



NSAI
Standards

Irish Standard
I.S. EN 60758:2016

Synthetic quartz crystal - Specifications and guidelines for use

I.S. EN 60758:2016

Incorporating amendments/corrigenda/National Annexes issued since publication:

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard — national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation — recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):

NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.

This document is based on:

EN 60758:2016

Published:

2016-09-23

*This document was published
under the authority of the NSAI
and comes into effect on:*

2016-10-11

ICS number:

31.140

NOTE: If blank see CEN/CENELEC cover page

NSAI
1 Swift Square,
Northwood, Santry
Dublin 9

T +353 1 807 3800
F +353 1 807 3838
E standards@nsai.ie
W NSAI.ie

Sales:
T +353 1 857 6730
F +353 1 857 6729
W standards.ie

Údarás um Chaighdeáin Náisiúnta na hÉireann

National Foreword

I.S. EN 60758:2016 is the adopted Irish version of the European Document EN 60758:2016, Synthetic quartz crystal - Specifications and guidelines for use

This document does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with this document does not of itself confer immunity from legal obligations.

In line with international standards practice the decimal point is shown as a comma (,) throughout this document.

This page is intentionally left blank

EUROPEAN STANDARD

EN 60758

NORME EUROPÉENNE

EUROPÄISCHE NORM

September 2016

ICS 31.140

Supersedes EN 60758:2009

English Version

Synthetic quartz crystal - Specifications and guidelines for use (IEC 60758:2016)

Cristal de quartz synthétique - Spécifications et lignes
directrices d'utilisation
(IEC 60758:2016)

Synthetischer Quarzkristall - Festlegungen und Leitfaden
für die Anwendung
(IEC 60758:2016)

This European Standard was approved by CENELEC on 2016-06-22. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

EN 60758:2016

European foreword

The text of document 49/1185/FDIS, future edition 5 of IEC 60758, prepared by IEC/TC 49 “Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection” was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60758:2016.

The following dates are fixed:

- latest date by which the document has to be (dop) 2017-04-07
implemented at national level by
publication of an identical national
standard or by endorsement
- latest date by which the national (dow) 2019-10-07
standards conflicting with the
document have to be withdrawn

This document supersedes EN 60758:2009.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 60758:2016 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60068-1	2013	Environmental testing - Part 1: General and guidance	EN 60068-1	2014
IEC 60122-1	2002	Quartz crystal units of assessed quality - Part 1: Generic specification	EN 60122-1	2002
IEC 60410	-	Sampling plans and procedures for inspection by attributes	-	-
IEC 61994	Series	Piezoelectric and dielectric devices for frequency control and selection - Glossary	-	-

This page is intentionally left blank



IEC 60758

Edition 5.0 2016-05

INTERNATIONAL STANDARD

Synthetic quartz crystal – Specifications and guidelines for use



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2016 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
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.



IEC 60758

Edition 5.0 2016-05

INTERNATIONAL STANDARD

Synthetic quartz crystal – Specifications and guidelines for use

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.140

ISBN 978-2-8322-3395-5

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references.....	9
3 Terms and definitions	9
4 Specification for synthetic quartz crystal.....	13
4.1 Standard values	13
4.1.1 Shape of synthetic quartz for optical applications.....	13
4.1.2 Orientation of the seed.....	13
4.1.3 Inclusion density	13
4.1.4 Striae in synthetic quartz for optical applications.....	14
4.1.5 Infrared quality indications of α_3 500 and α_3 585 for piezoelectric applications	14
4.1.6 Grade classification by α value and Schlieren method for optical applications	15
4.1.7 Frequency-temperature characteristics of synthetic quartz for piezoelectric applications	15
4.1.8 Etch channel density ρ	15
4.1.9 Internal transmittance for optical applications	16
4.2 Requirements and measuring methods	17
4.2.1 Orientation.....	17
4.2.2 Handedness.....	18
4.2.3 Synthetic quartz crystal dimensions	18
4.2.4 Seed dimensions	19
4.2.5 Imperfections	19
4.2.6 Evaluation of infrared quality by α measurement.....	22
4.2.7 Frequency versus temperature characteristics for piezoelectric applications	24
4.2.8 Striae in synthetic quartz for optical applications.....	25
4.2.9 Growth band in synthetic quartz for optical applications	25
4.2.10 Etch channel density.....	26
4.2.11 Internal transmittance for optical applications	27
4.3 Marking.....	27
4.3.1 General	27
4.3.2 Shipping requirements	28
5 Specification for lumbered synthetic quartz crystal	28
5.1 Standard values	28
5.1.1 Tolerance of dimensions	28
5.1.2 Reference surface flatness.....	29
5.1.3 Angular tolerance of reference surface	29
5.1.4 Centrality of the seed	30
5.2 Requirements and measuring methods	31
5.2.1 As-grown quartz bars used for lumbered quartz bars	31
5.2.2 Dimensions of lumbered synthetic quartz crystal.....	31
5.2.3 Identification on reference surface.....	31
5.2.4 Measurement of reference surface flatness.....	31

5.2.5	Measurement of reference surface angle tolerance	31
5.2.6	Centrality of the seed	31
5.3	Delivery conditions	32
5.3.1	General	32
5.3.2	Marking	32
5.3.3	Packing	32
5.3.4	Making batch	32
6	Inspection rule for synthetic quartz crystal and lumbered synthetic quartz crystal	32
6.1	Inspection rule for as-grown synthetic quartz crystal	32
6.1.1	Inspection	32
6.1.2	Lot-by-lot test	32
6.2	Inspection rule for lumbered synthetic quartz crystal	33
6.2.1	General	33
6.2.2	Lot-by-lot test	34
7	Guidelines for the use of synthetic quartz crystal for piezoelectric applications	34
7.1	General	34
7.1.1	Overview	34
7.1.2	Synthetic quartz crystal	34
7.2	Shape and size of synthetic quartz crystal	35
7.2.1	Crystal axis and face designation	35
7.2.2	Seed	36
7.2.3	Shapes and dimensions	36
7.2.4	Growth zones	37
7.3	Standard method for evaluating the quality of synthetic quartz crystal	37
7.4	Other methods for checking the quality of synthetic quartz crystal	38
7.4.1	General	38
7.4.2	Visual inspection	38
7.4.3	Infrared radiation absorption method	38
7.4.4	Miscellaneous	39
7.5	α grade for piezoelectric quartz	40
7.6	Optional grading (only as ordered), in inclusions, etch channels, Al content	40
7.6.1	Inclusions	40
7.6.2	Etch channels	40
7.6.3	Al content	40
7.6.4	Swept quartz	41
7.7	Ordering	42
Annex A (informative)	Frequently used sampling procedures	43
A.1	Complete volume counting	43
A.2	Commodity Y-bar sampling – Method 1	43
A.3	Commodity Y-bar sampling – Method 2	43
A.4	Use of comparative standards for 100 % crystal inspection	44
Annex B (informative)	Numerical example	45
Annex C (informative)	Example of reference sample selection	46
Annex D (informative)	Explanations of point callipers	47
Annex E (informative)	Infrared absorbance α value compensation	48
E.1	General	48
E.2	Sample preparation, equipment set-up and measuring procedure	48
E.2.1	General	48

E.2.2	Sample preparation	48
E.2.3	Equipment set-up	48
E.2.4	Measurement procedure	49
E.3	Procedure to establish correction terms	49
E.4	Calculation of compensated (corrected) absorbance values	51
Annex F (informative)	Differences of the orthogonal axial system for quartz between IEC standard and IEEE standard	52
Annex G (informative)	α value measurement consistency between dispersive infrared spectrometer and fourier transform infrared spectrometer	54
G.1	General	54
G.2	Experiment	54
G.3	Experimental result	55
Bibliography	58
Figure 1	– Quartz crystal axis and cut direction	17
Figure 2	– Idealized sections of a synthetic quartz crystal grown on a Z-cut seed	19
Figure 3	– Typical example of cutting wafers of AT-cut plate, minor rhombohedral-cut plate, X-cut plate, Y-cut plate and Z-cut plate	21
Figure 4	– Frequency-temperature characteristics deviation rate of the test specimen	25
Figure 5	– Typical schlieren system setup	25
Figure 6	– Lumbered synthetic quartz crystal outline and dimensions along X-, Y- and Z-axes	29
Figure 7	– Angular deviation for reference surface	30
Figure 8	– Centrality of the seed with respect to the dimension along the Z- or Z'-axis	31
Figure 9	– Quartz crystal axis and face designation	36
Figure 10	– Synthetic quartz crystal grown on a Z-cut seed of small X-dimensions	37
Figure 11	– Example of a relation between the α value and the Q value at wave number $3\,500\text{ cm}^{-1}$	39
Figure D.1	– Point callipers	47
Figure D.2	– Digital point callipers	47
Figure E.1	– Schematic of measurement set-up	49
Figure E.2	– Graph relationship between averaged α and measured α at two wave numbers of $\alpha_{3\,500}$ and $\alpha_{3\,585}$	50
Figure F.1	– Left- and right-handed quartz crystals	53
Figure G.1	– Relationship of α between measuring value and reference value	57
Table 1	– Inclusion density grades for piezoelectric applications	14
Table 2	– Inclusion density grades for optical applications	14
Table 3	– Infrared absorbance coefficient grades for piezoelectric applications	14
Table 4	– Infrared absorbance coefficient grades and Schlieren method for optical applications	15
Table 5	– Etch channel density grades for piezoelectric applications	16
Table 6	– Test conditions and requirements for the lot-by-lot test for group A	33
Table 7	– Test conditions and requirements for the lot-by-lot test for group B	33
Table 8	– Test conditions and requirements for the lot-by-lot test	34
Table B.1	– Commodity bar sampling, method 1	45

Table B.2 – Commodity bar sampling	45
Table E.1 – Example of calibration data at α_3 585	50
Table E.2 – Example of calibration data at α_3 500	50

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SYNTHETIC QUARTZ CRYSTAL – SPECIFICATIONS AND GUIDELINES FOR USE

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 60758 has been prepared by IEC technical committee 49: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection.

This fifth edition cancels and replaces the fourth edition, published in 2008. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- order rearrangement and review of terms and definitions;
- abolition as a standard of the infrared absorbance coefficient $\alpha_{3\ 410}$;
- addition of the α value measurement explanation by FT-IR equipment in annex;
- addition of the synthetic quartz crystal standards for optical applications.

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

FDIS	Report on voting
49/1185/FDIS	49/1190/RVD

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.

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.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

The reason for adding synthetic quartz crystal for optical application to this International Standard is as follows.

Quartz crystal produced for optical applications is produced by many of the same suppliers manufacturing quartz for electronic applications. The equipment and methods to produce optical quartz are similar to those used in the production of electronic quartz. Also, with a few exceptions the characterization methods of electronic and optical material are similar. Therefore, IEC 60758 serves as the proper basis for including addenda related to quartz crystal for optical applications.

SYNTHETIC QUARTZ CRYSTAL – SPECIFICATIONS AND GUIDELINES FOR USE

1 Scope

This International Standard applies to synthetic quartz single crystals intended for manufacturing piezoelectric elements for frequency control, selection and optical applications.

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 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60122-1:2002, *Quartz crystal units of assessed quality – Part 1: Generic specification*

IEC 60410, *Sampling plans and procedures for inspection by attributes*

IEC 61994 (all parts), *Piezoelectric and dielectric devices for frequency control and selection – Glossary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61994 and the following apply.

3.1

hydrothermal crystal growth

crystal growth in the presence of water, elevated temperatures and pressures by a crystal growth process believed to proceed geologically within the earth's crust

Note 1 to entry: The industrial synthetic quartz growth processes utilize alkaline water solutions confined within autoclaves at supercritical temperatures (330 °C to 400 °C) and pressures (700 to 2 000 atmospheres).

Note 2 to entry: The autoclave is divided into two chambers: the dissolving chamber, containing raw quartz chips at the higher temperature; the growing chamber, containing cut seeds at the lower temperature (see 7.1.2).

3.2

synthetic quartz crystal

single crystal of α quartz grown by the hydrothermal method

Note 1 to entry: Cultured quartz has the same meaning as synthetic quartz crystal.

3.3

as-grown synthetic quartz crystal

state of synthetic quartz crystal prior to grinding or cutting

3.4

as-grown Y-bar

crystals which are grown by using long stick seed in the Y-direction

This is a free preview. Purchase the entire publication at the link below:

[Product Page](#)

-
- Looking for additional Standards? Visit Intertek Inform Infostore
 - Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation
-