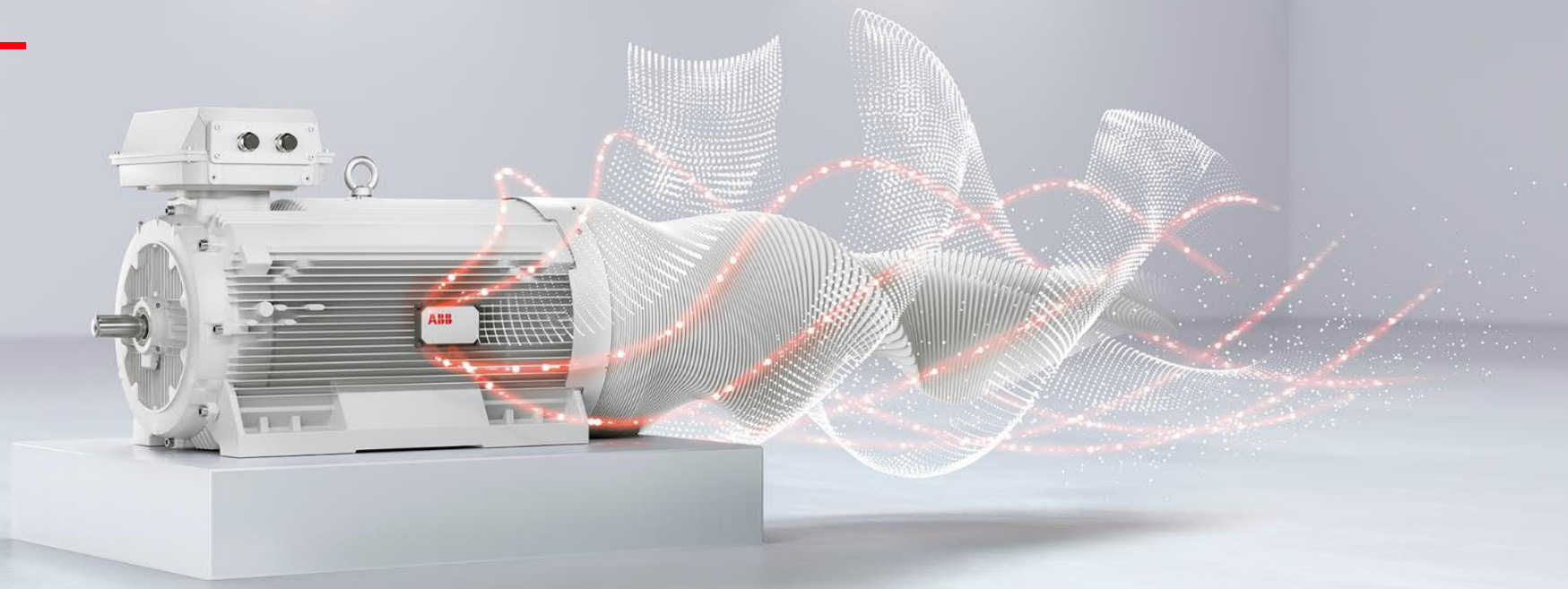
Attachments:

1. ABB Ex motors and drives - selection process flow (poster)
2. LV motors and drives for applications in ATEX (brochure)
3. Motors and drives in in ATEX - What you need to know (Guide)



Motors for hazardous area and drives

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Agenda

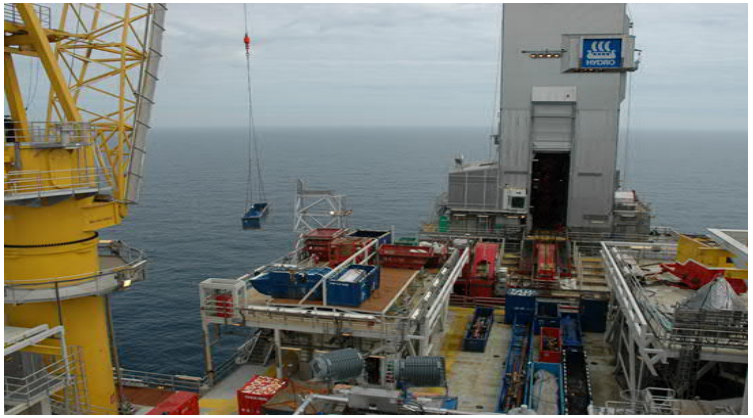
- Introduction to standards
- Motors in hazardous area and drives
- Maintenance and repair on Ex equipment

Introduction to standards

December 6, 2018

Motors for explosive atmospheres and drives

Why we talk about hazardous area requirements?



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Why are we talking about hazardous area standards?

Corn silo

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Corn silo - after the dust explosion

©ABB

What does ATEX mean?

ATEX (**AT**mosphères **EX**plosifs) is a set of EU directives concerned with all equipment installed in potentially explosive atmospheres (both gas and dust), working in them, and used protective devices (also ones installed outside the explosive atmosphere)

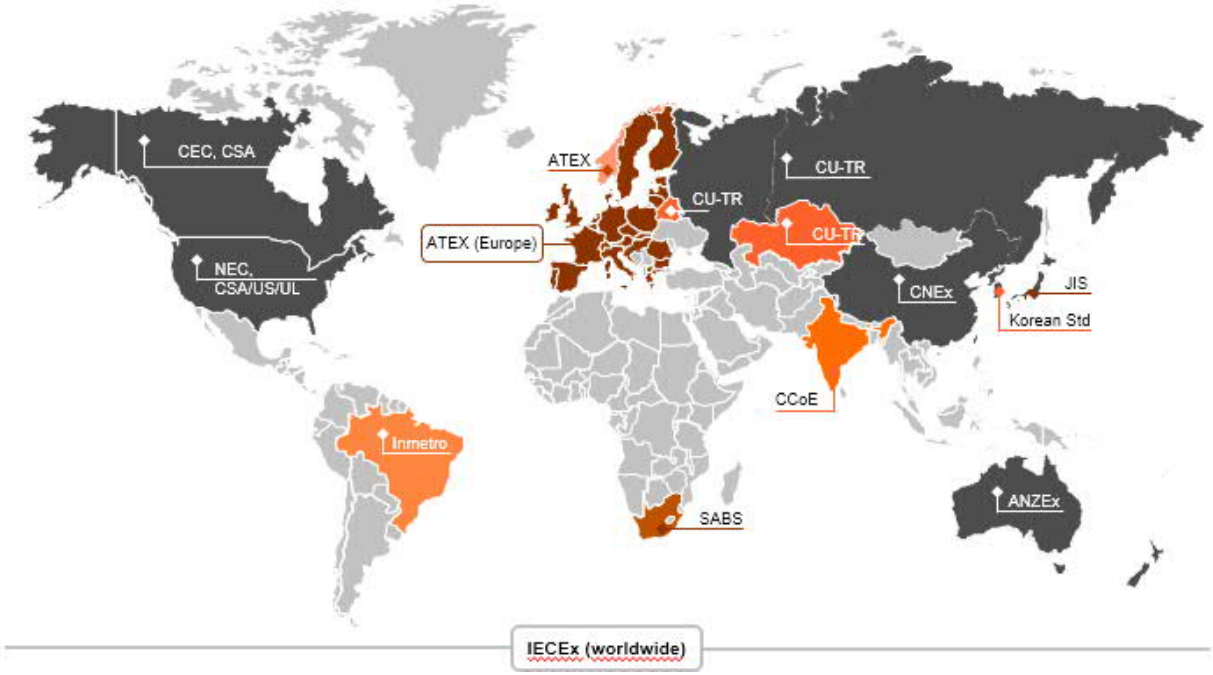
- ATEX 2014/34/EU: Duties of the manufacturer (Product safety)
- ATEX 1999/92/EC: End user's obligations (Worker safety)

ATEX harmonises various national technical and legal requirements across Europe to ensure a very high level of safety.

Across the whole EU and the European Economic Area (EEA), Mandatory from 1st July 2003 for all products (incl. Non-electrical)

ATEX = EU; *Ex* = global

World of standards



Other standards and specifications:

- National standards, like BS, DIN, SFS etc.
- Industrial specifications, like API, Shell DEP etc.

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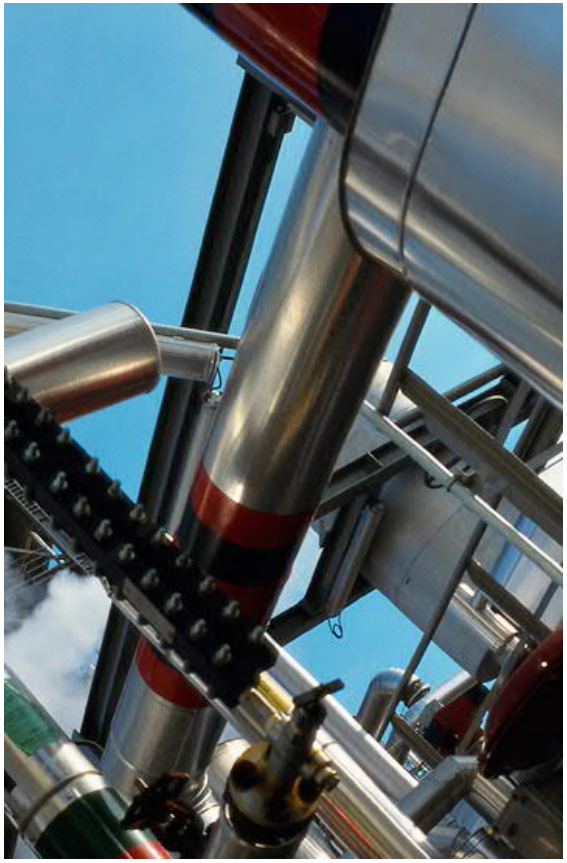
Global effect



Although ATEX directives are only applicable within EU, they are based on IEC (EN) standards which has lead to their principles being demanded by users throughout the world

ATEX approval is generally not recognized outside Europe and industries with hazardous areas should investigate which approval schemes apply locally

In addition to EN standards (ATEX directives), a number of other standards are used in the world

ATEX Directive

- Products Directive ATEX Concentrates on the duties of the manufacturers.
- Defines the Essential Health & Safety Requirements (EHSRs) applicable to equipment, such as motors, to be used in potentially explosive atmospheres containing gas or combustible dust.
- Ex equipment's intended for use in EU Countries shall be certified according the ATEX Directive ATEX 2014/34/EU
- The main mechanical and electrical design of the machine fulfils EN standards.

Motors for explosive atmospheres and drives

What is ATEX?

The European regulatory framework for manufacture, installation and use of equipment in explosive atmospheres

ATEX = Atmosphères Explosibles (french for Explosive atmospheres)

ATEX refers to two separate European Union (EU) directives

The Worker Protection Directive 1999/92/EC	⇔	The Product Directive 2014/34/EU (formerly 94/9/EC)
Is about classification of hazardous areas and the correct selection, installation, inspection and maintenance of Ex equipment		Is about the manufacture and sale of Ex equipment.

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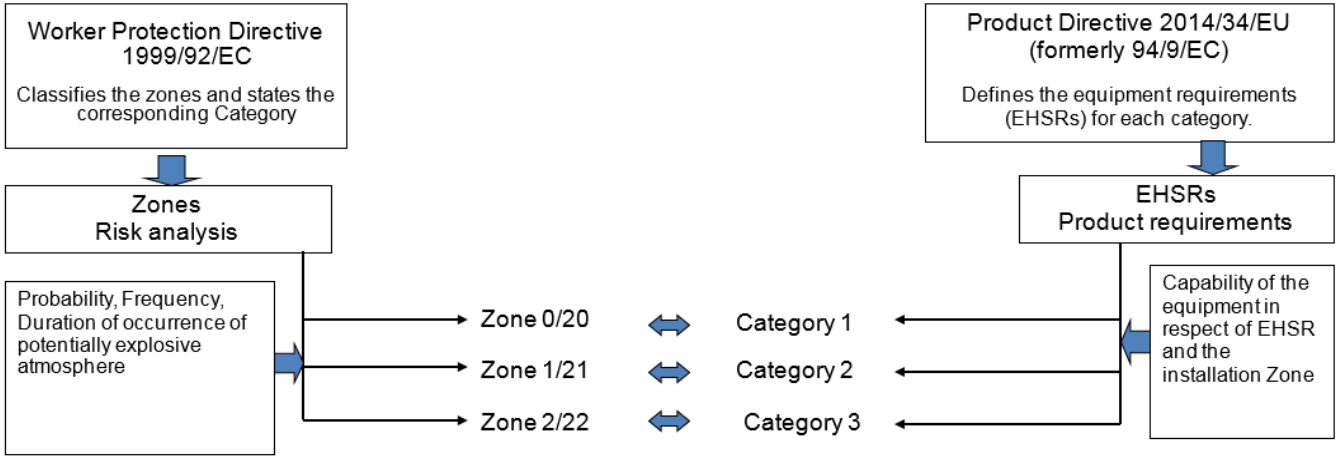
Motors for explosive atmospheres and drives

Legislation & standards – ATEX



EHSR = Essential Health & Safety Requirements

End-user must define Zone, gas group, temperature class and preferred protection class

– Zone is defined based on risk analysis

End-user is responsible for installation of products and equipment

Any third party work has to be verified by the end-user before start-up

End-user is responsible to create an explosive protection document (EPD) including above documents.

- Manufacturer proposes product to be used in end-user defined area
- Since electric drives are always installed in a safe area, they are only affected by ATEX directives when connected to elecric motors
  - Drive manufacturer has to meet requirements of motor manufacturer
- Product manufacturer is responsible for safety of his product and for delivering maintenance and installation instructions

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IEC and IECEx System

IEC = International Electrotechnical Commission

IEC is a non-profit, non-governmental international standards organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

IECEx = IEC System for Certification to Standards relating to Equipment for use in Explosive Atmospheres

The objective of the IECEx System is to facilitate international trade in equipment and services for use in explosive atmospheres, while maintaining the required level of safety.

- IECEx System is an international conformity assessment system for Ex equipment, installations, area classifications, repair shops and persons
- The IECEx System is based on the use of specific international IEC Standards for type of protection of Ex equipment.
- IECEx System includes additions to the certification system compared to IEC. These modifications do not include the product itself, but the process (quality, procedures, documentation…)
- IECEx is internationally recognized by all certification laboratories

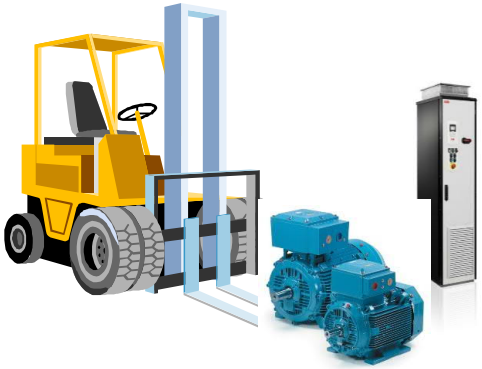
Motors for explosive atmospheres and drives

Legislation & standards – Zone classification

First define the area based on risk analysis!

-> Zone, gas group, temperature class

…and what level of protection is required from the device



Then you can install the devices with required protection level.

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Classification of locations/areas

The IEC 60079-10 standards define the Zones as follows:

Atmosphere	Zone	Definition
Gas Dust	0 20	Explosive atmosphere is present continuously or for long periods or frequently
Gas Dust	1 21	Explosive atmosphere is likely to occur in normal operation occasionally
Gas Dust	2 22	Explosive atmosphere is not likely to occur in normal operation but if it does occur, will persist for a short period only

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ABB motors for explosive atmospheres and drives

Equipment, gas/dust and temperature classification

IECEx

Equipment groups

Group I - mines susceptible to firedamp

Group II – surface areas with gas

Group III – surface areas with dusts

ATEX

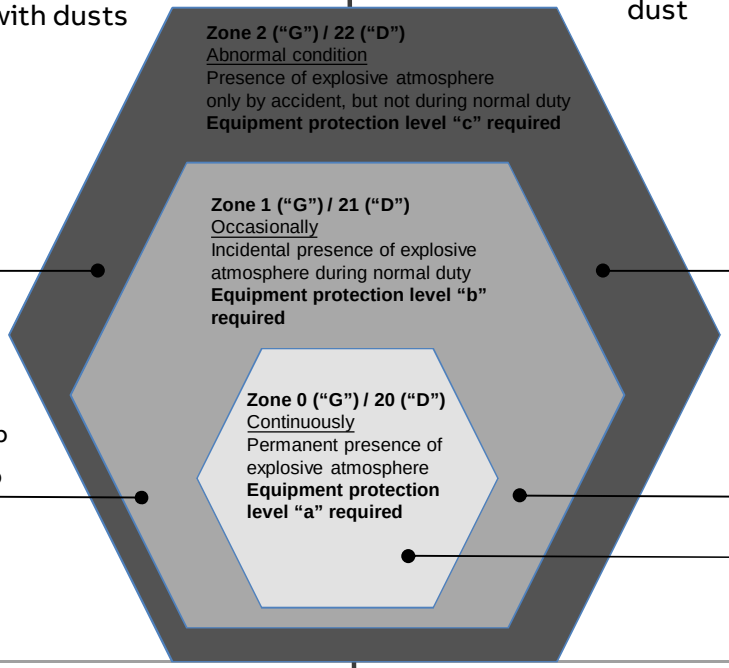
Equipment groups

Group I - mines susceptible to firedamp

Group II – surface areas with gas and dust

CE Conformity marking example

CE 0081 II 2G



Ex ec (=Ex nA) IIB/C T3 Gc

Ex tc IIIB/C T125°C Dc

Category 1, 2, 3

Ex ec (=Ex nA) IIB/C T3 Gc

Ex tc IIIB/C T125°C Dc

Ex d(e) IIB/C T4..T6 Gb

Ex tb IIIB/C T125°C Db

Category 1, 2

Ex d(e) IIB T4..T6 Gb

Ex tb IIIB/C T125°C Db

Category 1

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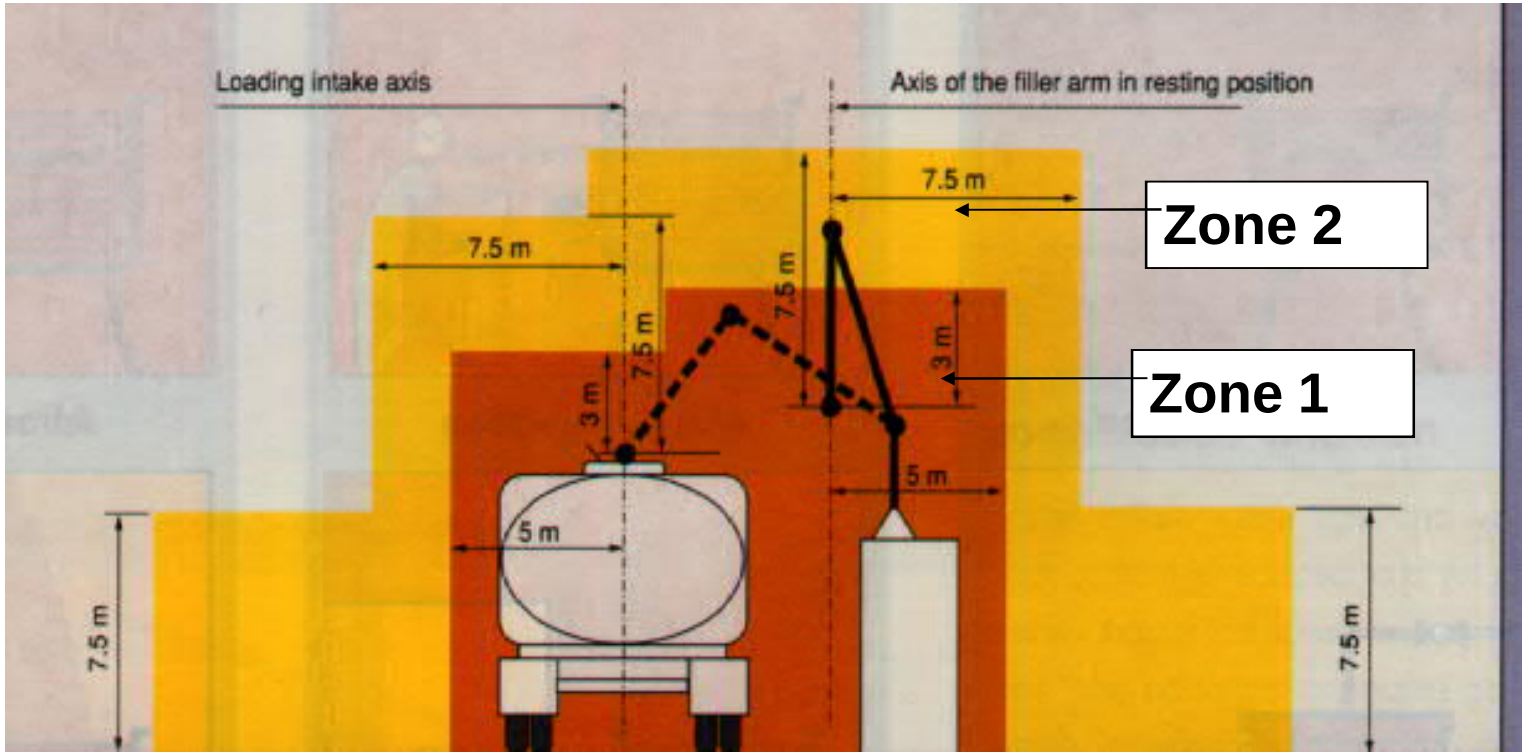
Area Classification



Example: Tanker lorry loading units

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Protection Types

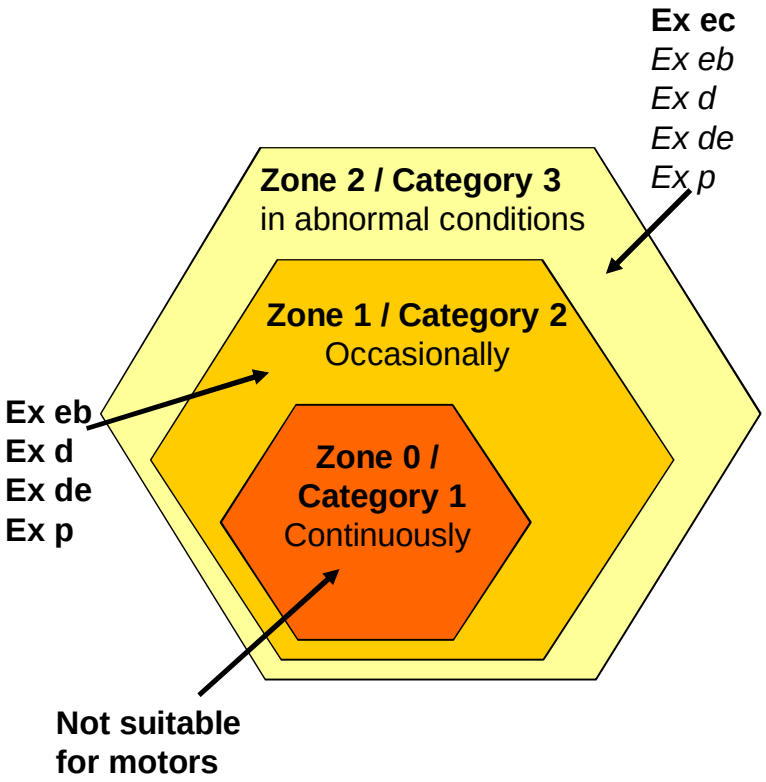
Old marking :IEC Ex/ ATEX

- Non-sparking apparatus — Ex nA
- Increased safety — Ex e
- Flame proof enclosures — Ex d, Ex de
- Pressurized enclosure — Ex p
- Dust Ignition Protection — Ex tc, Ex tb

New changes to the marking:

New standard for ExnA and Exe protection

- Ex nA -> Ex ec
- Ex e -> Ex eb



IEC and EN standards

- **Determination of Zones**
  - Zone 0 – permanent presence of explosive atmosphere (>1000 hrs/year)
  - Zone 1 – incidental presence of explosive atmosphere (10-1000 hrs/year)
  - Zone 2 - presence of explosive atmosphere only by accident (<=10 hrs/year
- **Apparatus groups**
  - Group I - mines susceptible to firedamp
  - Group II – areas with gas
  - Group III – areas with dust

- **Gas group**

  IIA (e.g. Propane)

  IIB (e.g. Ethylene)

  IIC (e.g. Acetylene and Hydrogen)

- **Dust group**

  IIIA (combustible flyings, eg. fibers)

  IIIB (non-conductive dust)

  IIIC (conductive dust)

- **Temperature classes**

  T1……T6

T1	T2	T3	T4	T5	T6
450C	300 C	200 C	135 C	100 C	85 C

Gas groups and temperature classes

Classification of gases and vapours in explosion groups and temperature classes						
	T1	T2	T3	T4	T5	T6
I	Methane				-	
IIA	Acetone Ethane Ethylacetate Ammonia Benzol Acetic Acid Carbon monoxide Methanol Propane Toluene	Ethylalcohol I-amyl acetate N-buthane N-btylalcohol	Petrol Diesel fuel Aviation fuel Heathing oil N-hexane	Acetaldehyde	-	
IIB	Town gas (lamp gas)	Ethylen			-	
IIC	Hydrogen	Acethylene			-	Carbon disulphide

Based on these values the appropriate temperature class will be determined for an equipment installed safely in the area containing a combustable substance which does not exceed the auto-ignition temperature of the substance. This temperature class is mostly not exceeding 80% of the AIT, and in many industries may be even lower to provide a bigger safety margin.

Equipment Protection Levels (EPL)

EPL	Definition	Relationship to Zones
G**a** (gas)	Equipment having a ”very high” (a) level of protection, e.g. ”ia”	0
G**b** (gas)	Equipment having a ” high” (b) level of protection, e.g.”ib”, ”d”, ”p”, ”e”,(”de”)	1
G**c** (gas)	Equipment having an ”enhanced ” (c) level of protection, e.g. ”ic”,”nA”	2
D**a** (dust)	Equipment having a ”very high” (a) level of protection, e.g. ”ta”	20
D**b** (dust)	Equipment having a ” high” (b) level of protection, e.g. ”tb”	21
D**c** (dust)	Equipment having an ”enhanced” (c) level of protection, e.g. ”tc”	22

Marking (ATEX, EN) gas

Marking according to ATEX-directive

CE 0537 Ex II 2 G

- CE → CE-marking
- 0537 → Notified body eg. 0537 - VTT
- Ex → Use in explosive atmosphere
- II → Equipment group for surface industry
- 2 → Equipment category 2 (Zone 1)
- G → for Gas

Standard marking according to EN-standards

Ex d II B T4 Gb

- Ex → Ex - Explosion protected apparatus
- d → Type of Protection
- II → II - Group (gas)
- B → A, B, C - Gas groups
- T4 → Temperature class
- Gb → Equipment protection level for gas

Marking (ATEX, EN) dust

Marking according to ATEX-directive

CE 0537 Ex II 3 D

- CE: CE-marking
- 0537: Notified body eg. 0537 - VTT
- Ex: Use in explosive atmosphere
- II: Equipment group for surface industry
- 3: Equipment category (Zone 22)
- D: for Dust

Standard marking according to EN-standards

Ex tc III B T125°C Dc

- Ex: Ex - Explosion protected apparatus
- tc: Type of Protection “t” for dust and protection level “c”
- III: III - Group (dust)
- B: A, B, C - Dust groups
- T125°C: Temperature class
- Dc: Equipment protection level for dust

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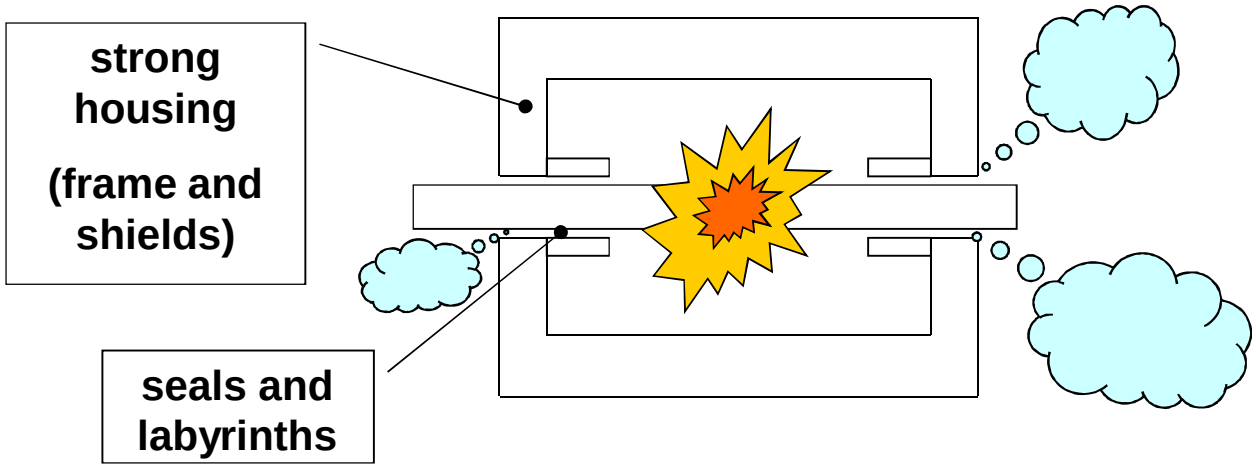
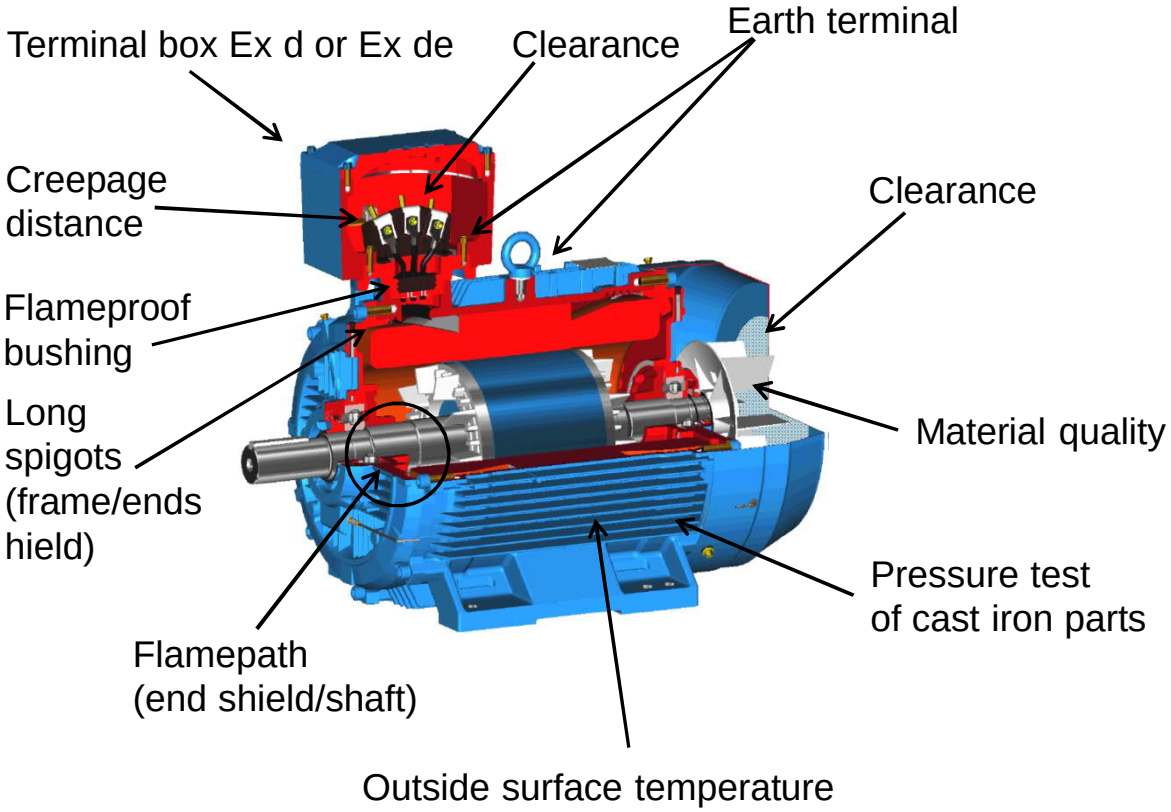
Ex d enclosure

What does mean Flameproof enclosure ?

The enclosure is designed in such a way that an explosion inside the motor will not cause any permanent deformation and will prevent the flame propagation outside



Critical parts in Ex d and Ex de



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Exd and Exde motor

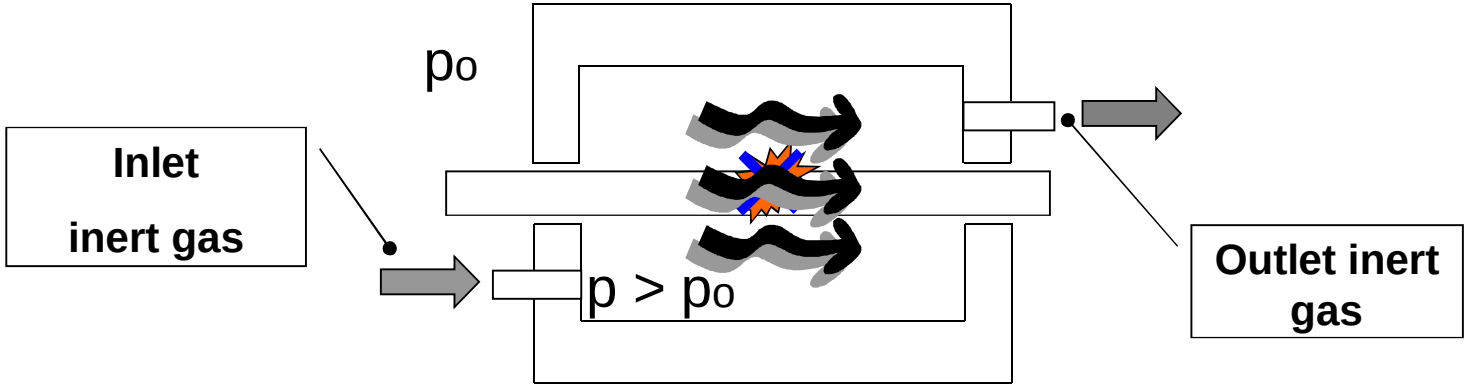
Exd motor with Exd terminal box

Exde motor with Exeb terminal box

Ex p enclosure

What does it mean Pressurized enclosure ?

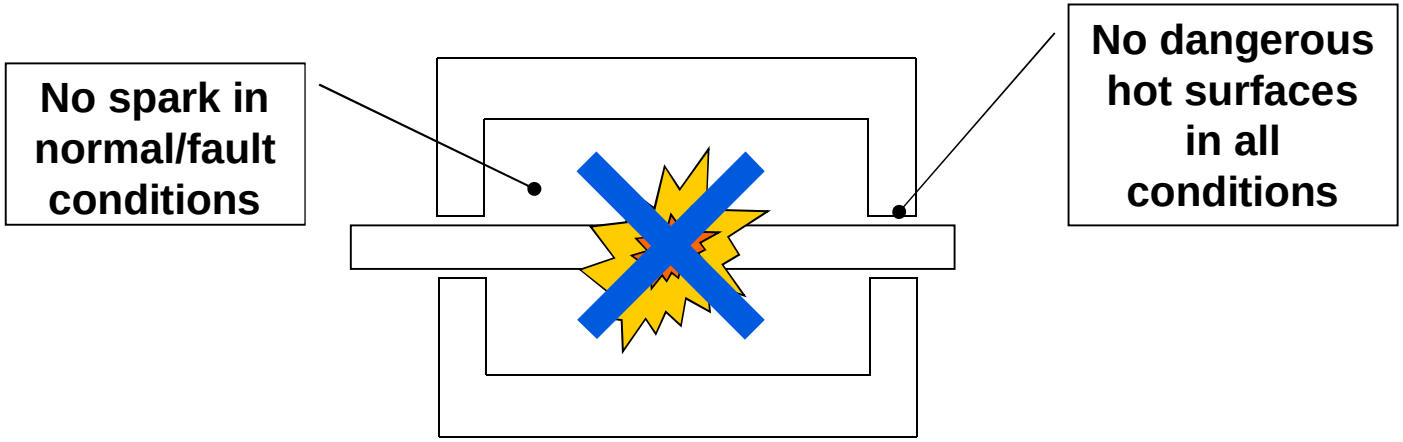
Parts which could ignite an explosive gas mixture are housed in an enclosure which is flushed and pressurized by a protective gas, e.g. clean air.



Ex eb (old Ex e) enclosure

What does it mean Increased Safety enclosure ?

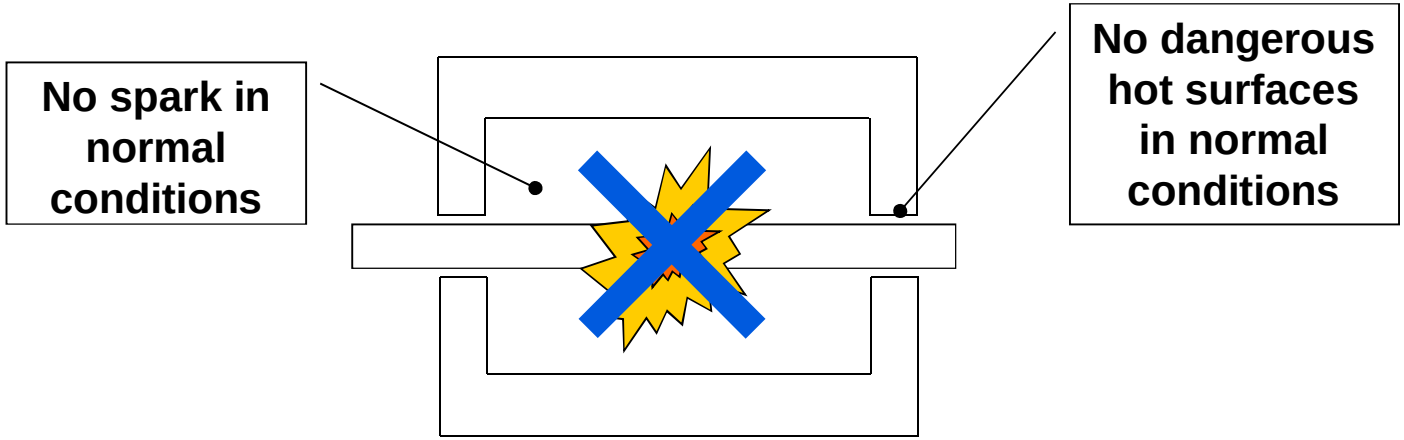
Parts which could ignite an explosive gas are manufactured in such a way that to prevent ignition of flammable gas



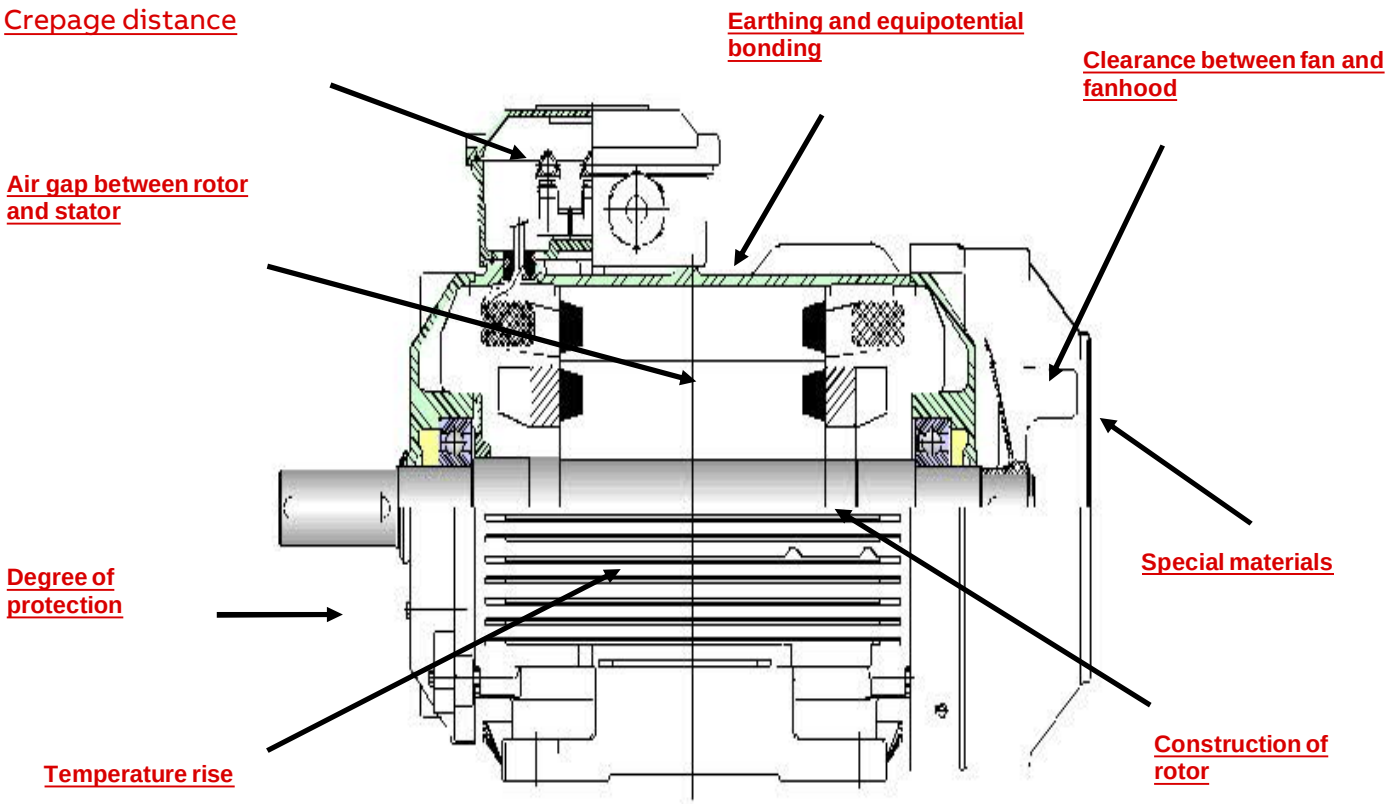
Ex ec (old Ex nA) enclosure

What does it mean Non Sparking enclosure ?

Parts which could ignite an explosive gas are manufactured in such a way that to prevent ignition of flammable gas



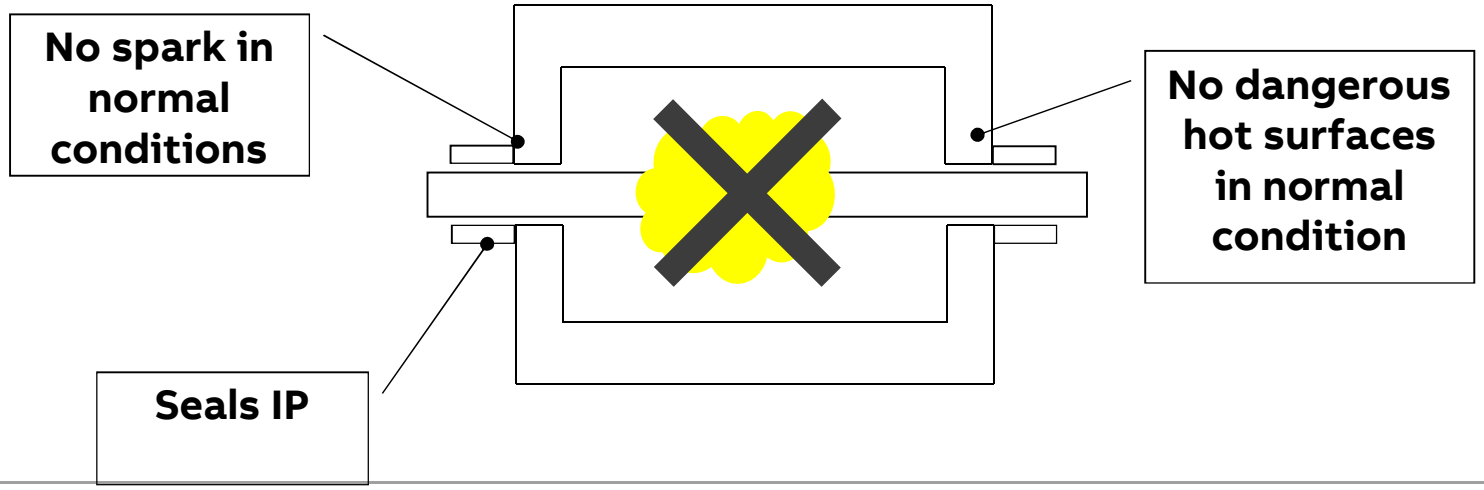
Critical parts in Ex eb (Exe), Ex ec (ExnA) motors



Ex tD enclosure

What does it mean Dust Ignition proof enclosure?

The enclosure is designed in such a way that no potentially explosive dust can penetrate inside the motor. The ingress of dust into the motor is prevented by the IP protection, being either IP65 or IP55. No sparks may occur outside the motor enclosure



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What’s happened

- Protection type Ex nA motor requirements on standard IEC 60079-15 moved to standard IEC 60079-7 Ex e
- Marking will be changed:
- Ex nA --> Ex ec
- Ex e --> Ex eb

- Technical requirements in the new standards are mostly the same as in the previous versions

New editions of IEC 60079-7 and EN 60079-7
Ex nA -> Ex ec, Ex e -> Ex eb

The protection concept for Ex nA and Ex e is fairly similar when it comes to rotating machines

– Slightly less requirements for Ex nA

New IEC 60079-7 standard Edition 5.0 has been published in June 2015

New EN 60079-7 standard version has been published in December 2015

EN 60079-7 is harmonized under ATEX Directive in the beginning of 2016

EU Declarations of Conformity documents (ATEX) must refer to the new revision of the standard latest by August 2018

All new equipment put on the market by manufacturers after August 2018 needs to be marked according to the new standards.

Sum up, decoding a rating plate for a Hazardous area motor

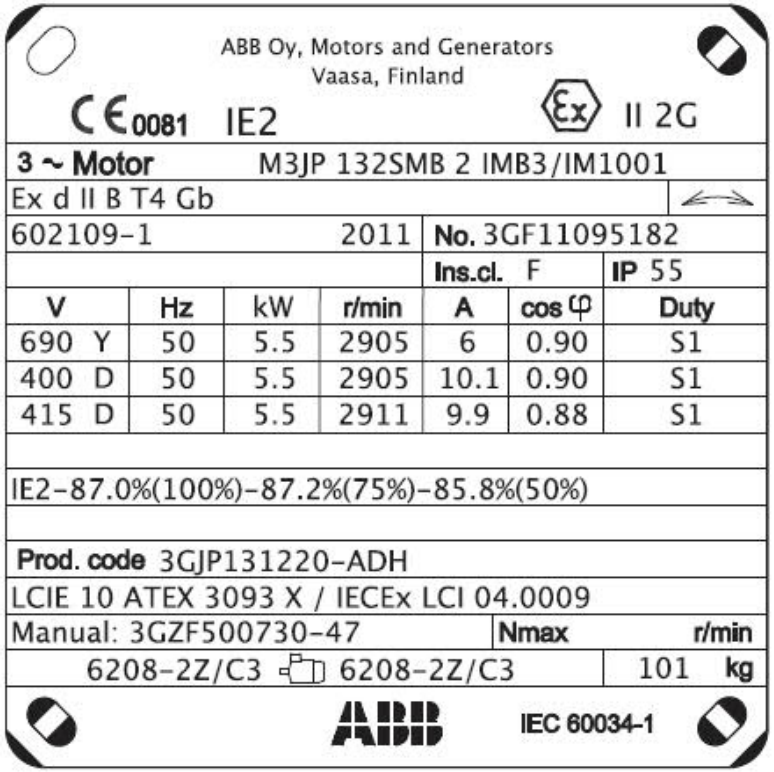

ABB Oy, Motors and Generators
Vaasa, Finland

CE 0081 IE2 Ex II 2G

3 ~ Motor M3JP 132SMB 2 IMB3/IM1001

Ex d II B T4 Gb

602109-1 2011 No. 3GF11095182

Ins.cl. F IP 55

V	Hz	kW	r/min	A	cos φ	Duty
690 Y	50	5.5	2905	6	0.90	S1
400 D	50	5.5	2905	10.1	0.90	S1
415 D	50	5.5	2911	9.9	0.88	S1

IE2-87.0%(100%)-87.2%(75%)-85.8%(50%)

Prod. code 3GJP131220-ADH

LCIE 10 ATEX 3093 X / IECEx LCI 04.0009

Manual: 3GZF500730-47 Nmax r/min

6208-2Z/C3 6208-2Z/C3 101 kg

ABB IEC 60034-1

Motors in hazardous area and drives

December 6, 2018

Motors for explosive atmospheres and drives

When an Ex Motor is controlled by variable speed drive (VSD), the motor shall be protected against becoming a potential ignition source

- A) by testing the VSD-Motor pair
- B) by safety devices

A) A tested package needs no additional protection (e.g. PTC/Pt100)

- However, it is always recommended to consider protection as “additional protection”

B) If the Ex motor – VSD package is not tested, temperature protection is needed

- In ATEX, protection devices shall be certified

©ABB

ABB motors for explosive atmospheres and drives

Tested VSD – Ex motor packages

ABB Motors have ATEX/Ex certifications for Motor-drive (VSD) packages:

- ACS600, ACS800, ACS880 with DTC
- ACS880 scalar
- ACS550, ACx580

ACS600, ACS800 and ACS880 (DTC) are comparable VSDs from the ABB motor perspective.

→ For type tested & certified Ex motor – ACS600/800 packages, ACS600 or ACS800 can be replaced by ACS880 without testing or re-certification

→ Same applies with ACS550 / ACS580

Ex motor's rating plates (and Declaration) show that the VSD is tested and certified with the motor. The plate also shows conditions for using other VSDs

- Note! It cannot be seen from the VSD markings whether the VSD is tested and certified with some Ex Motor(s) or not

(Drive's ATEX marking is related to safety device certification)!

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ABB EX motors and drives

How safe operation is ensured– When drive is connected to Ex motor

Though drive is being installed always in safe area, certain criteria must be taken into account when drive is connected to Ex motor.

- Drive manufacturer has to meet the requirements of motor manufacturer.
- The requirements depend on the protection type in use and the Zone.

ABB offers motors for explosive atmospheres for use with variable speed drives with the following protection types:

- flameproof, increased safety (on request), pressurized, non-sparking, and dust ignition protection.

These motors are designed and certified for operation with frequency converters. Instructions for the different protection types, as well as how safe operation is ensured, are provided in the following slides.

Note! It cannot be seen from the VSD markings whether the VSD is tested and certified with some Ex Motor(s) or not

- **Ex motor's rating plates (and Declaration) show which VSDs are tested and certified with the motor. The plate also shows conditions for using other VSDs**
- **The VSD's ATEX markings indicate of the safety device certificate of for temperature measurement circuits**

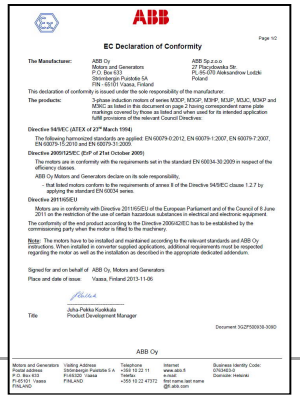
EC declaration of conformity

ATTESTATION D'EXAMEN CE DE TYPE

EC TYPE EXAMINATION CERTIFICATE

IECEx Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification Scheme for Explosive Atmospheres



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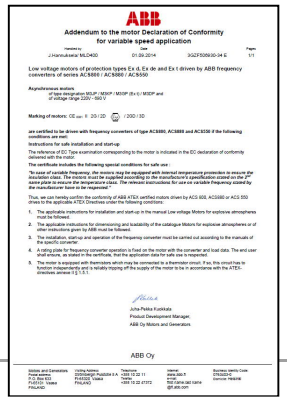
EC Declaration of Conformity



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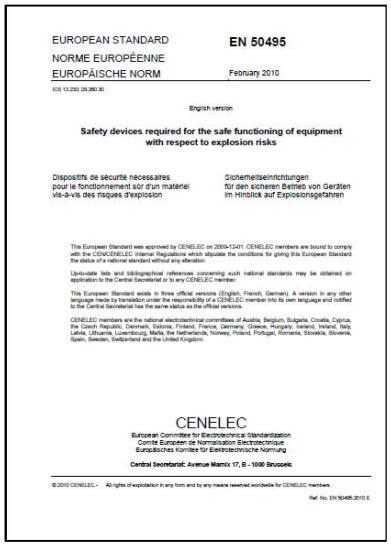
Addendum to the motor Declaration of Conformity for variable speed application

Motors for explosive atmospheres and drives

Protective devices - EN 50495



EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 50495

February 2010

ICS 13.230; 29.260.30

English version

Safety devices required for the safe functioning of equipment with respect to explosion risks

Dispositifs de sécurité nécessaires pour le fonctionnement sûr d'un matériel vis-à-vis des risques d'explosion

Sicherheitseinrichtungen für den sicheren Betrieb von Geräten im Hinblick auf Explosionsgefahren

This European Standard was approved by CENELEC on 2009-12-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: Avenue Marnix 17, B - 1000 Brussels

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Ref. No. EN 50495:2010 E

The protective devices of Ex (explosive atmosphere) equipment/products are within the scope of the ATEX regulations

Standard EN 50495:2010

- Harmonized to ATEX Directive 2014/34/EU
- refers to IEC 61508 - Safety Integrity levels (SIL)

This is the only applicable standard for drive integrated protection functions in the ATEX/Ex scheme

IECEx still does not have an applicable standard for complex control systems

→ <u>IECEx certification is not possible at the moment, only ATEX certification is possible</u> !

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Motors for explosive atmospheres and drives

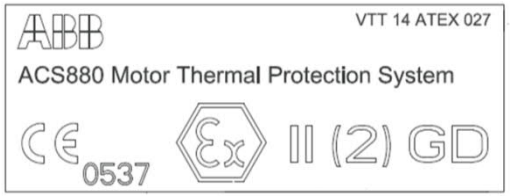
Protection concepts; safety devices

In ATEX, protective devices shall be certified and marked similarly as the Ex motors.

Marking can be found from the drive, but is does not mean the drive is certified with some motor, it only indicates that the protective device integrated into drive is certified! Drive must be always installed in safe area.

Certified temperature protection of Ex motor is an alternative protection method to use of tested VSD-motor package

- For certified packages, temperature protection is not mandatory since tested package already fulfills the requirements of Ex-standards.
- Still, certified temperature protection is always recommended as “additional protection”



Example of VSD labelled with ATEX marking.

Motors in frequency converter drive

Ensuring safe operation

Assumptions

Though drive is being installed always in safe area, certain criteria must be taken into account

- Drive is having an influence on the performance of the motor
  - Drive manufacturer has to meet the requirements of motor manufacturer
  - The requirements depend on the protection type in use
- ABB offers motors for explosive atmospheres for use with variable speed drives with the following protection types:
  - Flameproof, increased safety eb (on request), increased safety ec (non-sparking), and dust ignition protection
  - These motors are designed and certified for operation with frequency converters.

Ex motors used with a frequency converter (VSD)

Effects of a VSD on the motor

What should be considered?

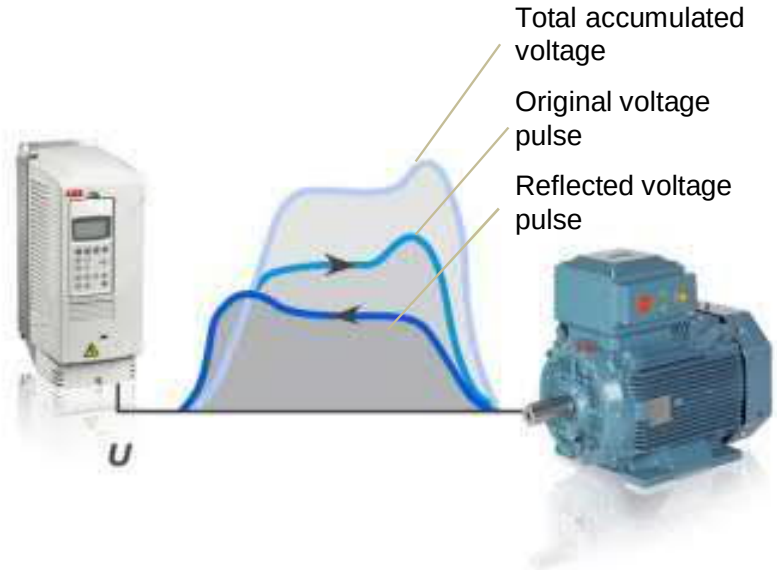
- Standards calls for extra attention when a motor for explosive atmospheres is used with a VSD
  - Motor must clearly marked and rated for the duty
- There are many benefits in using a VSD but it is important to be aware of the effects a VSD has on the motor compared to direct-on-line (DOL) operation.
- Possible effects:
  - Higher voltage stress due to steep voltage pulses → causing sparks in motor winding due to insulation breakdown.
  - Common mode voltages and currents → causing sparks in motor bearings.
  - Higher motor surface temperature rise → due to lower cooling at low speeds, harmonics or overload
- By testing and certifying our motors operated with our drives, ABB have established clear dimensioning rules.

Ex motors used with a frequency converter

Protection against ignition from sparks in motor windings

Selection rules for insulation

- The insulation system in the motor should be dimensioned to withstand the stresses brought about by the steep voltage pulses produced by the VSD
- These pulses can be even higher when arriving at the motor terminals due to reflecting pulses of the cables. (up to 2.5 x U_N)
- The motor's insulation must therefore be selected according to the actual pulses at the motor terminals, not according to the pulses at converter output terminals.
  - Standard insulation for supply voltage up to 500V
  - For 500…600 is either reinforced insulation or dU/dt filters needed
  - For 600…690V and cables ≤150m is reinforced insulation and dU/dt filters needed
  - For 600…690V and cables >150m is reinforced insulation but dU/dt filters can be left out



Ex motors used with a frequency converter

Protection against ignition from sparks in motor bearings

Selection rules for insulation

- AC drive can cause common mode voltages which induces voltages across motor bearings, leading to current flow through motor bearings
- This can result in premature bearing failure and a risk of sparks causing an ignition
- For larger motor sizes 280 (~75kW) and above ABB will provide insulated NDE bearings
  - Based on extensive ignition tests
  - For motors in frame size 355 and above (~250 kW) is also a common mode filter required in the converter
- Using recommended cabling, grounding and earthing configurations will greatly reduce the magnitude of common mode voltages and help prevent bearing currents

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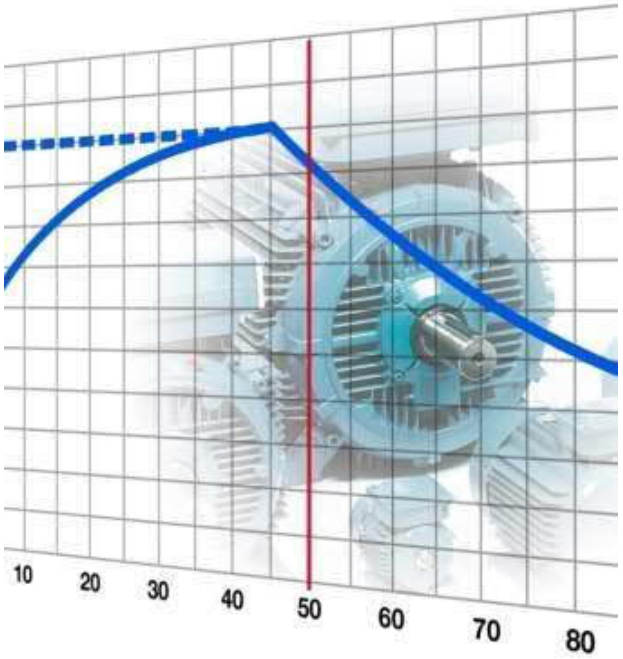
Ex motors used with a frequency converter

Protection against over heating

Selection rules for thermal class

- For use in Ex locations, motor temperature must be rigorously tested in accordance with appropriate standards
  - Standard motors have a shaft mounted cooling fan. Therefore a reduced speed will reduce air flow available to cool motor
  - VSD's by their very nature produce additional motor losses due to harmonics.
- Key is to ensure that essential surface temperature stays below allowed limits by:
  - Limiting the load and controlling and limiting the power below a safe level, or
  - Direct temperature control to shut down when temperature class is exceeded
- ABB have tested our Ex motors with our drives to ensure the limits above are adhered to



ATEX Directive 2014/34/EU

Technical requirements for products

Where are the technical requirements found?

- The ATEX directive does not contain technical specifications, neither any direct reference to any standard
- Compliance with the essential health and safety requirements in the directive is demonstrated by complying with the relevant harmonized EN standards
  - Conformity is declared in EU Declaration of conformity
  - Addendums for VSD

The harmonized EN standards

– EN 60079-0, 2012 + A2013	General requirements
– EN 60079-1, 2014	Flameproof enclosures “d”
– EN 60079-2, 2014 + A2015	Pressurized enclosures “p”
– EN 60079-7, 2015	Increased safety “e”
– EN 60079-31, 2014	Type of protection “t”

- The harmonized standards are published in the Official Journal of EU
- EN standards may exist with a prefix as BS, NF, SFS etc.

ATEX worker protection directive 1999/92/EC

What is it about?

- Is defining the obligations of the user
- The user must create an Explosion Protection Document (EPD) including:
  - Measures taken to reduce the risk of explosion
  - Substances present
  - Zone classification of the site
  - Equipment used etc.
- Standards used:
  - EN 1127-1 - Explosion prevention and protection
  - EN 60079-10 – classifications of areas
  - EN 60079-14 – Electrical installations design, selection and erection
  - EN 60079-17 - Electrical installations inspection and maintenance

ABB motor together with an ABB drive

Solution and benefits

- ABB motors are tested and certified together with ABB frequency converters. You do not necessarily need direct temperature protection to comply with the ATEX directive.
- Selection is easy with common tools and instructions
- No need to apply extra safety margins resulting in an oversized motor
  - Guaranteed performance
- Benefits of the speed control without giving an inch on safety
- No costs from motor + drive combined tests
- Conformity with the ATEX directive is declared through the addendum to the EU declaration of conformity <link>

ABB motor together with an untested drive

Solution

- As the combination is not tested must other means be used to ensure temperature class is not exceeded
  - Direct temperature protection (when available)
  - Dimensioning based on guiding curves
- Requirements on frequency converter
  - Switching frequency
  - Voltage transients dU/dt
- Conformity with the ATEX directive is declared through the addendum to the EU declaration of conformity <link>

See attachment Ex_motor_drive_selection_poster_3AUA000018179_REVB_EN

link to poster

ABB motors for explosive atmospheres and drives

Selecting the right motor drive combination

Customer input

Globally, a "Zone" system is used to classify potentially explosive areas. The Worker Protection Directive 1999/92/EC and the international standards IEC 60079-10-x, EN 60079-10-x define these Zones. In all cases, Zone classification is the responsibility of the owner of the site where the potentially explosive atmosphere exists.

The correct Ex motor can be can be chosen based on the EPL/protection level or product category required using the table on the right.

Standard IEC 60079-0 EN 60079-0			Installation zone acc. to IEC 60079-10-x EN 60079-10-x	ATEX Directive 2014/34/EU (former directive 94/9/EC)		Main motor protection types
Group	EPL	Protection level	Zones	Equipment group	Equipment category	
I (Mines)	Ma	very high	The Zone classification is not used in mines.	I (Mines)	M1	Requirements according to EN 1127-2
	Mb	high			M2	
II (Gas)	Ga	very high	0	II (Surface)	1G	No electric motors allowed
	Gb	high	1		2G	Ex d/Ex de, Ex p, Ex e
	Gc	enhanced	2		3G	Ex nA
III (Dust)	Da	very high	20		1D	No electric motors allowed
	Db	high	21		2D	Ex tb IP 66
	Dc	enhanced	22		3D	Ex tc, IP 65/IP 55

Selection of motor and drive

ABB Ex motor

ABB drives tested with ABB Ex motors
ACS880, ACS800 and ACS550
Certifications available
Safety functions **not required** but available:
ACS880: +Q971
ACS880/ACS800 cabinet/multidrives: +L513/L514 and +Q971

ABB drives not tested with ABB Ex motors
NON TESTED DRIVES
Motor thermal sensor (+813) and Certified PTC/Pt100 relay needed
Additional safety function needed

ABB Ex motor with Non ABB drive
ALL DRIVES
Motor thermal sensor (+813) and Certified PTC/Pt100 relay and Drives main contactor needed
The VSD must be able to limit the switching frequency

non-ABB Ex motor

Non-ABB Ex motor with ABB drive
ALL ABB DRIVES
Motor thermal sensor and Certified PTC/Pt100 relay and Additional safety needed
The ABB drives are able to limit the switching frequency

Dimensioning

Drivesize tool
The tool calculates correct drive and motor.

Manual sizing
Motor is selected by calculating the needed torque in duty point for applicable speed range and choosing the right drive accordingly.

Load capacity curves

Follow motor manufacturer's instructions

Insulation and filters

Selection of motor winding insulation and convertor output filters as well as elimination of bearing currents for ABB Ex motors and drives.

Supply voltage	Motor framesize	Winding insulation	Motor bearings	Drive filters
≤ 500 V	≤ IEC 250	ABB standard insulation	Standard bearing	No filter needed
	IEC 280 - 315	ABB standard insulation	Insulated non-drive end bearing	No filter needed
	IEC 355 - 450	ABB standard insulation	Insulated non-drive end bearing	Common mode filter
≤ 600 V	≤ IEC 250	ABB standard insulation	Standard bearing	du/dt filter
		ABB special insulation (variant code 405)	Standard bearing	No filter needed
	IEC 280 - 315	ABB standard insulation	Insulated non-drive end bearing	du/dt filter
		ABB special insulation (variant code 405)	Insulated non-drive end bearing	No filter needed
	IEC 355 - 450	ABB standard insulation	Insulated non-drive end bearing	du/dt filter, common mode filter
		ABB special insulation (variant code 405)	Insulated non-drive end bearing	Common mode filter
≤ 690 V	≤ IEC 250	ABB special insulation (variant code 405)	Standard bearing	du/dt filter
	IEC 280 - 315	ABB special insulation (variant code 405)	Insulated non-drive end bearing	du/dt filter
	IEC 355 - 450	ABB special insulation (variant code 405)	Insulated non-drive end bearing	du/dt filter, common mode filter
600 V - 690 V with cable length over 150 m	Any frame size	ABB special insulation (variant code 405)	Standard bearing	No filter needed

Follow motor manufacturerer's and ABB drives' instructions

Cables and EMC

The maximum motor cable length for DTC control in ACS880 varies by frame size.
Frames R1 - R3 can have 150 m cable
Frames R4 - R9 can have 300 m cable
Frames R10 → can have 500 m cable

Cable types for drive input

Cable types for motor

Follow ABB Motors and drive manufacturer's cable and EMC recommendations

Follow motor manufacturer's and ABB drives' cable and EMC recommendations

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Motors with frequency converter drive

Ensuring safe operation

Example 1

In the plant there is an 20 year old motor drive combination in an ATEX zone. Now the sami F/GTO drive needs to be replaced because there is no service parts available:

- What do we have to think of when we do this action?
- Can I still use the old motor in this ATEX zone?
- Will the motor still be certified in the area when I use IGBT drive?

Answer: The installation standard IEC/EN 60079-14 sets the requirements for the installation. This means in most cases that there should either be a test available which shows that the new motor and converter combination meets the Ex temperature class requirements and does not become an ignition source. Or that the motor is equipped with thermal protection that prevents the Ex temperature class to be exceeded (this not necessarily the same as PTC's protecting the insulation of motor).

If no tests exists or the motor does not have thermal protection is usually a new motor the most practical solution.

Generally can we consider ACS600, 800 and 880 series of DTC controlled converters as compatible with M3 series of ABB flame proof and non-sparking motors which have been available for approx.. 15 years. Other converter/motor combinations must be checked case by case.

Motors with frequency converter drive

Ensuring safe operation

Example 2

In the plant there is an DOL 15Kw motor in ATEX zone, now he would like to put an inverter on this motor:

- What do we have to think of when we do this action?
- Is derating needed?

Answer: It should be checked from the **motor certificate if converter duty is allowed** and what the selection and dimensioning and selection criteria are. Further should the motor be equipped with a **rating plate that meets the requirements** in IEC/EN 60079-0 for converter duty.

Derating is required to compensate for the additional losses created in the motor due to:

- Harmonic content of current fed to motor
- Reduced cooling with shaft mounted fans when speed is regulated below nominal speed
- Reduced flux in motor above field weakening point (eg. 50Hz) and voltage drop in converter

How much the derating is required depends on:

- At what speed the motor is running
- Type of converter and control method
- Where the field weakening point is set

Motors with frequency converter drive

Ensuring safe operation

Other typical questions

- What possibilities for thermal protection of a ATEX motor can be use?

Testing the motor and converter combination (if this is a thermal protection can be discussed…), or equip the motor with temperature detectors that protect the Ex temperature class, according to the ATEX directive should these be connected to an Ex certified protection circuit in the converter that either disconnects the supply or STO.

- Why does the thermal protection in the drive needs to certified?

This is required in ATEX, see paragraphs 1.5.1, 1.5.2 and 1.5.3

Motors with frequency converter drive

Ensuring safe operation

ATEX 2014/34/EU Guidelines

This is required in ATEX, see paragraphs 1.5.1, 1.5.2 and 1.5.3

1.5. Requirements in respect of safety-related devices

1.5.1. Safety devices must function independently of any measurement and/or control devices required for operation. As far as possible, failure of a safety device must be detected sufficiently rapidly by appropriate technical means to ensure that there is only very little likelihood that dangerous situations will occur. The fail-safe principle is to be applied in general. Safety-related switching must in general directly actuate the relevant control devices without intermediate software command.

1.5.2. In the event of a safety device failure, equipment and/or protective systems shall, wherever possible, be secured.

1.5.3. Emergency stop controls of safety devices must, as far as possible, be fitted with restart lockouts. A new start command may take effect on normal operation only after the restart lockouts have been intentionally reset

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Maintenance and repair on Ex equipment

December 6, 2018

Maintenance and repair on Ex equipment

All the equipment installed in explosive atmospheres have to be properly maintained, to secure the original safe conditions.

The safe conditions have to be secured during all the equipment life cycle

– Production

– Commissioning

– Operation

– Maintenance and Overhaul

– Repair

Life Cycle Management' processes are required to keep the safe conditions of Ex equipment (an equipment should never change the safe conditions for which it was originally designed!)

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Repair, overhaul and reclamation rules EN 60079-19

(***) : User = user of the equipment (end-user)

The EN 60079-19 is the main reference standard for ATEX, and it governs the repair and overhaul of electrical equipment in explosive atmosphere (***).

- It contains instructions to be followed by
  - Users (***)
  - Repairers
- The standard includes detailed instructions for different protection modes, working procedures etc.
- The repair or modification work should be carried out:
  - using good engineering practices
  - using only parts specified by the manufacturer or as specified in the certification documentation
  - using the methods detailed in the certification documents, if any, of the apparatus

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Requirements for the user according to EN 60079-19

(*) : organization providing a service that consists of repairs, overhauls, or reclamations of explosion protected equipment who may be the manufacturer, the user or a third party (equivalent : Service Center)

The User should utilize the most appropriate repair facilities.

- Where equipment is not being returned to the original manufacturer for repair or reclamation, the use of repair organizations that are recommended by the original manufacturer should be considered

The User has to make sure that the repair organization(*) works according to the standards, with respect of the following items :

- quality control,
- quality assurance,
- appropriate workshop equipment,
- competent persons directly involved in the work

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Reference from EN 60079-19

Requirements for the repairers acc. to EN 60079-19

The repairer (service center) must know and follow the Ex-standards and the equipment Certificate/s

The repairer (service center) should appoint a person (responsible person) with the required competency

- Knowledge of the appropriate ex standards
- Understanding of EN 60079-19
- Familiarity with measurement functions
- Basic knowledge of quality assurance

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Reference from EN 60079-19

Requirements for the repairer acc. to EN 60079-19

The repairer has to make sure that those who are directly involved in the repair or overhaul activities, are properly trained and competent on this type of work

- general principles of types of protection and marking
- protection concept designs
- certification and relevant parts of repair standard EN 60079-19
- identification of replacement parts authorized by manufacturer
- repair techniques

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Reference from EN 60079-19

Requirements for the repairer acc. to EN 60079-19

The repairer shall provide to the user full documentation of repair and overhaul work, including:

- Details of the fault detected
- Full details of the repair and overhaul work
- List of replaced or reclaimed parts
- Results of all checks and tests
- A comparison of the results against the criteria that have been used to determine compliance
- Copy of the user contract or order
- A recapitulation of the Marking applied after repair

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Reference from EN 60079-19

Marking of repaired equipment acc. to EN 60079-19

After repair, the equipment shall be marked to identify the repair or overhaul and the repairer's identity.

Symbols:

R

The apparatus is in full compliance with the repair standard and the repairer has sufficient evidence of full compliance with the certification documents and manufacturers specifications

R

a) The equipment is changed during repair so that it complies with the repair standard but repairer has insufficient evidence of full compliance with the certification documents

b) or the standards to which the previously certified equipment was manufactured are not known

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Reference from EN 60079-19

Questions

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