



**INTERNATIONAL ELECTROTECHNICAL COMMISSION SCHEME FOR
CERTIFICATION TO STANDARDS RELATING TO EQUIPMENT FOR
USE IN EXPLOSIVE ATMOSPHERES
(IECEX Scheme)**

Operational document No Ex/OD020

Title

**Guidance for the Sampling of Group I Ex d Motors for Testing as
Representative of a Range for Certification Purposes**

Introduction

This Operational Document provides guidance to ExTLs and ExCBs when selecting samples of Group I Ex d Motors as being representative of a specified range for certification purposes. This OD is the result of earlier work and discussions during the 2004 Brdo IECEx meetings (re Meeting Report ExTAG/69A/RM).

It is anticipated that a similar document may be prepared to cover Group II Ex d motors.

Document History

Date	Summary
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Operational Document

Sampling of Group I Ex d Motors for Test as Representative of a Range for Certification Purposes

1. Scope

This document examines an approach for sampling of Group I Ex d motors for acceptance for certification.

2. Background

There is often a need for a manufacturer to seek certification of a range of motors, rather than have them certified on an individual basis.

However, a range of motors can come with a significant number of variations; these include:

- Frame size
- Rating
- Speed/No of poles
- Core length
- Air gap
- Terminal box(es) size, mounting and number of entries
- Connection arrangements between motors and terminal box
- Construction methods and robustness
- Use of casting or other techniques for construction
- Mounting arrangements (eg foot or flange)
- Shaft gland arrangements
- Cooling – air or water
- Use of accessories, such as heaters, thermal sensing devices and vibration detectors.

The method of selecting the sample motors for test will need to take into account the above factors and how they might impact on compliance with the relevant explosion-protection standards (generally IEC 60079-0 & -1 or equivalents).

3. Discussion

The critical issue when selecting sample motors for test is considering how the variations can impact on the ability to extrapolate or interpolate results to other motors in the range.

When applying the above process only features that impact on the explosion-protection properties of the apparatus need to be considered.

Group I motors are generally of robust construction using steel or cast iron as the main construction material. Hence, consideration of requirements for plastics materials is likely to be limited to internal materials. Further, the ability of the enclosures to withstand impact tests is generally not an issue.

There are four major issues that need to be considered:

- a. Ensuring the motors meet the constructional requirements for the standards with particular reference to the requirements for flamepaths.
- b. Determining explosion pressures and then using them as a reference to test the ability of the motor to withstand pressure.
- c. Testing the ability of the motors to pass the test for non-transmission of internal ignition.
- d. Ensuring the maximum surface temperature for Group I (150°C) would not be exceeded, together with other requirements related to thermal tests.

Each of the above is further explored here.

3.1. Constructional Requirements

The constructional requirements, including any requirements of the relevant standards, need to be clearly detailed in the drawings for the range. The motors covered should be clearly identified with an indication of any changes that occur with change in motor size. All options need to be shown. All the items listed in the background for this paper should be covered.

3.2. Ability to Withstand Pressure

This can be a complex part of the exercise for flameproof motors. Two major factors that will affect pressures achieved in the pressure determination test with methane are the volume of gas and the presence of pressure piling.

Many of the variations that could occur in a range of motors will affect one or the other. It should be possible for the motor manufacturer to make a calculation of the internal volume for any particular configuration. However, for motors it is almost impossible to determine whether pressure piling may occur or take measures to confidently avoid it. For many other enclosures it is possible to ensure equipment layout does not introduce areas of restriction and hence remove the likely conditions for pressure piling to occur. This is not possible for motors because of the nature their inherent design, in particular the presence of air gaps.

Whether or not the terminal box is isolated from the motor enclosure may, perhaps, have one of the most significant affects on the reference pressure and it may not always be practical to achieve this isolation.

Hence it is wise to assume that pressure piling may occur. It is therefore suggested that the most onerous figure obtained in pressure testing of the samples from range be used for all motors for the over pressure test of all the samples. Better still, especially where motors are all subject to routine pressure testing, apply a figure that is a worst conceivable figure, based on experience for methane.

As an indication of worst case pressures IEC 60079-1 provides for overpressure testing at 10 bar (1,000 kPa) where testing is impractical. A search of the Internet suggests that pressure figures up to 8.1 bar (810 kPa) for methane may be possible. Hence, using a factor of safety of 1.5, a routine overpressure test at 1,215 kPa may be a more conservative approach.

An exception to the above can be where cooling ducts are used through the stator and/or rotor, or even welded externally to the main carcass. Feedback from testing bodies has indicated explosion pressures in the order of 20 bar in such arrangements for Group I motors and 40 bar

plus for Group IIB. There has been experience of similar pressures being developed in a Group I machine that had a long cable ducts.

The other matter to be considered is the ability of a motor in any configuration to withstand pressure. Given we are dealing with an item that is generally robust, the most likely variation to have impact on the strength is the number of cable entries.

This is unlikely to be an issue if all motors are subject to a routine pressure test and where no later modifications need to be covered by the certificate.

However, there are two cases where it might be desirable to test the product with the worst configuration of cable entries. The first is where a four times overpressure type test is done and hence there is no routine testing. The second is to cover the situation where a customer may later need additional entries. If the additional entries are provided for in the certificate then an appropriately accredited repair workshop could add the additional entry. In both cases we are talking about the type test not the routine test.

3.3. Flame Transmission

Representative configurations of each type of flamepath should be tested. Failures of enclosures under this test are rare. Hence, extensive testing of samples over the range should not be necessary but need to cover expected worse case scenarios.

Preparation might include:

- Removing the grease and seals from the bearings at the drive-end of the motor shaft if they in any way could influence the non-transmission testing.
- Depending on the flamepath design across this group of samples, a flamepath may be machined to represent a design used on a different motor than the one actually being tested.
- Engineering judgment always is required for the selection of spark plug location, but as a minimum, should include ignition at both the drive and non-drive end of a motor. Experience has suggested that

propagation through a particular flamepath is most likely when the spark plug is located near that flamepath, unless the pressures at that flamepath are so high with the spark plug located elsewhere, that dynamic distortion of the flamepath occurs with a resulting flame transmission.

3.4. Thermal Testing

Samples of motors across the range should be selected and either tested by the third party testing body or the tests supervised by that body at the manufacturer's works.

Typically the selection might include a frame size near the largest and a frame size near the smallest with one or more test samples in between. Where practicable the test sample would have the largest power in that frame size with the fastest speed.

Provided the results of the tests are satisfactory it should be possible to accept manufacturer's data for tests on other motors in the range. This would require the testing arrangements by the manufacturer to be deemed acceptable to the testing body and associated certifying body. This might be done by inspection or use of recognised accreditation.

Where variable voltage variable frequency drives are used, the testing scenarios will need to be agreed with the testing and certifying bodies. It is likely that some form of thermal protection will need to be used and proved during the testing process.

3.5. Selecting Motors

The number of motors selected as samples for testing by the certification or testing body would be dependent on the above four major issues, but as a minimum would be expected to include one near the bottom of the range and one near the top of the range. Depending on the size of the range and variation in size, one or more would need to be selected through the rest of the range. Typically each alternate frame size might be selected.

Attempts should be made to try to maximize the free internal volume for specific flamepath dimensions. Most motor series will use very similar

flamepath dimensions for several frame sizes. For the transmission tests, it is recommended that the largest frame size in this sub-set be selected and the manufacturer be asked to prepare a test sample with shortest stack length, largest gap and minimum number of poles (normally two) selected to maximize the free internal volume. The flamepath gaps would be machined to be at least 90% of design maximum gap and not more than 115% of design minimum length.

The machine provided for test may well not be standard production unit in order to combine these variables into the one construction. Use of a 2 pole pony motor can remove the need to wind a 2 pole test machine.

As a further check on frame sizes or configurations not tested it may be possible to apply strength calculations, for example along the lines permitted by the UL Standard for the motors.

4. Certification Documentation

It is critical that the certification documentation clearly defines the range of motors covered, their design and all options, including accessories such as heaters. Some certification bodies like to keep the ranges shorter and design characteristics restricted in order to ensure this information is unambiguous. In many cases a good system of product identification by the manufacturer can help this process.

It is also important at the start to know where each of the model ranges are being manufactured to ensure all the appropriate controls are applied and can be audited.