| | Technical Specification of Verification and Inspection for Octave-band Filter | S/N | CNMV 58-2 |
|---|---|---|---|
| | | Rev. | 1 |

1. This Technical Specification is enacted pursuant to Paragraph 2, Articles 14 and 16 of the Weights and Measures Act.
2. The revision, date of promulgations, document No, date of enforcement and content of the amendment are listed as follows:

| Rev. | Date of Promulgation | Document No. (Ching-Piao-Szu-Tsu ) | Date of Enforcement | Content of Amendment |
|---|---|---|---|---|
| 1 | 2015-10-29 | No.10440015000 | 2017-01-01 | |

1. Scope

1.1 This specification applies to the verification and inspection of sound level meters with octave-band or one-third-octave-band filter, conform to class 1 or class 2 specifications.

1.2 This specification applies to time-weighting, time-averaging sound level meters had been verified by technical specification for Verification and Inspection of Sound Level Meters (CNMV58-1).

2. Terminology

2.1 Octave frequency ratio: mid-band frequency ratio of adjacent filters, it expressed in G.

Note: the ratio of normalized mid-band frequency is 2:1, the ratio of exact mid-band frequency is:

$$G = 10^{3/10} \quad (1)$$

2.2 Bandwidth designator: reciprocal of a positive integer, including 1, to designate the fraction of an octave band, expressed in 1/b.

Note: for example, for 1/b=1/1, the filters are designated as octave-band filter; for 1/b=1/3, the filters are designed as one-third-octave-band filter.

2.3 Reference frequency: Reference frequency is 1000 Hz, expressed in $f_{\mathrm{r}}$.

2.4 Exact mid-band frequency: frequency that has a specified relationship to the reference frequency such that the ratio of the exact mid-band frequencies of any two contiguous band-pass filters is the same for all filters in a filter set of a specified bandwidth, the exact mid-band frequencies, $f_{\mathrm{m}}$ (Hz) of any filter in a set of filters shall be determined by the following formula:

$$f_{\mathrm{m}} = f_{\mathrm{r}} G^{x/b} \quad (2)$$

where x is positive integer, negative integer or zero

2.5 Normalized frequency: the ratio of a frequency to the corresponding exact mid-band frequency for a band-pass filter, $\Omega$ shall be calculated by the following formula:

$$\Omega = f / f_{\mathrm{m}} \quad (3)$$

2.6 Filter attenuation: at any frequency, for a band-pass filter, the input signal level minus the corresponding output signal level, expressed in A (dB)

$$A(\Omega) = L_{\mathrm{in}}(\Omega) - L_{\mathrm{out}}(\Omega) \quad (4)$$

2.7 Reference attenuation: for all band-pass filters in an instrument, nominal filter attenuation in the pass-band for determining relative attenuation, expressed in $A_{\mathrm{ref}}$ (dB)。

2.8 Relative attenuation: at any frequency, for a band-pass filter, relative attenuation filter attenuation minus the reference attenuation $\Delta A$ is given by following formula:

$$\Delta A(\Omega) = A(\Omega) - A_{\mathrm{ref}} \quad (5)$$

2.9 Reference level range: level range specified for testing the performance of a filter and containing the reference sound pressure level.

2.10 Reference input signal level: reference level of the input signal on the reference level range specified for testing the performance of a filter.

2.11 Level linearity deviation: on any level range at the exact mid-band frequency, an indicated output signal level minus the anticipated output signal level.

2.12 Linear operating range: on any level range and at a specified frequency, the range of sound levels over which level linearity deviations do not exceed the applicable acceptance limits specified in this standard.

3. Verification and inspection equipment

3.1 Verification and inspection equipment shall meet the following specification:

（1） Sinusoidal signal generator: frequency range shall be at least 2 Hz to 250 kHz, the error of output frequency shall be less than 0. 01 %, total harmonic distortion shall be less than 0.1 %.

（2） Attenuator: attenuation range shall be at least 70 dB, resolution (minimum scale) is better than 0.1 dB, the maximum expanded uncertainty shall be less than 0.2 dB.

Note: If the output voltage range of sinusoidal signal generator is greater than 70 dB, it may not be necessary to use the attenuator to test.

（3） Voltage meter: frequency range shall be at least 2 Hz to 250 kHz, the error of voltage measurement shall be less than 1 %.

The equipment listed above should be provided certificates of traceability and uncertainty.

3.2 Environmental conditions of verification and inspection

（1） Temperature: 20 ℃ to 26 ℃;

（2） Relative humidity: 25 % to 70 %;

（3） Temperature, relative humidity and static pressure should be measured and recorded at the beginning and the end of the test.

4. Construction

4.1 The measure unit of octave-band filters is ”decibel” and the symbol is ”dB”.

4.2 The following information shall be labeled on an obvious position of octave-band filters:

（1） Bandwidth and Type of the octave-band filters (for example: one-third-octave-band filter, class 1 or class 2).

（2） The name of manufacturer or trademark.

（3） Model number and instrument number

4.3 Octave-band filters shall be equipped with a device to indicate overload input.

4.4 The minimum scale interval for octave-band filters with digital output indicators shall be less than 0.1 dB.

4.5 The range of indicators for octave-band filters shall be at least 60 decibel for class l filter; 50 decibel for Class 2 filter.

4.6 If octave-band filters use batteries as energy, a warning device should be provided to indicate low power.

5. Verification procedures

5.1 Verify the construction and specifications of the octave-band filters according to the following items.

（1） Construction

（2） Flat frequency response

（3） Level linearity

（4） Relative attenuation

（5） Overload indication

（6） Self-generated noise

5.2 Construction: shall comply with the requirements of section 4

5.3 The test of the flat frequency response is specified as follows:

（1） Each instrument shall be connected as shown in figure 1, and warmed up according to the time specified by the manufacturer.

（2） The sinusoidal signal generator applies 1 kHz sinusoidal signal to filter, then have filter display the indication $(3 \pm 0.1)$ dB less than the upper limit of linear operating range by adjusting sine signal generator input signal, and use this indication as a reference level.

（3） Change the signal frequencies successively according to the exact mid-band frequencies listed in table 1 and keep the constant amplitude sinusoidal signal output. Measure the indication value of each filter in the set, and then calculate the deviation between the indication values of each filter in the set and the reference level.

（4） The measured value should be the arithmetic mean of at least three test results.

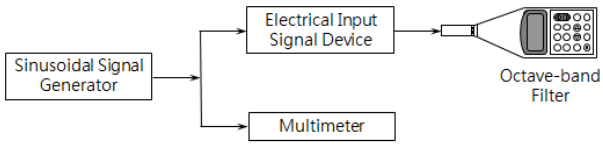


Figure 1 Test system for flat frequency response of octave-band-filter

Table 1 The exact mid-band frequency of an octave-band filter and an one-third-octave-band filter

| nominal mid-band frequency (Hz) | exact mid-band frequency (Hz) | 1/1 octave | 1/3 octave | nominal mid-band frequency (Hz) | exact mid-band frequency (Hz) | 1/1 octave | 1/3 octave |
|---|---|---|---|---|---|---|---|
| 20 | 19.953 | | X | | | | |
| 25 | 25.119 | | X | 800 | 794.33 | | X |
| 31.5 | 31.623 | X | X | 1000 | 1000.0 | X | X |
| 40 | 39.811 | | X | 1250 | 1258.9 | | X |
| 50 | 50.119 | | X | 1600 | 1584.9 | | X |
| 63 | 63.096 | X | X | 2000 | 1995.3 | X | X |
| 80 | 79.433 | | X | 2500 | 2511.9 | | X |
| 100 | 100.00 | | X | 3150 | 3162.3 | | X |
| 125 | 125.89 | X | X | 4000 | 3981.1 | X | X |
| 160 | 158.49 | | X | 5000 | 5011.9 | | X |
| 200 | 199.53 | | X | 6300 | 6309.6 | | X |
| 250 | 251.19 | X | X | 8000 | 7943.3 | X | X |
| 315 | 316.23 | | X | 10000 | 10000 | | X |
| 400 | 398.11 | | X | 12500 | 12589 | | X |
| 500 | 501.19 | X | X | 16000 | 15849 | X | X |
| 630 | 630.96 | | X | 20000 | 19953 | | X |

5.4 The test of level linearity is specified as follows:

（1） Level linearity of an octave-filter shall be measured at frequencies of 31.5 Hz, 1 kHz and 16 kHz, respectively.

（2） Each instrument shall be connected as shown in figure 2, and warmed up according to the time specified by the manufacturer.

（3） The level range of the filter shall be set at the reference level range, and input a sinusoidal signal. Then have the filter display on the reference input signal level by adjusting the input signal, and let the deviation of level linearity on this reference level be zero.

（4） When adjusting the level of an attenuator (or sinusoidal signal generator), this test shall be performed in 5 dB steps of increasing or decreasing input signal level. When the operating range of linearity is less than 5 dB between upper limit or lower limit, it shall be performed by changing input signal levels of 1 dB steps of increasing or decreasing input signal level.

（5） Calculate the deviations of the level linearity between the signal generator input levels and those corresponding output levels measured by the filter.

（6） The measured value should be the arithmetic mean of at least three test results.

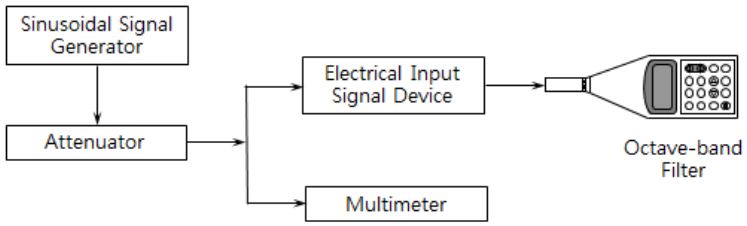


Figure 2 Test system for level linearity of filter

5.5 The test of the relative attenuation is specified as follows:

（1） The relative attenuation shall be measured at frequencies of 31.5 Hz, 1 kHz and 16 kHz, respectively.

（2） Each instrument shall be connected as shown in figure 3, and warmed up according to the time specified by the manufacturer.

（3） Adjust the sine signal generator out frequency signal to the exact frequency of the test filter according to table 3, then have the filter display the indication $(3 \pm 0.1)$ dB less than the upper limit of the linear operating range, and use this indication as reference attenuation.

（4） The test signal frequency $f_k$ should be calculated according to the normalized frequency and exact mid-band frequency listed in table 3 at section 7.1.

$$f_k = f_m \times \Omega \qquad (6)$$

（3） Sequentially changing the sinusoidal signal generator output signal according to the test signal frequency $f_k$ and keep the constant amplitude sinusoidal signal output. Measure the indication value of each filter in the set at difference test signal frequency, and then calculate the relative attenuation according to equation (5).

（6）The measured value should be the arithmetic mean of at least three test results.

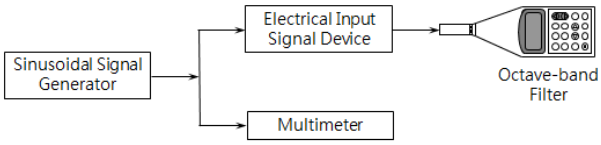


Figure 3 Test system for relative attenuation of filter

5.6 The test of the overload indication is specified as follows

（1） The overload indication shall be measured at frequencies of 31.5 Hz, 1 kHz and 16 kHz, respectively.

（2） Each instrument shall be connected as shown in figure 4, and warmed up according to the time specified by the manufacturer.

（3）Keep enhancing the input signal level of the sinusoidal signal generator to the filter until it indicates overload, and then record the overload level of the filter.

（4） The measured value should be the arithmetic mean of at least three test results

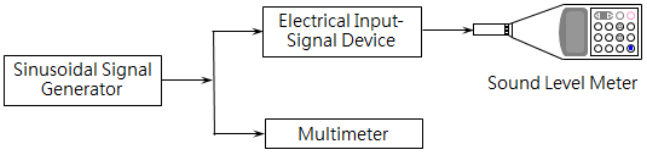


Figure 4 Test system for overload indication of filter

5.7 The test of the self-generated noise is specified as follows:

（1） The self-generated noise shall be measured at frequencies of 31.5 Hz, 1 kHz and 16 kHz, respectively.

（2） The test shall be performed on the reference level range and on the level range with the highest sensitivity.

（3） The device terminated in the manner specified in the instruction manual for self-generated noise levels measurement shown in figure 5. Short-circuit the input terminal or use similar means, then record the self-generated noise level from each filter in the set

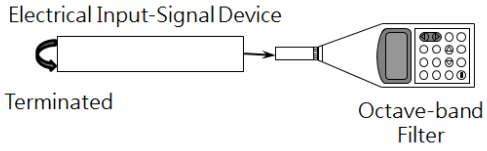


Figure 5 Test system for self-generated noise of filter

5.8 The validity period of the verification of a filter is two years from the first day of the next month that the filter bears the verification compliance mark.

6. Inspection procedures can adopt all or part verification items in this technical specification.

7. The maximum permissible errors of verification and inspection

7.1 The verification maximum permissible errors of the filter are as follows

（1）Flat frequency response:

The flat frequency response deviations shall not exceed ±0.4 dB for class 1 filter.

The flat frequency response deviations shall not exceed ±0.6 dB for class 2 filter.

（2） Level linearity: The deviations of level linearity corresponding to different linear operating range for octave-band filter are shown in table 2.

Table 2 The deviations of level linearity for octave-band filter

| Linear operating range of octave-band filter | The deviations of level linearity | |
|---|---|---|
| | Class 1 | Class 2 |
| $(L_u - L) \leqq 40$ dB[note] | ±0.5 dB | ±0.6 dB |
| $(L_u - L) > 40$ dB[note] | ±0.7 dB | ±0.9 dB |
| Note：$L_u$ is the upper limit of the linear operating range； L is the testing level | | |

（3）Relative attenuation: The deviations of the normalized frequency corresponding to the relative attenuation for octave-band filter are shown in table 3.

Table 3 The deviations of relative attenuation for octave-band filter

| Index | normalized frequency $\Omega=f/f_m$ | | The deviations of the relative attenuation dB | |
|---|---|---|---|---|
| | 1/3 octave-band filter | 1/1 octave-band filter | Class 1 | Class 2 |
| $G^{-4}$ | 0.18546 | 0.063096 | +70;+∞ | +60;+∞ |
| $G^{-3}$ | 0.32748 | 0.12589 | +60;+∞ | +54;+∞ |
| $G^{-2}$ | 0.53143 | 0.25119 | +40.5;+∞ | +39.5;+∞ |
| $G^{-1}$ | 0.77257 | 0.50119 | +16.6;+∞ | +15.6;+∞ |
| $G^{-3/8}$ | 0.91958 | 0.77179 | -0.4;+1.4 | -0.6;+1.7 |
| $G^{-1/4}$ | 0.94719 | 0.84140 | -0.4;+0.7 | -0.6;+0.9 |
| $G^{-1/8}$ | 0.97402 | 0.91728 | -0.4;+0.5 | -0.6;+0.7 |
| $G^{0}$ | 1.00000 | 1.0000 | -0.4;+0.4 | -0.6;+0.6 |
| $G^{1/8}$ | 1.02667 | 1.09018 | -0.4;+0.5 | -0.6;+0.7 |
| $G^{1/4}$ | 1.05575 | 1.18850 | -0.4;+0.7 | -0.6;+0.9 |
| $G^{3/8}$ | 1.08746 | 1.29569 | -0.4;+1.4 | -0.6;+1.7 |
| $G^{1}$ | 1.29437 | 1.99526 | +16.6;+∞ | +15.6;+∞ |
| $G^{2}$ | 1.88173 | 3.98107 | +40.5;+∞ | +39.5;+∞ |
| $G^{3}$ | 3.05365 | 7.94328 | +60;+∞ | +54;+∞ |
| $G^{4}$ | 5.39195 | 15.8489 | +70;+∞ | +60;+∞ |

7.2 The maximum-permitted expended uncertainties of each verification item at a confidence level of approximately 95 % for the octave-band filter are shown in table 4.

Table 4 Maximum-permitted expanded uncertainty of the verification items

| Verification items | Maximum-permitted expanded uncertainty |
|---|---|
| Flat frequency response | 0.20 dB |
| Level linearity deviation | 0.20 dB for $(L_u - L) \leqq 40$ dB[note]<br>0.35 dB for $(L_u - L) > 40$ dB[note] |
| Relative attenuation | 0.20 dB for $\Delta A \leqq 2$ dB<br>0.30 dB for 2 dB $< \Delta A \leqq 40$ dB<br>0.50 dB for $\Delta A > 40$ dB |
| Note：$L_u$ is the upper limit of the linear operating range；<br>L is the testing level | |

7.3 The inspection maximum permissible errors of the octave-band filters are the same as the verification maximum permissible errors.

8. The verification compliance marks and certificates

8.1 The verification compliance tag of an octave-band filter shall be stuck on an obvious place of the upper cover of the main device.

8.2 A verification certificate shall be issued after the octave-band filter passes the verification.

8.3 The verification certificate of a sound level meter with an octave-band filter shall be recorded with the following items: the applicant, address, specification, brand, model, serial number, type, the number of certificate, verification date, expiration date, and other necessary items.