

Approval Standard

for

Explosionproof Electrical Equipment General Requirements

Class Number 3615

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Foreword

Approvals are 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 Approvals Standards is to present the criteria for Approval of various types of products and services, as guidance for FM Approvals personnel, manufacturers, users and authorities having jurisdiction.

Products submitted for Approval shall demonstrate that they meet the intent of the Approvals Standard, and that quality control in manufacturing and/or applications shall ensure a consistently uniform and reliable product or service. FM Approval Standards strive to be performance-oriented and to facilitate technological development.

For examining equipment, materials and services, Approvals Standards:

- a) must be useful to the ends of property conservation by preventing, limiting or not causing damage under the conditions stated by the Approval listing; and
- b) must be readily identifiable.

Continuance of Approval and Listing depends on compliance with the Master Agreement, satisfactory performance in the field, on successful re-examinations of equipment, materials, and services as appropriate, and on periodic follow-up audits of the manufacturing facility or service/application.

FM Approvals LLC reserves the right in its sole judgment to change or revise its standards, criteria, methods, or procedures.

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I INTRODUCTION

1.1 Purpose

This standard serves as the basis for Approval of explosionproof electrical equipment.

1.2 Scope

This standard contains the basic requirements for the construction and testing of explosionproof electrical equipment. This standard is intended to be used in conjunction with Approval Standard 3600 which includes the general requirements that apply to all types of hazardous (classified) location protection methods.

1.3 Basis for Approval

See Approval Standard 3600, Paragraph 1.3.

1.4 Basis for Continued Approval

See Approval Standard 3600, Paragraph 1.4

1.5 Basis for Requirements

For general basis of requirements, see Approval Standard 3600, Paragraph 1.5.

1.6 Effective Date

The effective date of an Approval Standard mandates that all products tested for Approval after the effective date shall satisfy the requirements of that standard. Products FM Approved under a previous edition shall comply with the new version by the effective date or else forfeit Approval. The effective date shall apply to the entire Approval Standard, or, where so indicated only to specific paragraphs of the standard.

The effective date of this standard is **August 1, 2006** for full compliance with all requirements.

1.7 System of Units

See Annex A and Approval Standard 3600, Paragraph 1.7.

II DEFINITIONS

For purposes of this standard, the following terms apply:

Explosionproof: Equipment enclosed in a case which is capable of: 1) withstanding an internal explosion of a specified gas or vapor-in-air atmosphere; 2) preventing the ignition of a specified gas or vapor-in-air atmosphere surrounding the enclosure due to sparks, flashes or internal explosion; and 3) operating at temperatures which will not ignite the surrounding atmosphere

Flamepath: The place where corresponding surfaces of two parts of an enclosure come together and prevent the transmission of an internal explosion to the atmosphere surrounding the enclosure

Gap of Flamepath: The distance between the corresponding surfaces of a flamepath measured perpendicular to the surfaces. For circular surfaces, this gap is defined as the difference between the two diameters (diametrical clearance)

NOTE 1 – This definition does not apply to threaded flamepaths.

Length of Flamepath: The shortest un-interrupted distance along a flamepath.

NOTE 1 – This definition does not apply to threaded flamepaths.

NOTE 2 – Interruptions of a flamepath may include o-ring grooves, oil grooves, and bolt holes.

Joint, Cemented: A joint where the interface between the two mating surfaces is completely filled with cement so as to create a “no-gap” joint.

Joint, Flat/Flange: A flamepath with a straight joint with parallel surfaces.

Joint, Spigot: A joint with two or more flamepaths at right angles to each other.

Joint, Threaded: The interface of internally and externally threaded components.

Rod, Operating: A component normally of circular cross-section, used for transmitting control movements which may be rotary, linear, or a combination of both.

Shaft: A component, normally of circular cross-section, used for transmitting rotary motion.

Volume, Internal Free: All the unfilled space in an explosionproof enclosure, with the normally installed parts in place.

III GENERAL REQUIREMENTS (OTHER THAN PERFORMANCE REQUIREMENTS)

3.1 Marking Information

In addition to the marking information required in accordance with Approval Standard 3600, “General Requirements”, explosionproof electrical equipment shall be marked with the following information:

3.1.1 Precautionary Information — the words:

“TO PREVENT IGNITION OF FLAMMABLE GASES OR VAPORS, DO NOT REMOVE COVER WHILE CIRCUITS ARE LIVE” or equivalent wording.

3.1.2 If the equipment was tested according to the EXCEPTION of Table 4, the label shall contain the statement:

“SEAL ALL CONDUITS WITHIN 18 INCHES” or equivalent wording. Where the explosion pressure has been determined with a length of conduit shorter than that specified in Table 4, the enclosure marking shall reflect that length in lieu of the 18 inches.

3.1.3 Equipment supplied with a factory-installed conduit seal shall be marked with the words:

“FACTORY SEALED, CONDUIT SEAL NOT REQUIRED” or equivalent wording.

3.2 Required Documentation for Approval Examination

For the purposes of:

- a) assessing compliance of equipment with Approval requirements.
- b) determining what test samples will be required for the test and examination program, and
- c) providing a means for design modification control, the manufacturer shall submit documents which give a full and correct specification of the critical construction aspects of the equipment. One copy (except as noted) of the following documentation as it pertains to the Approval request should be assembled in an organized manner and submitted prior to scheduling of the test program. All documents shall identify the following:
 - the manufacturer’s name
 - document number or other form of reference number identification, title, and
 - date of latest revision of document and/or the revision reference (i.e. number or letter indicating revision level)

NOTE 1: A single certification drawing may be provided as an alternative to providing separate production drawings. However, the certification drawing must contain all of the detail required of production drawings.

NOTE 2: Drawings in a language other than English may require partial translation for use in an approval program.

- 1) Marketing/Ordering Literature showing general specifications and functions of the equipment. This information is generally very useful in determining project costs and may also be used as an attachment to the final report.

- 2) Model Number Breakdown: An engineering drawing or sales specification sheet showing all model variations and options to be examined. Each model variation shall be uniquely identifiable by nameplate marking, or by distinctive model designation.
- 3) Instruction Manual(s) providing installation, operation and maintenance instructions.
- 4) Quality Control Procedures document(s) detailing routing testing and final inspection procedures.
- 5) Production Drawings, including (as applicable)
 - i) Electrical schematic(s);
 - ii) Specifications (rated voltage, current, power, etc.) for mains powered components;
 - iii) Final assembly drawing and parts lists;
 - iv) Sub-assembly drawings or piece-part drawings/assembly drawings sufficient to detail primary circuit components, operator controls, enclosure design and safety interlocks;
 - v) Casting, machining, and sub-assembly drawing as applicable to define all flameproof joints, wall thickness, materials, minimum acceptable joint tolerances, surface finish and flatness, coating or paint, conduit opening gauging requirements, potting materials, sealing materials, and gasket materials.

NOTE: If a component or sub-assembly which is critical to the explosionproof characteristics of the device being submitted is manufactured by an outside supplier, all of the preceding design information is still required. That supplier shall be required to forward design drawings to FM Approvals, or the applicant shall prepare specification drawings detailing the inspection limits of acceptance on fabrication tolerances.

- vi) Protective Grounding Detail drawing(s) showing the method of protective grounding provided, including location, size, and marking.
 - vii) Product label drawing(s) showing all required marking information. The label drawing should show proposed artwork indicating the manufacturer's name, address, model and serial numbers, equipment ratings, warning markings, and the Approval Mark.
- 6) Documentation Control Specification showing proposed method of controlling documents which may be identified as Critical Documents by Approvals. These Critical Documents will be identified by FM Approvals at the conclusion of the Approval program. FM Approvals must be notified of changes to these documents via Form 797, "FM Approved Product Revision Report".

3.3 Construction Requirements

3.3.1 Enclosure Mechanical Strength

Enclosure strength shall be sufficient to withstand the stresses resulting from internal explosions, hydrostatic overpressure tests, impact, and thermal shock. As a result of these tests, no damage or deformation shall occur that would weaken or jeopardize the explosionproof characteristics of the enclosure.

3.3.2 Enclosure Joints

Flamepaths of other than threaded joints shall have a surface finish not rougher than 250 micro-inches (6.3 micro-meters) when measured in accordance with ANSI B46.1, "Surface Texture".

3.3.3 Flamepath Dimensions

The subject of flamepath dimensions has been researched by various international agencies and is well documented. This research developed maximum experimental safe gap (MESG) dimensions for explosionproof enclosures which have been tried and proved over many years.

A tabulation of flamepath length and gap dimensions of various joint types versus enclosure volume is given as Annex literature in this standard. The Annex Tables have been derived from the International Electrotechnical Commission (IEC) Publication 60079-1:2003, *Electrical Apparatus for Explosive Gas Atmospheres*, Part 1 Flameproof enclosure “d”.

The gap values given in the Annex Tables, or the additional margin of safety specified in this Section, yield a sufficient safety factor to assure confidence in the tested design for Approval. FM Approvals’ procedure is to enforce performance requirements versus design requirements wherever possible. Therefore, testing required by this Standard is based on use of the tabulations as a guideline, as an alternative to requiring strict adherence to the table values in a product design. Designs not meeting these criteria shall be evaluated by the modified gap test methods specified for the type of joint design, according to the following paragraphs. Presented in this manner, a manufacturer can design a product using the Annex Tables and anticipate passing the FM Approvals’ test program and other national and international test programs.

NOTE: No enclosure can be considered satisfactory based on meeting the Annex value alone, without testing, as factors such as enclosure geometry, internal parts proximity to flamepaths, pressure piling, environmental seal grooves, etc., have an effect that can be evaluated only by testing. The intent of these requirements is to incorporate into the design of the equipment a defined safety factor verified by tests.

A. Flat/Flange Joints: Flame propagation tests shall be conducted in accordance with 4.4.2 (compliant) unless either of the following two conditions exist. In those cases, flame propagation tests shall be conducted in accordance with 4.4.3 (modified) or 4.4.4 (nominal).

- The enclosure design maximum gap exceeds the gap specified for the flat/flange length values shown in the Annex Tables; or
- A maximum gap value is not shown in the Annex Tables

Modifications (ref. 4.4.3) for Flat/Flange Joints:

- Shimming to increase gap by 50% in excess of the design maximum gap.

B. Spigot Joints: In general, only the cylindrical portion of the joint is relied upon as a controlled flamepath.

Flame propagation tests shall be conducted in accordance with 4.4.2 (compliant) unless either of the two following conditions exist. In those cases, propagation tests shall be conducted in accordance with 4.4.3 (modified) or 4.4.4 (nominal). For those tests, flanged gaps of spigot joints, where the length of the joint L consists only of a cylindrical part (see Annex K) shall be enlarged to values of at least 0.04 in. (1 mm) for Group D, 0.02 in. (0.5 mm) for Group C and 0.01 in. (0.3 mm) for Group A or B.

- The enclosure design maximum diametrical gap exceeds the gap specified for the cylindrical portion joint lengths shown in the Annex Tables; or
- A maximum diametrical gap value is not shown in the Annex Tables.

EXCEPTION: Spigot joints having a flat flange portion greater than 0.25 inch (6 mm) in length and an internal chamfer less than 0.04 inch (1 mm) may rely on both the cylindrical portion and the flat/flange portions combined flamepaths. In such cases, the maximum gap or diametrical gap of any portion of the joint and the minimum combined flamepath length shall be used to evaluate the construction in the same manner as the basic spigot joints detailed previously.

NOTE: There is no relaxation on the required joint length for an interference-fit joint construction.

Modifications (ref. 4.4.3) for Spigot Joints:

- Shimming to increase diametrical gap by 50% in excess of the design maximum gap.

C. Threaded Joints: Flame propagation tests shall be conducted in accordance with 4.4.2 (compliant) unless the threaded joint has a number of engaged threads and/or a class of fit other than that specified in Annex J. In that case, flame propagation tests shall be conducted in accordance with 4.4.3 (modified).

Tapered threads shall meet the gauging requirements for conduit and are not required to be subjected to flame propagation testing.

Modifications (ref. 4.4.3) for Threaded Joints that do not comply with Annex J:

- Flamepath reduction by removing 30% of the effective thread engagement of the joint for Class 2 (6H/6g) or Class 3 fit; or by removing 50% of the effective thread engagement for a Class 1 fit (7H/8g).

D. Field Wiring Entries (Supply Connections): The enclosure shall be provided with means for connection to a recognized Class I, Division 1, wiring system.

1. Modified NPT (National Standard Pipe Taper) Openings (Suitable for Groups A, B, C and D Locations) 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 4½ full threads of engagement with a minimum 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 0 to +3½ turns 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.
2. NPS (National Standard Pipe Straight) Openings (Suitable for Groups C and D) shall be provided in not smaller than ½ inch trade size and not larger than 4 inch trade size. Acceptable openings shall provide for at least 5 full threads of engagement with an NPS threaded fitting conduit. Acceptable openings must also provide an integral conduit stop at the inner end of the conduit opening. The conduit stop shall be smooth and rounded, having an inner diameter as specified in Table 1.

Note: NPS threaded entries for other than supply connections may be provided on enclosures for Groups A and B if these openings are intended solely for the connection of accessories, such as a probe or operator, and not field wiring.

Table 1
Throat Diameter of Integral Conduit Stop

Trade Size of Conduit Opening	Throat Diameter of Conduit Stop			
	Minimum		Maximum	
<i>in.</i>	<i>in.</i>	<i>(mm)</i>	<i>in.</i>	<i>(mm)</i>
½	0.560	(14.22)	0.622	(15.80)
¾	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)

3. 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 5 full threads. The thread type and size shall be identified on the electrical equipment, for example M25 or M32.

Field wiring entries 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.

All NPT field wiring entries, except those which must be used for installation, shall be supplied with metal plugs capable of providing at least 4½ full threads of engagement. All metric wiring entries except those which must be used for installation, shall be supplied with metal plugs capable of providing at least 5 full threads of engagement.

The enclosure wall thickness shall provide for at least 4½ full threads of engagement with any NPT conduit threaded per ANSI/ASME B1.20.1.