity

3.5.4.1 The deviation in the sound pressure level displayed at any relative humidity from the sound pressure level displayed at reference relative humidity, increased by the expanded measurement uncertainty, must not exceed ±0.5 dB in class 1 sound level meters and ±1.0 dB in class 2 sound level meters. This requirement applies within a relative humidity range from 25 % to 90 % at any air temperature and within the applicable ranges specified in Article 3.5.3.1 or in Articles 3.5.3.2 and 3.5.1.4.

3.5.5 Electrostatic discharge

3.5.5.1 The sound level meter must function according to its intended purpose after being exposed to a contact electrostatic voltage discharge of up to ±4 kV and an air electrostatic voltage discharge of up to ±8 kV. The electrostatic voltage polarity is in relation to earthing.

3.5.5.2 The exposure to electrostatic discharges specified in Article 3.5.5.1 must not cause any long-term operational impairment or loss of function of the sound level meter. If specified in the user manual, the operation or function of the sound level meter may be temporarily impaired or lost as a result of electrostatic discharge. The specified impairment of operation or loss of function must not include any change in operational status, change in configuration or destruction or loss of saved data.

3.5.6 Magnetic fields caused by grid-frequency alternating current and high-frequency fields

3.5.6.1 Exposure to a specified magnetic field of grid frequency and high-frequency fields must not cause any change in the operational status, configuration, or saved data or impact it. This requirement applies to the entire sound level meter or associated component, or to a multi-channel sound level meter system and to any operating mode which is in accordance with normal operation. The user manual must specify the operating mode(s) of the sound level meter and any connecting component which has the highest sensitivity (lowest immunity) to magnetic fields of grid frequency and high-frequency fields.

3.5.6.2 The specification of sensitivity to magnetic fields of grid frequency must apply to exposure to a homogeneous alternating magnetic field with an effective intensity value of 80 A/m at frequencies of 50 Hz and 60 Hz. The homogeneity of the magnetic field must be determined without the sound level meter present.

3.5.6.3 The specifications for exposure to electrical grid frequencies apply to the orientation of the sound level meter which is specified in the user manual so that it has the highest sensitivity (lowest immunity) to magnetic fields of grid frequency.

3.5.6.4 The specifications for sensitivity to high-frequency fields must apply to exposure in the range of carrier frequencies from 26 MHz to 1 GHz. The signal of the high-frequency field's carrier frequency must be amplitude-modulated by a continuous sinusoidal signal with a frequency of 1 kHz with a depth modulation of 80 %. If the carrier frequency signal is not modulated, the homogeneous electrical field must have an effective intensity value of 10 V/m without the sound level meter present.

3.5.6.5 The sound level meter's immunity to magnetic fields of grid frequency and high-frequency fields must be demonstrated by means of a sinusoidal sound signal with a frequency of 925 Hz acting upon the microphone. Without the action of the magnetic field of grid frequency and the high-frequency field, the source of sound must be set so that the sound level meter indicates sound pressure level A with time

characteristic F or equivalent sound pressure level A of 74 dB ± 1 dB. If the sound level meter has more than one measurement range, the sound pressure level must be displayed in a measurement range whose lower limit is as close as possible to, but not higher than, 70 dB.

3.5.6.6 The deviation in the displayed sound pressure level from the sound pressure level displayed when not affected by the magnetic field of grid frequency or high-frequency field, increased by the expanded measurement uncertainty, must not exceed ±1.0 dB in class 1 sound level meters and ±2.0 dB in class 2 sound level meters.

3.5.6.7 With sound level meters from group Y or from group Z with an AC power supply input and, if integrated, with its own power output, immunity to common high-frequency interference must be demonstrated in a frequency range from 0.15 MHz to 80 MHz. The high-frequency field must be amplitude-modulated by a sinusoidal signal with a frequency of 1 kHz with a depth modulation of 80 %. If the signal is not modulated and is emitted from a source with an output impedance of 150 **Ω**, the effective high-frequency voltage value must be 10 V. The immunity to rapid transients at the power source must apply to a signal which has a peak voltage of 2 kV and a repetition frequency of 5 kHz.

3.5.6.8 With sound level meters from group Z with signal or control inputs/outputs, the requirements for immunity to interference from high-frequency fields in a frequency range from 0.15 MHz to 80 MHz apply to an effective unmodulated voltage value of 10 V. These requirements apply if there is any connecting cable longer than 3 m between parts of the sound level meter. The requirements for immunity to rapid transients in the public electrical grid apply to the entire dynamic range at any frequency in the sound level meter's frequency range and to a signal with a peak voltage of 2 kV and a repetition frequency of 5 kHz.

3.5.6.9 The user manual must state that the sound level meter meets the specified technical requirements when exposed to high-frequency fields at a sound pressure level lower than 74 dB. In this case, the sound level meter must be in compliance with the limits of the maximum permissible errors specified in Article 3.5.6.6 at sound pressure levels lower than 74 dB downwards toward the specified lower level. This requirement applies to all measurement ranges for all technical requirements concerning the group of sound level meters. The lower level, specified in the user manual with a resolution of 1 dB, must apply to all operating modes of the sound level meter.

3.6 Measures for the use of auxiliary devices

3.6.1 The user manual must specify details for all correctional measurement results conducted with optional microphone stands or cables installed between the microphone and microphone pre-amplifier or between microphone pre-amplifier and other components of the sound level meter which the manufacturer provides.

3.6.2 The user manual must specify the average effect of the optional accessories provided by the manufacturer of the sound level meter. The specifications must apply to all important characteristics of the sound level meter which are influenced by the installation of accessories. The optional accessories include wind protection covers and rain protection devices which are installed around the microphone (stable outdoor microphones such as those for measuring aircraft noise). Specifications under wind-free conditions must be provided for the typical effect of any kind of recommended wind protection cover on the microphone's sensitivity, directional characteristics and frequency weighting.

3.6.3 If optional accessories are installed in the sound level meter, then the user manual must state whether or not doing so will put the sound level meter into a different class in terms of the technical requirements. If, after optional accessories have been installed, the sound level meter does not meet the technical requirements for the original operational class, the user manual must state whether the sound level meter will meet the technical requirements for a different class, or whether it will still not meet the requirements for either class 1 or class 2.

3.6.4 The user manual must describe the means by which the sound level meter is to be used to measure filtered sound pressure levels or for spectral analysis, if its components include internal or external bandwidth filters.

3.6.5 The user manual must specify the details for connecting auxiliary devices supplied by the manufacturer of the sound level meter and any potential effects of such devices on the properties of the sound level meter. It must also specify auxiliary programs which may be used when saving and processing the measured values. The configuration of the computer (if used) must also be specified and a list must be provided of programs which may not be running on the computer at the same time as programs which constitute a part of the sound level meter (e.g. due to disruption of the synchronisation of the data flow, disturbance of operations of a program which must be operating properly in order for data processing to be correct).

3.7 User manual

3.7.1 Every sound level meter or equivalent device which meets the technical requirements of this measure must be supplied together with a user manual.

a) The user manual must contain all of the information required in Chapter 3.
b) If the sound level meter is made up of several independent components, then a user manual must be available for such combination as constitutes a complete sound level meter. The user manual must describe all essential components and their influences on one another.
c) The user manual must be available in print form in one or more parts.

3.7.2 The user manual must contain the following operating data relating to the sound level meter.

3.7.2.1 General

a) A description of the type of sound level meter; classification group X, Y or Z in terms of its sensitivity to high-frequency fields; and an indication of class 1 or class 2 in accordance with the technical requirements of this Measure. If relevant, a description of the sound level meter configurations which meet the technical requirements for class 1 and class 2.
b) A description of the complete sound level meter and its configuration in normal operating mode, including any potential wind protection cover and associated devices. The description must contain the method of fastening the microphone, identifying the additional elements, and the procedure for installing the wind protection cover around the microphone. The additional elements include a microphone stand or cable which may be necessary for the sound level meter in question to meet the technical requirements of this Measure for the given operating class.
c) The types of microphones with which a complete sound level meter meets the technical requirements in operating class 1 or class 2 in a free field, or, if applicable, in a field with random sound incidence.
d) If a microphone stand or cable is required, a declaration that the sound level meter meets the technical requirements for directional characteristics and frequency weighting, but only if the specific device or cable is installed.
e) The properties and operation of each separate channel in the case of multi-channel sound level meters.

3.7.2.2 Design properties

a) A description of the acoustic quantities which the sound level meter is capable of measuring with the use of each display device, such as the time-weighted sound pressure level, equivalent sound pressure level and sound exposure level, be it separately or in combination, including an explanation of all abbreviations and symbols specified.
b) Detailed descriptions of the function of the sound and frequency angle and the function of relative frequency characteristics on sinusoidal plane waves for a sound level meter with a configuration in the normal operating mode, optionally in tabular form.

c) A description of the frequency weighting functions which meet the technical requirements of this Measure and, if integrated, frequency characteristics of optional weighting functions Z and FLAT.

d) A description of the time-weighting characteristics which are available.

e) Measurement range identification by means of nominal sound pressure levels A at a frequency of 1 kHz.

f) A description of the functioning of the measurement range switches.

g) A description of all display devices, including operating modes and the applicable speeds of refreshing data on digital displays. If more than one display device is available, a declaration on which of these devices meets the technical requirements of this Measure and which devices are for other purposes.

h) The dynamic range of sound pressure levels A which can be measured at 1 kHz in the applicable tolerance range.

i) If integrated, the ranges of peak sound pressure levels C, which can be measured in each measurement range.

j) Clear identification of all computer programs essential to the operation of the sound level meter and the procedure for installing and using them.

k) Data on the nominal characteristics and tolerances which should be complied with for the quantities the sound level meter is able to indicate, but for which no operating requirements are specified in this Measure. The characteristics include selectable frequency weighting functions.

3.7.2.3 Power supply

a) Recommendations on permissible types of batteries or rechargeable batteries and the nominal duration of continuous operation in normal operating mode under reference ambient conditions when fully charged batteries or rechargeable batteries are installed in sound level meters with internal power supply.

b) A description of the indicator or method with which it is confirmed that the power is sufficient to operate the sound level meter in accordance with the technical requirements of this Measure.

c) A description of the means of ensuring the operation of the sound level meter via an external power source in sound level meters powered by a battery, which are designed so as to enable sound pressure level measurements for a period of time exceeding the nominal service life of the batteries or rechargeable batteries.

d) Declaration of the nominal voltage and frequency of power supply and permissible tolerances around the nominal values for sound level meters intended to operate using the public electrical grid.

3.7.2.4 Setting of indicated levels

a) Identification of the types of acoustic calibrators which can be used to check and maintain the sound level meter's precision of indication.

b) Calibration control frequency.

c) Control procedure and data for setting the sound level meter's indications. The procedure and data must apply to the reference sound pressure level in the reference measurement range and at the calibration control frequency.

d) A combination of corrections for deviations in the mean frequency characteristic of the microphone in a free field from the stable frequency characteristic and average effects of reflections from the instrument's cover and deflections around the microphone under ambient conditions which are close to the reference ambient conditions at the frequencies and under the test conditions specified in Articles 3.4.2.4 and 3.4.2.5, for microphones of all types which are specified for use with a sound level meter. The information must also contain corrections of the average effects of the wind protection cover, if a wind protection cover is an inseparable part of the sound level meter's configuration under normal operating mode or if it is specified that the sound level meter meets the technical requirements of this Measure with a wind protection cover placed around the microphone. The information may be specified in the form of separate data for the mean frequency characteristics

of the microphone in a free field and the average effects of sound reflection and deflection and of the wind protection cover.

3.7.2.5 Sound level meter operation

a) Reference direction.
b) Procedures for measuring sounds which generally come from one main direction or a random angle of incidence, including recommendations for minimising the influence of the cover on the instrument and of the operator, if present during the sound measuring.
c) Recommendations for selecting the optimum measurement range when measuring the sound pressure level or sound exposure levels.
d) Procedures for measuring in sound fields with low sound pressure levels at the most sensitive measurement ranges keeping in mind the influence of the instrument's intrinsic noise.
e) The time which must elapse from the instrument being turned on after reaching equilibrium with the surrounding environment before the sound level meter can be used to measure sound pressure levels.
f) Time interval after completing measurement before the data is displayed for integrating-averaging and integrating sound level meters.
g) Procedure for setting the integration time before measuring and, if applicable, setting the time of day.
h) The minimum and maximum integration time during measurement of equivalent sound pressure levels and sound exposure levels.
i) Operation of the 'hold' function and means to release a blocked display.
j) Operation of a zeroing device during measurement of equivalent sound pressure levels, sound exposure levels, maximum time-weighted sound pressure levels and selectable peak sound pressure levels C. Declaration on whether operation of the zeroing device interferes with the overexcitation indication. Nominal delay time between the operation of the zeroing device and the repeated initiation of measurement.
k) Function and interpretation of the overexcitation indication and the low signal level indication and means of zeroing the indication.
l) Operation and function of any measurement thresholds selectable by the user during measurement of equivalent sound pressure levels and sound exposure levels.
m) Method of transferring or recording digital data onto an external recording or display device and identification of software and technical computer equipment for performing such tasks.
n) Recommendations for the typical lengths and types of cables (such as shielded or unshielded) and description of the properties of devices which are expected to be connected by cables in sound level meters allowing for connection of an interface or connector cables.
o) Time-weighted, or, as the case may be, equivalent sound pressure levels corresponding to the highest internal noise level at the more sensitive measurement ranges under reference ambient conditions and for every accessible frequency-weighted function and frequency characteristic. The internal noise must correspond to the anticipated noise of the combination of any specified type of microphone and other components of the sound level meter. In the case of an equivalent sound pressure level, the averaging time must be specified. The averaging time must be at least 30 s.
p) The frequency weighting function, range of effective sinusoidal output signal voltage values, internal electrical impedance at the output and the recommended range of load impedances at the electrical outputs.

3.7.2.6 Accessories

a) Description of the average effects on important properties of the sound level meter under wind-free conditions caused by the microphone being surrounded by the recommended wind protection cover, rain protection device or other accessories provided or recommended in the user manual. Declaration of the operating class which the sound level meter meets after installation of such accessories, or

declaration that the sound level meter still does not meet the technical requirements for either class 1 or class 2.

b) Corrections which apply to measurement results, or procedure which is to be used when positioning an optional microphone stand or cable between the microphone pre-amplifier and other components of the sound level meter.

c) Information on the use of a sound level meter equipped with band filters.

d) Information on connecting auxiliary devices provided by the manufacturer to the sound level meter and the effect of such auxiliary devices on the sound level meter's properties.

3.7.2.7 Influence of fluctuations in ambient conditions

a) Identification of components of the sound level meter only intended for operation in areas with controlled ambient conditions.

b) Effects of electrostatic discharges on the sound level meter's operation. Declaration on potential temporary impairment of operation or loss of function of the sound level meter caused by exposure to electrostatic discharges. Declaration on preventative measures against damage caused by electrostatic discharges in sound level meters which require the user to access the instrument for maintenance reasons.

c) Declaration on whether the sound level meter meets the basic specifications of this Measure on the required immunity to a magnetic field of grid frequency and to high-frequency fields. Optional declaration on sound pressure levels with time characteristic F or, if applicable, equivalent sound pressure levels lower than 74 dB in all applicable measurement ranges in which the sound level meter meets the technical requirements of this Measure during exposure to a magnetic field of grid frequency and to high-frequency fields. The information must contain the specific frequency of the magnetic field.

3.7.3 The user manual must contain the following information for testing the applicable type of sound level meter:

a) Reference sound pressure level.

b) Reference measurement range.

c) Microphone reference point for the types of microphone specified for use with the sound level meter.

d) Settings for obtaining sound pressure levels A equivalent to the response to plane sinusoidal sound waves impacting in the reference direction and at least at the frequencies required for verification of the sound pressure level A displayed in the response to sound pressure created by the acoustic calibrator or in response to acoustic pressure simulated by the electrostatic calibrator. The type of acoustic or electrostatic calibrator to which the information on settings applies must be identified.

e) A table with the nominal sound pressure levels A at the lower and upper limits of the linearity ranges in each measurement range. The sound pressure levels must be specified in tabular form at frequencies of 31.5 Hz, 1 kHz, 4 kHz, 8 kHz and 12.5 kHz for class 1 sound level meters and at 31.5 Hz, 1 kHz, 4 kHz and 8 kHz for class 2 sound level meters.

f) The starting point at which tests are initiated for the amplitude characteristic linearity error in the reference measurement range at each frequency at which the frequency-weighted sound pressure levels are specified at the lower and upper limits of the linearity ranges. The reference sound pressure level must be the starting point for the frequency of 1 kHz.

g) A description of the nominal electrical characteristics and applicable tolerance of the input device or means to connect electrical signals to the electrical input device for each specified type of microphone.

h) For each specified type of microphone with which the sound level meter meets the technical requirements, the applicable time-weighted and equivalent sound pressure levels corresponding to the maximum anticipated internal noise created if, in place of a microphone, a specified electrical input device is installed, which is terminated by the specified means, and a sound level meter is positioned in a sound field with a low sound pressure level. The sound pressure level must be

specified at the most sensitive measurement ranges and for each available frequency weighting and each available frequency characteristic.

i) The maximum sound pressure level at the microphone's location and the maximum peak-to-peak voltage at the electrical input device which the sound level meter, based on its design, is able to process for each specified type of microphone with which the sound level meter meets the technical requirements.

j) The maximum and minimum voltages of the power source at which the sound level meter meets the technical requirements of this Measure.

k) The recommended means for tests of amplitude characteristic linearity errors within the limits of the display range in the case of sound level meters equipped with a display device whose spread is tighter than the linearity range within any measurement range.

l) The typical time interval needed to stabilise after changes in ambient conditions.

m) The effective intensity value of an unmodulated electrical field higher than 10 V/m at which the sound level meter meets the technical requirements of this Measure, if it is built that way.

n) Operating mode(s) of the sound level meter and any connecting parts which create the highest level of high-frequency emission in the specified measurement range. Description of the sound level meter's configurations which create the same or lower high-frequency emission.

o) Operating mode(s) of the sound level meter and any kind of connecting part which has/have the highest sensitivity (lowest immunity) to magnetic fields of grid frequency and high-frequency fields and the corresponding reference orientation of the sound level meter in relation to the main direction of the field.

4 Markings

All of the information on the sound level meter must be indelible, irremovable and legible for the entire duration of use.

4.1 Sound level meter markings

Every sound level meter must be marked with at least the following information:

a) manufacturer's name or trademark;

b) type of sound level meter;

c) standard whose requirements the sound level meter meets;

d) serial number and year of manufacture;

e) operating class of the sound level meter;

f) type-approval mark of the measuring instrument.

4.2 Marking individual parts of the sound level meter

If the sound level meter is made up of several separate parts, then, if feasible, each basic unit or component must be marked in the manner described in Article 4.1.

4.3 Placement of the official mark

Placement of official marks is stipulated in the type-approval certificate or other document or activity applied within the context of conformity assessment when placing the device on the market and putting it into use.

Official marks must be placed so that after their placement, the measuring instrument cannot be adjusted or components cannot be accessed, if forbidden in their case. Marks must be designed so that they cannot be removed without damaging or destroying them.

5 Type approval of the measuring instrument

5.1 General

The sound level meter type-approval process includes the following activities:

a) external inspection, including:
   - completeness of the required technical documentation;
   - conformity of the metrological and technical characteristics specified by the manufacturer in the documentation with the requirements of this Measure;
   - completeness and condition of the sound level meter pursuant to the specified technical documentation;
   - compatibility of the sound level meter's software version with the version specified by the manufacturer;

b) tests of the sound level meter's resistance to mechanical influences;
c) tests of resistance to environmental influences;
d) tests of influences of electrical properties;
e) electromagnetic compatibility (EMC) tests;
f) functional tests.

5.2 Submission for testing

5.1.1 At least three samples of the same type of sound level meter must be submitted for the type examination. The laboratory must select a minimum of two samples for testing. At least one of these two samples must be fully tested pursuant to the established procedures specified in this Measure. The laboratory must decide whether the complete tests will also be conducted for the second sample, or whether complete or limited testing will be sufficient for the type approval.

5.1.2 A user manual must be submitted with the three sound level meters as well as all other parts or accessories which the user manual identifies as inseparable components in normal operating mode. Examples of additional parts or accessories include microphone pre-amplifiers or microphone cables and peripheral devices.

5.1.3 If the sound level meter manufacturer supplies devices which are to be connected to the sound level meter with cables, then the devices and cables must be submitted together with the sound level meter.

5.1.4 A calibrated acoustic calibrator of the type specified in the sound level meter's user manual must be supplied with the sound level meter. The user manual for the acoustic calibrator must also be available. The calibrator type must meet the technical requirements for the given class of acoustic calibrator.

5.2 Sound level meter markings and specifications in user manual

5.2.1 It must be verified whether the sound level meter is marked in accordance with the requirements specified in this Measure.

5.2.2 Before any kind of tests are carried out, it must be verified whether the user manual contains all of the required information on the devices which are part of the sound level meter.

5.2.3 If the sound level meter does not meet the requirements of 5.2.1 and 5.2.2, then no type tests may be conducted.

5.2.4 After all tests have been completed, their results must be examined to ensure they are correct and none of the applicable limits specified in the user manual or technical specifications for the measuring instrument were exceeded.

5.3 Mandatory equipment and general requirements

5.3.1 No test specified in this Measure may be left out unless the sound level meter does not have the equipment which requires testing. If the design of a sound level meter which was type-approved is changed, and a new type approval is required, then it will be at the laboratory's discretion whether it will be necessary to test again those electroacoustic operating properties not affected by the change in design.

5.3.2 It must be verified whether a time-weighting sound level meter is capable of displaying sound pressure level A with time-weighting F and, if such a condition arises, whether it is capable of indicating the condition outside the maximum value in the upper range (overexcitation) and, on the other hand, the condition of the lower signal level, i.e. the lowest value in the lower range.

5.3.3 It must be verified whether an integrating-averaging sound level meter is capable of displaying the equivalent sound pressure level weighted by filter A and, if such a condition arises, whether it is capable of indicating the condition of overexcitation and the condition of the lower signal level below the specified range.

5.3.4 It must be verified whether an integrating sound level meter is capable of displaying sound exposure level A and, if such a condition arises, whether it is capable of indicating the condition of overexcitation and the condition of the lower signal level.

5.3.5 It must be verified whether all display devices of the sound level meter are capable of displaying the sound pressure level or sound exposure level with the required resolution. The display range must correspond to at least the minimum required range.

5.3.6 If the sound level meter is capable of displaying the measured maximum sound pressure level or peak sound level (or both), it must be verified whether it is equipped with a 'hold' function.

5.3.7 It must be verified whether a class 1 sound level meter is equipped with frequency weighting C.

5.3.8 If the sound level meter is capable of indicating peak sound pressure level C_{Peak}, it must be verified whether it is also capable of displaying time-weighted sound pressure level C or the equivalent sound pressure level C_{Leq} as well.

5.3.9 With sound level meters which are able to display more than one measurement quantity, it must be verified whether there is any clear means of ascertaining which quantity is being displayed at the moment.

5.3.10 Sound level meters having multiple measurement ranges must be verified to ascertain whether the overlapping of the measurement ranges is in accordance with the prescribed technical requirements.

5.3.11 If the sound level meter does not have the mandatory equipment specified in Articles 5.3.2 to 5.3.10, then the sound level meter does not meet the technical requirements of this Measure and none of the type tests may be conducted.

5.3.12 In all type tests, the configuration of the sound level meter or multi-channel sound level meter system must be in accordance with the specifications listed in the user manual for one or more normal operating modes, including the required accessories. The configuration must also include the wind protection cover, if a wind protection cover is an inseparable part in normal operating mode or if it is specified in the user manual that the sound level meter meets the technical requirements of this Measure with a wind protection cover installed around the microphone. The type of wind protection cover must be identical to the type which is specified in the user manual for use with the sound level meter. All the sound level meter configurations must be tested which are defined in the user manual as configurations meeting the requirements of this Measure.

5.3.13 If the user manual states that the sound level meter meets the requirements of this Measure with the optional equipment installed, then it must also be tested in combination with the optional equipment installed in order to demonstrate conformity.

5.3.14 If the sound level meter is equipped with an electrical output and the laboratory intends to use the electrical output instead of the display device, the laboratory must verify whether changes to the

levels of acoustic or electrical input signals applied cause changes to the level of the signals on the display device and at the electrical output in accordance with the specifications specified in this Measure. This requirement applies to each channel of a multi-channel system. If multiple outputs are available and the user manual specifies an output for testing, then this output is recommended for use in the type tests.

5.3.15 The sound level meter must be powered by its preferred source in all tests.

5.3.16 Before the power supply is switched on to conduct the test, it must be possible for the sound level meter to reach a state of equilibrium under the prevailing ambient conditions, i.e. to adapt to the temperature, pressure and humidity of the environment in which the sound level meter is to be tested.

5.3.17 The tests for demonstrating conformity with the technical requirements on the effects of changes in ambient conditions are preferably to be carried out before the tests for demonstrating conformity with the technical requirements for electroacoustic operating properties.

5.3.18 If the sound level meter has more than one channel for signal processing, the type tests must be carried out on each channel which uses an exclusive method of signal processing. In the case of multi-channel systems with the same functional equivalence on all channels, the number of channels which can be tested may, at the laboratory's discretion, be lower than the total number of channels. With a multi-channel system, the number of channels should be determined in consideration of the milieu, in which there is an array of microphones which supply each input with a signal and in which the signals are processed by the same means on each channel. When selecting the number of channels and the testing method, it is recommended to take into consideration the differences described in the user manual concerning the signal processing method integrated in various channels.

NOTE If the sound level meter is a multi-channel device (such as a sound level meter with two or more separate signal inputs with non-parallel processing of digital data in time-sharing mode, but with a quasi-parallel display for the signals displayed), it is generally possible to test the same functionality of the channels either by setting the function of the channels for the same processing and indication on the display(s), or by enabling cyclical changing of the channels' functionality in the settings for a special test procedure whereby the display(s) can be compared.

5.3.19 Conformity with the technical requirements is demonstrated if both of the following criteria are met:

a) the measured deviation from the nominal value does not exceed the applicable acceptance limit; and
b) the corresponding measurement uncertainty does not exceed the corresponding maximum permissible measurement uncertainty specified in the technical requirements for sound level meters for the same probability of coverage of 95 %.

These requirements include an example of evaluating conformity with the help of these criteria.

5.3.20 The laboratory must use instruments with valid calibrations for the applicable quantities. Depending on the requirement, the calibration must be tied to national standards.

5.3.21 At least the following elements are included when calculating the actual measurement uncertainties in the applicable test:

- Uncertainty attributed to the calibration of the individual components and devices used in carrying out tests, including the acoustic calibrator.
- Uncertainty resulting from small errors which may occur in the signals used.
- Uncertainty resulting from environmental effects or corrections.
- Uncertainties assigned to the resolution of the display device of the sound level meter being tested. With digital display devices which indicate the signal level with a resolution of 0.1 dB, the element of uncertainty should be assessed in such a manner that it has a rectangular distribution with a half-range of 0.05 dB.
- The uncertainty attributed to the effects associated with the repeatability of the measurement results. If the laboratory is only required for an individual measurement, it is essential for the laboratory to determine an estimate of the random contribution to the overall uncertainty of

measurement. The estimate should be determined from previous assessments of multiple measurements of the operating properties of similar sound level meters.

- The uncertainty resulting from the deviation of the sound field in the free-field test facility from the ideal sound field.
- The uncertainty assigned to the device used to fasten the sound level meter in the free-field test facility.
- The uncertainty assigned to each correction made to the measurement data.

5.3.22 If the measurement uncertainty exceeds the maximum permissible measurement uncertainty, the test results may not be used to demonstrate conformity with the technical requirements and the type approval may not be granted.

5.3.23 When carrying out type tests, the laboratory is required to make use of the recommendations specified in the user manual.

5.4 Tests of the influence of the environment, electrostatic discharges and high-frequency fields

5.4.1 General

5.4.1.1 The indication of sound pressure level A at the calibration control frequency must be checked using an acoustic calibrator specified in 5.1.4 before starting, but not during, the tests described in the articles of Chapter 5.4. If necessary, the sound level meter must be configured so that the required sound pressure level is indicated under reference ambient conditions. In a multi-channel device, the corresponding indication must be checked in all channels selected for testing.

5.4.1.2 The ambient conditions at the time the indication is checked must be recorded.

5.4.1.3 The effect of the ambient conditions (air temperature, barometric pressure and relative humidity) at the sound pressure level created by the acoustic calibrator must be determined in accordance with the procedure specified in the user manual for the acoustic calibrator and with the data from its calibration. The effects must be assessed in terms of the sound pressure level created under reference conditions.

5.4.1.4 An acoustic calibrator which creates a signal about a known sound pressure level in the sound level meter's microphone must be used in the environmental influence tests. In the case of class 1 sound level meters, the acoustic calibrator must meet the technical requirements of the applicable standard for acoustic calibrators for either class LS or class 1. In the case of class 2 sound level meters, the acoustic calibrator must meet the technical requirements of the applicable standard for acoustic calibrators for either class LS, class 1 or class 2. If the acoustic calibrator meets the requirements of the applicable operating class at a nominal frequency of 1 kHz, then the environmental influence tests must be carried out at a nominal frequency of 1 Hz. The corrections for static pressure, air temperature and relative humidity on the sound pressure level created in the coupler of the acoustic calibrator in the range of ambient conditions specified for the tests must be known.

NOTE The range of ambient conditions specified for type tests exceeds the range specified in the applicable standard for class LS acoustic calibrators.

5.4.1.5 The sound level meter must be configured so that a typical measurement of the time-weighted sound pressure level, equivalent sound exposure level or sound exposure level, takes place in the reference measurement range. The frequency weighting must be set to weighting function A.

5.4.1.6 The time-weighted sound pressure levels, equivalent sound pressure levels or sound exposure levels indicated by the sound level meter in response to the signal from the acoustic calibrator must be recorded for every testing condition. If necessary, the equivalent sound pressure levels must be calculated in accordance with the technical requirements for sound level meters from the sound exposure level indication and the time elapsed. The averaging time in the case of equivalent sound pressure levels and the integration time in the case of sound exposure levels must be recorded.

5.4.2 Uncertainties in ambient test condition measurements

When measuring static pressure, the actual measurement uncertainties must not exceed 0.2 kPa. When measuring air temperature and relative humidity, the actual expanded measurement uncertainties must not exceed 0.3 °C or 4 %, respectively. These measurement uncertainties must be determined for a coverage probability of 95 %.

5.4.3 Influence of static pressure

5.4.3.1 During measurements of the influence of static pressure, the air temperature must be maintained within an accuracy of ±2.0 °C with respect to the reference air temperature. At reference static pressure, the relative humidity must be maintained with respect to the reference relative humidity with an accuracy of +20 % relative humidity to −10 % relative humidity.

5.4.3.2 The relative humidity is specified at the reference static pressure. The relative humidity in this area changes with the reduction or increase in static pressure in an enclosed area around the sound level meter. No corrections may be made to such an effect.

5.4.3.3 The influence of static pressure must be tested at the reference static pressure and at seven other static pressures. Before recording the indicated sound pressure level, the acoustic calibrator specified in 5.4.1.4 and the sound level meter (or other important components) must be acclimatised for at least 10 minutes for each static pressure. The acoustic calibrator must remain connected to the microphone during the acclimatisation period during tests of the effect of static pressure. The sound level meter's power supply may be continuously switched on or it may be switched on and switched off via remote control.

5.4.3.4 The sound pressure levels must be measured twice at the nominal static pressures, which are distributed in approximate corresponding intervals between the lowest and highest static pressure specified in the applicable standard. The two static pressures measured must not differ by more than 1 kPa under each nominal static pressure condition. One measurement sequence must begin at the lowest static pressure and continues by gradually increasing by each selected nominal pressure until the maximum is reached. The other sequence must continue by reducing the pressure from the maximum across each of the selected nominal pressures until the minimum is reached. Only one indication must be recorded at the highest static pressure.

5.4.3.5 At each static pressure test condition, the measured deviations of the indicated sound pressure level from the sound pressure level indicated first at the reference static pressure must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters.

5.4.3.6 The indicated sound pressure levels must be corrected in terms of any difference between the sound pressure level generated by the acoustic calibrator under test conditions and the sound pressure level generated under reference ambient conditions.

5.4.4 Limits for air temperature, relative humidity and static pressure

Unless specified otherwise, each test of the influence of air temperature and relative humidity, including the requirements for acclimatisation specified in 5.4.5, the measured air temperature must not exceed ±1.0 °C of the specified air temperature, the relative humidity must not exceed ±5 % of the specified relative humidity and the difference between the highest and lowest value of the prevailing static pressure must not exceed 6.0 kPa.

5.4.5 Requirements for acclimatisation in tests of the influence of air temperature and relative humidity.

5.4.5.1 During the test of the influence of air temperature and relative humidity on the sound level meter, the acoustic calibrator corresponding to the specifications pursuant to 5.4.1.4 and the sound level meter (or relevant component thereof) must be placed in a climatic chamber.

5.4.5.2 The acoustic calibrator and sound level meter must be acclimatised for a period of at least 12 h under reference ambient conditions.

5.4.5.3 Under all test conditions which are different from the reference ambient conditions, after the initial 12 h acclimatisation period has elapsed, additional acclimatisation of the acoustic calibrator and sound level meter must be allowed for a period of at least 7 h, unless the laboratory has sufficient proof that a shorter acclimatisation period will suffice.

5.4.5.4 In tests of the influence of air temperature and relative humidity, the acoustic calibrator and sound level meter with the fastened microphone disconnected and during the acclimatisation period, both instruments must be supplied with power in the 'off' position.

5.4.5.5 Once the acclimatisation period has elapsed, the acoustic calibrator must be placed on the sound level meter's microphone and the power supply is switched on for both instruments.

5.4.5.6 The laboratory may be equipped with equipment with which the acoustic calibrator is connected to the microphone on the sound level meter without influence of temperature and relative humidity in a climatic test chamber. If such equipment is available, the sound pressure level may be recorded after the period of time specified in the user manual after the pressure in the microphone has equalised. If such equipment is not available, then an additional acclimatisation period must take place for at least 3 h before the test begins.

5.4.6 Abbreviated test of the combined influence of air temperature and relative humidity

5.4.6.1 In order to limit the time and cost for verifying the influence of air temperature and relative humidity on the sound level meter's operation, a set of abbreviated tests at the specified air temperature and relative humidity will have to be carried out first.

5.4.6.2 The acceptance limits for abbreviated tests of the influence of combined air temperature and relative humidity are narrower than the acceptance limits specified in the applicable standards. If the sound level meter meets the narrower acceptance limits under all specified test conditions, the sound level meter must be deemed to be an instrument which entirely meets the specifications listed in the technical requirements for sound level meters. After that, no additional tests will be required. If the sound level meter does not meet the narrower acceptance limits in any of the specified test conditions, then additional tests described in 5.4.7 and 5.4.8 must be conducted to determine compliance with the technical requirements specified in this Measure.

5.4.6.3 After completing the acclimatisation procedures described in 5.4.5, the sound pressure level indicated in the response to the action of an acoustic calibrator which meets the requirements specified in 5.4.1.4 must be recorded for the specific combination of air temperature and relative humidity. When setting the test conditions, it is necessary to prevent sudden changes in air temperature in the test chamber. One must proceed with caution so that changes in temperature in the climatic test chamber do not cause condensation. In order to make sure that the relative humidity remains within the specified range, it is important to monitor the relative humidity in the climatic test chamber every time the air temperature changes.

NOTE The combinations of temperature and relative humidity specified in 5.4.6.4 and 5.4.6.5 were selected in consideration of the condensation points which may be reached in accessible climatic test facilities. The combinations also reflect the range of ambient conditions during common applications of class 1 and class 2 sound level meters.

5.4.6.4 In the case of sound level meters in which all components can function in a wide range of air temperatures and relative humidity covered by the technical requirements specified in the technical requirements for sound level meters, the following test conditions are required:

a) for class 1 sound level meters:
   - reference air temperature and reference relative humidity;
   - air temperature of −10 °C and relative humidity of 65 %;
   - air temperature of +5 °C and relative humidity of 25 %;
   - air temperature of +40 °C and relative humidity of 90 %;
   - air temperature of +50 °C and relative humidity of 50 %;

b) for class 2 sound level meters:
   - reference air temperature and reference relative humidity;
   - air temperature of +0 °C and relative humidity of 30 %;
   - air temperature of +40 °C and relative humidity of 90 %.

5.4.6.5 For those parts of the sound level meter which, according to the user manual, are designed for operation in an area with controlled ambient conditions, the following ambient conditions are required:
- reference air temperature and reference relative humidity;
- air temperature of +5 °C and relative humidity of 25 %;
- air temperature of +35 °C and relative humidity of 80 %.

5.4.6.6 With sound level meters which are made up of combinations of components, the abbreviated environmental influence tests must be carried out in three steps.

In the 1st step, components which can function in a wide range of ambient conditions (such as microphone and pre-amplifier) and components which only function when conditions are controlled (such as a computer) must show functionality under reference ambient conditions.

In the 2nd step, components which can function in a wide range of ambient conditions must be shown to function in combinations of ambient conditions pursuant to 5.4.6.4 (four conditions for class 1 sound level meters or two conditions for class 2 sound level meters), while components which only function when conditions are controlled, remain as showing functioning under reference ambient conditions.

In the 3rd step, components which only function when conditions are controlled must be shown to function under two combinations of ambient conditions pursuant to 5.4.6.5, while components which can function in a wide range of ambient conditions remain as showing functioning under reference ambient conditions. If it is essential to ensure that the actual measurement uncertainty does not exceed the maximum permissible uncertainty, it is permissible to replace an acoustic signal from an acoustic calibrator with an equivalent electrical signal when exposing the microphone to reference ambient conditions.

The acclimatisation procedure specified in 5.4.5 must be complied with under each test condition. The indicated sound pressure levels must be recorded.

5.4.6.7 In all tests, the indicated sound pressure levels must be corrected in terms of any difference between the sound pressure level created by the acoustic calibrator under test conditions and the sound pressure level created under reference ambient conditions.

5.4.6.8 In sound level meters which are not made up of independent components, as well as in each test condition, the absolute value of the maximum deviation of the indicated sound pressure level from the sound pressure level indicated under reference air temperature and reference relative humidity must be determined. In those sound level meters which are made up of combinations of components, the sum of the absolute value of the maximum deviation of the sound pressure level ascertained pursuant to the 2nd step in 5.4.6.6 from the sound pressure level measured pursuant to the 1st step and the absolute value of the maximum deviation of sound pressure level ascertained in the 3rd step from the sound pressure level measured pursuant to the 1st step must be determined.

5.4.6.9 Other than the above-mentioned tests of the influence of temperature and humidity on the sound level meter's operation, a special test of the influence of increased temperature on amplitude characteristic linearity errors described in 5.6.8.2 must also be conducted.

5.4.6.10 The absolute values or sums of absolute values of the maximum deviations determined pursuant to 5.4.6.8 must not exceed the narrower acceptance limit of 0.7 dB in class 1 sound level meters and 1.2 dB in class 2 sound level meters.

5.4.7 Influence of air temperature

5.4.7.1 If the sound level meter does not meet the requirements in the abbreviated tests pursuant to 5.4.6, the following tests of the influence of air temperature on the operation of the sound level meter must be carried out. The specified relative humidity is the reference relative humidity. To make sure that the

relative humidity does not exceed the specified ranges, it is important to monitor the relative humidity in the climatic test chamber every time the air temperature changes. When setting the test conditions, it is necessary to prevent sudden changes in air temperature in the test chamber. One must proceed with caution so that changes in temperature in the climatic test chamber do not cause condensation.

5.4.7.2 In the case of sound level meters in which all components can function in a wide range of air temperatures defined in this Measure, the sound pressure levels indicated in the response to the action of an acoustic calibrator which meets the requirements specified in 7.1.4 must be measured at five air temperatures, specifically:

a) at reference air temperature;
b) at the minimum valid air temperature specified in the technical requirements for sound level meters;
c) at the maximum valid air temperature specified in the technical requirements for sound level meters;
d) at a temperature of +15 °C;
e) at a temperature of +30 °C.

The acclimatisation procedures pursuant to 5.4.5 must be carried out at each test condition.

5.4.7.3 With sound level meters which are made up of combinations of components, the influence of air temperature must be tested in three steps.

In the 1st step, all components must be exposed at the reference air temperature.

In the 2nd step, components which can function in a wide range of ambient conditions must be shown to function:

a) at the minimum valid air temperature specified in the technical requirements for sound level meters;
b) at the maximum valid air temperature specified in the technical requirements for sound level meters;
c) at a temperature of +15 °C;
d) at a temperature of +30 °C,

while components which only function when conditions are controlled remain exposed under the reference air temperature.

In the 3rd step, components which only function when conditions are controlled must be shown to function:

a) at the minimum valid air temperature specified in the technical requirements for sound level meters;
b) at the maximum valid air temperature specified in the technical requirements for sound level meters,

while components which can function in a wide range of ambient conditions remain as showing functioning at reference air temperature.

The acclimatisation procedure specified in 5.4.5 must be complied with under each test condition. The sound pressure levels indicated in the response to the action of the acoustic calibrator must be recorded.

5.4.7.4 The sound pressure levels must be corrected in terms of any difference between the sound pressure level created by the acoustic calibrator under test conditions and the sound pressure level created under reference ambient conditions.

5.4.7.5 In sound level meters which are not made up of independent components, as well as in each test condition, the absolute value of the maximum deviation of indicated sound pressure level from the sound pressure level indicated under the reference air temperature and the reference relative humidity must be determined. In those sound level meters which are made up of combinations of components, the sum of the absolute value of the maximum deviation of the sound pressure level ascertained in the 2nd step in

Article 5.4.7.3 from the sound pressure level measured pursuant to the 1st step and the absolute value of the maximum deviation of the sound pressure level ascertained in the 3rd step from the sound pressure level measured pursuant to the 1st step must be determined.

5.4.7.6 The absolute deviations and sums of absolute values of the maximum deviations determined in 5.4.7.5 must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters.

5.4.8 Influence of relative humidity

5.4.8.1 If the sound level meter does not meet the requirements in the abbreviated tests pursuant to 5.4.6, the tests of the influence of relative humidity must be carried out.

5.4.8.2 During the tests of the influence of relative humidity, the deviation in static pressure from the specified static pressure must not exceed the limits specified in 5.4.4. The deviation in actual relative humidity from the required relative humidity specified in 5.4.8.3 and 5.4.8.4 must not exceed the limits specified in 5.4.4.

5.4.8.3 In the case of sound level meters in which all components can function in a wide range of relative humidity defined in the applicable standard, the sound pressure levels indicated in the response to the action of an acoustic calibrator which meets the requirements specified in 5.4.1.4 must be measured at four combinations of relative humidity and air temperature. The test conditions are:

- reference relative humidity at the reference air temperature;
- minimum relative humidity at an air temperature of +40 °C;
- maximum relative humidity at an air temperature of +40 °C;
- relative humidity of 70 % at an air temperature of +40 °C.

The acclimatisation procedure specified in 5.4.5 must be complied with under each test condition.

5.4.8.4 With sound level meters which are made up of combinations of components, the influence of relative humidity must be tested in three steps.

In the 1st step, all components must be shown to function at the reference relative humidity at the reference air temperature.

In the 2nd step, components which can function in a wide range of ambient conditions must be shown to function in an air temperature of +40 °C:

a) at the minimum relative humidity specified in the technical requirements for sound level meters;
b) at the maximum relative humidity specified in the technical requirements for sound level meters;
c) at relative humidity of 70 %,

while components which only function when conditions are controlled remain at the reference relative humidity and the reference air temperature.

In the 3rd step, components which only function when conditions are controlled must be shown as functioning in an air temperature of +35 °C:

a) at the minimum relative humidity specified in the technical requirements for sound level meters;
b) at the maximum relative humidity specified in the technical requirements for sound level meters,

while components which can function in a wide range of ambient conditions remain at the reference relative humidity and the reference air temperature.

The acclimatisation procedure specified in 5.4.5 must be complied with under each test condition. The sound pressure levels indicated in the response to the action of the acoustic calibrator must be recorded.

5.4.8.5 The sound pressure levels must be corrected in terms of any difference between the sound pressure level created by the acoustic calibrator under test conditions and the sound pressure level created under reference ambient conditions.

5.4.8.6 In sound level meters which are not made up of independent components, as well as in each test condition, the absolute value of the maximum deviation of the indicated sound pressure level from the

sound pressure level indicated under the reference air temperature and the reference relative humidity must be determined. In those sound level meters which are made up of combinations of components, the sum of the absolute value of the maximum deviation of the sound pressure level ascertained in the 2nd step in Article 5.4.8.4 from the sound pressure level measured pursuant to the 1st step and the absolute value of the maximum deviation of the sound pressure level ascertained in the 3rd step from the sound pressure level measured pursuant to the 1st step must be determined.

5.4.8.7 The absolute deviations and sums of absolute values of the maximum deviations determined in 5.4.8.6 must not exceed the applicable acceptance limits specified in the applicable standard.

5.4.9 Influence of electrostatic discharges

5.4.9.1 The sound level meter must be immune to the influence of electrostatic discharges.

5.4.9.2 Tests with electrostatic discharges must be carried out with the sound level meter switched on and set so that it exhibits the lowest immunity to electrostatic discharge, as determined in a preliminary test. If the sound level meter can be equipped with connecting components which, according to specifications in the user manual, are not required as part of the configuration in normal operating mode, then no cables may be connected during the tests on electrostatic discharges. The sound level meter systems with two or more channels for signal processing must have at least two microphone systems installed.

5.4.9.3 Discharges of electrostatic voltage must not be conducted at the outlet of the connectors which are hidden beneath the surface of either the connector or the body of the sound level meter.

5.4.9.4 Electrostatic discharges of the maximum positive and maximum negative voltage specified in the applicable standard must be conducted ten times at the contacts and ten times through the air. The discharges must be conducted at any point on the sound level meter which the laboratory deems to be a suitable point. The range of points must be limited to those points which are accessible during normal use. It must also encompass those points inside the sound level meter to which the user has access, unless the user manual prescribes preliminary measures to prevent damage from electrostatic discharges. It is necessary to proceed with caution so that the sound level meter being tested is free of any kind of effects of the discharge before the discharge is repeated.

5.4.9.5 After the discharge, the sound level meter must return to the same operating status it was in before the discharge. Any data saved on the sound level meter before the discharge must remain unchanged after the discharge. Unquantified changes in the sound level meter’s activity are permissible during the discharge.

5.4.10 Effects of magnetic fields caused by a grid-frequency alternating current and high-frequency fields

5.4.10.1 Sound signal

5.4.10.1.1 A sound signal which has the properties specified in the technical requirements for sound level meters must be set so as to create an indication of the equivalent sound pressure level A or sound pressure level A with time characteristic F 74 dB ±1 dB. In the case of equivalent sound pressure level indications, the averaging time must be recorded. If the sound level meter has more than one measurement range, the measurement range in which the lower sound pressure level limit is specified must be set as closely as possible, but not higher than 70 dB. If the sound level meter only indicates the sound exposure level, it is necessary to calculate the corresponding equivalent sound pressure level as specified in the technical requirements for sound level meters for the averaging time.

5.4.10.1.2 The method of applying the sound signal to the microphone must not cause any mutual interference with the grid-frequency alternating current caused by the acting magnetic field or high-frequency field. The method of using the sound signal must not disrupt the normal operation of the sound level meter or affect the sound level meter’s sensitivity to magnetic fields caused by a grid-frequency alternating current or to high-frequency fields.

5.4.10.2 Tests of the influence of magnetic fields caused by a grid-frequency alternating current

5.4.10.2.1 The sound level meter being tested must be oriented pursuant to the specifications listed in the user manual, in which it has the minimum resistance to magnetic fields caused by a grid-frequency alternating current. In the case of sound level meters in which a microphone must be connected via microphone cable in order to meet the specifications listed in the technical requirements for sound level meters, the tests in a magnetic field caused by a grid-frequency alternating current must also include the microphone unit.

5.4.10.2.2 In tests of the influence of a magnetic field caused by a grid-frequency alternating current, equipment must be used which is capable of creating an essentially homogeneous magnetic field with an effective intensity value of 80 A/m. The equipment must enable the complete sound level meter or relevant parts thereof marked in the user manual to be located in the magnetic field. The frequency of the alternating magnetic field must be 50 Hz or 60 Hz. The measurement uncertainty of the intensity of the magnetic field must not exceed 8 A/m.

5.4.10.2.3 Before the tests of the influence of alternating magnetic fields are initiated, the sound signal described in 5.4.10.1.1 must be connected and the indicated sound pressure level must be recorded. After the sound level meter is placed in the alternating magnetic field, the sound pressure level must be recorded at the same acoustic signal at the microphone's location in which it was used in the first test. The exposure period must be at least 10 s. The deviation of the indicated sound pressure level A from the sound pressure level A indicated before placement in the magnetic field must be determined.

NOTE The maximum permissible measurement uncertainty specified in the technical requirements for sound level meters does not include any contribution from the measurement uncertainty of the magnetic field's intensity.

5.4.10.2.4 The deviations determined in 5.4.10.2.3 must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters.

5.4.10.3 Tests in a high-frequency field

5.4.10.3.1 A sound level meter must be immune to the effect of high-frequency fields.

5.4.10.3.2 If the sound level meter is equipped with any kind of connecting component which enables the connection of an interface cable and connector cables, then all tests of immunity to high-frequency poles must be conducted with the cables connected to all the connection components which are available. The lengths of the cables must be identical to the lengths of the cables recommended in the user manual. All cables must be left unconnected on the other end. If the sound level meter manufacturer also supplies devices which are connected to the sound level meter via cable, the influence of the high-frequency field must be determined under the conditions in which all components are connected together.

5.4.10.3.3 The test of the influence of high-frequency fields must be carried out with the sound level meter set up in normal operating mode as specified in the user manual. In the case of sound level meters for which the specific orientation includes a microphone connected by cable, the microphone must be placed above the centre of the sound level meter's body at a height of approximately 250 mm. If the cable is longer than 250 mm, the cable must be wrapped around itself so as to form a figure eight. An even number of loops of the same length must be formed, in which all parts are secured together on both ends and in the centre. The reference orientation of the sound level meter specified in the user manual must be initially identical to the main axis of the emitter of the high-frequency fields.

5.4.10.3.4 If several connections can be made with the same connecting component, then the influence of the high-frequency fields must be tested in the configuration which is specified in the user manual as the configuration which has the lowest immunity to high-frequency fields. Other configurations which are equally or more resistant to high-frequency fields may be specified in the user manual in the list of suitable configurations. As long as the configuration tested fully meets the specifications listed in the technical requirements for sound level meters, other configurations may be specified without further testing.

5.4.10.3.5 In sound level meters of group Z, which are hand-held, the accessories typically held in the hand must be positioned around the sound level meter during tests of the influence of high-frequency fields.

5.4.10.3.6 The effective intensity value of the electrical field (unmodulated) must meet the specification listed in the technical requirements for sound level meters. The carrier frequency of the modulated signal must change in increases of up to a maximum of 4 % in a range from 26 MHz to 500 MHz. At frequencies from 500 MHz to 1 GHz and at frequencies from 1.4 GHz to 2.7 GHz, the interval must be up to a maximum of 2 %. The effective intensity value of the electrical field must be within a range from 0 % to +40 % of the nominal intensity of the electrical high-frequency field.

NOTE An increase in frequency of 2 % or 4 % means that an additional signal frequency is higher than the previous signal frequency by a factor of 1.02 or 1.04, respectively. Increases in carrier frequency from 2 % to 4 % are deemed to be suitable increases.

5.4.10.3.7 Before the tests of the influence of high-frequency fields are initiated, the sound level meter must be exposed to the sound signal described in 5.4.10.1.1 and the indicated sound pressure level must be recorded. The indicated sound pressure level for the same sound signal must be recorded at the microphone's location at every carrier frequency, as described in the initial test. The equivalent sound pressure level (or sound exposure level) must be zeroed at the beginning of measurement at every carrier frequency. The measuring period must be at least 10 s with the high-frequency field present, as well as in its absence.

5.4.10.3.8 The measured deviation in the indicated sound pressure level A from the sound pressure level A indicated before the high-frequency field was added must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters.

NOTE The maximum permissible measurement uncertainty specified in the technical requirements for sound level meters does not include any contribution from the measurement uncertainty of the electrical field's intensity.

5.4.10.3.9 Testing at the discrete frequencies specified in 5.4.10.3.6 does not exclude the requirement to meet the specifications listed in the technical requirements for sound level meters at all carrier frequencies within the range specified in the technical requirements for sound level meters. If there are signs that the acceptance limits specified in the technical requirements for sound level meters pursuant to 5.4.10.3.6 could be exceeded at the carrier frequencies between two sequential frequencies, then tests will have to be carried out at further carrier frequencies.

5.4.10.3.10 If the user manual states that the sound level meter meets the specifications listed in the technical requirements for sound level meters at electrical field intensities higher than those specified in the technical requirements for sound level meters, then all tests of the influence of high-frequency fields must be repeated at the highest of these electrical field intensities.

5.4.10.3.11 The tests pursuant to 5.4.10.3.6 to 5.4.10.3.10 must be repeated while maintaining the configuration described in 5.4.10.3.2 to 5.4.10.3.5 in order to measure the influence of high-frequency fields on at least one other plane. The other plane must be approximately perpendicular to the basic plane in the reference orientation while complying with the limits of the test fastening's setting. The measured deviation in the indicated sound pressure level A from the sound pressure level A indicated before the high-frequency field was added must not exceed the acceptance limits specified in the technical requirements for sound level meters.

5.4.10.3.12 While the high-frequency field is being applied, the sound level meter must remain functional and in the same configuration as it was before it was exposed to the effect of the high-frequency field.

5.4.10.3.13 The user manual must state that the sound level meter meets the specifications listed in the technical requirements for sound level meters at sound pressure levels lower than 74 dB. In this case, additional tests of the influence of high-frequency fields must be carried out in each applicable measurement range. The additional test must be carried out at the lowest sound pressure level specified in the user manual at which the specifications listed in the applicable standard are complied with. The

source of sound described in 5.4.10.1.1 and the sound signal described in 5.4.10.1.2 must be used in these additional tests.

5.4.10.3.14 The measured deviation in the indicated sound pressure level A from the sound pressure level A indicated before the high-frequency field was added must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters for every step of the signal level from the sound source.

5.4.10.3.15 In the case of sound level meters from group Y or group Z, additional tests must be carried out which verify conformity with the specifications listed in the technical requirements for sound level meters for immunity to high-frequency interference at the AC inputs/outputs. The effective intensity value of the electrical field must not be lower than −0 % or higher than +40 % of the nominal intensity of the electrical high-frequency field.

5.4.10.3.16 In the case of sound level meters from group Z, which use or for which connector cables longer than 3 m are specified, additional tests must be carried out in order to demonstrate conformity with the specifications listed in the technical requirements for sound level meters for immunity of signals and control inputs/outputs to high-frequency interference. The AC voltage of the electrical grid must not be lower than −0 % or higher than +5 % of the nominal voltage.

5.5 High-frequency emissions and interference from the public electrical grid

5.5.1 The high-frequency field intensity emission levels in decibels are in relation to the reference value of 1 μV/m. The high-frequency emissions tests must be carried out with a switched-on sound level meter which is powered from the preferred source and set in operating mode and in the measurement range in which the highest levels of high-frequency emissions are generated.

5.5.2 All design elements and fastening components used to maintain the position of the sound level meter, including microphone and cable (if used), must have a negligible effect on the measuring of high-frequency emissions from the sound level meter.

5.5.3 The high-frequency emissions levels must be measured in the frequency ranges specified in the applicable standard with the sound level meter set up in the specified reference orientation.In the case of sound level meters with which a specific configuration includes a microphone connected via cable, the microphone and cable must be arranged as described in 5.4.10.3.1. Multi-channel sound level meter systems must be equipped with microphones connected to the input of each channel.

5.5.4 The high-frequency emissions levels must be measured on one other plane selected by the laboratory while maintaining the arrangement (if applicable) of microphone and cable with respect to the body of the sound level meter as specified in 5.5.3. The other plane must be approximately perpendicular to the main plane in the reference orientation in the limits of the position of the system used when measuring the high-frequency emissions level.

5.5.5 If the sound level meter is equipped with any kind of connecting component which enables the connection of an interface cable or connector cables, then the high-frequency emissions levels must be measured with the cables connected to all connection components which are available. The length of the cables must be the maximum length recommended in the user manual. All cables must be left unconnected on the other end. If the sound level meter manufacturer also supplies devices which are connected to the sound level meter via cable, the influence of the high-frequency field must be determined under the condition in which all components are connected together.

5.5.6 If several connections can be made with the same connecting component, then the high-frequency emissions levels must be measured in the configuration which is specified in the user manual as the configuration which produces the highest level of high-frequency emissions. As long as the configuration tested fully complies with the limits specified in the technical requirements for sound level meters, other configurations with the same or lower high-frequency emissions levels may be specified in the form of a list in the user manual without further testing.

5.5.7 In the case of sound level meters from group Y or group Z, which are powered from the public electrical grid, a test of interference from emissions radiated by the public electrical grid must be carried

out. Unless a different measurement range is specified in the user manual, the sound level meter must be set to the reference measurement range during these tests.

5.6 Electroacoustic operating tests

5.6.1 General

5.6.1.1 The tests described in this chapter are conducted by means of acoustic or electrical signals pursuant to the specifications for each test. The operator may not be present in the sound field during tests with acoustic signals. Electrical signals of equivalent output from the microphone must be sent to the sound level meter by means of the input device which is specified in the user manual. It must be verified whether the difference between the changes in signal level indicated on the display device and the changes corresponding to the signal level at the electrical output (if used) do not exceed the limit specified in the technical requirements for sound level meters.

5.6.1.2 In tests with acoustic signals, the sound pressure level at the location of the sound level meter's microphone must be measured by a calibrated laboratory reference microphone which meets the technical requirements specified in the applicable standard for measurement microphones. When determining the sound pressure level at the test frequency, the frequency characteristics of the reference microphone must be taken into consideration. With multi-channel sound level meter systems having identical microphone units and identical installation configurations, at least one microphone channel must be tested and any other microphone channels must be tested based on the laboratory's judgement. If the microphone units or installation configurations are not identical, then each different microphone channel must be tested.

5.6.1.3 The stability of the sound pressure level between measurements with the laboratory reference microphone and measurements with the sound level meter must be known either based on a previous assessment, or according to the measurement of the stability of the sound pressure level with a monitoring microphone during tests with acoustic signals.

5.6.1.4 In tests with acoustic signals and measurements of internally generated noise, the ambient conditions must be within the following ranges for the duration of the test: static pressure of 97 kPa to 103 kPa, air temperature of +20 °C to +26 °C and relative humidity of 40 % to 70 %.

5.6.1.5 The deviation in frequency of the input signal from the specified frequency must not exceed ±0.25 % of the specified frequency

5.6.1.6 If the laboratory is situated in a way which makes it infeasible to the maintain static pressure within the range specified in 5.6.1.4, the laboratory may use the results of the tests conducted pursuant to 5.4.3 to determine the operation of the sound level meter under the reference static pressure. In this case, the actual measurement uncertainty must include the additional elements of the valid corrections to offset the effects of differences between the prevailing static pressure and the reference static pressure.

5.6.1.7 The ambient conditions at the time of the test must be recorded.

5.6.1.8 With respect to the properties of the applicable free-field facility and the applicable test method used, the contribution of the measurement uncertainty of the sound level meter's acoustic response from the uncertainty caused by the sound field deviations in the facility from an ideal sound field without reflections must be assessed in the case of tests conducted in a free-field test facility.

NOTE Practical considerations to measurements in free-field facilities are discussed in the applicable standard concerning determination of the sensitivity of operative reference microphones.

5.6.2 Indication at calibration control frequency

5.6.2.1 If an acoustic calibrator specified in 5.1.4 is used, the indication must be checked at the calibration control frequency before starting (but not during) the tests described in the various articles of Chapter 5.6. If necessary, the sound level meter must be set so that the required sound pressure level is indicated under reference ambient conditions.

5.6.2.2 The settings at the calibration control frequency are verified if the difference between the setting during measurement and the corresponding setting specified in the user manual does not exceed ±0.3 dB.

5.6.2.3 The effect of the ambient conditions at the sound pressure level created by the acoustic calibrator must be determined in accordance with the procedure and data setting specified in the user manual for the acoustic calibrator and the data from its calibration. The effects must be determined in terms of the sound pressure level created under reference ambient conditions.

5.6.3 Directional characteristics

5.6.3.1 The sound level meter's directional characteristics must be determined using plane progressive sinusoidal sound waves in a free-field test facility. All sound level meter configurations must be tested which are defined in the user manual as configurations which meet the requirements for directional characteristics specified in the technical requirements for sound level meters.

5.6.3.2 The equivalent sound pressure levels or sound pressure levels with time characteristic F must be measured. If absolutely necessary, the equivalent sound pressure level must be calculated for any suitable integration time, as is specified in the technical requirements for sound level meters from the indicated sound exposure levels. Frequency weighting C or Z must be selected if available; otherwise, frequency weighting A must be selected.

5.6.3.3 In the case of sound level meters which are symmetrical around the main axis passing through the microphone connected to the sound level meter by an extension cable or other device, then the directional characteristics may be measured on any plane passing through the axis of symmetry. The sound pressure levels indicated on the display device or equivalent indication of sound pressure levels at the electrical output must be recorded with sounds impacting the microphone at the applicable range of angles in relation to the reference direction pursuant to the technical requirements for sound level meters. One of the angles of sound incidence must be in the reference direction.

5.6.3.4 If an electrical output is integrated and used in the directional characteristic tests, preliminary tests must be carried out which determine how the frequency-weighted signal levels correspond to the voltages at the electrical output. With sound level meters without an electrical output, the directional characteristic tests can be conducted on an acoustically and electrically equivalent device supplied by the sound level meter manufacturer which has exactly the same physical dimensions and shape, but is equipped with an electrical output.

5.6.3.5 In the case of sound level meters, including wind protection cover and accessories, if they are part of the configuration in normal use, which are not symmetrical around the main axis passing through the microphone, or in which the microphone is not connected to the sound level meter by an extension cable or other device, the directional characteristics must be measured on two mutually perpendicular planes. Each plane comprises the main axis of the microphone. Each plane must be perpendicular to the surface of the sound level meter which contains control elements and potentially a display device.

5.6.3.6 The following test method must be used in case the user manual does not provide detailed information indicating that the directional characteristics of the complete sound level meter meet the technical requirements for sound level meters.

- With class 1 and class 2 sound level meters, the frequency of the sound signal must be in the range of frequencies from 500 Hz to 2 kHz at third-octave intervals and then in a range of frequencies higher than 2 kHz to 8 kHz at intervals of one-sixth of an octave.
- With class 1 sound level meters, the frequency of the sound signal must be in the range of frequencies higher than 8 kHz to 12.5 kHz at intervals of one-twelfth of an octave.
- The test frequencies at third-octave intervals, at intervals of one-sixth of an octave and at intervals of one-twelfth of an octave must be in accordance with the technical requirements for sound level meters.
- The angle intervals at each test frequency must not exceed 10° during measurements of directional characteristics.

5.6.3.7 If the user manual provides detailed tables of information on directional characteristics, including any potential directivity factors for random sound incidence, the directional characteristics must be measured on every plane of symmetry in the entire range of angles of sound incidence specified in the technical requirements for sound level meters, albeit at intervals not exceeding 30°. It is necessary that the test signal frequency be:

- in a range from 500 Hz to 12.5 kHz at third-octave intervals for class 1 sound level meters and
- in a range from 500 Hz to 8 kHz at octave intervals for class 2 sound level meters.

5.6.3.8 With sound level meters designed to measure sounds with a random direction of incidence, the measurement of the directional characteristics must cover the range of angles of sound incidence up to ±180° on each plane of symmetry in relation to the reference direction on each measurement plane.

5.6.3.9 In measurements of directional characteristics at various angles of sound incidence, based on movement of the sound level meter or of the source of sound, the axis of the microphone's rotation symmetry and the main axis of the source of sound must remain on the same, principally horizontal, plane. Movement of the sound level meter on the horizontal plan is preferably made by rotating around the vertical axis passing through the reference point of the microphone. If the equivalent sound pressure level or sound exposure levels is being measured, it is necessary to ensure a stable indication for every increase in angle by allowing a sufficiently long integration time.

NOTE If the source of sound and the reference point of the microphone remain at fixed locations during the measurement of the directional characteristics, it will minimise the influence of slight fluctuations in the sound field in the testing room.

5.6.3.10 An alternative test procedure consists of measuring the directional characteristics under conditions when the signal frequency from the sound source changes, but the given angle of sound incidence is retained. The test is repeated for each angle of sound incidence. The sound pressure level at the location of the sound level meter's microphone should stay the same at any angle of sound incidence at the given test frequency. The same signal from the sound source must be used for each angle of sound incidence at each test frequency.

5.6.3.11 A constant signal level from the sound source must be maintained at any test frequency when the sound level meter is placed in positions with various angles of sound incidence. In all tests, the sound pressure level at the microphone's location with the sound source switched on must be at least 30 dB higher than the sound pressure level indicated when the sound source is switched off.

5.6.3.12 On each measurement plane and at all applicable frequencies, the greatest absolute difference between the sound pressure levels at any two angles of sound incidence in each range of angles specified in the applicable standard must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters.

5.6.3.13 If the user manual provides detailed data on directional characteristics and if the directional characteristics are measured in a limited number of angles of sound incidence and signal frequencies, then, other than the requirements specified in 5.6.3.12, the measured values of the maximum absolute differences between sound pressure levels must not exceed the corresponding nominal values of the maximum absolute differences in sound pressure levels which are specified in the user manual.

5.6.4 Frequency weighting tests via acoustic signals

5.6.4.1 General

5.6.4.1.1 The procedure described in Article 5.6.4.3 for verifying frequency weighting by means of tests in a free-field test facility assumes that the sound level meter does not have an electrical output and that the sound pressure level at the sound level meter's location is first determined with the help of a calibrated laboratory reference microphone. If an electrical output is available, it may be expedient to conduct measurements in reverse order, i.e. in that the sound level meter is first installed in the test facility and the sound source is set so that the applicable indication is on the sound level meter. The sound level meter is then removed and a laboratory reference microphone is placed at the location of the

sound level meter's microphone in order to determine the corresponding sound pressure level in the free field

5.6.4.1.2 If an electrical output is available and used in tests, preliminary tests must be carried out to determine how the frequency-weighted signal levels indicated on the display device correspond to the voltage levels at the electrical output. There must be no attempt made to determine the amplitude characteristic linearity errors in any of the frequency weighting tests.

5.6.4.1.3 At least one of the frequency weightings for which fulfilment criteria are specified in the technical requirements for sound level meters must be tested using sinusoidal acoustic and electrical signals. Further frequency weightings which are integrated into the sound level meter and for which nominal values and acceptance limits are specified in the technical requirements for sound level meters or in the user manual must be tested with either acoustic or electrical signals. In tests of further frequency weightings via electrical signals, the test methods must include correction for the actual frequency characteristics of the microphone and the average effects of reflections from the body of the sound level meter and sound deflection around the microphone.

5.6.4.1.4 The sound level meter must be set to measure the sound pressure level with the time characteristic F, if available; otherwise it must be set as per the equipment for measuring the equivalent sound pressure level or sound exposure levels. If absolutely necessary, the equivalent sound pressure level must be calculated from the results of measuring the sound exposure levels, pursuant to how it is specified in the applicable standard for any suitable integration time.

5.6.4.1.5 If possible, all tests of frequency weightings and other frequency characteristics must be conducted in the sound level meter's setting for reference measurement range. If the laboratory decides that the setting of the measurement range switch may affect compliance with the technical requirements for frequency weighting, additional tests must be carried out in further measurement ranges.

5.6.4.1.6 If the sound level meter enables frequency weighting, tests with acoustic signals must be carried out with frequency weighting C or Z. If weighting function C or Z is not available, then frequency weighting A must be used for the tests. The tests with acoustic signals must be carried out with plane progressive sound waves in a free-field test facility at frequencies higher than the lower limit frequency of the free-field test facility. The tests at frequencies lower than the lower limit frequency must be carried out by means of a comparative coupler.

5.6.4.1.7 In the case of a sound level meter configuration in which the specified reference direction is not in accordance with the microphone's main axis of symmetry, the frequency weighting must be verified in the reference direction for the specified polar angle around the main axis in at least three further positions on the conical surface created by rotating the reference direction around the microphone's main axis.

5.6.4.2 Correction for wind protection cover

5.6.4.2.1 If a wind protection cover is required pursuant to 5.3.12 and the user manual states that the sound level meter meets the technical requirements of this Measure in both the configuration including the wind protection cover as well as in the configuration not including the wind protection cover, the frequency weighting determined with the acoustic signals must be measured in the free-field test facility with the cover and without the wind protection cover of the specified model which is installed around the microphone. The differences between frequency weightings are the measured corrections for the wind protection cover for sound impacting in the reference direction on the specified measurement plane passing through the microphone's main axis. Data on the corrections and associated measurement uncertainties must be determined at each test frequency. The difference must be determined between the measured correction for the wind protection cover and the corresponding correction for the wind protection cover specified in the user manual.

5.6.4.2.2 In sound level meter configurations in which the specified reference direction is not in accordance with the microphone's main axis of symmetry, the correction for the wind protection cover must be determined in the reference direction for the specified polar angle around the main axis and in

at least three further positions on the conical surface created by rotating the reference direction around the microphone's main axis.

5.6.4.3 Free-field tests

5.6.4.3.1 If frequency weighting C or Z is selected for free-field tests and for the purpose of comparing data needed to verify corrections in a free field, the tests must also be conducted with frequency weighting A, albeit only at test frequencies for which data on corrections in a free sound field are provided in the user manual.

5.6.4.3.2 In tests of class 1 and class 2 sound level meters, the frequency of the acoustic signal in the free-field test facility must be in the range from the lower limit frequency of the free-field test facility up to 2 kHz at third-octave intervals and, at frequencies higher than 2 kHz to 8 kHz, at intervals with a width of one-sixth of an octave. With class 1 sound level meters, the frequency of the acoustic signal must be in the range of frequencies higher than 8 kHz to 20 kHz at intervals with a width of one-twelfth of an octave. An index of the required frequencies is specified in the technical requirements for sound level meters.

5.6.4.3.3 If the user manual specifies tables with detailed data on frequency weighting, tests to verify the manufacturer's data may be limited to third-octave intervals with class 1 sound level meters and to octave intervals in class 2 sound level meters.

5.6.4.3.4 At all test frequencies, the sound pressure level at the location of the reference point of the microphone on the sound level meter must be determined with the help of a laboratory reference microphone without the sound level meter present. The sound waves must arrive at the reference point of the laboratory reference from the direction in which the microphone was calibrated. At any test frequency, the sound pressure level with the sound source switched on must be at least 30 dB higher than the sound pressure level with the sound source switched off.

5.6.4.3.5 At each test frequency, the output from the sound source must be set so that a reference sound pressure level is generated at the selected location in the free-field test facility. If it is not possible to maintain the reference sound pressure level at any test frequency, then another sound pressure level may be used. The sound pressure levels and any corrections which were used must be recorded.

5.6.4.3.6 The laboratory reference microphone must then be replaced with a sound level meter. The reference point of the microphone on the sound level meter must take the same position as the reference point of the reference microphone. The sounds must arrive at the microphone from the specified reference direction. At each test frequency, the signals from the sound source must be the same as they were in the tests with the laboratory reference microphone. The signal level indicated by the sound level meter must be recorded at each test frequency.

5.6.4.3.7 At each test frequency, the frequency weighting must be calculated from the level of the frequency-weighted sound pressure indicated by the sound level meter minus the sound pressure level measured with the laboratory reference microphone.

5.6.4.3.8 The tests described in 5.6.4.3.2 to 5.6.4.3.7 must be repeated in at least two other suitable locations or distances between the sound source and the microphone in the free-field test facility.

5.6.4.3.9 At each test frequency, the measured frequency weighting must be calculated from the arithmetic mean of the frequency weightings determined at various distances and in various locations between the sound source and the microphone.

5.6.4.4 Tests in the comparative coupler

5.6.4.4.1 At frequencies lower than the lower limit frequency of the free-field test facility, the frequency weightings must be measured at third-octave intervals from 10 Hz to the lower limit frequency in the case of class 1 sound level meters and from 20 Hz to the lower limit frequency in the case of class 2 sound level meters. In tests in the comparative coupler, the microphone of the sound level meter and the laboratory reference microphone must be exposed to the effect of the sound field in the comparative coupler or in an equivalent device. The sound pressure level measured by the sound level meter and the

sound pressure level measured by the laboratory reference microphone must be recorded. If a wind protection cover is installed, it can be removed before the tests in the comparative coupler are initiated.

5.6.4.4.2 If the tube for equalising the static pressure beneath the diaphragm of the microphone is exposed to the effect of a sound field in the comparative coupler, at frequencies lower than approximately 250 Hz, it is permissible to assume that the pressure frequency characteristics of the microphone inserted into the comparative coupler will be the same as the corresponding frequency characteristics of the microphone in a free field or in a field with random sound incidence. If the upper limit frequency exceeds approximately 250 Hz in tests in the comparative coupler, it is recommended that the laboratory ensure the equivalence between the pressure frequency characteristic measurements and the corresponding measurements in the reference direction in the free-field test facility and with sound incidence in a random direction. If the microphone tube to equalise the static pressure is not exposed to the sound field in the comparative coupler, the laboratory must clarify the difference between the microphone's pressure frequency characteristics and frequency characteristics in a free field and in a field with random sound incidence.

5.6.4.4.3 The measurement of the frequency weightings in the comparative coupler must be conducted at least three times. In each test, the microphones must be disconnected from the comparative coupler and reinstalled. In each test frequency, the frequency weighting measurement results must be calculated as the arithmetic average of the separate determinations.

5.6.4.4.4 The sound level meter's linearity range must be greater than 70 dB in order to carry out tests of frequency weighting A toward low frequencies down to 10 Hz. If necessary, tests of frequency weighting A must be conducted down to the lowest frequency at which a sound pressure level of 5 dB higher than the lower limit of the linearity range is indicated.

5.6.4.4.5 In tests in the comparative coupler, the measured frequency weighting must be calculated from the frequency-weighted sound pressure levels indicated by the sound level meter minus the corresponding sound pressure level measured with the laboratory reference microphone.

5.6.4.5 Conformity

The measured deviations in frequency weightings from the corresponding nominal frequency weightings must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters. The nominal values of the frequency weightings must be identical to the values specified in this Measure or the values calculated according to the equations specified in it and rounded to the nearest tenth of a decibel.

5.6.4.6 Sound incidence in a random direction

5.6.4.6.1 The tests must be carried out with sound incidence in a random direction with a cover and without a wind protection cover installed around the microphone in order to verify the corrections for the wind protection cover with sound incidence in a random direction.

5.6.4.6.2 The average frequency-weighted response to random sound incidence must be determined at third-octave internals in a frequency range from the lower limit frequency of the free-field test facility up to 16 kHz in class 1 sound level meters and from the lower limit frequency up to 8 kHz in class 2 sound level meters. At frequencies lower than the lower frequency limit, the frequency weighting upon sound incidence in a random direction must be determined with the above-described method for tests in the comparative coupler.

5.6.4.6.3 The directivity factors upon random sound incidence must be determined with the use of the data obtained in directional characteristics pursuant to 5.6.3. The measured directivity factors must be used when determining the measurement of the relative frequency-weighted response upon random sound incidence as the sum of the relative frequency-weighted response in a free field in the reference direction and the corresponding directivity factors.

5.6.4.6.4 The measured frequency weightings upon random sound incidence constitute the relative frequency-weighted response to random sound incidence at each test frequency. The measured deviations in frequency weightings upon random sound incidence from the nominal frequency

weightings must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters.

NOTE Until higher-quality data are available, it is essential to consider the maximum permissible measurement uncertainties specified in the technical requirements for class 1 sound level meters as the valid uncertainties for frequency weighting measurements in the case of sounds with random incidence.

5.6.5 Frequency weighting tests via electrical signals

5.6.5.1 General

5.6.5.1.1 Tests with electrical signals must be carried out for all frequency weightings incorporated in the sound level meter for which nominal values and acceptance limits are specified in the technical requirements for sound level meters or in the user manual. Sinusoidal input signals of the same test frequencies as used in tests pursuant to 5.6.4 must be used in all tests, with the exception that increases in frequencies may not be greater than one-third of an octave. All tests specified in this article must be conducted with the sound level meter set to the measurement range which was used in the tests pursuant to 5.6.4.

5.6.5.1.2 Two alternative procedures are provided for the tests of frequency weightings with electrical signals. The first procedure requires the input signal level at each test frequency and frequency weighting to be set so that the display device shows the same indication when acoustic signals and electrical signals are used. This procedure minimises the influence of amplitude characteristic linearity errors, but may make it impossible to measure the frequency weighting at certain frequencies because the high voltage of the input signal may cause overexcitation in certain frequency weightings. If the preliminary test reveals that overexcitation is caused in certain frequency weightings at certain test frequencies, then a second alternative test procedure will have to be used in all tests.

5.6.5.1.3 There must be no attempt made to determine amplitude characteristic linearity errors in the sound level meter's response in either of the two test procedures.

NOTE If the linearity range in the selected measurement range is sufficiently broad, then the second test procedure enables measuring frequency weighting at any desired test frequency, but the influence of amplitude characteristic linearity errors may be somewhat greater than in the first test procedure.

5.6.5.2 First alternative test procedure (variable input signal level)

5.6.5.2.1 The test is initiated with frequency weighting selected in tests with acoustic signals pursuant to 5.6.4; at each test frequency, the input electrical signal level must be adjusted so that the indication on the sound level meter's display device is the same as that obtained at the relevant frequency in the tests with acoustic signals pursuant to 5.6.4. The test must then be repeated for the other frequency weightings. The input signal levels and corresponding indications on the display device must be recorded.

NOTE The input signal levels can be measured as effective voltage values or the settings for the input signal attenuator expressed in decibels can be recorded.

5.6.5.2.2 Frequency weightings via equivalent weighting which were obtained with acoustic signals must be calculated by the following means. The differences expressed in decibels between the input signal level recorded for the frequency weighting and the input signal level recorded for the frequency weighting which was selected in the tests with acoustic signals pursuant to 5.6.4 must be calculated at each test frequency. In order to obtain equivalent frequency weightings in the tests with electrical signals, the differences in the input signal level must be subtracted from the frequency weightings determined in the tests with acoustic signals.

NOTE The difference between the electrical input signal levels may be determined from the differences in the attenuator settings of the input signal or according to the relation $10 \lg(V_2/ V_1)^2$ dB, in which V_2 and V_1 are the effective voltage levels measured during frequency weighting, or during the frequency weighting which was selected in the tests with acoustic signals.

5.6.5.3 Second alternative test procedure (constant input signal level)

5.6.5.3.1 The test is initiated with the frequency weighting used in the tests pursuant to 5.6.4; the input signal level must be adjusted at a frequency of 1 kHz so that the indication is 5 dB lower than the upper linearity range limit at a frequency of 1 kHz. The input signal level at any other test frequency must be identical to the signal level at a frequency of 1 kHz. The input signal levels and corresponding indications on the display device must be recorded.

5.6.5.3.2 The differences between the indications on the display device obtained pursuant to 5.6.5.3.3 and the indications obtained pursuant to 5.6.5.3.1 must be calculated at each test frequency. In order to obtain equivalent frequency weightings in the tests with electrical signals, these differences in indicated levels must be attributed to the corresponding frequency weighting measured with acoustic signals.

5.6.5.3.3 In all further frequency weightings, the input signal level at each test frequency must be the same as the level recorded in the tests pursuant to 5.6.5.3.1. The indications on the display device must be recorded.

5.6.5.4 Conformity

The measured deviations in equivalent frequency weightings from the nominal values must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters or in the user manual, depending on what is suitable.

5.6.5.5 Frequency weightings C or Z at 1 kHz

5.6.5.5.1 A sound level meter which is equipped with frequency weightings C or Z must be tested with continuous sinusoidal electrical signals with a frequency of 1 kHz. The input signal must be set so that the reference sound pressure level is indicated in the reference measurement range with classified frequency weighting A, and the indication must be recorded. The sound pressure level with time weighting F or S, the equivalent sound pressure level or sound exposure level indicated with weighting functions C and Z must then be recorded at the same input signal.

5.6.5.5.2 The measured deviations in the measurement quantity level weighted with function C and Z from the corresponding measurement quantity level weighted with function A must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters.

5.6.6 Correction for the effect of reflections from the body of the sound level meter and sound deflection around the microphone

5.6.6.1 The tests listed in this article are intended to verify the corrections and associated measurement uncertainties which are specified in the user manual for the typical effects of reflections from the body of the sound level meter and sound deflection around the microphone on the frequency characteristics of the microphone. The tests must be carried out with the sound level meter set to the ordinary operating mode specified in the user manual, with the exception that no microphone or wind protection cover is installed.

5.6.6.2 Corrections must be verified with constant sinusoidal electrical signals. The frequency weighting must be identical to the weighting which was selected in the tests with acoustic signals. The corrections must be verified for a microphone of the same type specified in the user manual for use with a sound level meter for which different corrections for the effects of reflections and sound deflection are specified.

5.6.6.3 The input signal with a frequency of 1 kHz must be set so that the indicated sound pressure level is the same as that which was indicated in the same measurement range in the tests with an acoustic signal with a frequency of 1 kHz pursuant to 5.6.4. The electrical input signal levels and corresponding signal level indications must be recorded.

5.6.6.4 The input signal frequencies must be at third-octave intervals for class 1 sound level meters in a range from a frequency greater than the lower frequency limit of the free-field test facility up to 16 kHz

and, for class 2 sound level meters, in a range from a frequency greater than the lower frequency limit up to 8 kHz.

NOTE In the case of an electrical input signal, the level corresponding to the effective voltage value or input signal attenuator setting expressed in decibels can be recorded.

5.6.6.5 Under the condition that the input signal is kept constant, the signal level indicated by the sound level meter must be recorded at all test frequencies other than 1 kHz.

5.6.6.6 The relative frequency weighting of the electrical signal must be calculated from the level indicated at the test frequency minus the level indicated at a frequency of 1 kHz.

5.6.6.7 At each test frequency, the measured effects of reflection from the body of the sound level meter and sound deflection around the microphone must be calculated from the frequency weighting of the acoustic signal determined in accordance with the method specified in 5.6.4 minus the relative frequency weighting of the electrical signal determined in accordance with 5.6.6.6.

5.6.6.8 At each test frequency, the differences between the measurement of the effects of reflections and sound deflection and the corresponding data specified in the user manual must not exceed the uncertainty values specified in the user manual for the correction for reflections from the body of the sound level meter and sound deflection.

NOTE This method of verifying the effects of reflections and sound deflection does not apply to any kind of non-linearity of amplitude characteristics between the sound pressure levels measured in the free-field test facility and the signal levels indicated in the response to the electrical signals.

5.6.7 Corrections for obtaining sound pressure levels in a free field and sound pressure levels in a field with random sound incidence

5.6.7.1 If the user manual recommends the use of a multi-frequency acoustic calibrator, comparative coupler and electrostatic actuator to control the frequency weighting during verification, then it is essential for the user manual to specify data on correcting the indicated sound pressure levels for the equivalent sound pressure levels which were indicated in the response to plane sound waves from the reference direction in a free field or, if applicable, in the response to sound waves in a field with random sound incidence. The data on the correction for a free field and the associated uncertainties must be verified as part of the type tests.

5.6.7.2 If necessary, the sound pressure indication levels must be corrected for the difference between the sound pressure level created by the acoustic calibrator at the test frequency and the sound pressure level created at a frequency of 1 kHz, or according to the corresponding difference expressed by the relative frequency characteristics level when the comparative coupler or electrostatic actuator is used. In order to determine the equivalent sound pressure level in a free field with sound incidence in the reference or, if applicable, equivalent sound pressure level in a field with random sound incidence, the correction data specified in the user manual must be used to correct the sound pressure levels. The relative equivalent sound pressure level A must then be calculated at each frequency in relation to the equivalent sound pressure level A at a frequency of 1 kHz. The result is the relative equivalent frequency characteristic weighted with function A.

5.6.7.3 Before the tests for verifying the data on corrections specified in the user manual are carried out, it must be verified that the measured deviations in the measured frequency weighting A from the nominal value at a frequency of 1 kHz, which was verified in the tests of the frequency weighting with acoustic signals pursuant to 5.6.4, do not exceed the applicable acceptance limits specified in the technical requirements for sound level meters. Sound pressure level A indicated in the response to the effect of the acoustic calibrator, comparative coupler and electrostatic actuator must then be recorded for each frequency for which data on corrections are specified in the user manual.

5.6.7.4 At frequencies different from 1 kHz, the measured deviations of the relative equivalent frequency characteristics weighted by function A, determined in the use of the acoustic calibrator, comparative coupler or electrostatic actuator from the arithmetic mean of the relative frequency characteristics weighted by function A, which was measured in a free-field test facility or from frequency weighting in

a field with random sound incidence measured in accordance with 5.6.4.6 must not exceed the values of uncertainty specified in the user manual for data on corrections.

5.6.7.5 The procedure for verifying the data on corrections specified in the user manual must be repeated with each model of microphone specified for the sound level meter for which different data are provided on corrections in a free field and in a field with random sound incidence.

5.6.8 Amplitude characteristic linearity

5.6.8.1 Tests at air temperatures close to the reference air temperature

5.6.8.1.1 The amplitude characteristic linearity must be tested with the help of continuous sinusoidal electrical signals. The air temperature must be 18 °C and 23 °C at any suitable relative humidity and static pressure. The signal frequencies must be 31.5 Hz, 1 kHz and 12.5 kHz for class 1 sound level meters and 31.5 Hz, 1 kHz and 8 kHz for class 2 sound level meters.

5.6.8.1.2 The amplitude characteristic linearity must be tested with the sound level meter set to indicate sound pressure level A with time characteristic F, if available, and with the sound pressure level set to indicate equivalent sound pressure level A, if available. If only sound exposure level A is displayed, the amplitude characteristic linearity error must be determined according to the equivalent sound pressure levels A calculated from the indication of sound exposure levels A, as specified in the technical requirements for sound level meters, for any suitable integration time.

5.6.8.1.3 For all input signals, the amplitude characteristic linearity error is given by the deviation in the indicated sound pressure level from the corresponding anticipated sound pressure level. At any test frequency and any measurement range, the anticipated sound pressure level must be calculated from the sound pressure level in the starting point specified in the user manual in the reference measurement range plus the difference between the input signal level and the input signal level which caused the sound pressure level at the starting point to be displayed.

NOTE 1 The zero error of amplitude characteristic linearity is at the starting point in the reference measurement range at any test frequency.

NOTE 2 The changes in input signal level in decibels can be determined from the changes in input signal attenuator settings or calculated from the levels of the ratio of two consecutive measurements of the effective voltage values of the input signals.

5.6.8.1.4 At any test frequency, the amplitude characteristic linearity tests must begin with the input signal set so that the sound pressure level at the starting point is displayed in the reference measurement range. Amplitude characteristic linearity errors must be measured in input signal level steps which are not greater than 1 dB. The tests must continue from the starting point upwards to the first indication of overexcitation and then back downwards through the starting point to the first indication of the lower signal level. The tests must then continue back upwards up to the starting point. The same input signal must be used in measurements with a rising and falling signal level.

5.6.8.1.5 In measurement ranges other than the reference measurement range, the amplitude characteristic linearity errors must be measured toward the specified upper linearity range limit and then back downwards toward the lower limit in input signal level steps which are not greater than 10 dB. At each of the other measurement ranges, the tests for the amplitude characteristic linearity error must begin at the sound pressure level indicated with the input signal at which the starting point was displayed in the reference measurement range, and must be set according to the nominal change of the measurement range switch in relation to the settings for the reference measurement range. Within a range of 5 dB from the specified upper limit and 5 dB from the specified lower limit, there must not be any steps in input signal levels toward the first indication of overexcitation or toward the first indication of low signal level greater than 1 dB in each measurement range.

NOTE In measurement ranges other than the reference measurement range, the zero error in amplitude characteristic linearity need not necessarily be at the starting point at any test frequency (see 5.6.8.1.3, note 1).

5.6.8.1.6 At each test frequency and in the entire spread of the linearity range specified in the user manual for each measurement range, the measured amplitude characteristic linearity errors must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters.

5.6.8.1.7 The measured amplitude characteristic linearity errors corresponding to the changes in input signal level from 1 dB to 10 dB must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters.

5.6.8.1.8 At each test frequency, the dynamic range of sound pressure levels A in which the measured amplitude characteristic linearity errors do not exceed the applicable acceptance limits must not be narrower than the corresponding dynamic range specified in the user manual.

5.6.8.2 Tests at increased air temperatures

5.6.8.2.1 As specified in 5.4.6.9, the amplitude characteristic linearity errors must also be measured at increased air temperatures. This test must be carried out with the help of continuous sinusoidal electrical signals with a frequency of 1 kHz. In this test, components of the sound level meter which are intended for use under a wide range of ambient conditions must be exposed to the effect of an air temperature which is within a range of 2 °C from the applicable maximum temperature specified in 5.4.6.4, but does not exceed this temperature. The relative humidity and static pressure may have any suitable values.

5.6.8.2.2 The measured amplitude characteristic linearity errors must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters. The dynamic range of sound pressure levels A in which the measured amplitude characteristic linearity errors do not exceed the applicable acceptance limits also must not be narrower than the corresponding dynamic range specified in the user manual.

5.6.8.2.3 The procedure specified in 5.6.8.1 must be followed in these tests at increased air temperatures, except that the amplitude characteristic linearity errors must only be measured at the reference measurement range and only in steps of 10 dB from the starting point upwards to the specified upper linearity range limit, downwards to the lower limit and back to the starting point, and must encompass the lower and upper limit.

5.6.9 Low signal level indication

In each measurement range and at each frequency used in the amplitude characteristic linearity tests, it must be verified that the low signal level indication is not displayed under conditions in which the level of the time-weighted acoustic pressure, equivalent sound pressure level or sound exposure level is greater than or equal to the lower limit of the linearity range specified in the user manual. If the low level signal is indicated, it must be verified that the low signal indicator is functioning as specified in the technical requirements for sound level meters.

5.6.10 Internally generated noise level

5.6.10.1 The internally generated noise level must be measured with the microphone attached to the sound level meter. The sound level meter must be placed into a sound field with a low sound pressure level in a configuration which is specified in the user manual for normal operating mode. If a microphone stand is specified for normal operating mode, it is not necessary to place all parts of the sound level meter on the opposite side of the stand from the microphone into the sound field with a low sound pressure level. The internally generated noise levels must be measured with each type of microphone which is specified in the user manual for use with the sound level meter. The internally generated noise levels must also be measured if the microphone is replaced with a specified electrical input device and the input is loaded by the means specified in the user manual.

5.6.10.2 The internally generated noise levels must be measured in the measurement ranges in which the maximum internally generated noise levels are anticipated pursuant to the data specified in the user manual.

5.6.10.3 The air temperature and relative humidity must not exceed the ranges specified in 5.6.1.5 during measurements of internally generated noise levels.

5.6.10.4 The internally generated noise levels must be recorded for all available frequency weightings and frequency characteristics. The sound pressure levels with time weightings F and S must be determined from the arithmetic mean from ten measurements distributed randomly at intervals of 60 s. In measurements of equivalent sound pressure levels, the averaging time must be the same as the period specified in the user manual for maximum internally generated noise levels.

5.6.10.5 With each type of microphone and in tests in which the microphone is replaced by an electrical input device, the measured internally generated noise levels should not exceed the corresponding maximum anticipated internally generated noise levels which the user manual specifies in the measurement range by more than 10 dB.

NOTE The specified internally generated noise level is only for the user's information and is not used for assessing conformity with the requirement.

5.6.11 Time constants of decline for time weightings F and S

5.6.11.1 The exponential time constants of decline F and S must be tested with continuous sinusoidal electrical signals with a frequency of 4 kHz. The signal level must be set so that the sound pressure level indicated is 3 dB lower than the upper limit specified for the linearity range in the reference measurement range. The continuous signal must be active for at least 10 seconds.

5.6.11.2 The signal must be abruptly switched off and the speed of decline of the displayed sound pressure level must be measured from the initial switching off. The measured speeds of decline of time weightings F and S must not exceed the acceptance limits specified in the technical requirements for sound level meters.

NOTE The exponential decline speeds may be measured by visually observing the sound pressure levels indicated on the display device and simultaneously determining the corresponding times which have elapsed since it was initially switched off, determined by a stopwatch or the equivalent timing device or from the speed of sampling specified as the data refresh speed when displaying digital signal levels. Another method consists of using a video camera or equivalent device for recording the sound pressure levels indicated on the display device and digital clocks which simultaneously display time in milliseconds.

5.6.11.3 With sound level meters equipped with time weighting S, a continuous sinusoidal electrical input signal with a frequency of 1 kHz must be set so that it indicates the reference sound pressure level in the reference measurement range during time weighting F. Sound pressure level A must be recorded. The indicated sound pressure level A with time weighting S must then be recorded at the same input signal.

5.6.11.4 The measured deviation in the sound pressure level measured with time weighting S from the sound pressure level measured with time weighting F must not exceed the acceptance limits specified in the technical requirements for sound level meters.

5.6.11.5 If the sound level meter is able to display the indicated sound pressure level as a function of time with the appropriate resolution, this function may be used when verifying the time constants of the decline.

5.6.12 Response to a tone impulse with sound level meters which measure the time-weighted sound pressure level

5.6.12.1 Response to a tone impulse in sound level meters which measure sound pressure levels with time weightings F and S must be tested in the reference measurement range with the help of sinusoidal electrical signals with a frequency of 4 kHz.

5.6.12.2 Tests of response to a tone impulse must begin with a continuous signal being sent to the sound level meter set with the frequency weighting A. When setting to time weighting F, the input signal must be set so that the indication is 3 dB lower than the specified upper limit of the linearity range. The indication of the sound pressure level with time weighting F must be recorded. If the sound level meter is equipped with time weighting S, the procedure must be repeated for the sound pressure level with the time weighting S.

5.6.12.3 Tone impulses derived from a continuous signal must be used for all periods of tone impulse duration specified in the applicable standard for the time weighting F and, if integrated, for the time weighting S. Indications of the maximum sound pressure levels must be recorded in the response to the tone impulses.

5.6.12.4 Tone impulse tests must be repeated with the indicated continuous signal level reduced in steps of 20 dB, whereby one begins with the indication specified in 5.6.12.2. The steps of 20 dB must be repeated until a sound pressure level indication is reached during the last step which is less than 20 dB higher than the specified lower linearity range limit. The responses must also be measured to tone impulses during a continuous signal which results in an indication which is 10 dB higher than the specified lower linearity range limit.

5.6.12.5 In each step, the indications of the sound pressure level with time weighting F and sound pressure level with time weighting S must be recorded for the tone impulses as well as the corresponding indications of the maximum sound pressure level with the time weighting F and the maximum sound pressure level with the time weighting S. In each step, the responses to tone impulses must be measured for all periods of tone impulse duration specified in the technical requirements for sound level meters for which the maximum sound pressure levels with time weighting F and maximum sound pressure levels with time weighting S can be observed on the display device with indications which are at least 16 dB higher than the anticipated internally generated noise levels of weighting function A which are specified in the user manual for the reference measurement range.

5.6.12.6 The response to tone impulse measurement results must be calculated from the maximum sound pressure level with time weighting F and the maximum sound pressure level with time weighting S, which are indicated in signals with tone impulses minus the corresponding sound pressure level with the time weighting F and with the time weighting S indicated in the corresponding continuous signals.

5.6.12.7 Tone impulse response tests must also be conducted in a mode in which the indicated continuous signal level is increased in steps of 1 dB above the level of the signal specified in 5.6.12.2 until the first indication of overexcitation appears. The tone impulse duration times must be the shortest valid duration times pursuant to the applicable standards for time weightings F and S.

5.6.12.8 Deviations in the measured responses to tone impulses from the corresponding reference responses to tone impulses specified in the technical requirements for sound level meters must not exceed the applicable acceptance limits specified in this Measure.

5.6.13 Response to a tone impulse with sound level meters which measure the sound exposure level or equivalent sound pressure level

5.6.13.1 Response to a tone impulse in sound level meters which measure the sound exposure level or equivalent sound pressure level, or both levels, must be tested in the reference measurement range with the help of sinusoidal electrical signals with a frequency of 4 kHz. If only sound exposure levels are being measured, the equivalent sound pressure level of the continuous signal must be calculated from the measurement of the sound exposure levels and integration time. If only the equivalent sound pressure levels are measured, the sound exposure levels from the tone impulses must be calculated from the measurement of the equivalent sound pressure level and the averaging time.

5.6.13.2 Tests with tone impulses must begin with a continuous signal being sent to the sound level meter set with the frequency weighting A. The input signal must be set so that the indication is 3 dB lower than the upper limit of the linearity range specified in the user manual. If the sound level meter only displays the sound exposure levels, the input signal must be set so that the sound exposure level is indicated at which the corresponding equivalent sound pressure level corresponds to the specifications. An integration time of 10 s is recommended, in which the sound exposure level is 10 dB higher than the corresponding equivalent sound pressure level. The equivalent sound pressure level and averaging time or sound exposure level and integration time must be recorded. If available, the averaging time or integration time must be identical to the periods indicated on the display device.

5.6.13.3 Tone impulses derived from a continuous signal must be used for all tone impulse duration times which are specified for sound exposure levels in the technical requirements for sound level meters.

The indicated sound exposure levels or equivalent sound pressure levels and averaging times must be recorded for every test. The integration times for sound exposure level indications must be sufficiently long to include all contributions from the tone impulse. If the sound level meter only displays the equivalent sound pressure level, then the sound exposure level of the tone impulse must be determined from the equivalent sound pressure level and corresponding averaging time as specified in the technical requirements for sound level meters. The averaging times for equivalent sound pressure level measurements must be longer than the tone impulse duration time.

5.6.13.4 The test with tone impulses must be repeated with the indicated continuous signal levels reduced in steps of 20 dB, whereby one begins with the indication specified in 5.6.13.2. The steps of 20 dB must be repeated until an equivalent sound pressure level indication is reached during the next step which is less than 20 dB higher than the specified lower linearity range limit. The responses to tone impulses must also be measured during a continuous signal which results in an indication which is 10 dB higher than the specified lower linearity range limit. The indication of the equivalent sound pressure level of the continuous signal and the sound exposure level of the tone impulse must be recorded for each step. Responses to tone impulses must be measured for all tone impulse duration times specified in the technical requirements for sound level meters for which sound exposure levels or equivalent sound pressure levels are defined and these levels are not lower than the lower linearity range limit at a frequency of 4 kHz.

5.6.13.5 The response to tone impulse measurement results must be calculated from the sound exposure levels indicated or calculated from the tone impulse signals minus the equivalent sound pressure level indicated or calculated from the corresponding continuous signals.

5.6.13.6 Tone impulse response tests must also be conducted in a mode in which the indicated continuous signal level is increased in steps of 1 dB above the level of the signal specified in 5.6.13.2 until the first indication of overexcitation appears. The duration times of the tone impulses must be 0.25 ms.

5.6.13.7 Deviations in the measured responses to tone impulses from the corresponding reference responses to tone impulses must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters.

5.6.14 Response to a series of repeated tone impulses with sound level meters which measure the equivalent sound pressure level

5.6.14.1 Response to a series of repeated sinusoidal electrical tone impulses with a frequency of 4 kHz with sound level meters which measure the equivalent sound pressure levels must be tested in the reference measurement range.

5.6.14.2 Tests of responses to a series of repeated tone impulses must begin with a continuous signal being sent to the sound level meter set with the frequency weighting A. The input signal must be set so that the indication of the equivalent sound pressure level is 3 dB lower than the upper limit of the linearity range specified in the user manual. The equivalent sound pressure level and corresponding averaging time must be recorded.

5.6.14.3 The series of repeated tone impulses must be derived from a continuous signal. Individual tone impulses from a series of repeated tone impulses must have duration times which are specified for sound exposure levels in technical requirements for sound level meters. In order to ensure the stable measurement of the equivalent sound pressure level, each series of repeated tone impulses must contain a sufficient number of tone impulses. Each individual tone impulse in the series must begin and end at the zero transition point. The period between the individual tone impulses in the series must be at least three times longer than the duration time of the individual tone impulse. The equivalent sound pressure level must be recorded in each series. The averaging time must be equal to the period used when determining the equivalent sound pressure level of the continuous signal.

5.6.14.4 Tests of responses to a series of repeated tone impulses must be repeated with a continuous input signal which results in the indication of an equivalent sound pressure level which is 10 dB higher than the specified lower limit of the linearity range. Tests of results to a series or repeated tone impulses

must be carried out in all duration times of individual tone impulses, specified for sound exposure levels in the technical requirements for sound level meters in which the indications of the equivalent sound pressure levels are specified. The equivalent sound pressure levels and corresponding averaging times of the continuous signals and the series of repeated tone impulses must be recorded.

5.6.14.5 The response measurements for a series of repeated tone impulses must be calculated from the equivalent sound pressure level series minus the equivalent sound pressure level corresponding to the continuous signal.

5.6.14.6 Deviations in the measured responses to the series of repeated tone impulses from the corresponding theoretical responses to tone impulses must not exceed the applicable acceptance limits specified in the technical requirements for sound level meters for sound exposure level. The theoretical responses must be determined as specified in these requirements.

5.6.15 Overexcitation indication

5.6.15.1 Overexcitation is partially tested in measurements of amplitude characteristic linearity or the response to tone impulses. The additional overexcitation indication tests are described here.

5.6.15.2 The overexcitation indication must be tested in the reference measurement range with the sound level meter set so as to display the level of time-weighted sound pressure A or equivalent sound pressure level A. The overexcitation indication must be verified for the time-weighted sound pressure level with the time weighting F and, if available, with the time weighting S. The positive and negative half periods of sinusoidal electrical signals with frequencies of 31.5 Hz, 1 kHz and 4 kHz. At each test frequency, the signals with a half period derived from continuous signals must be of the same level and must begin and end at the zero transition points.

5.6.15.3 At each test frequency, the overexcitation indication test must begin at the time-weighted or equivalent sound pressure level indicated for a continuous input signal which corresponds to a level 1 dB lower than the specified upper linearity range limit. The level of the input signals with a positive half period which were derived from a continuous signal must be increased by steps of 0.1 dB until the overexcitation appears. The same procedure must be repeated for signals with a negative half period. The levels of the input signals with a half period which result in the first indication of overexcitation must be recorded with a resolution to one tenth of a decibel.

NOTE The relative levels of input signals with a half period may be determined from the input attenuator setting.

5.6.15.4 The measured differences between input signals with a positive and negative half period which first results in the overexcitation indication being displayed must not exceed the acceptance limits specified in the technical requirements for sound level meters.

5.6.15.5 If the sound level meter enables measurements of peak sound pressure levels C, the overexcitation indication measurement must be repeated with signals with positive and negative half periods in the sound level meter setting for measurement of peak sound pressure levels C.

5.6.15.6 If the sound level meter is used to measure sound pressure levels with the time weighting F or S, it must be verified that the overexcitation indication appears in accordance with the specification listed in the technical requirements for sound level meters. If the equivalent sound pressure levels, sound exposure levels, maximum sound pressure levels or peak sound pressure levels C are being measured, it must be verified whether, after the condition for overexcitation has appeared, the overexcitation indicator remains blocked in accordance with the specifications listed in the technical requirements for sound level meters.

5.6.16 Peak sound pressure level C

5.6.16.1 The indication of the peak sound pressure level C must be tested with continuous sinusoidal electrical signals and electrical signals with one period and a half period. Signals with one period and a half period must be signals described in the technical requirements for sound level meters and must be derived from continuous signals. Signals with one period and a half period must begin and end at the zero transition point.

5.6.16.2 The measurement of peak sound pressure level C must be tested at the levels of the three continuous input signals in the reference measurement range and in the measurement ranges with the lowest sensitivity. The first continuous signal is a signal which gives an indication of the sound pressure level C with the time weighting F or equivalent sound pressure level C which is 4 dB lower than the upper limit specified in the user manual for the range of peak sound pressure levels. The second continuous input signal is a signal which gives an indication of the sound pressure level C which is 1 dB higher than the lower limit specified for the range of peak sound pressure levels. The third continuous input signal is the signal which causes the indication, rounded to 1 dB, in the middle of the range of the peak sound pressure levels C specified in the user manual for the upper and lower limit of the range of peak sound pressure levels.

5.6.16.3 Peak sound pressure levels C must be measured on the three signal levels specified in 5.6.16.2 with the signals with one period and a half period which are specified in the technical requirements for sound level meters. The equivalent sound pressure levels or sound pressure levels with the time weighting F must be measured with corresponding continuous signals. The differences must be calculated between the indications of peak sound pressure level C for signals with one period and a half period and the indications of the equivalent sound pressure level or sound pressure level with time weighting F of the corresponding continuous signals.

5.6.16.4 The differences in the measured differences between peak sound pressure levels C and the corresponding sound pressure levels of the continuous signal from the corresponding nominal differences specified in the technical requirements for sound level meters must not exceed the applicable acceptance limits specified in these technical requirements.

5.6.16.5 It must be verified whether there is any indication of overexcitation for all of the measured peak sound pressure levels C conducted in accordance with the above-mentioned procedure.

5.6.17 Zeroing

If a zeroing function is integrated, it must be verified whether the activity of the zeroing device interferes with the previous indication on the display device. It must also be verified whether or not the activity of the zeroing device causes any inaccurate indications on any display device.

5.6.18 Electrical output

A sinusoidal electrical signal with a frequency of 1 kHz must be connected to the electrical input device of the sound level meter. The sound level meter must be set to measure sound pressure level A with the time weighting F or the equivalent sound pressure level A. The signal must be set so that the indication of the reference sound pressure level appears in the reference measurement range, and the indication must be recorded. A shorting circuit must successively be connected to all analogue electrical outputs and all indications must be measured. The measured difference between the indicated sound pressure levels must not exceed the acceptance limits specified in the technical requirements for sound level meters.

5.6.19 Timing devices

It must be verified whether or not the shortest averaging times when measuring equivalent sound pressure levels or the shortest integration times when measuring sound exposure levels are longer than the corresponding shortest periods specified in the user manual. It must be verified whether or not the longest averaging times or integration times are shorter than the corresponding longest periods specified in the user manual. The longest averaging time or integration time to be verified pursuant to this Measure must not exceed 24 h.

5.6.20 Crosstalk in multi-channel sound level meter systems

5.6.20.1 The crosstalk between any pairs of channels in a multi-channel system must be tested with continuous electrical signals connected to the electrical input device of one channel from the given pair at frequencies of 31.5 Hz, 1 kHz and 8 kHz.

5.6.20.2 The input signal must be set at each test frequency so as to result in an indication at the upper limit of the linearity range specified in the user manual. The signal level indicated in the given channel and all other channels must be recorded. The differences between the indicated signal levels must not be lower than the applicable lowest differences specified in the technical requirements for sound level meters. The frequency weighting must be the weighting function C or Z or, if necessary, the weighting function A.

5.6.21 Power supply source

5.6.21.1 The sound level meter must first be tested under conditions in which its power supply source supplies the nominal voltage specified in the user manual. The acoustic calibrator supplied with the sound level meter must be attached to the microphone and the sound level meter must be placed in the reference measurement range. The indication of the sound pressure level A with the time weighting F or equivalent sound pressure level A must be recorded. The test must be repeated under conditions when the power supply source is supplying the highest and the lowest voltage specified in the user manual.

5.6.21.2 The measured deviations in the sound pressure level indicated at the highest voltage and at the lowest voltage from the sound pressure level indicated at nominal voltage must not exceed the acceptance limits specified in the technical requirements for sound level meters.

NOTE The term ‘power supply source’ includes batteries.

6 Initial verification

The initial verification procedure is identical to the follow-up verification procedure.

7 Follow-up verification

The instruments specified in Chapter 1 of this Measurement may be verified separately. Microphones must be type-approved together with the sound level meter.

7.1 Submission for testing

7.1.1 The user manual of the applicable model and version of sound level meter must be submitted for verification together with the sound level meter.

7.1.2 The sound level meter must be submitted for verification together with all components and/or accessories with which it is to be tested. The device specified in the user manual for connecting electrical signals equivalent to signals from the microphone must also be submitted.

7.1.3 The data required to conduct verification must be available and the laboratory must record and note the origin of the data. The data must include all relevant information required in the technical requirements for sound level meters and in the specifications on the correction methods for obtaining the sound level meter’s frequency characteristics in a free field.

7.1.4 An acoustic calibrator must be available. If the acoustic calibrator is supplied by the user, it must be used to determine the absolute acoustic sensitivity of the sound level meter.

7.2 Conformity

7.2.1 Conformity with the technical requirements is demonstrated if both of the following criteria are met:

a) the measured deviation from the nominal value does not exceed the applicable acceptance limit; and
b) the corresponding measurement uncertainty does not exceed the corresponding maximum permissible measurement uncertainty specified in the technical requirements for sound level meters for the same probability of coverage of 95 %.

7.2.2 If the actual measurement uncertainty during verification exceeds the corresponding maximum permissible uncertainty, then the test result must not be used to assess conformity with the electroacoustic requirements for sound level meters during verification.

7.2.3 The actual measurement uncertainty during verification without including the uncertainty of the data on corrections in a free field or in a field with random sound incidence specified by the manufacturer must not exceed the corresponding maximum permissible uncertainty specified in the technical requirements for sound level meters. If, however, the uncertainty of the data on corrections specified by the manufacturer is figured in, it is possible that the actual measurement uncertainty during verification may only exceed the corresponding maximum permissible uncertainty because the uncertainty of the data on corrections specified by the manufacturer was a significant part of the sum of uncertainties during verification. In this case, the test may continue, but the documentation on verification must contain a statement explaining the causes why the test results do not meet the technical requirement specified in the technical requirements for sound level meters.

7.3 Preliminary inspection

Before any kind of measurement, the sound level meter and all accessories must be visually inspected, with special attention paid to any damage or accumulation of foreign matter on the protective screen or diaphragm of the microphone. All of the important control elements must be functional and it is necessary to verify that they are in good working order. If the control elements, display and other basic elements are not in good working order, then no tests may be conducted.

7.3.1 If the sound level meter does not bear the markings required in the technical requirements for sound level meters or there is no evidence that the sound level meter was originally marked that way, then verification must not be carried out. At least the model marking and serial number must be visible on the sound level meter.

The sound level meter must be powered from its preferred source or suitable alternative in all tests. Before and after conducting the set of tests with acoustic signals and before and after conducting the set of tests with electrical signals, the voltage supplied by the power supply source to the sound level meter must be checked using the method specified in the user manual and it must be ascertained that it is within the specified operating limits. If the voltage or equivalent indication of the power source status is not within the operating limit range and the reason cannot be attributed to a partially drained battery or improper voltage setting on the power supply source connected to the public electrical grid, then no tests may be conducted due to an indication of improper functioning.

NOTE: Changes at the output of the power supply source may be determined as changes in the percent of voltage of a fully charged battery or by an equivalent procedure.

7.5.1 Verification must be conducted in the following ranges of ambient conditions: static pressure of 80 kPa to 105 kPa, air temperature of 20 °C to 26 °C and relative humidity of 25 % to 70 %.

7.5.2 The static air pressure, air temperature and relative humidity must be measured and recorded at least at the beginning and end of the test.

7.5.3 If data on the influence of deviations under the prevailing ambient conditions from the reference ambient conditions are not available, then, during tests of frequency weightings conducted at static pressure under 97 kPa, the laboratory must assign a standard uncertainty of 0.09 dB to measurements at frequencies lower than or equal to 3 kHz and assign a standard uncertainty of 0.14 dB to measurements at frequencies higher than 3 kHz.

NOTE: Both standard uncertainties are intended for use if the values of standard uncertainties from the potential sources specified in 7.10.6 are not available. Both values were determined from estimates of 0.15 dB and, respectively, 0.25 dB of the maximum influence of static pressure on the frequency characteristics of the models of microphones which have the greatest resistance to air in the rear cavity.

7.6.1 The tests described in the following articles only apply to those design characteristics which are required in the technical requirements for sound level meters and which are accessible in the sound level meter when it is submitted for the test. All such characteristics must be tested.

7.6.2 In all tests pursuant this chapter, the configuration of the sound level meter must be in accordance with the user's requirement and must be as specified in the user manual for one of the normal modes, including all required accessories. With sound level meters which enable elective settings of corrections to the relative frequency characteristics for the influence of any kind of accessories and for other sound level meter configurations, the tests must be carried out with the use of the settings which are suitable for the configuration of the sound level meter in its normal operating mode. Any such settings must not be changed during the test.

7.6.3 Electrical signals must be delivered to the sound level meter with the help of an input device or by the means specified in the user manual. The deviation in frequency of the input signal from the specified frequency must not exceed ±0.25 % of the specified frequency

7.6.4 In the case of a sound level meter with an electrical output which is to be used during verification, it must be confirmed that the indication obtained from the electrical output and corresponding indication on the display device of the sound level meter are consistent in the range of acceptance limits specified in the technical requirements for sound level meters. If there are multiple outputs and if one output is specified in the user manual for the test, this output must be used during verification.

An acoustic calibrator specified in the manual must be used with the sound level meter or an acoustic calibrator generating the same nominal sound pressure level and frequency as the model specified in the user manual must be used. In the second case, publicly available data must be used from either the sound level meter manufacturer or from the manufacturer of the acoustic calibrator on any kind of settings on the sound level meter which must be applied after connecting the given model of calibrator to the given model of microphone.

NOTE: It is possible that publicly available data for the model of acoustic calibrator which are not specified in the user manual have not been verified or type-tested in accordance with this Measure.

NOTE 1: The sound pressure level indication is influenced by background noise as well as by internally generated noise.

NOTE 2: Sound pressure level A corresponding to the internally generated noise is only given as information and is not used for assessing conformity with the requirement. The internally generated noise level is specified without the associated uncertainty.

NOTE: The internally generated noise level is only given as information and is not used for assessing conformity with the requirement. The internally generated noise level is specified without the associated uncertainty.

7.10 Frequency weighting tests via acoustic signals

NOTE 1: If pertinent data are available on corrections in a free field or in a field with random sound incidence, it is preferable to conduct these tests with the help of a multi-frequency acoustic calibrator, comparative coupler or electrostatic actuator in order to minimise testing time.

NOTE 2: A microphone which meets the requirements specified in the technical requirements for laboratory reference microphones also meets the requirements in the technical requirements for operating reference microphones.

- equivalent frequency characteristics of a sound level meter in a free field or in a field with random sound incidence, if the source of sound or simulated sound of a pressure field is in a multi-frequency acoustic calibrator, in a comparative coupler or from an electrostatic actuator;
- average influence of the wind protection cover and any accessories which are part of the sound level meter's configuration in ordinary use on the frequency characteristics of a typical microphone.

NOTE: It is possible that publicly available data which are not specified in the user manual have not been verified or type-tested in accordance with this Measure.

NOTE: At frequencies lower than 1 kHz, the measured frequency weighting during the use of the electrostatic actuator will not show the effects of defects such as openings in the diaphragm of the microphone.

7.11 Tests of frequency weighting via electrical signals

- in tests of class 1 sound level meters:

  nine nominal frequencies in octave intervals from 63 Hz to 16 kHz;

- in tests of class 2 sound level meters:
  eight nominal frequencies in octave intervals from 63 Hz to 8 kHz;
- deviation in frequency characteristics of the microphone in the reference direction in a free field or in a field with random sound incidence from stable frequency characteristics;
- average effects of reflections from the body of the sound level meter and sound deflection around the microphone and pre-amplifier;
- if relevant, the average influence of the wind protection cover and any accessories of the wind protection cover which are part of the sound level meter's configuration in normal use on the frequency characteristics of a typical microphone.

7.12 Frequency and time weighting at 1 kHz

7.13 Long-term stability

7.14 Amplitude characteristic linearity in a reference measurement range

7.15 Amplitude characteristic linearity including a measurement range switch

7.16 Response to tone impulses

- maximum sound pressure level with time weighting F;
- maximum sound pressure level with time weighting S; or
- sound exposure level.

7.17 Peak sound pressure level C

7.18 Overexcitation indication

NOTE: The relative levels of input signals with a positive and negative half period may be determined from the setting of the input signal attenuator.

7.19 Stability at high levels

7.19.1 The stability of a sound level meter to work continuously in response to a high signal level without significant changes in sensitivity is evaluated from the difference between the sound pressure levels A indicated in the response to a continuous signal with a frequency of 1 kHz connected at the beginning and end of a long-term exposure period with a signal lasting 5 minutes.

7.19.2 The level of the continuous electrical input signal must correspond to the level required when displaying a sound pressure level which is 1 dB lower than the upper limit of the linearity range at a frequency of 1 kHz in the measurement range with lowest sensitivity. It is permissible for the indicated sound pressure level to be the equivalent sound pressure level for 10 seconds, the sound pressure level with time characteristic F or sound pressure level with time characteristic S.

7.19.3 The difference measured between the initial and final indication of sound pressure level A must not exceed the acceptance limits specified in the technical requirements for sound level meters.

8 Examination of the specified measuring instrument

During examination of verified measuring instruments conducted in accordance with § 11a Act on Metrology, this examination shall, at the request of a party whose interests may be affected by improper measurement, be conducted in the same range as the follow-up verification pursuant to Chapter 7.

9 Notified standards

For the purposes of specifying the metrological and technical requirements for measuring instruments and specifying the testing methods for their type approval and verification arising from this General Measure, the CMI shall notify Czech technical standards, other technical standards or technical documents of international or foreign organisations, or other technical documents containing more detailed technical requirements (hereinafter 'notified standards'). The CMI shall publish a list of these notified standards attached to the relevant measures, together with the general measure, in a manner accessible to the public (on www.cmi.cz).

Compliance with notified standards or parts thereof is considered, to the extent and under the conditions stipulated by a general measure, to be compliance with the requirements stipulated by this measure to which these standards or parts thereof apply.

Compliance with notified standards is one way of demonstrating compliance with the requirements. These requirements may also be met by using another technical solution guaranteeing an equivalent or higher level of protection of legitimate interests.

II.

G R O U N D S

The CMI issues, pursuant to § 14(1)(j) of the Metrology Act, for the implementation § 6(2), § 9(1) and (9) as well as § 11a(3) of the Metrology Act, this General Measure, stipulating metrological and technical requirements for specified measuring devices and test methods for type approval for verification of the following specified measuring devices – 'sound-measuring instruments of classes 1 and 2, bandwidth filters, measurement microphones'.

Under item 6.1.1 Class 1 and 2 Sound-measuring instruments, furthermore under item 6.1.2 Bandwidth filters and under item 6.1.4 Measurement microphones in the Annex 'List of the Types of Specified Measuring Instruments' to Implementing Decree No 345/2002 specifying the measuring instruments whose verification is mandatory and measuring instruments subject to type approval, as amended, this type of measuring instrument is classified as an instrument subject to mandatory verification.

This legislation (General Measure) will be notified in accordance with Directive (EU) 2015/1535 of the European Parliament and of the Council of 9 September 2015 laying down a procedure for the provision of information in the field of technical regulations and of rules on Information Society services.

III.

I N S T R U C T I O N S

In accordance with § 172(l) APC, in conjunction with § 39(l) APC, the CMI has stipulated a time limit for comments of 30 days from the date of posting the draft on the official notice board. Comments submitted after this time limit will not be considered.

The persons concerned are hereby invited to comment on this general draft measure. With regard to the provisions of § 172(4) APC, comments are to be submitted in writing.

Pursuant to the provisions of § 174(1) APC, in conjunction with the provisions of § 37(1) APC, it must be clearly stated who is submitting the comments, which general measure the comments concern, how the draft contradicts legislation or how the general measure is inaccurate. The comments must also contain the signature of the person making the comments.

The supporting documents for this draft General Measure may be consulted at the Czech Metrology Institute, Legal Metrology Department, Okružní 31, 638 00 Brno, after making arrangements by telephone.

This draft General Measure shall be posted for 15 days.

.....

RNDr. Pavel Klenovský

Director-General

Person responsible for accuracy: Mgr. Tomáš Hendrych

Posted on:

Signature of the authorised person confirming posting:.....

Removed on:

Signature of the authorised person confirming removal: .....