
# Examination Standard for Dust-Ignitionproof Electrical Equipment – General Requirements

**Class Number 3616**

**January 2022**

# 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 compliance 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 dust-ignitionproof electrical equipment for Class II, Division 1, Groups E, F and G; and Class III, Division 1 hazardous (classified) locations.

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 contains the basic requirements for the construction and testing of dust-ignitionproof electrical equipment.

1.2.2 This standard is intended to be used in conjunction with FM Approvals Examination Standard 3600 which includes the general requirements that apply to all types of hazardous (classified) location protection methods.

1.2.3 This standard does not apply to equipment rated for use in atmospheres containing pyrophoric substances, or other dusts that do not require oxygen for combustion.

1.2.4 This standard does not take into account the risk of ignition of a dust due to electrostatic causes nor from sparking due to friction or parts striking the equipment enclosure.

## 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. The advice of manufacturers, users, and loss control specialists was also considered.

1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of dust-ignitionproof electrical equipment for the purpose of obtaining certification. Dust-ignitionproof electrical 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 for certification and as far as practical,
- the durability 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 this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of that 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:

FM Approvals Examination Standard 3600, *Electrical Equipment for use in Hazardous (Classified) Locations, General Requirements*

FM Approvals Examination Standard 3615, *Explosionproof Electrical Equipment, General Requirements*

ANSI/IEC 60529, *Degrees of Protection Provided by Enclosures (IP Code)*

ANSI/ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*

ISO 965-1, *ISO general purpose metric screw threads - Tolerances - Part 1: Principles and basic data*

ISO 965-3. *ISO general purpose metric screw threads - Tolerances - Part 3: Limit deviations for screw threads*

## 1.9 Terms and Definitions

For purposes of this standard, the following terms apply, as well as joint construction definitions given in FM Approvals Examination Standard 3615:

**Dust-ignitionproof:**

Equipment enclosed in a manner that excludes dusts and does not permit arcs, sparks, or heat otherwise generated or liberated inside of the enclosure to cause ignition of exterior accumulations or atmospheric suspensions of a specified dust on or in the vicinity of the enclosure**.**

# 2 GENERAL INFORMATION

## 2.1 Certification Application Requirements

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

- A completed Application/Request for Quote form.
- 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, electrical schematics, nameplate format, brochures, sales literature, spec. sheets, installation, operation and maintenance manuals, and
- 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.

## 2.2 Requirements for Samples for Examination

2.2.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing based on the following:

- Sample requirements to be determined by the certification agency.

2.2.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.

2.2.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency.

2.2.4 It is the manufacturer's responsibility to provide any necessary test fixtures required to test their specific design.

# 3 GENERAL REQUIREMENTS

## 3.1 Markings

In addition to the marking information required in accordance with FM Approvals Examination Standard 3600, dust-ignitionproof electrical equipment shall be marked with the following information:

Precautionary Information — the words:

> ‘‘WARNING - TO REDUCE THE RISK OF IGNITION OF HAZARDOUS ATMOPHERES, DO NOT REMOVE COVER WHILE CIRCUITS ARE LIVE’’ or equivalent wording.

## 3.2 Manufacturer’s Installation and Operation Instructions

The manufacturer shall

- prepare instructions for the installation, maintenance and operation of the product;
- provide facilities for repair of the product and supply replacement parts, if applicable; and
- provide services to ensure proper installation, inspection, or maintenance for products of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection, or maintenance.

## 3.3 Calibration

3.3.1 Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service provider’s accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.

3.3.2 When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of thus equipment.

# 4 CONSTRUCTION REQUIREMENTS

## 4.1 General

All joints in the construction of the equipment enclosure, whether permanently closed or designed to be opened from time to time, shall fit together with tolerances specified on the manufacturer's documentation to provide effective sealing against the ingress of dust particles.

## 4.2 Enclosure Joint Construction

4.2.1 Threaded Parallel Joints - Threaded joints that include a gasket, seal or o-ring to provide ingress dust protection shall have a minimum parallel (straight) thread engagement of 3.5 threads. Threaded joints that do not include a gasket, seal or o-ring shall have a minimum parallel (straight) thread engagement of 5 threads. The thread class of fit shall be medium or fine with a maximum of 32 threads per inch (≥0.7 mm/thread).

4.2.2 Threaded NPT (National Standard Pipe Taper) Joints - NPT type thread joints shall comply with ANSI/ASME B1.20.1, and shall be made up wrench tight.

4.2.3 Non-Threaded (Plain) Joints – These plain joints are such as flat-flanged, cylindrical, or spigot type construction. Gaskets, seals or o-rings included in this type of joint shall be protected from mechanical abuse when the joint is assembled. When a gasket, seal or o-ring is not included, the joint shall be of tight tolerance with sufficient width contact so as to provide ingress protection per the dust exclusion test with the joint at its worse case design value (i.e. at least 90% of maximum design joint gap with not more than 115% of minimum joint width.)

4.2.4 Operating Rods, Spindles and Shafts – Openings in enclosures for rods, spindles or shafts shall have means, other than grease or compounds, that will prevent the ingress of dust, both when they are in motion or at rest.

4.2.5 Hinges – Hinges shall be clear of joints and shall not be used as a means of obtaining a seal.

4.2.6 Cover Bolts – The spacing of bolts for securing covers to other removable parts shall be such as to ensure ingress protection. Bolts that thread through the enclosure wall shall engage not less than 5 full threads. If cover bolts are provided with a washer, the bolt shall not bottom with the washer removed.

NOTE: The use of grease alone to maintain the integrity of the seal is not considered to satisfy the ingress requirement.

## 4.3 Gaskets, Seals and O-rings

These sealing devices shall:

- be constructed so they are under compression to ensure effectiveness of the enclosure sealing;
- be secured to either the enclosure or the removable part in such a manner that they can not readily be removed. Acceptable means include screws or rivets, tight-fitting slots or adhesive. If adhesive is used as the sole means of securement, the adhesive material is to be applied to one side of the mating surface and sealing device;
- be of one-piece continuous construction, i.e. with an uninterrupted periphery; and
- be suitably rated for the service temperature range used in the equipment.

### 4.4 Cemented Joints

Cement joint materials used for sealing shall be suitably rated for the service temperature range of the equipment and shall have an effective joint width of not less than 3 mm. The cement joint shall be used on mated parts that are not intended to be separated. The cement joint design shall be such that the cement material is directly in the wall of the enclosure so as to form with the latter an inseparable assembly, or into a frame such that the assembly can be replaced as a unit.

### 4.5 Field Wiring Entries (Supply Connections)

The equipment enclosure shall be provided with means for connection to a recognized Class II and III, Division 1, wiring system.

1. Modified NPT (National Standard Pipe Taper) Openings shall be provided in not smaller than ½ inch trade size and not larger than 4 inch trade size. Acceptable conduit openings must provide for a minimum 3½ full thread engagement with a thread conduit or fitting. An opening meeting this requirement will have a deeper tapping than described in ANSI/ASME B1.20.1, ''Pipe Threads, General Purpose (Inch)''. Acceptable conduit openings will be within -½ to +3½turns deeper than nominal in lieu of the ±1 turn of nominal described in ANSI/ ASME B1.20.1. A conduit stop, if provided, shall be smooth and rounded, having an inner diameter as specified in Table 1.

**Table 1**
**Throat Diameter of Integral Conduit Stop**

| *Trade Size of Conduit Opening* | *Throat Diameter of conduit Stop* | | | |
|---|---|---|---|---|
| *in.* | *in.* | *(mm)* | *in.* | *(mm)* |
| 1⁄2 | 0.560 | (14.22) | 0.622 | (15.80) |
| 3⁄4 | 0.742 | (18.85) | 0.824 | (20.93) |
| 1 | 0.944 | (23.98) | 1.049 | (26.65) |
| 1¼ | 1.242 | (31.55) | 1.380 | (35.05) |
| 1½ | 1.449 | (36.81) | 1.610 | (40.89) |
| 2 | 1.860 | (47.24) | 2.067 | (52.50) |
| 2½ | 2.222 | (56.44) | 2.469 | (62.71) |
| 3 | 2.761 | (70.13) | 3.068 | (77.93) |
| 3½ | 3.193 | (81.10) | 3.548 | (90.12) |
| 4 | 3.623 | (92.02) | 4.026 | (102.26) |

2. Metric Entries: Metric threaded entries in the enclosure shall have a tolerance class of 6H or better according to ISO 965-1 and ISO 965-3, and any chamfer or undercut is limited to a maximum depth of 2 mm from the external wall surface. Acceptable openings shall provide at least five full threads.

Conduit openings not employing a conduit stop shall be smooth and well rounded at the interior end to reduce the likelihood of conductor insulation damage during installation.

For enclosures intended for field installation of NPT entries, the enclosure wall thickness shall provide for at least 3.5 full threads.

# 5 PERFORMANCE REQUIREMENTS

## 5.1 General

This section describes the tests and required results to show equipment compliance to the requirements of Section 4. Unless otherwise specified, all tests are conducted under prevailing laboratory conditions with respect to temperature, humidity, and atmospheric pressure.

## 5.2 Resistance to Impact and Thermal Shock Tests

See FM Approvals Examination Standard 3600. The resistance to impact and thermal shock test results shall be considered satisfactory if there is no damage to the equipment that would invalidate the dust-ignitionproof protection method.

## 5.3 Drop Test

5.3.1 Portable equipment (as defined in FM Approvals Examination Standard 3810) shall be subjected to a drop test as specified in Section 5.3.2. There shall be no damage to the equipment that would invalidate the dust-ignitionproof protection method.

5.3.2 Equipment is to be dropped six times, not more than once on any one equipment surface, from a height of 3 feet (0.9 m) onto a smooth concrete floor. A nonrestrictive guide may be used.

## 5.4 Conduit Opening Torque Test

The enclosure mechanical strength at NPT conduit openings shall be verified by a conduit opening torque test.

Each NPT conduit opening shall be fitted with a test plug/fitting and tightened to the test value accordingly to Table 2. After tightening, the test plug/fitting shall be removed and the enclosure examined. Damage to the enclosure resulting from the torque test shall not invalidate the dust-ignitionproof properties of the enclosure.

**Table 2**
**Conduit Torque Specifications**

| *Trade Size of Conduit Opening (inches)* | *Torque* | |
|---|---|---|
| | *(lb•ft)* | *(N•m)* |
| ½, ¾ | 67 | 90 |
| 1, 1¼ and 1½ | 83 | 113 |
| 2, 2½, 3, 3½ and 4 | 133 | 181 |

## 5.5 Thermal Endurance Conditioning

Non-metallic enclosures or non-metallic parts of enclosures, including seals, gaskets and o-rings, on which the integrity of the dust-ignitionproof protection depends, shall be subjected to thermal endurance to heat and cold as follows:

5.5.1 Thermal endurance to heat shall be conducted at continuous storage for four weeks at (90 ± 5) % relative humidity at a temperature of (20 ± 2) K above the maximum service temperature, but at least 80°C. In the case of a maximum service temperature above 75°C, the period of four weeks specified above shall be replaced by a period of two weeks at (95 ± 2) °C and (90 ± 5) % relative

humidity followed by a period of two weeks in an air oven at a temperature of (20 ± 2) K higher than the maximum service temperature.

5.5.2 The thermal endurance to cold shall be conducted for 24 h in an ambient temperature corresponding to the minimum service temperature reduced by at least 5K but at most 10K.

EXCEPTIONS

Exception 1: It is generally acknowledged that glass and ceramic materials are not adversely affected by the thermal endurance to heat and cold, and conditioning for these materials is not necessary.

Exception 2: Metallic equipment enclosures not containing seals, gaskets and o-rings need not be subjected to the thermal endurance conditioning, but the dust exclusion test on equipment is to be conducted with the joint at its worse case design value (i.e. at least 90% of maximum design joint gap with not more than 115% of minimum joint width).

Exception 3: Thermal endurance conditioning is not required for metallic equipment enclosures containing seals, gaskets and o-rings, if the metallic equipment enclosure satisfactorily passes the dust exclusion test without seals, gaskets and o-rings installed, but with the joint at its worse case design value (i.e. at least 90% of maximum design joint gap with not more than 115% of minimum joint width).

## 5.6 Pressure Test

Following thermal endurance conditioning and prior to the dust exclusion test, the equipment enclosure shall be subjected to a positive internal pressure of at least 2kPa for at least 60 seconds. During this test, any breathing and draining devices shall be removed and the entry plugged.

## 5.7 Dust Exclusion Test

The equipment shall exclude the entry of dust as a result of the equipment being subjected to the IP6X dust exclusion test per ANSI/IEC 60529 for a Category 1 enclosure.

## 5.8 Thermal (Temperature) Test

Temperature test is conducted on the equipment to determine its maximum external surface temperature under the most adverse condition with an input voltage between 90% and 110% of the rated equipment's rated voltage. In the event that the voltage change does not result in an increase in the surface temperature on the equipment, such as on a switch, then the current will be increased to 110% of rated current. During this test, dust shall be applied on the equipment until no more will accumulate on the equipment enclosure. The maximum external surface temperature shall be used to determine the temperature class (T Code) marking per FM Approvals Examination Standard 3600. During measurement for the maximum external surface temperature, wheat flour, corn flour or grain is to be used as the dust median.

NOTE: During this test, the equipment will be mounted above the floor, which will allow dust to freely accumulate on the equipment, but not bury the equipment.

## 5.9 Additional Tests

Additional tests may be required, at the discretion of the certification agency, depending on design features and results of any foregoing tests.

Any test following a failure shall be acceptable only at the discretion of the certification agency and with a technical justification of the conditions or reasons for failure.

# 6 OPERATIONS REQUIREMENTS

See FM Approvals Examination Standard 3600.

# 7 BIBLIOGRAPHY

ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories.

IEC 60079-31, Explosive atmospheres – Part 31: Equipment dust ignition protection by enclosure “t”