



Member of the FM Global Group

Examination Standard for Condition Monitoring Systems for Switchgear Equipment

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Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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1 INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states testing and certification requirements for condition monitoring of electrical switchgear and other high voltage electrical equipment.
- 1.1.2 Testing and certification criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2 Scope

- 1.2.1 This standard applies to any component or system intended to be used for condition monitoring of electrical switchgear and other high voltage equipment. Such equipment is referred to as “the system” or “the monitored equipment” throughout this document.
- 1.2.2 This standard is intended mainly for condition monitoring equipment classified as Class I and Class II as defined in section 2.1.

1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. Advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of condition monitoring of switchgear equipment for the purpose of obtaining certification. Condition monitoring of switchgear equipment having characteristics not anticipated by this standard may be certified if performance equal, or superior, to that required by this standard is demonstrated.

1.4 Basis for Certification

Certification is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

- 1.4.1 Examination and tests on production samples shall be performed to evaluate
 - the suitability of the product.
 - the performance of the product as specified by the manufacturer and required by FM Approvals; and as far as practical,
 - the durability, safety and reliability of the product.
- 1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be made to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.5 Basis for Continued Certification

The basis for continual certification may include, but is not limited to, the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified.
- the continued use of acceptable quality assurance procedures.
- satisfactory field experience.
- compliance with the terms stipulated by the certification.
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agency's product surveillance program.

1.6 Effective Date

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

1.7 System of Units

Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

1.8 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 cited edition applies.

ANSI/IEEE/ASTM SI 10 *American National Standard for Metric Practice*
IEEE C37.24 – *Evaluating the effects of solar radiation on outdoor metal-enclosed switchgear*
ANSI/UL 50E *Enclosures for Electrical Equipment, Environmental Considerations*
ANSI/IEC 60529 *Degrees of Protection provided by Enclosures (IP Code)*
IEC 62478 *High voltage test techniques – Measurement of partial discharge by electromagnetic and acoustic methods.*
EN 60068-2-1 *Environmental Testing – Test A: Cold*
EN 60068-2-2 *Environmental Testing – Test B: Dry Heat*
EN 60068-2-30 *Environmental Testing – Test DB: Damp Heat, Cyclic (12 H+ 12 H Cycle)*
EN 60255-21-1 *Electrical Relays -Vibration Tests (sinusoidal)*
EN 61000-4-2 (EMC) – *Electrostatic discharge immunity test*
EN 61000-4-3 (EMC) – *Radiated, radio-frequency, electromagnetic field Immunity.*
EN 61000-4-4 (EMC) – *Electrical fast transient/burst immunity test*
EN 61000-4-5 (EMC) – *Surge immunity test*
EN 61000-4-6 (EMC) – *Immunity to conducted disturbances, induced by radio-frequency fields*
EN 61000-4-8 (EMC) – *Power frequency magnetic field immunity test*
EN 61000-4-11 (EMC) – *Voltage dips, short interruptions and voltage variations immunity tests*
EN 61000-4-16 (EMC) – *Conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz*
EN 61000-4-18 (EMC) – *Damped oscillatory wave immunity test*

1.9 Terms and Definitions

For purposes of this standard, the following terms apply:

BIL – Basic Insulation Level: A design voltage for electrical apparatus that refers to a short duration crest voltage and is used to measure the ability of an insulation system to withstand high surge voltage.

EMC – Electromagnetic Capability: Ability of equipment or a system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

ESD – Electrostatic Discharge: Transfer of electrical charge.

EUT – Equipment Under Test: A manufactured product undergoing testing.

FTP – File Transfer Protocol: A standard network protocol used for the transfer of computer files between client and server on a computer network.

NTP - Network Time Protocol: For networked applications and should be synchronized to network time.

PD – Partial Discharge: Electric discharge that only partially bridges the insulation between conductors [a partial discharge may occur inside the insulation or adjacent to a conductor].

RF – Radio Frequency: Frequency of a periodic radio wave or of the corresponding electric oscillation. [‘radio frequency’ and ‘RF’ term can qualify an electric device designed to generate or to collect radiated waves].

RTC – Real Time Clock: Is an electronic device that measures the passage of time.

SSL - Secure Sockets Layer: Security technology used for establishing an encrypted link between server and client.

2 GENERAL INFORMATION

2.1 Product Information

Switchgear or other high voltage equipment, in their lifetime usage, are subject to ageing of their electrical contacts. This can be due to poor adherence to installation instructions (such as cable connections), to usage conditions (overload current rating), environmental conditions (temperature and humidity). Ageing on its electrical contacts increase its contact resistance, increasing consequently its temperature and its resistance even higher. These phenomena cause overheating, leading to thermal failure of nearby insulation and in the worst case, increases the risk of a fire. The early detection of temperature, humidity and partial discharge of insulation can greatly increase the life of this equipment and prevent damage from occurring or getting worse. Applications of Condition Monitoring Systems may be used in such locations as remote substations, switchgear, ISO-phase / bus ducts, Generator PT cabinets, liquid filled transformers and generator circuit breaker enclosures.

Monitoring systems may have various communication and data handling capabilities. Systems shall be identified by classes of capability. It is foreseeable that systems may have one classification when installed and may change to another classification by additions or expansions of equipment and features throughout its life cycle.

Class I – monitoring system that collects data and provides local or nearby warning/alert outputs based on thresholds.

Class II – monitoring system that collects data and provides warning/alert outputs based on thresholds and can communicate remotely through its own system or through other systems to transmit monitoring data.

Class III – most advanced monitoring system configuration includes all capability of Classes I&II with the addition of analytical capability of early detection of a potential problem (uses additional informational data such as load, temp conditions and pattern recognition).

2.2 Certification Application Requirements

The manufacturer shall provide the following preliminary information with any request for certification consideration:

- A complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration;
- General assembly drawings, complete set of manufacturing drawings, materials list, anticipated marking format, piping and electrical schematics, nameplate format, brochures, sales literature, spec. sheets, installation, operation, testing and maintenance procedures, product / system rating labels and any other relevant documentation.
- The number and location of manufacturing facilities.
- All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

2.3 Requirements for Samples for Examination

- 2.3.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing based on the following:
- Samples to be of the most recent manufacturing revision and software versions.
- 2.3.2 Sample requirements to be determined by the certification agency. Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.
- 2.3.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency.
- 2.3.4 It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the extreme temperature, humidity or partial discharge attributes of system sensors.