

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fixed inductors for electromagnetic interference suppression –
Part 1: Generic specification

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Inductances fixes d'antiparasitage –
Partie 1: Spécification générique

IEC 60938-1:2021

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Part 1: Generic specification**

**Inductances fixes d'antiparasitage –
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COMMISSION

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**FIXED INDUCTORS FOR ELECTROMAGNETIC
INTERFERENCE SUPPRESSION –****Part 1: Generic specification**

FOREWORD

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IEC 60938-1 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment. It is an International Standard.

This third edition cancels and replaces the second edition published in 1999. This edition constitutes a technical revision.

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

- a) material tests added;
- b) improved readability and clear separation between test descriptions in the generic spec and requirements in the sectional specification;
- c) creepage and clearance requirements are now defined in sectional specifications only;
- d) AC testing for voltage test included.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
40/2834/FDIS	40/2851/RVD

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

The language used for the development of this International Standard is English.

A list of all parts in the IEC 60938 series, published under the general title *Fixed inductors for electromagnetic interference suppression*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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

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- withdrawn,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

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INTRODUCTION

The specification system for fixed inductors for electromagnetic interference suppression is structured in a hierarchical system consisting of the following specification types.

Generic specification

The generic specification covers all subjects mainly common to the family of fixed inductors for electromagnetic interference suppression, such as terminology, methods of measurement and tests. Where the individual subjects require the prescription conditions or parameters specific to the particular sub-family or type of inductor, such prescriptions are required to be given by one of the subordinate specifications.

For the scope of fixed inductors, the numeric reference to the generic specification is IEC 60938-1.

Sectional specification

Sectional specifications cover all subjects additional to those given in the generic specification, which are specific to a defined sub-group of fixed inductors for electromagnetic interference suppression. These subjects normally are preferred values for dimensions and characteristics, relevant prescriptions for test methods given in the generic specification, prescriptions for sampling and for the preparation of specimen, recommended test severities and preferred acceptance criteria. The sectional specification also outlines the structure and scope of the test schedules, which are to be applied in all subordinate detail specifications.

For the scope of fixed inductors for electromagnetic interference suppression, the numeric reference to the only sectional specification is 60938-2 for line chokes.

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Detail specification

Detail specifications give directly, or by making reference to other specifications, all information necessary to completely describe a given type and range of fixed inductors for electromagnetic interference suppression, including prescriptions of all values for dimensions and characteristics. They also give all information required for all applied test severities and acceptance criteria, and the completed test schedules.

Detail specifications can be either specifications within the IEC system, another specification system linked to IEC, or specified by the manufacturer or user.

Blank detail specification

The hierarchical system of specifications can be supplemented by one or more blank detail specifications to a sectional specification, which are used to ensure a uniform presentation of detail specifications. The blank detail specifications provide the specification writer with a template on the layout to be adopted and on the information to be given and with guidance for the preparation of detail specifications in line with the requirements of the superior generic or sectional specifications. Blank detail specifications are not considered to be relevant specifications since they do not themselves describe any particular component.

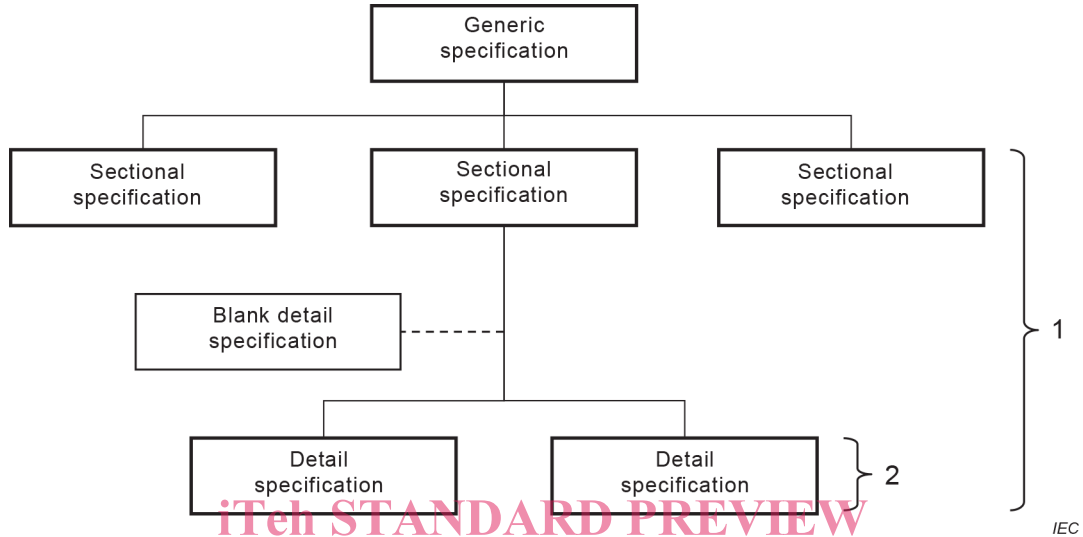
The presence of an established hierarchical specification system with blank detail specifications permits the preparation of detail specifications, even outside of the relevant IEC technical committee.

For the scope of fixed inductors for electromagnetic interference suppression, the numeric references to blank detail specifications are, for example, IEC 60938-2-1, if related to the sectional specification IEC 60938-2.

Relevant specification

In this system, the term "relevant specification" addresses subordinate specifications containing specific requirements, where applicable (see Figure 1).

Any generic or sectional specification can use abstract and universal references to subordinate specifications of either hierarchical level by use of the expression "relevant specification".



Key

- 1) Indicates the range of "relevant specifications" to the superior generic specification, where applicable.
- 2) Indicates the range of "relevant specifications" to the superior sectional specification, where applicable.

Figure 1 – Relevant specification

FIXED INDUCTORS FOR ELECTROMAGNETIC INTERFERENCE SUPPRESSION –

Part 1: Generic specification

1 Scope

This part of IEC 60938 applies to inductors designed for electromagnetic interference suppression intended for use within all kind of electric and electronic equipment.

In this generic specification, normative references and terms and definitions are given. It also prescribes general requirements and the suitable test and measurement procedures for interference suppression inductors. Annex B states special requirements for earth inductors.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CISPR 17, *Methods of measurement of the suppression characteristics of passive EMC filtering devices*

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IEC 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050 (all parts), *International Electrotechnical Vocabulary (IEV)* (available at www.electropedia.org)

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60062, *Marking codes for resistors and capacitors*

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

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Tests A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Tests B: Dry Heat*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-13, *Environmental testing – Part 2-13: Tests – Test M: Low air pressure*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-17, *Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-20, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-21, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic*

IEC 60068-2-45, *Basic environmental testing procedures – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*

IEC 60068-2-58, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD).*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60335-1, *Household and similar electrical appliances – Part 1: General requirements*

IEC 60617, *Graphical symbols for diagrams* (available at <http://std.iec.ch/iec60617>)

IEC 60695-2-11, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

IEC 60695-2-12, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*

IEC 60695-2-13, *Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials*

IEC 60695-10-2, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60695-11-20, *Fire hazard testing – Part 11-20: Test flames – 500 W flame test method*

ISO 80000-6, *Quantities and units – Part 6: Electromagnetism*

3 Terms, definitions and conventions

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

For the purposes of this document, the following terms and definitions apply.

3.1 Terms and definitions

3.1.1

choke

inductor

construction that employs one or more windings for a frequency-dependent impedance

**3.1.2
rated voltage** U_R

maximum RMS operating voltage of the rated frequency or the maximum DC operating voltage that can be applied continuously to the terminations of the inductor

Note 1 to entry: Because the rated voltage against any surrounding conducting surface is defined by the mounting in the application, an inductor with only one winding can have no rated voltage.

**3.1.3
lower category temperature**

minimum surface temperature for which the inductor has been designed to operate continuously

**3.1.4
upper category temperature** T_c

maximum surface temperature for which the inductor has been designed to operate continuously

**3.1.5
rated temperature** T_r

maximum ambient temperature at which an inductor can carry its rated current

**3.1.6
rated current** I_r

maximum RMS operating current at rated frequency or maximum DC operating current, which allows continuous operation of the inductor at the rated temperature

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**3.1.7
nominal inductance** L_n

inductance value for which the inductor has been designed and which is usually indicated upon it

**3.1.8
insertion loss**

ratio of a voltage before and after the insertion of the suppressor in the circuit as measured in accordance with CISPR 17

**3.1.9
insulated inductor**

inductor in which all live parts, except for the terminations, are protected against touch or contact with surrounding conductive parts

**3.1.10
uninsulated inductor**

inductor in which at least one live metal part, other than a termination, is not protected against touch or contact with surrounding conductive parts

**3.1.11
common-mode inductor
current-compensated choke**

inductor having more than one winding on a single core arranged in such a way that the resultant magnetization caused by the symmetrical current is near zero

3.1.12**earth inductor**

inductor connected in series with the protective conductor of equipment

3.1.13**power line choke**

mains inductor

inductor intended for direct electrical connection to the supply mains

3.1.14**clearance**

shortest distance in air between two conductive parts or between a conductive part and a touchable surface

3.1.15**creepage**

shortest distance between two conductive parts or between a conductive part and a touchable surface, measured over the surface of the insulator

3.1.16**micro-environment**

conditions that immediately surround the clearance or creepage distance under consideration

3.1.17**pollution degree**

level of pollution present at the location on or in a product where the clearance and creepage measurement is made

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3.2 Conventions

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In IEC standards, a "rated" value, e.g. a rated temperature, is a value under which a component may be operated continuously. It is a maximum limit, which may not be exceeded.

A "nominal" value is a value a component typically has, e.g. a nominal inductance. A nominal value has an upper and a lower tolerance limit and within this range the respective characteristic can be measured.

4 General requirements**4.1 General**

If possible, units, graphical symbols, letter symbols and terminology shall be taken from the following publications:

- IEC 60027,
- IEC 60050,
- IEC 60617,
- ISO 80000-6.

When further items are required, they shall be derived in accordance with the principles of the documents listed above.

4.2 Preferred values

4.2.1 General

In general, there are no preferred values for nominal inductance, rated voltage, rated current or rated frequency, because different applications require many different designs. Sectional specifications may define preferred values.

Inductors designed for electromagnetic interference suppression attenuate common-mode and differential-mode currents differently. They can be named common-mode inductor or differential-mode inductor depending on the primary use for which they are designed.

4.2.2 Rated current

For every inductor, the rated current I_r shall be assigned by the manufacturer for one or both of the following conditions:

- a) free air (I_{RO});
- b) with a specified heat sink (I_{RH}).

4.2.3 Temperature de-rated current

Figure 2 shows the relation between applied current and ambient temperature.

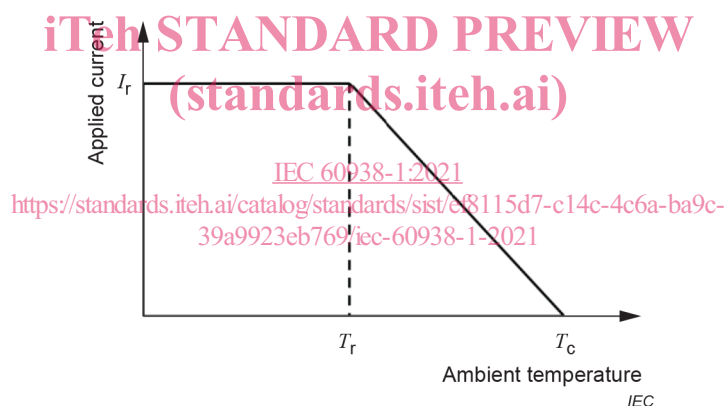


Figure 2 – Relation between ambient temperature and applied current

If not stated otherwise in the detail specification, a linear de-rating of applied current over ambient temperature is assumed up to zero current at the upper category temperature.

4.3 Information to be given in a detail specification

4.3.1 General

Detail specifications shall be derived from the relevant blank detail specification.

Detail specifications shall not specify requirements inferior to those of the generic or sectional specification. When more severe requirements are included, they shall be listed separately.

4.3.2 Outline drawing and dimensions

There shall be an illustration of the inductor as an aid to easy recognition and for comparison of the inductor with others. Dimensions and their associated tolerances, which affect interchangeability and mounting, shall be indicated on the drawing. All dimensions shall be stated in millimetres.

The numerical values shall be given for the length of the body, the width and height of the body or for cylindrical types, the body diameter, and the length and diameter of the terminations. When necessary, for example when a number of items (inductance values/ voltage ranges) are covered by a detail specification, the dimensions and their associated tolerances shall be placed in a table below the drawing.

When the configuration is other than that described above, the detail specification shall state such dimensional information to describe the inductor adequately. When the inductor is not designed for use on printed boards, this shall be clearly stated in the detail specification.

4.3.3 Mounting

The detail specification shall specify the method of mounting to be recommended for normal use and the method that is mandatory for the application of the vibration and shock tests. The design of the inductor can be such that special mounting fixtures are required in its use. In this case, the detail specification shall describe the mounting fixtures and they shall be used in the application of shock and vibration tests. The specified heat sink shall be used in the application of the endurance test.

4.3.4 Ratings and characteristics

The ratings and characteristics shall be in accordance with the relevant clauses of this specification. Additional characteristics may be listed when they are considered necessary to specify adequately the inductor for design and application purposes.

4.4 Insulated inductors

Insulated inductors may be built either with a housing, or with isolated wires whose isolation provides basic insulation, e.g. TIW, FIW-wires, PVC-isolated wires, wires in insulation sleeves or the like. The isolated wires or the insulating materials used shall be in accordance with relevant IEC standards.

Instead of fulfilling requirements for clearance and creepage inside inductors, the windings may be insulated by potting or insulation sleeves or the windings may be built from wires with basic insulation like TIW, FIW, PVC-isolated wires or the like.

Insulation materials used between terminals and windings, for housing or potting shall be certified to a minimum rating of V-2, VTM-2 or HF-2 in accordance with IEC 60695-11-10 and IEC 60695-11-20 (or UL 94) at the appropriate minimum thickness, which is determined by the smallest thickness of insulation in direct contact with a conductor.

4.5 Marking

Necessary marking in accordance with the relevant specifications shall be prescribed in the detail specification. Deviations from these requirements shall be listed separately and the reason for them shall be stated specifically in the detail specification.

The sectional specification shall indicate the identification criteria and other information to be shown on the inductors and its packaging. The order of priority for marking small components shall be specified. When coding is used for inductance values, tolerance or date of manufacture, the method shall be selected from those given in IEC 60062.