

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Power transformers –
Part 22-6: Power transformer and reactor fittings – Electric fans for transformers**

**Transformateurs de puissance –
Partie 22-6: Accessoires pour transformateurs de puissance et bobines
d'inductance – Ventilateurs électriques pour transformateurs**



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NORME INTERNATIONALE

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

POWER TRANSFORMERS –

**Part 22-6: Power transformer and reactor fittings –
Electric fans for transformers**

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

Draft	Report on voting
14/1022/CDV	14/1041A/RVC

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.

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.

A list of all parts in the IEC 60076 series, published under the general title *Power transformers*, can be found on the IEC website.

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

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- replaced by a revised edition, or
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POWER TRANSFORMERS –

Part 22-6: Power transformer and reactor fittings – Electric fans for transformers

1 Scope

This part of IEC 60076 covers the electric fans used in the cooling circuits of power transformers and reactors. It applies to electric fans mounted on liquid immersed power transformers according to IEC 60076-1 and reactors according to IEC 60076-6 with and without conservator for indoor or outdoor installation. It outlines the service conditions and the mechanical and electrical requirements that are common to all the equipment.

The electric fans concerned by this document are of the axially operating type and are for use on liquid to air coolers and for blowing out radiators.

This document also outlines the operation requirements specific to each equipment as well as the preferred dimensions relevant for interchangeability and uniform fan assembly and the type and routine tests to be performed.

STANDARD PREVIEW

2 Normative references (standards.iteh.ai)

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.

IEC 60034-1, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60076-1:2011, *Power transformers – Part 1: General*

IEC 60076-10, *Power transformers – Part 10: Determination of sound levels*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

ISO 281, *Rolling bearings – Dynamic load ratings and rating life*

ISO 5801:2017, *Fans – Performance testing using standardized airways*

ISO 9227, *Corrosion tests in artificial atmospheres – Salt spray tests*

ISO 12944 (all parts), *Paints and varnishes – Corrosion protection of steel structures by protective paint systems*

ISO 13347-1, *Industrial fans – Determination of fan sound power levels under standardized laboratory conditions – Part 1: General overview*

ISO 13347-3, *Industrial fans – Determination of fan sound power levels under standardized laboratory conditions – Part 3: Enveloping surface methods*

ISO 13348, *Industrial fans – Tolerances, methods of conversion and technical data presentation*

ISO 13857:2019, *Safety of machinery – Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14694, *Industrial fans – Specifications for balance quality and vibration levels*

3 Terms and definitions

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

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>

3.1

electric fan

<for transformers> fan specifically designed to blow air through the cooling system of a transformer

Note 1 to entry: See IEC 60050-811:2017, 811-22-01 for definition of "fan".

4 Service conditions

4.1 General

The service conditions set out in IEC 60076-1:2011, 4.2 represent the normal scope of operation of the equipment specified in this document. For any unusual service conditions which require special consideration in the design of the equipment see IEC 60076-1:2011, 5.5. Operation under such unusual service conditions shall be subject to agreement between the purchaser and supplier, as they require special consideration in the design of the equipment.

4.2 Degree of protection of electrical components (IP)

The degree of protection of the connection box or terminal box and of the motor drive shall be at least IP 54 according to IEC 60529, unless otherwise specified by the purchaser.

4.3 Corrosion protection

The materials used for the construction of the equipment or the surface treatment shall be resistant to the insulating liquid and suitable to withstand the environmental conditions given in 4.1. Unless otherwise specified the dielectric liquid is mineral oil according to IEC 60296.

The corrosion protection shall be agreed between purchaser and manufacturer according to ISO 12944 (all parts) or other standards as agreed with the purchaser. The responsibility to specify the correct level of corrosion protection lies with the purchaser and is dependent on the environment where the transformer will be located and on the durability required. Where no level of corrosion protection is specified, the minimum shall be C4 medium.

5 General characteristics and requirements

5.1 Main components and characteristics

5.1.1 Nameplate and rating plates

5.1.1.1 General

The fan shall be identified by a nameplate and carry a rating plate for the fan and for the motor. The plates shall be of the all-weather type and clearly visible. They can also be unified in one plate.

5.1.1.2 Nameplate

The nameplate shall contain the following information:

- name or logo of the manufacturer;
- country and manufacturing location;
- number of this document (i.e. IEC 60076-22-6);
- device manufacturer's identification;
- manufacturer's serial number and year of manufacture.

The device manufacturer's identification shall allow identification of the device characteristics from the mounting, operating and maintenance manual supplied by the manufacturer.

5.1.1.3 Electric fan rating plate (standards.iteh.ai)

The electric fan rating plate shall contain the following information:

- the rating indicated for 50 Hz and/or 60 Hz operation;
- the rating data referring to free blowing conditions;
- volume flow in m³/s referred to in the type test document;
- rotational speed in min⁻¹;
- input power in kW;
- maximum current consumption at rated voltage given in A;
- a direction arrow indicating the air flow direction (in connection with the rotational direction) either attached to the rating plate or mounted in its immediate vicinity.

All values shall be indicated for the fan without gratings.

5.1.1.4 Specifications for the motor rating plate

The motor rating plate shall be according to IEC 60034-1.

5.1.2 Motor drive

To drive the fan wheel any type of electric motor may be used, for instance three-phase AC motors or EC motors.

The electric motor shall comply with IEC 60034-1 and be suitable for unprotected outdoor installation.

Thermal class 155 as per IEC 60034-1 applies to all motors.

Condensation water and any other intrusive water shall be able to run off without any damaging effect. This applies to both horizontal and vertical mounting of the fan (blowing upwards).

The lifetime of the bearings of the motor shall be in accordance with ISO 281 at standard conditions; when ball bearings are used, they shall be of standard design with lifetime exceeding L10 30 000 h. Extreme conditions such as high temperatures, vibrations, and frequent starts and stops can reduce the bearing lifetime considerably.

5.1.3 Connection box

The electrical connection to the power supply shall be accomplished by a connection box on the motor drive or by a connection box at a different place, for example, at the fan housing. The cables to the connecting box shall be suitably fixed.

The connection box provides a terminal board with clamps or similar connection facilities.

This is also applicable in the case of control systems.

The connection box shall be easily accessible and shall have a minimum of two cable entries with metric thread.

Terminals, including the earthing terminal, shall be suitable to connect 1,5 mm², 2,5 mm², 4,0 mm² or 6,0 mm² cables according to the electric power to be connected. All terminals shall be easily accessible.

Captive screws shall be used for the cover of the connection box.

The cover seal shall be designed to prevent overpressing or slipping at all times.

<https://standards.iteh.ai/catalog/standards/sist/2ff3858c-1ff2-48bf-872f-b5355e0bdfa4/iec-60076-22-6-2021>

5.1.4 Housing

The housing is the structure surrounding a fan, which forms the outer boundary of the coolant gas passing through the fan.

The purpose of the housing is to duct the airflow in a specific direction.

The motor with fan wheel is mounted on the housing. The housing shall also include fixing points to fit the fan unit to the radiator or to the cooling unit, and fixing points for the protective grating.

The direction of air flow and rotational direction shall be indelibly marked on the housing or be combined with the nameplate.

5.1.5 Fan wheel

The fan wheel can be mounted rigidly on the motor shaft. It can also be an integrated part of the motor drive.

The fan wheel shall be designed in such a way that no water is able to gather, for example leading to unbalancing. This applies to both horizontal and vertical mounting of the fan (blowing upwards).

5.1.6 Protective grating

The protective grating is provided to prevent accidental contact with the fan wheel as well as the access of large foreign bodies.

Fans for radiator cooling systems shall be fitted with two protective gratings (on inlet and discharge side), fans for liquid-to-air coolers shall be fitted with one protective grating on the accessible side. The protective gratings shall provide protection as per ISO 13857:2019, Table 4.

5.1.7 Materials

The materials shall be chosen according to the specific environmental conditions of the application, which shall be specified by the purchaser. Table C.1 shows a common selection of the materials used in the construction of the fans.

5.1.8 Vibration limits

The vibration severity determined at the outer perimeter of the fan housing shall be in accordance with ISO 14694 (BV-3).

5.2 Supply conditions

5.2.1 Transport and storage

Electric fans shall be dispatched in assembled condition ready for mounting and in such a way that no damage can occur.

The packaging shall be suitable for indoor storage; if outdoor storage is required, this shall be specified by the purchaser.

The instructions of the supplier (concerning transport and storage) shall be followed.

5.2.2 Installation and operation, operational performance

All of the fan properties given in this document are related to normed conditions. Mounting and installation conditions affect the operational properties of the fan.

Tolerances of fan performance values shall be according to ISO 13348.

The operational conditions shall be defined using IEC 60076-1 (ambient temperature range: -25 °C to +40 °C).

If other ambient temperatures apply, they shall be specified in the order.

5.2.3 Technical documentation

Minimum documentation to be supplied with the fan is:

- manual;
- outline drawing;
- data sheet with characteristic curve;
- conformity to the related standard.

These requirements are for the electric fan, not for the fan alone.

If requested, other documentation shall be specified in the order.

5.3 Performance requirements

5.3.1 General

In 5.3.2, all rated values are with reference to fans without gratings. Depending on the mounting situation, the supplier shall provide specific values.

In Annex A the minimum designation for ordering is indicated, in Annex B a typical example of performance curves is shown (see Figure B.1) and in Annex C design examples are reported (see Figure C.1 and Figure C.2).

5.3.2 Rated values

The following designations apply, conforming to ISO 5801:

- f [Hz] = frequency;
- U_N [V] = rated voltage;
- I [A] = operating current during free blowing;
- I_N [A] = rated current of the motor;
- P_e or P_{ed} [W] = motor input power during free blowing;
- η_{es} or η_{eds} [%] = static overall efficiency of the fan;
- n [min^{-1}] = rotational speed;
- q_{V1} [m^3/s] = volume flow of the fan during free blowing;
- p_{fs} [Pa] = maximum static pressure according to installation type A;
- L_{WA5} [dB(A)] = A weighted sound power level on suction side of a fan during free blowing;
- D [mm] = diameter of the fan wheel.

The characteristic curve shall be provided by the supplier ($p_{fs} = f(q_V)$). The noise is dependent on the working point and the installation conditions.

The value L_{WA5} is indicated to compare different types of fans. The complete sound power level of the transformer shall be investigated in accordance with IEC 60076-10.

5.3.3 Ambient conditions for rated power and noise

The volume flow refers to an air density of $1,20 \text{ kg/m}^3$ at a temperature of $t = 20 \text{ °C}$ and an air pressure of $101,325 \text{ kPa}$ (this corresponds to a site altitude below $1\,000 \text{ m}$). These values shall be measured at rated voltage with the associated frequency if no other operating data has been specified in the order.

5.4 Tests

5.4.1 General

The tests shall be carried out in the conditions stated in 5.3.1.

Performance measurements (volume flow, static pressure, motor input and rotational speed) shall be carried out in accordance with ISO 5801.

Noise measurements shall be carried out in accordance with ISO 13347-3.

Terms, quantities, and measuring instruments shall be in accordance with ISO 13347-1.