IEC 61260-2

Edition 1.0 2016-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electroacoustics – Octave-band and fractional-octave-band filters –
Part 2: Pattern-evaluation tests

Électroacoustique – Filtres de bande d'octave et de bande d'une fraction d'octave –
Partie 2: Essais d'évaluation d'un modèle

IEC 61260-2:2016-03(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue
Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,…). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org
Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary
65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

IEC 61260-2

Edition 1.0 2016-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electroacoustics – Octave-band and fractional-octave-band filters – Part 2: Pattern-evaluation tests

Électroacoustique – Filtres de bande d'octave et de bande d'une fraction d'octave – Partie 2: Essais d'évaluation d'un modèle

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 17.140.50

ISBN 978-2-8322-3245-3

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

ELECTROACOUSTICS – OCTAVE-BAND AND FRACTIONAL-OCTAVE-BAND FILTERS –

Part 2: Pattern-evaluation tests

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.

3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.

4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.

6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61260-2 has been prepared by IEC technical committee 29: Electroacoustics.

This first edition of IEC 61260-2 (together with IEC 61260-1:2014 and IEC 61260-3:2016), cancels and replaces the first edition of IEC 61260 published in 1995 and its Amendment 1 published in 2001. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 61260.

a) The single document in the first edition of IEC 61260:1995 is now separated into three parts of the IEC 61260 series covering: specifications, pattern-evaluation tests and periodic tests.

b) IEC 61260:1995 specified three performance categories: class 0, 1 and 2 while the IEC 61260 series specifies requirements for class 1 and 2.

c) In IEC 61260:1995, the design goals for the specification can be based on base-2 or base-10 design. In the IEC 61260 series only base-10 is specified.

d) The reference environmental conditions have been changed from 20 °C/65 % RH to 23 °C/50 % RH;

e) IEC 61260:1995 specified tolerance limits without considering the uncertainty of measurement for verification of the specifications. The IEC 61260 series specifies acceptance limits for the observed values and maximum-permitted uncertainty of measurements for laboratories testing conformance to specifications in the standard.

The text of this standard is based on the following documents:

CDV	Report on voting
29/845/CDV	29/881A/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts of the IEC 61260 series, published under the general title *Electroacoustics – Octave-band and fractional-octave-band filters* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

IEC 61260:1995 and IEC 61260:1995/AMD 1:2001 are now separated into the following three parts of IEC 61260 series:

- Part 1: Specifications
- Part 2: Pattern-evaluation tests
- Part 3: Periodic tests

For assessments of conformance to performance specifications, IEC 61260-1 uses different criteria than were used for the IEC 61260:1995 edition.

IEC 61260:1995 did not provide any requirements or recommendations to account for the uncertainty of measurement in assessments of conformance to specifications. This absence of requirements or recommendations to account for uncertainty of measurement created ambiguity in determinations of conformance to specifications for situations where a measured deviation from a design goal was close to the limit of the allowed deviation. If conformance was determined based on whether a measured deviation did or did not exceed the limits, the end-user of the octave-band and fractional-octave-band filters incurred the risk that the true deviation from a design goal exceeded the limits.

To remove this ambiguity, IEC Technical Committee 29, at its meeting in 1996, adopted a policy to account for measurement uncertainty in assessments of conformance in International Standards that it prepares.

This edition of IEC 61260-2 uses an amended criterion for assessing conformance to a specification. Conformance is demonstrated when (a) measured deviations from design goals do not exceed the applicable *acceptance limits* and (b) the uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty. Acceptance limits are analogous to the tolerance limits allowances for design and manufacturing implied in the IEC 61260:1995.

Actual and maximum-permitted uncertainties of measurement are determined for a coverage probability of 95 %. Unless more specific information is available, the evaluation of the contribution of a specific filter or filter set to a total measurement uncertainty can be based on the acceptance limits and maximum-permitted uncertainties specified in this standard.

ELECTROACOUSTICS – OCTAVE-BAND AND FRACTIONAL-OCTAVE-BAND FILTERS –

Part 2: Pattern-evaluation tests

1 Scope

1.1 This part of IEC 61260 provides details of the tests necessary to verify conformance to all mandatory specifications given in IEC 61260-1:2014 for octave-band and fractional-octave-band filters.

1.2 Tests and test methods are applicable to class 1 and class 2 bandpass filters. The aim is to ensure that all testing laboratories use consistent methods to perform pattern-evaluation tests.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-6-1, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments*

IEC 61000-6-2:2005, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

IEC 61000-6-3, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*

IEC 61260-1:2014, *Electroacoustics – Octave-band and fractional-octave-band filters – Part 1: Specifications*

IEC 61672-1, *Electroacoustics – Sound level meters – Part 1: Specifications*

CISPR 16-1-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

CISPR 16-1-2, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Coupling devices for conducted disturbance measurements*

CISPR 16-2-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of disturbances and immunity – Conducted disturbance measurements*

CISPR 16-2-3, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements*

CISPR 22:2008, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

ISO/IEC Guide 98-3, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC Guide 98-4, *Uncertainty of measurement – Part 4: Role of measurement uncertainty in conformity assessment*

ISO/IEC Guide 99, *International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61260-1:2014, IEC 61000-4-2, IEC 61000-4-3, IEC 61000-6-1, IEC 61000-6-2, and IEC 61000-6-3, ISO/IEC Guide 98-3, ISO/IEC Guide 98-4 and ISO/IEC Guide 99 apply.

4 Submission for testing

4.1 At least three specimens of the same pattern of bandpass filter shall be submitted for pattern-evaluation testing. As a minimum, the testing laboratory shall select two of the specimens for testing. At least one of the two specimens shall then be tested fully according to the procedures of this standard. The testing laboratory shall decide whether the full tests shall also be performed on the second specimen or whether limited testing is adequate to approve the pattern.

4.2 An instruction manual and all items or accessories that are identified in the instruction manual as integral components for the normal mode of operation shall be submitted along with the filters.

4.3 If the manufacturer of the filters supplies devices that are to be connected to the bandpass filter by cables for a typical mode of operation for the filter, then the devices and cables shall be submitted with the filter.

5 Marking of the filter and information in the instruction manual

5.1 It shall be verified that the filter is marked according to the requirements of IEC 61260-1:2014.

5.2 It shall be verified that the instruction manual contains all the information that is required by IEC 61260-1:2014 as relevant to the facilities provided by the filter.

5.3 If the filter does not conform to the requirements of 5.1 and 5.2, no pattern-evaluation tests shall be performed.

5.4 After completion of all tests, the information shall be reviewed to ensure that it is correct and that no applicable acceptance limits are exceeded.

6 Mandatory facilities and general requirements

6.1 General

6.1.1 No test specified in this part of IEC 61260 series shall be omitted unless the bandpass filter does not possess the feature described for the test. When the design of a fractional-octave-band filter, which has been pattern approved, is changed and a new pattern approval is requested, then – at the discretion of the testing laboratory – it is not necessary to repeat those tests for performance characteristics that are not affected by the design change.

6.1.2 If the filter does not possess the mandatory features listed in IEC 61260-1:2014, such as overload indicator or means to check that the power supply is adequate for battery powered instruments which contain the filter, the filter does not conform to the specifications of IEC 61260-1:2014, and no pattern-evaluation tests shall be performed.

6.1.3 For all pattern-evaluation tests, the configuration of the filter shall be as specified in the instruction manual for one of the normal modes of operation, including required accessories. All configurations of the filter that are stated in the instruction manual as conforming to the requirements of IEC 61260-1:2014 shall be tested.

6.1.4 If the instruction manual states that the filter conforms to the specifications of IEC 61260-1:2014 with optional facilities installed, the combination with the optional facilities installed shall also be tested to verify conformance to the relevant specifications.

6.1.5 If the filter is enclosed in an instrument containing a level detector and a display device for displaying the level of the filtered signal with a resolution of at least 0,1 dB, the displayed value from this display device shall be used for testing, if appropriate. If an electrical output is provided corresponding to the displayed value and the testing laboratory intends to utilize the electrical output instead of the display device, the laboratory shall verify that changes in the levels of applied electrical input signals produce corresponding changes in the signal levels indicated on the display device and at the electrical output that are in accordance with the specifications of IEC 61260-1:2014.

6.1.6 For bandpass filters that are designed to operate with measuring devices that comply with the requirements for sound level meters as specified in IEC 61672-1, the display indicator of this device shall be used to measure the level of the output signal from the filter set.

6.1.7 For filter sets with digital readout devices, or with output that is available in a manufacturer-specified digital format (for example over a digital interface connection), the level of the output should be determined from the numeric readout or via the digital output to a suitable display or recording device. Where multiple outputs are present, if an output is specified in the instruction manual for testing, this output shall be used for the pattern-evaluation tests.

6.1.8 If the instruction manual specifies a procedure for adjusting the filter, e.g. sensitivity adjustment, this procedure shall be followed before any measurements are performed.

6.1.9 For all tests, the filter shall be powered from its preferred supply. If the instruction manual specifies requirements for the internal batteries, such batteries shall be installed for the pattern-evaluation tests.

6.1.10 The filter shall be allowed to reach equilibrium with the prevailing environmental conditions before switching on the power to perform a test.

6.1.11 If the filter has more than one signal-processing channel, pattern-evaluation tests shall be performed for each channel that utilizes unique signal processing techniques. For multi-channel systems with the same functional equivalence in all channels, the number of channels to be tested may be less than the total number of channels, at the discretion of the testing laboratory.

6.1.12 Conformance to a performance specification is demonstrated when the following criteria are both satisfied:

a) the measured deviation from the design goal does not exceed the applicable acceptance limit and;

b) the corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in IEC 61260-1:2014 for the same coverage probability of 95 %.

IEC 61260-1:2014 gives example assessments of conformance using these criteria.

6.1.13 Laboratories performing pattern-evaluation tests shall calculate all uncertainties of measurements in accordance with the guidelines given in the ISO/IEC Guide 98-3. Actual measurement uncertainties shall be calculated for a coverage probability of 95 %. Calculation of the actual measurement uncertainty for a particular test should consider at least the following components, as applicable:

- the uncertainty attributed to calibration of the individual instruments and equipment used to perform the test;
- the uncertainty resulting from environmental effects;
- the uncertainty resulting from errors that may be present in the applied signals;
- the uncertainty attributed to effects associated with the repeatability of the results of the measurements. When a laboratory is only required to perform a single measurement, it is necessary for the laboratory to make an estimate of the contribution of random effects to the total uncertainty. The estimate should be determined from an evaluation of several measurement results previously obtained for a similar filter and parameter;
- the uncertainty associated with the resolution of the display device used to display the response from the filter. For digital display devices that indicate signal levels with a resolution of 0,1 dB, the uncertainty component should be taken as a rectangular distribution with semi-range of 0,05 dB.

6.1.14 If the uncertainty of measurement exceeds the maximum-permitted uncertainty of measurement, the result of the test shall not be used to demonstrate conformance to a specification, and pattern approval shall not be granted.

6.1.15 As appropriate, the laboratory shall utilize the recommendations given in the instruction manual for performing the pattern-evaluation tests.

6.2 Test instruments

6.2.1 The laboratory shall use instruments with valid calibrations for the appropriate quantities. The calibrations shall be traceable to national standards, as required.

6.2.2 Most of the required tests utilize steady sinusoidal signals of various frequencies and signal levels. Sinusoidal signals for test of filter attenuation shall have a total distortion of not more than 0,01 % for class 1 filters and not more than 0,03 % for class 2 filters. The total distortion for sinusoidal signals for other tests shall not exceed 0,1 %.

6.2.3 Tests for time invariant operation use a constant amplitude sinusoidal signal the frequency of which is varied, or swept, at an exponential rate. The effect on the deviation of the measured time-averaged output signal level from the uncertainty in the amplitude and sweep-rate for the determination of time-invariant operation shall be determined. The expanded uncertainty shall not exceed the values given in IEC 61260-1:2014, Annex B.

NOTE The informative Annex A gives examples of how such uncertainties may be obtained.

6.2.4 Instruments for measuring the environmental conditions during the tests shall have an expanded uncertainty not exceeding 0,5°C for temperature and 3 % for humidity.

7 Tests at reference conditions

7.1 General

7.1.1 All tests at reference conditions except test for electromagnetic and electrostatic compatibility shall be made within the temperature range 20 °C to 26 °C and within the range for relative humidity 35 % to 65 %.

7.1.2 The filter shall be permitted to acclimatize at the reference environmental condition for at least 6 h.

7.1.3 The measured values of temperature and humidity shall be extended with the actual expanded uncertainty of measurement and shall not exceed the specified range. It is assumed that the influence from changes in the atmospheric pressure is insignificant compared to the sensitivity to other environmental parameters. If this is not the case, the observation shall be reported.

7.2 Relative attenuation, effective bandwidth deviation and summation of output signals

7.2.1 General

7.2.1.1 The measurement of relative attenuation, effective bandwidth deviation and summation of output signals are made by the same set of measurements using the response to constant amplitude sinusoidal signals at various frequencies.

7.2.1.2 The measurement shall be performed on the reference level range. The level of the input signals shall be (1 ± 0,1) dB below the specified upper boundary of the linear operating range.

7.2.1.3 With the input and output of the instrument terminated, if appropriate, with the impedances specified by the manufacturer, a steady sinusoidal signal is applied to the input of the filter set. The relative attenuation at appropriate frequencies is measured.

7.2.1.4 The frequencies of the sinusoidal test signal for one filter are spaced at equal intervals on a logarithmic scale centred on the exact midband frequency. If S is the number of test frequencies per filter bandwidth, the normalized frequency Ω_i of the i-th test signal is determined from:

$$\Omega_i = G^{\frac{i}{b \cdot S}} \tag{1}$$

where

i is a positive or negative integer, including zero. The number of test frequencies per filter bandwidth, S, shall be not less than 24. G and b are, as defined in IEC 61260-1:2014, the octave frequency ratio and the inverse of the bandwidth designator.

NOTE If the filter consists of a set of filters operating in parallel (real time analysers), it will normally be suitable to measure the response to a particular frequency for all filter bands simultaneously and store the result for further calculations.

7.2.2 Relative attenuation

7.2.2.1 The relative attenuation $\Delta A(\Omega)$ at any frequency is determined from Formula (8) given in IEC 61260-1:2014. The measured relative attenuation shall not exceed the acceptance limits given in section 5.10 of the same standard.

7.2.2.2 The relative attenuation shall be measured from 0,5 times the exact midband frequency of the filter in the set with the lowest midband frequency, to 1,5 times the midband frequency of the filter in the set with the highest midband frequency.

7.2.2.3 Deviation between actual and requested frequency shall be considered when stating the uncertainty for testing of relative attenuation.

7.2.3 Effective bandwidth deviation

7.2.3.1 The effective bandwidth, B_e, shall be determined from Formulas (13) and (14) given in IEC 61260-1:2014, based on numerical evaluation of the integral expression in Formula (14) of the same standard for normalized effective bandwidth.

7.2.3.2 For each filter in a filter set, the recommended procedure for numerical integration of Formula (14) of IEC 61260-1:2014 is by the trapezoidal rule for summation of elemental areas according to:

$$B_e = \sum_{i=-N}^{N} \left(\frac{2}{\Omega_i + \Omega_{i+1}} \right) \frac{1}{2} \left[10^{-0,1\Delta A(\Omega_i)} + 10^{-0,1\Delta A(\Omega_{i+1})} \right] \left[\Omega_{i+1} - \Omega_i \right] \quad (2)$$

where

$\Delta A(\Omega_i)$ is the relative attenuation in decibels measured at the i-th normalized test frequency;

N is an integer equal to or greater than $2 \times S$ for any filter bandwidth and accuracy class as long as the frequencies are within the limits in 7.2.2.2.

7.2.3.3 The measured effective bandwidth deviation shall not exceed the acceptance limits given in 5.12 in IEC 61260-1:2014.

7.2.4 Summation of output signals

7.2.4.1 Let j identify a filter in a set of filters with j-1 and j+1 representing the contiguous filters with midband frequencies lower and higher than for the j-th filter. Let ΔA_j, ΔA_{j-1} and ΔA_{j+1} represent measured relative attenuations of the three filters, respectively, at any test frequency.

7.2.4.2 With S equal to the number of test frequencies per filter bandwidth from the relative attenuation tests, let M be equal to the largest integer just less than or equal to $S/2$ and let i be any integer between $-M$ and $+M$ to determine a frequency for a measurement of relative attenuation.

7.2.4.3 At any normalized frequency, $\Omega_i = f_i / f_m = G^{\frac{i}{b \cdot S}}$, between the lower and upper bandedge normalized frequencies of the j – th filter with exact midband frequency, f_m, the difference $\Delta P_j(\Omega_i)$ between the input signal level minus the reference attenuation and the level of the summed output signals is determined from the relationship:

$$\Delta P_j(\Omega_i) = 10 \lg \left[10^{-0,1\Delta A_{j-1}} + 10^{-0,1\Delta A_j} + 10^{-0,1\Delta A_{j+1}} \right] \text{ dB} \quad (3)$$

where

ΔA_{j-1} is the relative attenuation measured for filter (j – 1) at normalized frequency for that filter $G^{[i/(bS)\,+\,1/b]}$;

ΔA_{j} is the relative attenuation for filter j measured at normalized frequency $G^{[i/(bS)]}$;

ΔA_{j+1} is the relative attenuation for filter (j + 1) measured at normalized frequency for that filter $G^{[i/(bS)\,-\,1/b]}$.

7.2.4.4 The test shall be carried out from the filter with index j corresponding to the filter adjacent to the filter with the lowest midband frequency to the filter adjacent to the filter with the highest midband frequency in the set of filters.

7.2.4.5 For any filter bandwidth provided, the difference $\Delta P_j(\Omega_i)$ calculated according to formula (3), shall not exceed the acceptance limits given in 5.16 of IEC 61260-1:2014.

7.3 Linear operating range, measurement range, level range control and overload indicator

7.3.1 Linearity of the response of a filter resulting from changes in the level of the signal at the input shall be tested with steady sinusoidal signals with specified level and frequency. The linearity shall be measured at the exact midband frequency. The level linearity deviations shall be determined in accordance with 5.13 of IEC 61260-1:2014.

7.3.2 The level linearity shall be tested for three filters on each available level range. The filters shall be the filter with the lowest and the highest midband frequency in the set of filters and a filter in the middle of the frequency range selected by the laboratory performing the test.

7.3.3 The level range control shall be set to select the reference level range. The level of the input signal shall first be set to the specified reference input signal level. The corresponding output level shall be used for calculating the level linearity deviation for all input levels on any level range for the particular filter.

7.3.4 The test shall be performed for levels from the specified lower boundary of the specified linear operating range up to a level where the overload indicator displays an overload. Adjust the level of the input signal with steps that are not greater than 5 dB. The difference between successive steps of the input signal level shall be reduced to 1 dB when the distance to the lower or upper boundaries of a linear operating range is less than 5 dB and when the level is above the upper boundary. The boundaries are as stated in the instructions manual for the filter. If no overload is displayed, the filter does not conform to the requirements.

7.3.5 The averaging time during a measurement shall be long enough to establish a stable indication considering the actual frequency and the influence of internally generated noise at low input signal levels so the uncertainty of the measurement is within the required maximum-permitted uncertainty.

7.3.6 The measured level linearity deviation shall not exceed the acceptance limits given in 5.13.3 and 5.13.4 in IEC 61260-1:2014 for all measured levels between the lower boundary of the linear operating range for the appropriate level range as stated in the instructions manual for the filter, and up to the highest level, measured as described above, without an overload indication.

7.3.7 An overload shall not be indicated if the level of the input signal is below the stated upper boundary of the appropriate level range.

7.3.8 It shall be verified that the minimum time for presenting an overload is as specified in 5.17.3 in IEC 61260-1:2014.

7.3.9 For bandpass filters with a device that displays time-averaged output signal levels, time-integrated band levels, maximum levels, or displays stored results, it shall be verified that an overload is displayed if an overload condition occurred during any part of the measurement duration and that the indication remain displayed until the measurement result is reset.

7.3.10 Repeat the test for all available level ranges for the selected filters.

7.4 Time-invariant operation

7.4.1 If the instruction manual specifies that the filter performs time-invariant operation, the time-invariant operation of the filter shall be demonstrated by a swept-frequency test as described in 5.14 in IEC 61260-1:2014. The test shall be conducted on the reference level range. The level of the input signal shall be 3 dB less than the upper boundary of the linear operating range on the reference level range.

7.4.2 The sweep shall start at the frequency, f_{start}, less than the lowest bandedge frequency and where the relative attenuation of a filter is at least 55 dB and ends at a frequency, f_{end}, greater than the highest bandedge frequency and where the relative attenuation of the filter is again at least 55 dB.

7.4.3 For bandpass filters consisting of a set of filters with different midband frequencies, the measurement may be performed as one sweep covering all filters in the set. f_{start} is then less than the lowest bandedge frequency for the filter with the lowest midband frequency in the set and where the relative attenuation for this filter is at least 55 dB. f_{end} is then greater than highest bandedge frequency for the filter with the highest midband frequency and where the relative attenuation of this filter is at least 55 dB.

7.4.4 The time-averaged level of the output signal is measured for an averaging time, T_{avg}, which starts no later than the time when the sweep frequency is less than the lowest midband frequency and where the relative attenuation of a filter is at least 55 dB, and ends at a time not less than when the sweep frequency is greater than the highest midband frequency where the relative attenuation of the filter is again at least 55 dB. The averaging time shall be sufficiently long to also contain parts of the output signal delayed by the operation of the filter.

7.4.5 The measured time-average or equivalent-continuous output signal level for each filter in the set shall be compared with the calculated value, L_{c}, given in Formula (17) in IEC 61260-1:2014. The difference shall be less than or equal to the acceptance limit given in 5.14.3 in IEC 61260-1:2014.

NOTE 1 The informative Annex B gives an example for selecting adequate start and end frequency, sweep rate and averaging times.

Both the amplitude and the sweep-rate shall be considered when the uncertainty of measurement is calculated. Some commercial sweep generators approximate an exponential sweep by a piecewise linear sweep giving large deviations from the calculated results, while others demonstrate a constant exponential sweep rate within small tolerances. The exponential sweep signal may be generated by playing a calculated signal through a digital-to-analogue converter with known and verified specifications. See the informative Annex A for further information.

7.5 Power supply check

7.5.1 For instruments that require a battery power supply, a suitable power source with an adjustable supply voltage shall be substituted for the battery. The filter shall first be tested at the nominal voltage specified in the instructions manual with a sinusoidal input signal corresponding to the reference level on the reference range and at the exact midband frequency in a filter selected by the laboratory performing the test. The output level for the filter with a midband frequency corresponding to the frequency of the test signal shall be noted.