

## Product note

# Risk assessment and gas tests for non-sparking and increased safety motors



Non-sparking (Ex nA) and increased safety (Ex e) motors now have to meet tough requirements with regard to sparking. The latest IEC and EN standards specify criteria for risk assessment and gas environment tests for rotor and stator designs to show that the motors are spark-free in all operational conditions.

### What are the causes of sparking?

Stator sparking consists of partial discharges at the winding surface due to high potential differences, and it tends to occur continuously while the motor is running. Typical causes are high voltages or inappropriate stress grading, degradation of the insulation due to ageing, voltage transients, or dirt in the windings.

Rotor sparking takes place during starting and occurs between the rotor bars and rotor core, especially in the vicinity of the first radial cooling ducts. It is generally caused by 'shaking' of the rotor bars in the slots, which interrupts current flow between the bars and core. The shaking is the result of angular and radial forces which act on the rotor during starting.

### What do the latest standards require?

The tables on next page summarize the main requirements contained in the standards. The requirements depend on a duty type, the voltage and power rating of the motor, and are specified separately for rotors and stators.

Where a risk assessment is required, this is performed using risk factor tables provided in the standards. Depending on the risk factors identified in the assessment, the motor may have to be equipped with a space heater, and / or special measures may be required. Special measures typically involve the provision of pre start ventilation.

**Requirements for Ex nA non-sparking motors according to IEC 60079-15:2010 and EN 60079-15:2010 (already required in versions of 2005)**  
(Waived for certain duty types).

Voltage rating	Rotor	Stator
≤ 1 kV	Either gas environment test or risk assessment, possible need for special measures. Waived for machines with a rated power is ≤ 100 kW.	No requirements
Over 1 kV		Gas environment test for certain equipment groups and space heater.

**Requirements for Ex e increased safety motors according to IEC 60079-7:2006 and EN 60079-7:2007**

Voltage rating	Rotor	Stator
≤ 1 kV	Either gas environment test or risk assessment, possible need for special measures. Waived for machines with starting current ≤ 3 In	No requirements
Over 1 kV		Gas environment test (* and need for space heater and special measures/risk assessment.

(\* Type tests in accordance with standards IEC 60079-7:2006/EN 60079-7:2007 shall be conducted for stator with rated voltage above 1 kV.

**How are the gas environment tests performed?**

The standards specify that a series of three tests should be carried out in an explosive gas environment. The gas mixture used is either 21% (+5%) hydrogen in air or 7.8% (+1%) ethylene in air.

The stator tests consist of a sinusoidal voltage test, to check for sparking during normal operation, and an impulse test, which checks the stator discharges in case of voltage transients.

The rotor test, which is preceded by a process to simulate ageing, checks for sparking on starting or stalling.

**What is ABB's approach to meeting the new requirements?**

Following a program of gas environment tests in which all tests were passed, ABB has secured certification for its AMI, HXR, AMA, and M3/M4 motors, frame size up to 630 mm, as follows:

- All rotor tests passed
- Stator tests passed up to 13.2 kV with Group IIC gases\*
- Stator tests passed up to 15 kV with Group IIA and IIB gases\*

For higher voltage levels pre-start ventilation or risk assessment can be used.

The stator tests also apply for AMG (frame sizes 710 upwards) and AMZ motors and generators, for the same voltage ratings and gas groups as shown above. The rotor test was also passed and ABB LV Motors has secured certification for its cast iron M3\_P motors with aluminum die-cast rotor.

\* Examples of gases in the three groups  
 IIA: methane, benzene, ammonia  
 IIB: ethylene, propyne, nitroethane  
 IIC: hydrogen, acetylene and carbon disulphide

**What are the benefits of ABB's approach?**

By testing and securing certification for its motors, ABB is helping to streamline the risk assessment process for its customers. Due to these tough tests to be fulfilled, it re-inforce the insulation system and increase the time life of products.

The alternative to testing and certification involves, in the majority of cases, equipping the motor with provision for pre-start ventilation. This means investing in a higher capacity air compressor, piping, and a ventilation control unit. It also requires an additional operation – ventilation – every time the motor is started.

Benefits of the ABB approach therefore include reduced initial capital expenditure, lower operating costs, and faster starting. Reliability is improved as no additional components are required.

Most importantly, ABB's certified motors offer proven safety, as testing represents the only way to verify that equipment is really safe.

ABB offers risk assessed high voltage and synchronous motors and generators in frame sizes 315 to 2500 and low voltage cast iron motors.

For more information please contact:

[www.abb.com/motors&generators](http://www.abb.com/motors&generators)

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