IEC 60034-23

Edition 1.0 2019-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Rotating electrical machines –
Part 23: Repair, overhaul and reclamation

Machines électriques tournantes –
Partie 23: Réparation, révision et remise en état

IEC 60034-23:2019-01(en-fr)

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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.
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International Standard IEC 60034-23 has been prepared by IEC technical committee 2: Rotating machinery.

This first edition cancels and replaces IEC TS 60034-23 published in 2003. This edition constitutes a technical revision.

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

– the title of the standard has been changed to *Rotating electrical machines – Part 23: Repair, overhaul and reclamation*;
– Clause 1 Scope
  - Hydrogen cooled turbine generators added to special applications,
  - maintaining or improving the rated energy efficiency added
  - ensuring environmental considerations are taken into account added;

– Clause 4 General Principles added to cover: hazardous areas, traction motors, machine efficiency, environment, end of life recycling. and circular economy considerations;
– Clause 5 General: Scope of work, health and safety, standards, quality, information required and documentation now covered;
– Original Annexes B and C incorporated into the standard;
– Clause 9 Final tests updated;
– Clause 10 Additional requirements for the repair and testing of DC machines added;
– Clause 11 Additional requirements for the repair and testing of High Voltage AC machines added;
– Clause 12 Customer reports and handover added;
– New Annex B standard tolerances added.

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

FDIS	Report on voting
2/1923/FDIS	2/1924/RVD

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

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

A list of all parts in the IEC 60034 series, published under the general title *Rotating electrical machines*, 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

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- withdrawn,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

ROTATING ELECTRICAL MACHINES –

Part 23: Repair, overhaul and reclamation

1 Scope

This part of IEC 60034 covers the procedures necessary to ensure the satisfactory repair, overhaul, and reclamation of all types and sizes of rotating electrical machines covered by the IEC 60034 series. The standard creates a generic industry procedure covering common aspects of a complete repair. The scope of work depends on the machine type, rating, condition, and the importance of plant reliability and safety. It includes

- determining cause of failure, where necessary;
- determining the extent of repair, as applicable;
- defining revised performance, operating and ambient conditions, if required;
- reviewing the original design, and upgrading the specification of the design, if required;
- proving the quality and performance of the repaired machine, maintaining or improving the rated energy efficiency;
- ensuring environmental considerations are taken into account.

This document does not supersede the requirements prescribed in IEC 60079-19 or elsewhere concerning the repair and overhaul for machines used in explosive atmospheres.

Machines for special applications such as hermetic, submersible, nuclear, hydrogen cooled machines, military, aviation and traction motors might have additional requirements, which are the subject of agreement between the service facility and user.

This document is not intended to take the place of the original machine manufacturer's instructions and recommendations.

Re-designs and performance changes requiring machine designer input are beyond the scope of this document.

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.

IEC 60034 (all parts), *Rotating electrical machines*

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

IEC 60034-6, *Rotating electrical machines – Part 6: Methods of cooling (IC Code)*

IEC 60034-11, *Rotating electrical machines – Part 11: Thermal protection*

IEC 60034-30-1, *Rotating electrical machines – Part 30-1: Efficiency classes of line operated AC motors (IE code)*

IEC TS 60034-30-2, *Rotating electrical machines – Part 30-2: Efficiency classes of variable speed AC motors (IE-code)*

IEC 60050-411:1996, *International Electrotechnical Vocabulary – Chapter 411: Rotating machines*

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

IEC 60072-2, *Dimensions and output series for rotating electrical machines – Part 2: Frame numbers 355 to 1000 and flange numbers 1180 to 2360*

IEC 60079-19, *Explosive atmospheres – Part 19: Equipment repair, overhaul, and reclamation*

IEC 60136:1986, *Dimensions of brushes and brush-holders for electrical machinery*

ISO 21940-11, *Mechanical vibration – Rotor balancing – Part 11:Procedures and tolerances for rotors with rigid behaviour*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60034 (all parts) and the following 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
customer
person or company, who places the order for a repair with the service facility and may or may not be the owner or user of the machine

3.2
dismantling
disassembly of a machine into component parts or sub-assemblies

3.3
maintenance
routine actions taken to preserve the installed equipment in a fully serviceable condition

3.4
manufacturer
party responsible for the manufacture of the machine as originally supplied

3.5
overhaul
action to restore to fully serviceable condition equipment which has been in use or in storage for a period of time but which is not faulty

3.6
reclamation
means of repair involving the removal or addition of material to reclaim component parts which have sustained damage, in order to restore such parts to a serviceable condition in accordance with the original standards and specifications

3.7
refurbisher
party responsible for the refurbishing work, its sub-contractors and suppliers

3.8
refurbishment
total process of preparing a machine, no longer adequate for duty with normal maintenance, to make it suitable for further service

3.9
relevant standard
standard to which the equipment was originally designed

3.10
repair
action to restore faulty equipment to its fully serviceable condition complying with the relevant standard

3.11
repairer
manufacturer, user, or a third party (repair agency) who carries out the repair of the equipment

3.12
rewinding
part of the refurbishment related to removing and replacing some or all of the machine winding their insulation, connection and support systems

3.13
service facility
manufacturer, user, or a third party (repair agency) providing a service that consists of the repair, overhaul, or reclamation of equipment

3.14
serviceable condition
condition which permits parts or equipment to be used without prejudice to performance

3.15
user
owner, or party arranging or requiring the repair

4 General principles

4.1 Use of referenced documents

Older machines being repaired were designed to conform to earlier versions of the relevant standards applicable when they were manufactured. It is possible that they would not be able to meet the requirements of the latest standards. If this is the case the earlier standard should be referred to for the specifications that the machine was manufactured to.

4.2 Hazardous areas

This document can be used in conjunction with IEC 60079-19, but does not supersede the requirements prescribed in the latest version of IEC 60079-19. Special restrictions apply including

- the scope of repair allowed by machine certification,
- individual personnel 'Ex' competency,
- the specific design limitations of different protection concepts.

4.3 Special applications

For rail and road traction motors, IEC 60349-1 is used by the manufacturers of these machines. The service centre should also use the information in IEC 60349-1 to ensure the quality of their repair, in conjunction with the IEC 60034-23 repair standard.

4.4 Efficiency

Where machines have been designed to meet Minimum Energy Performance Standards (MEPS), as in the IEC 60034-30-1 efficiency classes and IEC TS 60034-30-2, they might be subject to legal requirements to maintain efficiency levels. The designs might have been verified by third party testing with declared minimum efficiencies shown on the nameplate. It is important to follow when repairing or rewinding all machines to ensure no degradation of performance.

Current energy efficient motors have to be within a set tolerance of their rated efficiency label. Any repair workshop, manufacturer's or independent service centre, with a good quality control system, using modern materials and using this standard, can maintain or improve the efficiency of a machine within the original efficiency tolerances that the machine was designed to meet.

4.5 System efficiencies

If a motor has already been updated to an energy efficient machine, then a repair is often the most environmentally friendly solution to extend the life of the machine, and maintain its rated efficiency. During the course of a machine evaluation the decision to repair or replace should be considered.

This is often the best time to calculate whether replacement with a new, more efficient machine would be cost effective. This varies greatly with the number of hours the machine is used and requires careful specialist consideration. As an example, unregulated pumps, fans, and compressors might use more energy, depending on how much they are used, due to less slip and the higher speeds of energy efficient motors. The application might be suitable for use with a converter to overcome this problem, or the impeller could be re-profiled. Many machines are also special due to limitations of size, fit, duty, speed, torque, etc. Consideration should also be given to the possible lower downtime and lower carbon footprint of a repair and re-use.

Electric motors are generally very efficient and reliable converters of energy. The majority of wasted energy and energy losses are often caused in other areas of the driven system such as pumps, piping design, gearboxes, fans and fan ducting, compressors, wiring, transmission etc. All of these items should be looked at as a complete system when looking for energy savings.

4.6 Environment and End of life recycling

Environmentally there are many advantages in a service centre handling a machine at, or close to, the end of its life and environmentally disposing of replaced machines to remove them from the system. Where hazardous substances (such as asbestos, PCB, lead, etc.) are identified, suitable measures shall be adopted using best practice to meet legislative requirements on their removal and disposal.

a) Root cause failure analysis of a failed machine can identify problems of overloading, contamination, misalignment, faulty power supply, incorrect application, design or contractual limitations, etc., and significantly increase the service life of the repaired machine, or any new replacement.

b) The feasibility of whether a machine should be repaired or replaced can be calculated by a service facility taking into account its actual usage, power usage, cost of repair, cost of replacement, and payback period.

c) If the equipment is not repaired and it is at the end of its life, the equipment can be scrapped in the most cost efficient way and to prevent it entering the second hand market. The old equipment should be split into its component materials for recycling, for example:

- clean or burnt copper wire;

- copper wire mixed with insulation and varnish;
- cast aluminium housings;
- steel solids: bearings, shafts;
- light cast iron: housings etc.;
- remnants of mixed scrap.

Any replaced components during a repair, such as copper wire and bearings replaced, should also be similarly recycled. Apart from the varnish and insulation, the repair industry is able to sort and recycle around 98 % of an old machine, and any components used in a repair.

When recycled into the separate elements, these materials require minimal energy input and transportation before reuse. They are also correspondingly “greener” and more valuable.

4.7 Circular economy

The repair process complies with all aspects of the circular economy, doubling or trebling the active life of rotating electrical machines and the use of materials in them. The rotating electrical equipment market has undergone a process of upgrading to more energy efficient machines to save on power usage, with the focus of standardisation on IE3 machines, or equivalent. The repair/refurbishment of energy efficient machines ensures the most efficient use of the world’s dwindling resources. When repairing/maintaining a typical 110 kW machine with new bearings, the effective life is doubled and 99 % of the original machine is maintained. The old bearings, making up 1 % of the machine, are recycled as high quality “green” steel scrap. If the machine is rewound 90,5 % of the machine is reused during refurbishment. Weight for weight of the materials used during a rewind are returned as high quality green copper and steel scrap. The only items not reused or recycled during repair are the varnish, insulation, paint and grease, representing just 0,9 % by weight of the materials present in a typical 110 kW machine.

5 General requirements for repair

5.1 General

This clause covers those aspects of repair, overhaul, and refurbishment, which are common to all IEC 60034 series electrical machines. Subsequent subclauses deal with specific requirements for various machine types. In accordance with the needs of the user and local facilities, machines can be repaired on site, at the service facility works, or elsewhere. The key machine components are the stator and the rotor as shown below, see Figure 1.

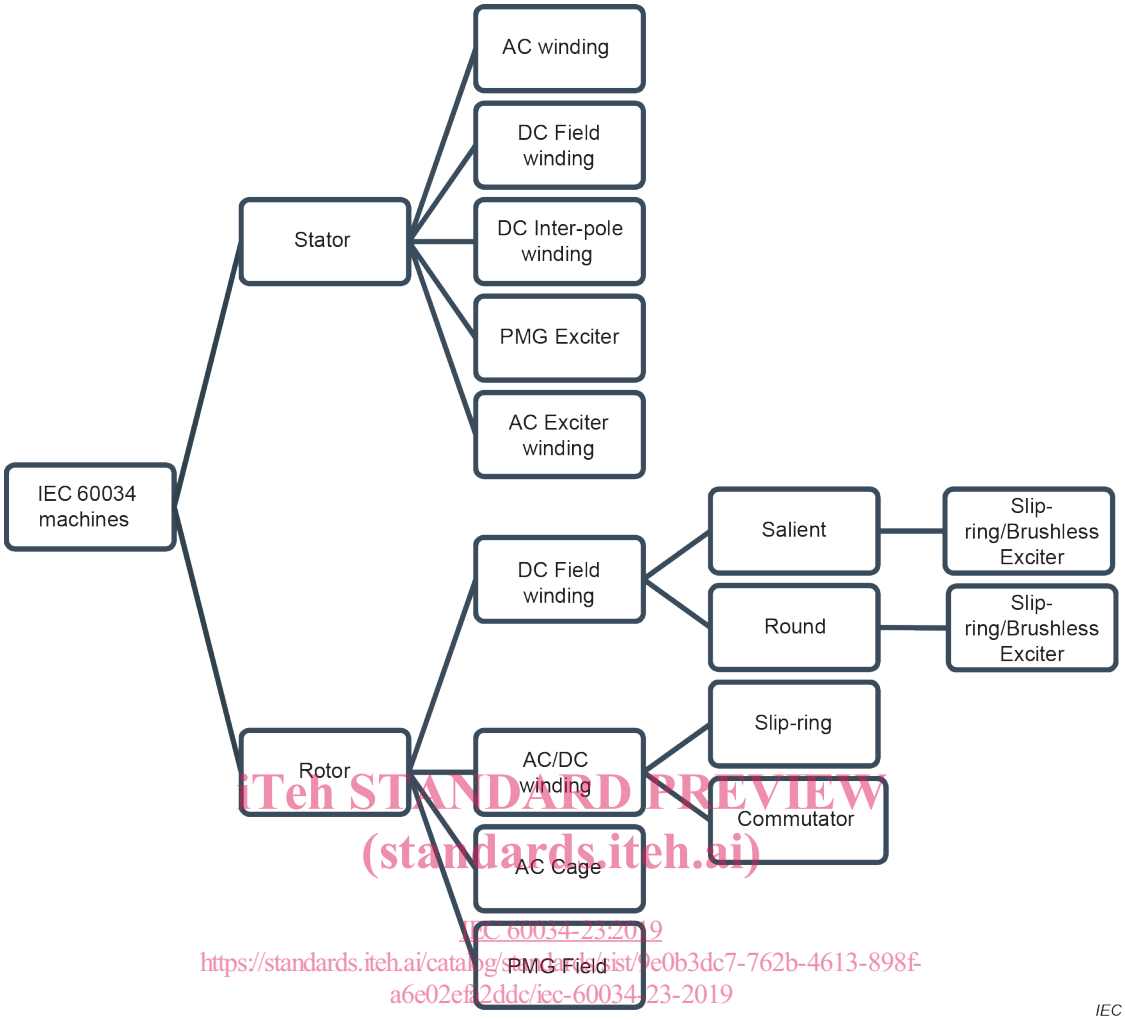

Figure 1 – Electrical machine components

5.2 Service facility

The user should ascertain that the service facility can demonstrate the ability to undertake the repair being proposed. This includes adequate repair and overhaul facilities, the appropriate equipment necessary and trained operatives.

The service facility shall be competent in the techniques and technologies required for the repair of the original machine, and shall be able to predict the influence of the repair on the machine.

Clean conditions are extremely important during the storage and assembly of machines, and should be appropriate to the type of machine being repaired. These shall be provided and maintained by the responsible parties.

Precautions shall be taken to ensure protection from contamination and foreign material entry during the storage of components after strip down and during repair. Winding and final assembly should be undertaken in a clean and dry area protected from any ingress of foreign matter arising from disassembly, cleaning, machining, open doors, or poor housekeeping.

5.3 Scope of work

The service facility shall conduct an initial assessment of the state of the equipment and agree with the user the scope of work to be done.