General information

European ATEX Directives
The ATEX Directives harmonize safety rules in line with the free trading principles of the European Community.
Responsibilities are split between the manufacturers and end users. Manufacturers have to comply with the “Essential Health and Safety Requirements” of the Products Directive 2014/34/EU and end users must prepare an Explosion Protection Document based on risk assessments of their “work places” and “work equipment” to fulfi l the “minimum requirements” listed in the Worker Protection Directive 1999/92/EC.

ABB low voltage motors for explosive atmospheres comply fully with the ATEX Product Directive.

According to the regulations, low voltage motors for explosive atmospheres are exempted from the Low Voltage Directive, the EMC Directive and the Machinery Directive.

IECEx System
The IECEx System is a certification system which verifies compliance with IEC (International Electrotechnical Commission) standards relating to safety in explosive atmospheres. It covers equipment, service facilities and personnel competencies and conformity mark licensing system.

Created in September 1999, the System aims “to facilitate international trade in equipment and services for use in explosive atmospheres, while maintaining the required level of safety…” (source: IECEx website, www.iecex.com). It is a voluntary system which provides an internationally accepted means of proving that products and services are in compliance with IEC standards. The voluntary and international aspects of the IECEx System differentiate it from certification under ATEX, for example, which is mandatory but applies only within the European Economic Area.

The IECEx System comprises global certification programs for both equipment and service facilities.

IECEx certification involves – in addition to product tests - assessment of quality control procedures and testing plans, audits of manufacturing plants, and routine on-going surveillance and inspections.

In addition, IECEx has established a comprehensive set of operational documents and procedures to develop a single internationally standardized approach to Ex testing and certification.

The approach includes:
- A standardized “IECEx way of Ex Testing and Certification”. There is a single set of operational procedures, and Ex test procedures are always applied in the same way.
- A dedicated Technical and Operational Secretariat to maintain operations. Ex test procedures are evaluated and monitored on a centralized basis.

Who is responsible for the certification work?
A manufacturer needing to have equipment certified under the IECEx System can apply to an IECEx Competent Body (ExCB) in any member country. At present there are more than 30 IECEx member countries. The ExCB performs or coordinates the activities of certification.

A quality assessment of the manufacturer is undertaken by the ExCB itself, and the auditor issues an IECEx Quality Assessment Report (QAR).

Type testing of product samples is performed on behalf of the ExCB by an IECEx Assessment and Testing Laboratory (ExTL). On completion of its work the ExTL’s assessment engineer prepares an IECEx Test Report (ExTR).

The ExTR is then submitted to the ExCB for endorsement. Based on the QAR and ExTR, the ExCB then issues the Certificate of Conformity (CoC). The CoC provides internationally accepted

verification that the equipment in question is in compliance with the relevant IEC standards. Once formally issued by the ExCB, both the ExTR and QAR are registered on the IECEx Internet site. This provides verification that an ExTR and QAR exist for the product and manufacturer.

How do I know if a motor is IECEx certified?
IECEx certified motors show the certification number on their rating plate, for example: "IECEx LCI 05.0008". In this case "LCI" indicates that the IECEx certificate was issued by LCIE, an IECEx approved Certification Body in France.

In addition, IECEx certificates are issued in electronic form and are publicly available on the IECEx website. They can therefore be viewed and printed by anyone with access to the Internet. See "Certificates & Licences" at www.iecex.com.

IECEx certification is particularly useful in certain markets. In Australia, New Zealand, and Singapore, for example, IECEx certificates are accepted, but not all IEC certificates are accepted. Certain other countries, including Russia, China and Korea, are prepared to accept ExTRs as a basis for their own national certificates. There are also many countries that are willing to accept products covered by current IECEx certificates, even though the countries in question are not members of the IECEx Management Framework.

IECEx Conformity Mark License
The IECEx Conformity Mark System was introduced in 2008. IECEx Conformity Mark Licenses are issued by approved Certification Bodies in IECEx participating countries.

The IECEx Conformity Mark shows that a product has been granted an IECEx Certificate of Conformity. IECEx Certification confirms that the product has the appropriate protection for use in explosive atmospheres and that it has been manufactured under systems subject to ongoing surveillance by Certification Bodies. It is recognized in all the countries participating in the IECEx System, and it also means that the product can be supplied to the market without the need for additional tests.

ABB has been granted IECEx Certification for a wide range of low and high voltage motors, and these can therefore display the IECEx Conformity Mark. The hazardous area protection types provided by these motors include

– Flameproof Ex d, Ex de
– Non-sparking Ex nA
– Increased safety Ex ec
– Dust protection Ex t

The IECEx Conformity Mark License will considerably enhance ABB's ability to market its products globally. It complements ABB's existing ATEX and other approvals.

Benefits of IECEx System for end users
A significant advantage of IECEx is that vendor certificates are available for inspection on the IECEx website. End users can therefore confirm the validity of IECEx certificates at any time - which is not possible with ATEX, for example. This increases end user confidence that the motor vendor will be committed to maintaining the necessary quality systems.

Under the quality based IECEx certification approach the interpretation of the standard is shared throughout the 30 participating countries and individual interpretations by Notified Bodies are not allowed. Another advantage of IECEx is that the Certificate of Conformity also covers EPL (equipment protection level) "c", see table on next page.

Which ABB motors and generators are IECEx certified?
All motors listed in this catalogue are IECEx certified, except motor types M3HP and M3AA in frame sizes 71 to 80.

Compliance on basis of recently updated standards
In complying with the ATEX 95 directives, ABB follows the requirements of recently updated IEC and EN standards. Otherwise ABB follows the requirements of the IEC standards shown in the relevant certificates.

Main standards for explosive atmospheres:	
IEC/EN 60079-0	Equipment - General requirements
IEC/EN 60079-1	Equipment protection by flameproof enclosures "d"
IEC/EN 60079-7	Equipment protection by increased safety "e"
EC/EN 60079-15*	Equipment protection by type of protection "n"
IEC/EN 60079-31	Equipment dust ignition protection by enclosure "t"
IEC/EN 60079-14	Electrical installations design, selection and erection
IEC/EN 60079-17	Electrical installations inspections and maintenance
IEC/EN 60079-19	Equipment repair, overhaul and reclamation
IEC 60050-426	Equipment for explosive atmospheres
IEC/EN 60079-10	Classification of hazardous areas (gas areas)
IEC 60079-10-1	Classification of areas - Explosive gas atmospheres
IEC 60079-10-2	Classification of areas - Combustible dust atmospheres

* Moved to IEC/EN 60079-7 in 2015 revision.

Equipment protection levels (EPLs)
The latest revisions of the IEC and EN standards introduce the concept of "equipment protection levels", which identify products according

to the ignition risk they might cause. A motor's EPL therefore indicates its inherent ignition risk, regardless of its protection type. This makes the selection of equipment for different zones easier. EPLs also enable a true risk assessment approach, where the potential consequences of a possible explosion are taken into consideration. Please refer to the table on the next page for more information about EPLs and EPL markings.

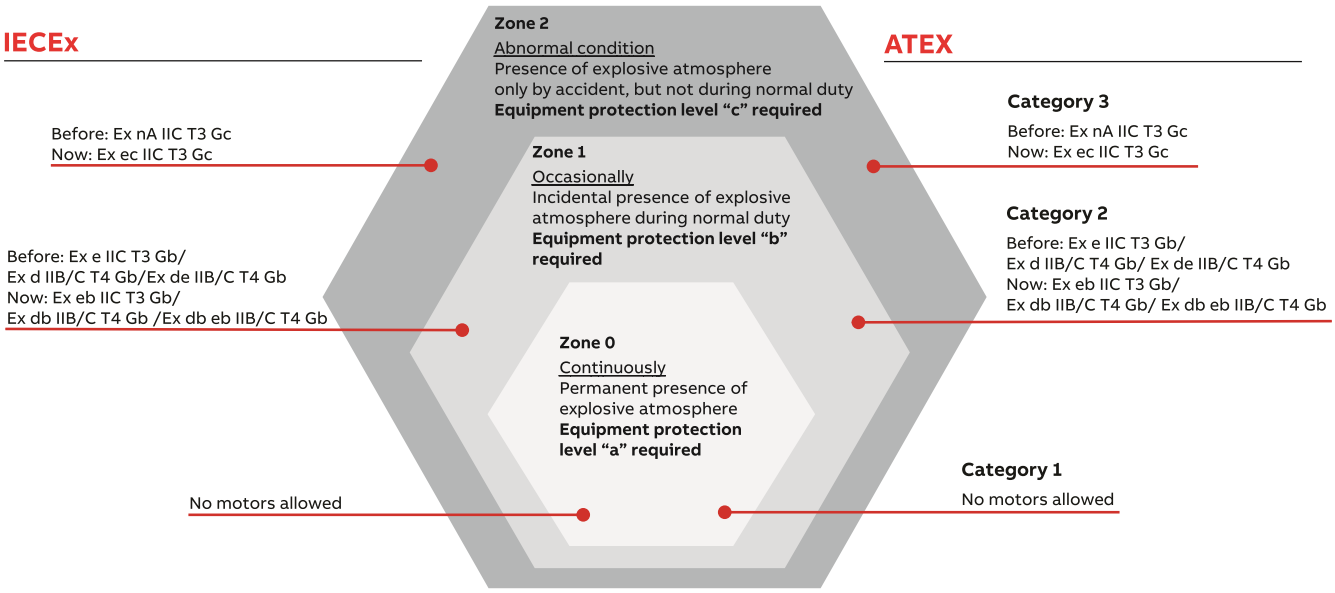
New markings introduced

The latest revisions of the standards IEC/EN 60079-7 and IEC/EN 60079-1 have introduced some new markings for equipment suitable for locations where there is a potential risk of gas present. The non-sparking protection method is no longer used on rotating electrical machines, instead have two levels on increased safety protection been introduced in edition 5 of IEC/EN 60079-7. One higher level of protection with EPL Gb that technically corresponds to the old Ex e, an a new lower level with EPL Gc that corresponds to Ex nA as previously defined in IEC/EN 60079-15.

Further have also several levels of protection been introduced in edition 7 of IEC/EN 60079-1 for flame proof protection. These two changes does affect the markings used both flameproof, increased safety and non-sparking equipment for group II as shown in table below. Product certificates are updated gradually to show new markings, during the transition period may both old and new markings be used in parallel depending type and size of motor.

Old way of marking	Old protection method	New way of marking	New protection method	Zone	ATEX category
Ex e IIC T3 Gb	Increased safety	Ex eb IIC T3 Gb	Unchanged	1 (or 2)	2G
Ex nA IIC T3 Gc	Non-sparking	Ex ec IIC T3 Gc	Increased safety	2	3G
Ex d IIB/C T4 Gb	Flameproof	Ex db IIB/C T4 Gb	Unchanged	1 (or 2)	2G
Ex de IIB/C T4 Gb	Flameproof and increased safety	Ex db eb IIB/C T4 Gb	Unchanged	1 (or 2)	2G

Zones - IECEx and ATEX



Note: Based on traditional relationship between EPL`s and zones.

There are systems in place worldwide to classify explosive atmospheres by zones, according to the risk posed by explosive gas ("G") or dust ("D").

Classification of explosive atmospheres according to CENELEC and IEC

The following standards define areas according to the presence of gas or dust in the atmosphere:

– IEC/EN 60079-10-1 Gas
– IEC/EN 60079-10-2 Dust

Standard IEC 60079-0 EN 60079-0 Group	EPL	Protection level	Installation Zone acc. to IEC 60079-10-x EN 60079-10-x Zones	ATEX Directive 2014/34/EU Equipment group	Equipment category	Main motor protection types
I (Mines)	Ma	very high	NA	I (Mines)	M1	NA
	Mb	high			M2	
II (Gas)	Ga	very high	0	II (Surface)	1G	NA
	Gb	high	1		2G	Ex d/Ex de Ex p, Ex db, Ex db eb, Ex p, Ex eb (Ex e)
	Gc	enhanced	2		3G	Ex ec (Ex nA)
III Dust	Da	very high	20		1D	NA
	Db	high	21		2D	Ex tb IP 65
	Dc	enhanced	22		3D	Ex tc IP 65/IP 55

Marking of temperatures, gas groups and explosive atmospheres

To ensure equipment can be safely used in potentially explosive atmospheres, the explosive atmospheres where the equipment is installed must be known. The temperature class of equipment must be compared with the spontaneous ignition the equipment of the gas mixtures concerned, and in specific cases the gas group must be known (e.g. flameproof protection).

Classification

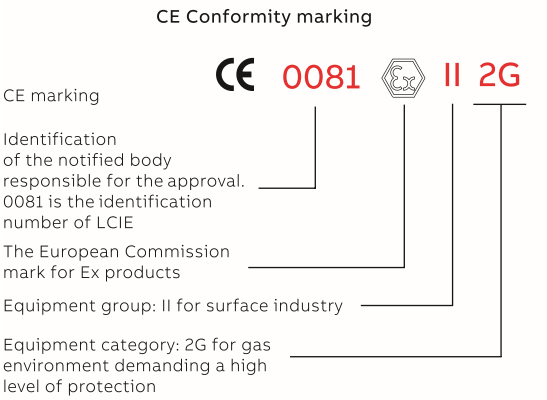
Gas classification

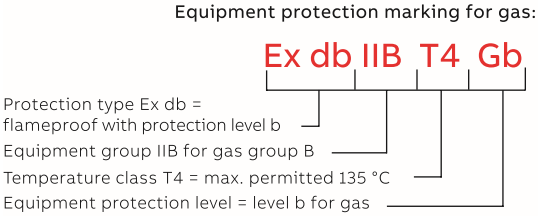
Temperature class	Ignition temp. of gas/ vapor °C	Max. permutiet temp. of equipment °C	Gas examples
T1	> 450	450	Hydrogen
T2	> 300 < 450	300	Ethanol
T3	> 200 < 300	200	Hydrogen sulfide
T4	> 135 < 200	135	Diethyl ether
T5	> 100 < 135	100	-
T6	> 85 < 100	85	Carbon disulfide

Gas subdivision

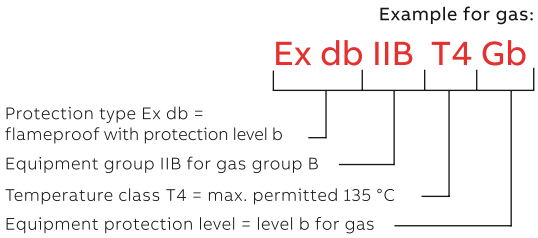
IIA	~120 gases and vapors, e.g. butane / petroleum / propane
IIB	~30 gases and vapors, e.g. ethylene / dimethyl ether
IIC	limited number of gases and vapors, e.g. hydrogen H_2 / acetylene C_2H_2 carbon disulfide CS_2

Marking of equipment protection for gas according to ATEX

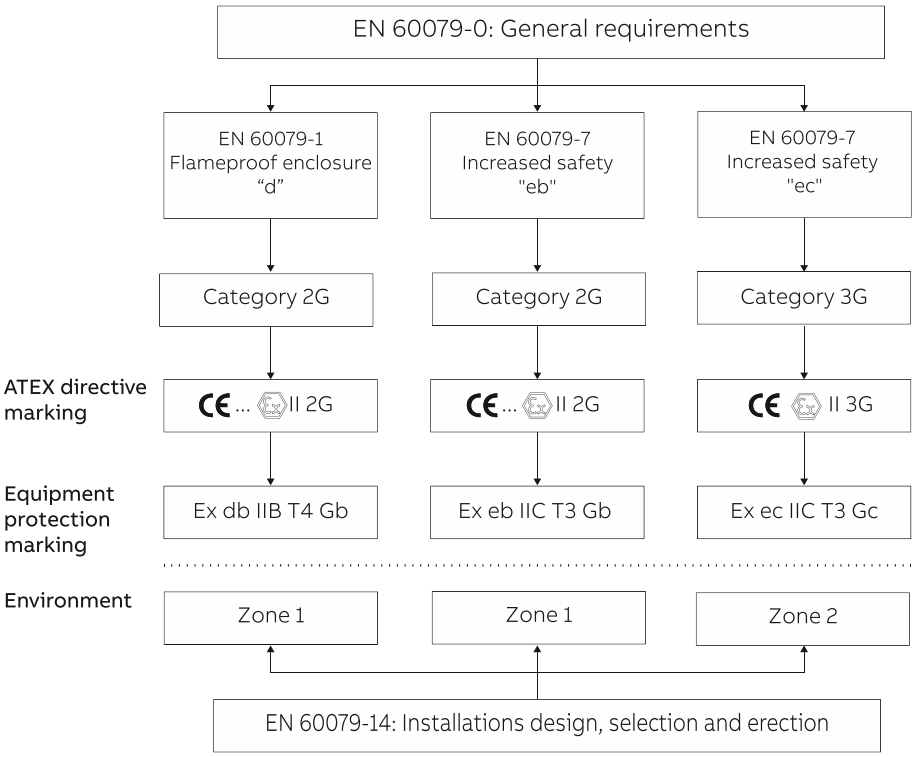




Marking of equipment protection for gas according to IEC



Selection of products for explosive atmospheres EN Standard and ATEX Directive for gas environments



Explosive atmospheres

In explosive atmospheres, it is of the utmost importance to ensure the safe use of electrical apparatus. To this end, many countries have regulations concerning both the design and use of such apparatus. These regulations are becoming increasingly harmonized within the framework of IEC recommendations and European Standards. The hazard may be due to an explosive atmosphere composed of a mixture of gas, vapors or dusts with air. This section is concerned only with safety in explosive gas atmospheres for which European Standards and IEC recommendations exist.

Flameproof enclosure Ex db and Ex db eb
The motor enclosure is designed in such a way that no internal explosion can be transmitted to the explosive atmosphere surrounding the motor. The enclosure must withstand, without damage, any pressure levels caused by an internal explosion. The shape, length and gap of joints of part assemblies, at shaft openings, cable entries, etc., shall be designed to allow for throttling and cooling of hot gases escaping outside. The standards emphasize the impact of an explosive atmosphere (for instance, explosion pressure) over constructional requirements of such apparatus.

Work on accessories of enclosure components is only permitted using prescribed tools. Cable entries must meet the requirements of this type of protection.

The temperature of the motor's external enclosure shall not exceed the self-ignition temperature of the explosive atmosphere of the installation area during operation. For this reason, rated output depends on this rated maximum temperature for the area in question. The standard temperature class on flameproof motors from ABB is T4 (135 °C), other temperature classes as T5 (100 °C) and T6 (85 °C) are available on request.

No motor device outside the flameproof enclosure (e.g., ventilator) shall be a potential source of sparks, arcs or dangerous overheating.

Variants combining two types of protection usually combine "d" and "e" protection. The motor is designed with an Ex d flameproof enclosure, while the terminal box features Ex e increased safety protection. Such design combines the superior safety degree of the "d" type of protection with the more simple and worker friendly "e" type protection terminal box.

Alleinschutz – thermistors as sole protection (optional)
Flameproof motors from ABB have been designed to use thermistors as the sole method of protection against overload. This construction, "Alleinschutz", is available as an option, please refer to variant code section for availability information.

"Alleinschutz" refers to the protection of a flameproof motor by a protective device which is triggered by thermistors. The thermistors and relays will switch off the motor in case of overheating before the temperature of the motor's external enclosure exceeds the temperature marking stamped on the rating plate.

Each motor ordered with thermistors as sole protection will be tested, with locked rotor, up to the point where the thermistors trigger the relay to turn off the motor. At the triggering temperature, the motor has to be within the certified temperature class limit.

Only approved relays can be used for "Alleinschutz".

Please note that sizes 315 to 450 require special technical solutions, consult ABB.

Increased safety design, Ex eb
The design of this motor type prevents the occurence in operation (including starting and locked rotor situations), in all inner and outer parts of the machine, of sparks, arcs or hot spots that could reach the self-ignition temperature of the surrounding, potentially explosive atmosphere.

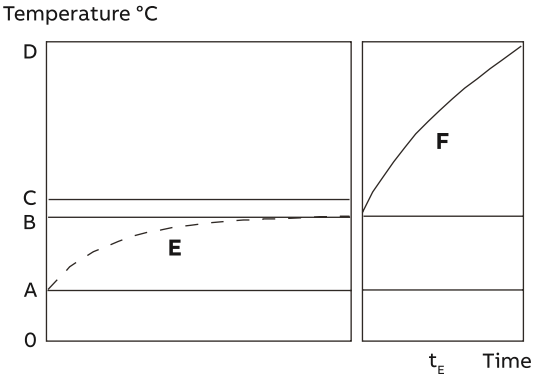
This is ensured by applying constructional or dimensional provisions that mainly concern:

– specified minimum values for creepage distances and clearances
– use of tracking-proof isolating materials
– suppression of sharp angles where static electrical loads could build-up
– ensuring electrical and mechanical assemblies are tightly secured
– minimum backlash values between stationary and rotating parts (e.g. air gap, ventilator, etc.)
– temperature-rise limits, taking into account locked rotor, normal operation, accidental mechanical stalling of machine under the most adverse thermal conditions, i.e. when thermal equilibrium of machine is reached while in service.

Temperature rise limits should be considered for two operating aspects; normal operating conditions and accidental stalling conditions.

Temperature rise limits under normal operating conditions

The expected electrical lifespan of a motor depends on its temperature rise for a given insulation class, and on the motor winding temperature, during operation, which is not homogeneous due to the appearance of hot spots. For these reasons, a safety margin of 10 K is allowed between the winding's temperature rise at rated output, as measured by the change of resistance method, and the maximum temperature rise permitted by the winding insulation class.



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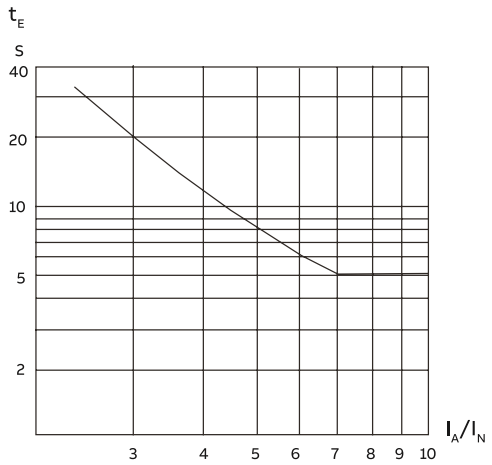
Temperature rise limits during short circuit under accidental stalling conditions

Should the machine stall while in operation, a short circuit current nearly equal to the starting current will develop, and stator and rotor winding temperatures will rise rapidly (see Figure 01).

To prevent this temperature value from exceeding the maximum limit temperature as set by the nature of the potentially explosive atmosphere (D in Figure 01), protection devices must trip within a specified time (t_E). This tripping time depends on the short-circuit current level or the short circuit current to rated current ratio (I_A/I_N). Figures 02 and 03 show, for commonly used protection devices, the limiting ratio between short-circuit current inrush I_A/I_N and rotor stalling time t_E, according to the EN and IEC standards and "VIK" specification. VIK is an industry specification originating in Germany.

This type of protection is inappropriate for commutator machines or brake-motors which, by principle, are capable of producing arcs, sparks or hot spots.



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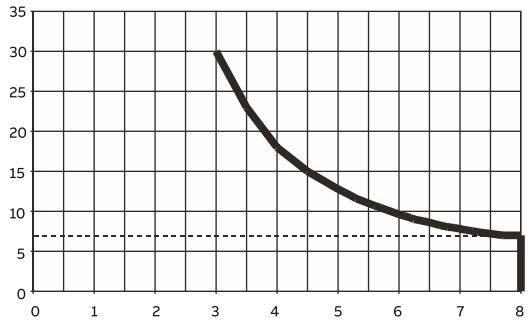

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Increased safety design, Ex ec

The use of this type of protection is allowed in hazardous areas corresponding to zone 2. The design is known as "non-sparking" or nowdays increased safety ec, because the motor must be designed in such a way that no sparks can occur in any conditions, when used within the ratings specified by the manufacturer, and that no excessive temperatures occur under normal operating conditions, which excludes thermal requirements due to starting or accidental stalling.

Risk assessment and gas tests

Increased safety Ex eb and Ex ec motors have to meet tough requirements with regard to sparking. The latest IEC and EN standards specify criteria for

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O = Temperature 0 °C,
A = Max. ambient temperature (reference 40 °C),
B = Temperature at rated load and under worst voltage conditions,
C = Max temperature as permitted by the insul. class,
D = Max limit temperature as set by the nature of the potentially explosive atmosfeer,
E = Temperature-rise curve of motor at rated output and underworst voltage conditions,
F = Temp. rise curve under stalled rotor conditions,
tE = Stalled rotor time.

02 Min. value of time t_E as a function of I_A/I_N acc. to IEC/EN60019-7.

03 Min. value of time t_E as a function of I_A/I_N acc. to VIK.

Note: tE time for VIK differs from EN.

risk assessment and gas environment tests for rotor and stator designs to show that the motors are spark-free in all operational conditions.

By testing and securing certification for its motors, ABB is helping to streamline the risk assessment process for its customers.

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 – pre-start 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.

ABB's approach to meeting the requirements
Following a program of gas environment tests in which all rotor and stator tests were passed, ABB has secured certification for its low voltage cast iron motors for explosive atmospheres with aluminum die cast rotor.

Ex ec motors are certified according to the ATEX directive with a voluntary type examination certificate from an ATEX notified body, and according to the IECEx system with an IECEx certificate of conformity.

Aluminum frame motors type M3AA in sizes 71 and 80 with manufacturer ATEX EU Declaration of conformity only.

Dual certificaten for gas or dust
Due to the high IP protection class and low surface temperature of the products, the certificates allow also in many cases dual certification for either gas or dust environments. This gives further flexibility as the same motor can either be used in a location with potentially explosive atmospheres with gas, or another with dust. For use in hybrid atmospheres (gas and dust present simultaneously) should limitations in IEC/EN 60079-14 be respected.

The following combinations are possible:

– Ex db IIB/C T4 Gb / Ex tb IIIB/C T125°C Db
– Ex db eb IIB/C T4 Gb / Ex tb IIIB/C T125°C Db
– Ex eb IIC T3 Gb / Ex tb IIIB/C T125°C Db
– Ex ec IIC T3 Gc / Ex tc IIIB/C T125°C Dc

Please refer to the variant code section of flameproof, increased safety eb and ec motors for further information about availability of dual certification.