ABB drives and motors
ATEX compliant low voltage AC drives and motors for chemical, oil and gas
When an electric motor and an AC drive, together with the driven equipment, are installed in a potentially explosive atmosphere, there is an increased risk of an explosion occurring.

To tackle this situation, European Union (EU) directives – known as ATEX – have been implemented covering the Essential Health and Safety Requirements (EHSRs) for products used in potentially explosive atmospheres.

ATEX is the French acronym for Atmosphères Explosibles (explosive atmospheres) and is used to describe the application of two directives, covering product safety and worker safety - see page 12 to 15.

**The importance of ATEX**

ATEX is not new: it is a group of EU directives to rationalize legislation and increase the harmonization of equipment sales across the EU so that a UK company, for example, can purchase equipment from Germany without worrying about standards in different countries.

The objective of Product Directive 94/9/EC (also known as ATEX 95) is to ensure that equipment and protective systems function safely when used in potentially explosive atmospheres. ATEX 95 covers the minimum requirements applicable to mechanical and electrical equipment capable of causing an explosion through its own potential sources of ignition.

Directive 94/9/EC is made under Article 95 of the European Treaties and is referred to as ATEX 95. It is intended to allow the free movement, within the EU, of equipment and systems for use in a hazardous area without the need for separate testing and documentation.

The Worker Protection Directive 1992/92/EC (also known as ATEX 137) covers the minimum requirements for improving the health and safety protection of workers operating in potentially explosive atmospheres. ATEX 137 also defines the various Zones for gases, vapors and dusts.

ATEX 95 and ATEX 137 harmonize the standards and rules for designing, manufacturing, testing, using and maintaining products and equipment throughout the EU. They also establish a framework of certification bodies - the Ex Notified Bodies - who are able to undertake the supervision of products and quality systems.

**Shared responsibility**

The installation of electrical equipment in potentially explosive atmospheres used to be a straightforward procedure, requiring only the selection of equipment certified for the appropriate area. However, the arrival of the ATEX directives from the EU changes all that.

While the end-user is responsible for installation of products and equipment, the electric motor manufacturer is responsible for safety of the motors and for delivering maintenance and installation instructions. The end-user must define the Zone, the gas group, the temperature class and the preferred protection class. Based on this information, the manufacturer proposes the product/equipment to be used.
Profile

The impact on AC drives and motors

Electronic speed control of AC motors brings a range of benefits to processing industry applications including:

- soft start
- precise control of speed and torque
- significant energy savings
- optimal process control, removing bottlenecks in production

An ATEX approved AC motor and AC drive combination gives safe, economical power combined with effective control. Usually only the motor and driven load are installed in the potentially explosive atmosphere, with the drive being installed in a safe area.

By choosing an ABB ATEX package, end-users can be confident that the motor and drive combination is optimized for their application. The package can result in a cost benefit: end-users that choose to match their own drive and motor combinations may be forced to select a larger motor than optimum because of the limited selections available from their chosen manufacturers.

Global impact

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

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

The Zone system divides hazardous areas into Zones, based on the presence of a potentially explosive atmosphere. The Zone system is used all over the world, except in North America. Here, a system of Classes and Divisions is used to denote hazardous locations. The Classes are based on the type of hazard, while the Divisions are based on the risk of explosion that the material presents (see Table 1 below). Both the EU and the US system provides effective solutions for managing electrical equipment (ATEX directives also apply to mechanical equipment) in hazardous areas and both systems have excellent safety records.

Some US companies have now established the use of Zoning in their coding to be compliant with ATEX directives and are therefore able to sell products and equipment to EU end-users.

<table>
<thead>
<tr>
<th>Hazardous material</th>
<th>US Class, Division system</th>
<th>EU Zone system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gases or vapors</td>
<td>Class I, Div. 1, Class I, Div. 2</td>
<td>Zone 0 and Zone 1, Zone 2</td>
</tr>
<tr>
<td>Dust</td>
<td>Class II, Div. 1, Class II, Div. 2</td>
<td>Zone 20, Zone 21, Zone 22</td>
</tr>
</tbody>
</table>

Table 1: US system of Classes and Divisions compared to EU Zone system.

About this brochure

This brochure aims to give a practical overview of the requirements to be considered when selecting an AC drive and electric motor for use in hazardous environments within chemical, oil and gas.

The focus is on using ABB low voltage AC drives alongside an ABB AC motor. With this combination, users can rest assured that by following the advice contained herein, a safe and reliable ATEX approved installation will result.
Main sources of ignition risk

The main sources of risk affecting AC drives and motors in hazardous environments are:

- Sparks in the motor windings – due to insulation breakdown caused by steep voltage rises and reflected voltages.
- Sparks in the motor bearings - due to common mode voltages caused by the AC drive.
- Increase in the motor surface temperature - resulting in reduced cooling capacity or overload of the motor. Reduced cooling capacity is caused by driving the motor outside its specified speed range. Increased surface temperature can occur if the motor is incorrectly dimensioned for use with an AC drive.

Protection against ignition from sparks in the motor windings

The steep voltage rises in the output waveform of some AC drives can cause stator winding insulation breakdown. These voltage rises can also lead to another phenomenon called reflected voltages, which can increase the motor terminal volts by as much as 2.5 times the nominal voltage. For nominal voltages between 500 V and 600 V, the motor needs either reinforced insulation or the drive requires \( \frac{du}{dt} \) filters. Above 600 V, both reinforced insulation and \( \frac{du}{dt} \) filters are needed. Please consult the motor manufacturers catalog for more detailed instructions. More information on pages 11 to 12.

Figure 1. Reflected voltages can cause sparks in motor windings.

Factors affecting selection of Ex motor and AC drive

Protection against ignition from sparks in the motor bearings

An AC drive can be a source of common mode voltages. Depending on the motor frame size, this source can induce voltages across the frame of a motor, which in turn can give rise to a current through the motor bearings. This can cause premature bearing failure with a risk of sparks, which could cause ignition.

For motors with frame size IEC 280 and above, insulated non-drive end bearings are critical to break the potential paths for circulating currents. In addition to insulated bearings, a common mode filter within the AC drive is required for motors with frame size IEC 344 and above.

The above measures will reduce the risk of ignition and prolong the bearing life.
Protection against excess motor surface temperature

High motor surface temperatures may be caused by running the motor at reduced speed without adequate cooling. With a shaft mounted cooling fan the reduced speed will reduce the air flow available to cool the motor.

For use in hazardous area locations, the motor surface temperature rise must be rigorously tested in accordance with the appropriate standards.

The methods for ensuring the correct motor surface temperature depends on the flammable material surrounding the motor. The key goal is to ensure that the surface temperature stays below the allowed limits. For some cases, only testing is allowed; while for others, direct measurement is possible; while some require calculations as a last option, if testing is not practical.

**Method 1:**
Use a direct temperature measurement signal from the motor and use this signal to initiate shut down when excess temperature is present. This is only valid for stator-critical motors.

**How to obtain certification**
The motor, especially when used with a non-DTC drive, can be protected using direct thermal control. This can be achieved using thermal sensors in the motor windings that control either a certified disconnection circuit or contactor.

**Method 2:**
To control and limit the power which is transferred to the motor and thus prevent excess temperature.
To achieve adequate cooling of motors driven by AC drives, separate cooling is sometimes used as the fan speed of a self-cooled motor drops with the motor speed.

**How to obtain certification**
Option 1: When using an ABB industrial drive, its motor control platform - Direct Torque Control (DTC) - can help reduce the temperature. Using DTC control, along with ABB’s dimensioning and selection tool DriveSize, prevents overtemperature. The dimensioning is based on type tested load capacity curves. This also ensures the application is optimized for the load.
Option 2: Combined test with motor and drive to ensure that the motor surface temperature does not exceed the limits.

![Figure 2. Typical motor load capacity curves.](image)
ABB drives

ABB drives is the generic name used to define the portfolio of AC drives, from 0.18 to 5600 kW, manufactured by ABB.

ABB is a world leading brand that is recognized as the global number one supplier of low voltage AC drives, with the widest available range from any manufacturer.

ABB drives is a reference for drives users the world over signifying reliability, simplicity, flexibility and ingenuity, throughout the lifecycle of an AC drive.

ABB industrial drives, 0.55 to 5600 kW

ABB industrial drives are available as complete AC drives and as modules to meet the requirements of the chemical, oil and gas industries. These highly flexible AC drives can be tailored to meet the precise needs of industrial applications and as such specific configuration of the drives can be carried out during ordering.

The complete drives and modules cover a wide range of powers and voltages. ABB industrial drives come with a broad selection of inbuilt options. These drives can be easily programmed which makes adaptation to different applications easy.

- Adaptive programming - like having a PLC (programmable logic controller) inside the drive
- DTC (Direct Torque Control) - well proven motor control platform
- All major types of drive topology covered - 6-pulse, 12-pulse, 4-quadrant, low harmonic, air-cooled, water-cooled, etc.

Wall-mounted drives from 0.55 to 200 kW, (230 to 690 V)
Free-standing drives from 45 to 560 kW, (230 to 690 V)
Drive modules from 0.55 to 1900 kW (230 to 690 V)
Cabinet-built drives from 45 to 2800 kW, (380 to 690 V)
Multidrives from 1.1 to 5600 kW, (400 to 690 V)

What is DTC?

Widely recognized as a major leap forward in motor control, DTC (Direct Torque Control) is an optimized AC drives control principle where inverter switching directly controls the motor variables i.e. flux and torque. The measured motor current and voltage are used as inputs to an adaptive motor model which produces an exact actual value of flux and torque every 25 microseconds. This is the motor control method used in the ABB industrial drive.
Products

**ABB standard drives, 0.75 to 355 kW**

ABB standard drives are simple to buy, install, configure and use, saving considerable time. They are widely available through ABB’s channel partners, hence the use of the term standard. The drives have common user and process interface with fieldbus, common software tools for sizing, commissioning, maintenance and common spare parts.

- Assistant control panel providing intuitive use of the drive
- Patent pending swinging choke for superior harmonic reduction
- Sensorless vector and scalar control

Note: These drives DO NOT feature DTC

Wall-mounted drives from 0.75 to 110 kW, (380 to 480 V)
(230 V also available)
Free-standing drives from 110 to 355 kW, (380 to 480 V)

**ABB general machinery drives, 0.37 to 22 kW**

ABB general machinery drives are specifically designed for use in machines. The drives are designed to be the fastest drives in terms of installation, setting parameters and commissioning. The basic products are as user-friendly as possible, yet providing high intelligence. The drives offer diverse functionality to cater for the most demanding needs.

- IP20 as standard (UL type 1 as option)
- Advanced functionality with sequence programming
- Configuration of unpowered drive in 2 sec.
**ABB hazardous area low voltage motors**

- Flameproof motors, frame size 80 to 400, 0.55 to 630 kW
- Increased safety motors, frame size 80 to 560, 0.25 to 1000 kW
- Non-sparking motors, frame size 71 to 560, 0.25 to 2000 kW
- Ex tD/DIP motors, frame size 71 to 400, 0.25 to 630 kW
  
  (see below)

Terminal boxes of ABB low voltage Ex motors are designed for 240 V or higher and thus meet the requirements of AC drive use.

**ABB Ex tD/DIP motors**

With Ex tD/DIP motors, any explosion transmission of dust is prevented. The following should be considered when using Ex tD/DIP motors.

- The ingress of dust into the motor is prevented - IP55 or IP65 for non-conductive dust and IP65 for conductive dust.
- The maximum surface temperature outside the motor must not exceed the temperature class for which the motor is certified.
- No sparks must occur outside the motor enclosure.

When using an AC drive:

- Certification can be based on type test results or calculation results - depends on agreement between the manufacturer and certification authority.
- Certificate for Ex tD/DIP (in Zone 22 area with non-conductive dust) motors with AC drive can be announced by factory or authorized certification body (third party certification). Certificate can be machine specific or standard type.
Considerations when using an ABB drive with a non-ABB motor

This brochure aims to show the merits of using an ABB low voltage AC drive with an ABB motor and the benefits of this ATEX approved combination.

However, while ABB drives can be used with motors from other manufacturers it is important to consult the motor manufacturer. In particular, the following considerations need to be discussed:

- Load capacity of the motor.
- Protection method - see page 5 for options.
- Peak voltage.
- \(\frac{du}{dt}\) limitation - needed to combat steep voltage rises in the output waveform. \(\frac{du}{dt}\) filters protect motor insulation and reduce bearing currents.
- Approval (test/calculation).
The route to EC Declaration of Conformity for ABB low voltage AC drives and motors

Important note: This flowchart only applies to standard ABB motors.

If the motor voltage is <500 V

<table>
<thead>
<tr>
<th>Check the frame size:</th>
<th>ABB drive without DTC</th>
<th>ABB drive with DTC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to IEC 250...</td>
<td>Ex nA</td>
<td>Ex nA</td>
</tr>
<tr>
<td>IEC 280 to 315...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEC 355 and above...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Motor needs reinforced winding insulation OR AC drive needs du/dt filtering fitted

If the motor voltage is 500 to 600 V

<table>
<thead>
<tr>
<th>In addition, check the frame size.</th>
<th>ABB drive with DTC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to IEC 250...</td>
<td>Ex nA</td>
</tr>
<tr>
<td>IEC 280 to 315...</td>
<td>Ex p</td>
</tr>
<tr>
<td>IEC 355 and above...</td>
<td>Ex d Ex de</td>
</tr>
<tr>
<td>AC drive needs</td>
<td>Ex tD/DIP</td>
</tr>
</tbody>
</table>

Motor needs reinforced winding insulation AND AC drive needs du/dt filtering fitted

If the motor voltage is 600 to 600 V

<table>
<thead>
<tr>
<th>In addition, check the frame size.</th>
<th>Ex nA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to IEC 250...</td>
<td></td>
</tr>
<tr>
<td>IEC 280 to 315...</td>
<td></td>
</tr>
<tr>
<td>IEC 355 and above...</td>
<td></td>
</tr>
<tr>
<td>AC drive needs</td>
<td></td>
</tr>
</tbody>
</table>

...no additional motor or drive requirements other than those above...
Figure 3. EC Declaration of Conformity for ABB low voltage AC drives and motors

Products

ABB industrial drive, without DTC
ABB general machinery drive, ACS350
ABB standard drive, ACS550

**Please check motor load capacity curves to ensure correct dimensioning of the motor**

**Additional testing required to obtain EC Declaration of Conformity**

**EC Declaration of Conformity**

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**DriveSize** - Using ABB’s DriveSize tool, users can select a suitable combination of motor and drive. The tool also shows combinations that have not been tested.

**Web site** - contains all relevant certificates for tested drive and motor combinations.  
www.abb.com/drives  
www.abb.com/motors&generators
**What is a potentially explosive atmosphere?**

The following constitutes a potentially explosive atmosphere:

- The frequency with which a potentially explosive atmosphere may exist.
- The capability of a gas or dust laden atmosphere to ignite.

Explosive gases and dust are classified according to the likelihood of their ignition, and other characteristics including:

- Minimum ignition energy
- Minimum ignition temperature
- Layer ignition temperature

Because of the addition of dust within ATEX 95, the new directives will include a large number of industrial sites which were not regulated under the previous explosive atmosphere directives. These industrial sites include power plants using coal or organic material, timber industries, the food industry, etc.

<table>
<thead>
<tr>
<th>Atmosphere</th>
<th>Zone</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>0</td>
<td>Explosive atmosphere is present continuously, for long periods or frequently due to malfunctions</td>
</tr>
<tr>
<td>Gas</td>
<td>1</td>
<td>Explosive atmosphere is likely to occur due to expected malfunctions in normal operation</td>
</tr>
<tr>
<td>Gas</td>
<td>2</td>
<td>Explosive atmosphere is unlikely to occur or, if occurring, is likely to only be of short duration and not in normal duty</td>
</tr>
</tbody>
</table>

| Dust       | 20   |
| Gas        | 21   |
| Dust       | 22   |

Table 2. Categorization of Zones

**Connection between ATEX 95 and ATEX 137**

ATEX 95 and ATEX 137 cover any electrical or mechanical product/equipment that constitutes a potential source of ignition risk and which requires a special design or installation procedure to prevent an explosion.

Safe operation of the product/equipment is the result of cooperation between the manufacturer, the end-user and, if involved, the contractor. However, the responsibility for explosion protection of the product/equipment can never be contracted out to a third party.

The manufacturer is responsible for ensuring that the product/equipment is safe when it leaves its factory. The end-user is responsible for ensuring that the product/equipment is installed, maintained and operated so that it does not pose any danger of explosion.

**ATEX 95 The Product Directive**

ATEX 95 concentrates on the manufacturer’s duties, giving the safety requirements for product/equipment – electrical and non-electrical – installed in hazardous areas within the European Union. The directive defines the Essential Health and Safety Requirements (EHSRs) of product/equipment for each Category of equipment (see Figure 5 and 6, page 14).
All product/equipment shall be delivered with instructions for safe:

- assembling, installation and taking into service.
- operation, adjustment and maintenance.
- dismantling.

To fulfil requirements from the end-user directive (ATEX 137), ATEX 95 guides manufacturers of product/equipment to:

- prepare classifications of the product/equipment.
- prepare instruction for installation and use.
- certify the product/equipment and production.

To be certified according to ATEX 95, the product/equipment must be classified as belonging to one of the three Categories. Only Categories 2 and 3 apply to motors (see Figure 6, page 14). The notion of Zones does not exist in the Product Directive; it has been replaced by that of Categories.

This point is of particular importance, because all the inspection, maintenance and repair duties of the end-user will depend on the Category of the product/equipment and not on the Zone where it is installed.

**ATEX 137**

The Worker Protection Directive, ATEX 137, concentrates on the duties of the end-user. The directive proposes a new system of risk identification and requires a consistent assessment of all measures to prevent risks of explosions and injury to people both inside and outside of the plant.

ATEX 137 defines the Zones for gas (0, 1, 2) and for dust (20, 21, 22) and indicates which Category of product/equipment must be used in each Zone (see Figure 4, below). ATEX 137 then assigns to the end-user the duty of selecting the right product/equipment for the right Zone.

To reduce the risk of explosion and flash fires, ATEX 137 guides end-users to use certified product/equipment and to prepare:

- a risk analysis
- safety instructions and training
- procedures for operation and maintenance

Collecting all of the above documents as one file will form a part of the Explosive Protection Document (EPD).

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**Figure 4. Permitted equipment categories, ABB recommends that this figure is consulted in conjunction with the detailed explanation on Categories and Zones which is given on page 14.**

<table>
<thead>
<tr>
<th>Zone 0 / 20</th>
<th>Category 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuously</td>
<td>Permanent presence of explosive atmosphere (&gt; 1000 hours per year)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone 1 / 21</th>
<th>Category 1, 2 and 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occasionally</td>
<td>Incidental presence of explosive atmosphere during normal duty (10 to 1000 hours per year)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone 2 / 22</th>
<th>Abnormal condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of explosive atmosphere only by accident, but not during normal duty (≤ 10 hours per year)</td>
<td></td>
</tr>
</tbody>
</table>

**Categories 1 and 2**

- Category 1
- Categories 1 and 2

**Categories 1, 2 and 3**

- CE... II 2 G Ex d/Ex de
- CE... II 2 G Ex e
- CE... II 2 G Ex p
- CE... II 2 D Ex tD A21

- CE... II 3 G Ex nA
- CE... II 3 D Ex tD A22
The Product Directive 94/9/EC (ATEX 95) concentrates on the responsibilities of the equipment manufacturer and defines the Essential Health and Safety Requirements (EHSRs) of equipment.

The directive makes a clear distinction between the duties of the end-user, which include the definition of the Zones, and those of the manufacturer, who will be concerned with meeting the Category requirements rather than the Zones. Based on the EHSRs, these Categories define three safety levels:

- **Category 1** for Zones 0 and 20, where no motors can be installed
- **Category 2** for Zones 1 and 21, where motors must be “e”, “p”, “d”, or “tD A21” types
- **Category 3** for Zones 2 and 22, where motors must be at least “nA” or “tD A22” types

The Worker Protection Directive 1999/92/EC (ATEX 137) concentrates on the responsibilities of the end-user. It classifies the environment into Zones and states which Category of equipment must be used in each Zone.
According to ATEX 95 - The Product Directive

- the product shall comply with following, so-called harmonized standards:
  - EN 60079-0 General requirements
  - EN 60079-2 Pressurized protection
  - EN 60079-1 Flameproof protection
  - EN 60079-7 Increased safety protection
  - EN 60079-15 Non-sparking protection
  - EN 61241-1 Protection by enclosure ‘tD’

According to ATEX 137 - The Worker Protection Directive

- the end-users must comply with the following standards:
  - EN 60079-14 Installation rules of equipment in hazardous gas areas
  - EN 60079-17 Inspection and maintenance rules for equipment in gas
  - EN 60079-19 Repair and overhaul rules for equipment in gas
  - EN 61241-14 Selection and installation of Ex tD equipment

The equivalent EN standards, so-called harmonized standards, are commonly used for ATEX certification to meet the Essential Health and Safety Requirements (EHSR) with respect to each category of equipment.

The EN standards introduced major changes in the case of increased safety and non-sparking motors, as risks occurring in the starting of the motors must now be considered. The standard for Ex tD/DIP protection is totally new.

To meet the “minimum requirements” of the Worker Protection Directive (ATEX 137), the end-user will find that the standards EN 60079-14, EN 60079-17, and IEC 60079-19 contain all the necessary detail, as they describe, respectively, the installation, inspection and maintenance, repair and overhaul rules for equipment in areas where gas is present. EN 61241-14 provides the same information for Ex tD/DIP motors.

These standards are of particular importance for the installation of flameproof motors with an AC drive supply; the maintenance of Ex tD/DIP motors; and the repair of increased safety motors.

ABB will provide documentation, instructions and spare parts in conformity with the EN product standards.
Certification procedure

Obtaining Declaration of Conformity certification depends on the Category of the product or equipment. The procedure for mechanical equipment having no certification “history” is different from that applying to electric motors, which were already subject to certification.

For Category 3 motors (see Figure 5), typically non sparking “nA” or Ex tD/DIP, the directives accept Self Declaration of Conformity by the motor manufacturer. The Self Declaration of Conformity is based on internal quality control, checking that all the motors produced comply with the EHSRs as described in the EN 60079-15 standard.

The CE marking appears on the motor nameplate (see page 17) with no further number or indication, and the complementary marking will not refer to a certificate number as there is no certificate.

For Category 2 motors, increased safety “e”, pressurized “p”, flameproof “d”, or Ex tD/DIP, certification by a Notified Body, is mandatory. Certification includes the product tests for the “EC type examination” and a factory inspection for a “Product” or “Production” Quality Assurance Notification. As a result, the identifying number of the Notified Body appears near the CE mark on the nameplate and the certificate number is part of the complementary marking on the motor nameplate. The factory inspection is valid for three years only and is subject to a yearly audit. This audit can include suppliers or service providers who are part of the supply chain.

Even though the self-certification associated with Category 3 motors may look straightforward and therefore attractive, it does not provide any real benefits.

This is because the motor manufacturer is nevertheless supposed to fulfill all the EHSRs described in the standards, including the new requirements intended to prevent the risk of explosion during the starting of the motor, and to produce the motors according to strict quality assurance procedures.

Ultimately the only difference when compared with Category 2 product/equipment is in the extra costs for assessment by a Notified Body, which represent less than one per cent of the total costs.

For this reason - and because Category 3 product/equipment is governed by totally new standards – ABB has decided to follow the same certification procedure as for Category 2 equipment, with the support of the relevant Notified Bodies.

The marking of motors; the EC Declaration of Conformity; and the Production Quality Assurance Notification will be identical to those for Category 2 and supported by the same documents confirming motor safety issued by the competent body.
Labelling of motors in potentially explosive atmospheres

In areas where an explosive gas presents a hazard, the motor protection is denoted by a sequence of letters detailing the type of protection. When the motor meets the appropriate harmonized standard/s in terms of electrical, mechanical and thermal requirements, this sequence commences Ex. This designation will appear on the motor nameplate.

In a dust hazard environment, motors are referred to as “Ex tD/DIP” types, but this designation may not appear on the nameplate.

To be sure that the motor is ATEX certified and may be used in a potentially explosive atmosphere, the following markings must appear on the nameplate of the motor.

**CE conformity marking**

- Protection: EEx d = “Flameproof”
- Gas group: II = atmospheres other than mines
- Gas type: (C = Hydrogen)
- Temperature class: (T4 = max permitted 135 °C)

**Complementary marking**

- Motor grouping: II for surface industry (I = mines)
- Equipment category: 2 allowed for Zone 1 or 21 or lower (1 for Zone 0 or 20, 3 for Zone 2 or 22)
- Atmosphere surrounding the motor: G for explosive gas, (D for dust)

Identification of the notified body responsible for the approval.
0081 = LCIE

The European Community mark for products used in potentially explosive areas

Figure 7. This is an example of ATEX labelling for a gas hazard which appears on the motor nameplate. It is important to note that it is mandatory that the motor is CE marked if it is operating in a hazardous area.
Electric motors in potentially explosive atmospheres

In areas where an explosive gas presents a hazard, the motor protection is denoted by a sequence of letters detailing the type of protection. When the motor meets the appropriate harmonized standard/s (see following tables) in terms of electrical, mechanical and thermal requirements this sequence commences Ex.

This designation appears on the motor nameplate.

In a dust hazard environment, motors are referred to as tD/DIP types, but this designation may not appear on the motor nameplate.

<table>
<thead>
<tr>
<th>Protection</th>
<th>Product requirements</th>
<th>Installation requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex d flameproof</td>
<td>EN/IEC 60079 –1:</td>
<td>EN/IEC 60079-14</td>
</tr>
<tr>
<td></td>
<td>No specific requirements</td>
<td>a) Either a direct temperature control by embedded</td>
</tr>
<tr>
<td></td>
<td>NB Clarification sheet 00/02/059/CS</td>
<td>temperature sensors or other effective measures. The</td>
</tr>
<tr>
<td></td>
<td>The combination shall be designed and tested always as</td>
<td>action of the protective device shall be to cause the motor</td>
</tr>
<tr>
<td></td>
<td>a unit with converter (AC drive) parameters listed, or</td>
<td>to be disconnected. The motor and converter (AC drive)</td>
</tr>
<tr>
<td></td>
<td>direct thermal protection with sufficient margin to protect</td>
<td>combination does not need to be tested together; or</td>
</tr>
<tr>
<td></td>
<td>bearings or rotor.</td>
<td>b) the motor shall have been type-tested for this duty as a</td>
</tr>
<tr>
<td>Ex e increased safety</td>
<td>EN/IEC 60079 -7</td>
<td>unit in association with the converter (AC drive) and with</td>
</tr>
<tr>
<td></td>
<td>The combination shall be tested and certified for this</td>
<td>the protective device provided.</td>
</tr>
<tr>
<td></td>
<td>duty as a unit in association with converter (AC drive)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>specifications as detailed.</td>
<td></td>
</tr>
</tbody>
</table>
## Electric motors in potentially explosive atmospheres

<table>
<thead>
<tr>
<th>Protection</th>
<th>Product requirements</th>
<th>Installation requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ex nA</strong> non sparking</td>
<td>EN/IEC 60079 -15</td>
<td>EN/IEC 60079 -14:</td>
</tr>
<tr>
<td></td>
<td>● Motors shall be tested with the specified converter (AC drive) or with a comparable converter (AC drive) in reference to the output and current specifications, or ● Alternatively the temperature class may be determined by calculation.</td>
<td>a) <strong>Either</strong> the motor shall have been <strong>tested</strong> in accordance with EN/IEC60079-15, with the specific converter (AC drive) or with a comparable converter (AC drive) in reference to the output voltage and current, or b) the motor has its temperature class determined by calculation in accordance with EN/IEC60079-15.</td>
</tr>
<tr>
<td><strong>Ex p pressurized</strong></td>
<td>IEC/EN 60079 -2:</td>
<td>EN/IEC 60079-14:</td>
</tr>
<tr>
<td></td>
<td>The safety of the combination shall be shown by calculations or other measures.</td>
<td>a) <strong>Either a direct temperature control</strong> by embedded temperature sensors or other effective measures. The action of the protective device shall be to cause the motor to be disconnected. The motor and converter (AC drive) combination does not need to be tested together; or b) the motor shall have been <strong>type-tested</strong> for this duty as a unit in association with the converter (AC drive) and with the protective device provided.</td>
</tr>
<tr>
<td><strong>Ex tD protection by enclosures</strong> (former DIP)</td>
<td>EN/IEC 61241-0 and 61241-1</td>
<td>EN/IEC 61241-14:</td>
</tr>
<tr>
<td></td>
<td>No specific requirements.</td>
<td>a) <strong>Either a direct temperature control</strong> by embedded temperature sensors or other effective measures. The action of the protective device shall be to cause the motor to be disconnected. The motor and converter (AC drive) combination does not need to be tested together; or b) the motor shall have been <strong>type-tested</strong> for this duty as a unit in association with the converter (AC drive) and with the protective device provided.</td>
</tr>
</tbody>
</table>
ABB has the largest service team of all variable speed drives suppliers. Field service engineers with experience throughout the chemical, oil and gas industries are located worldwide.

The service team works to the ABB drive lifecycle management model (see Figure 9 below). This model offers maximum profit for any investment by maintaining high availability, eliminating unplanned repair costs and extending drive lifetime.

The lifecycle management model comprises a palette of dedicated services for the entire lifecycle of ABB low voltage AC drives. Services include:

**Energy audit**

The increasing interest in AC drives in the chemical, oil and gas industries is partly due to a greater awareness of energy issues and rising energy prices. In many countries, ABB offers energy audits that can rapidly determine just where and how much energy can be saved.

Power savings up to 50 per cent can be reached by reducing the motor speed by just 20 per cent, with payback as short as six months.

**Harmonic survey**

ABB collects data on harmonic currents and voltages interfering with the electricity supply network and details actions to minimize them.

**Selection and dimensioning**

Whatever the application, ABB’s vast experience will help in the correct selection and dimensioning of the drive. This ensures the correct drive installation, powerful enough for any motor requirements.

![Figure 9. ABB drive lifecycle management model](image)

**Drive lifecycle phases:**

- **Active**: The drive, with complete lifecycle services, is available for purchase.
- **Classic**: The drive, with complete lifecycle services, is available for plant extensions and spare parts.
- **Limited**: Spare parts, maintenance and repair services are available as long as materials can be obtained.
- **Obsolete**: ABB cannot guarantee availability of lifecycle services for technical reasons or within reasonable cost.

ABB follows a four-phase model for managing drive lifecycles, which brings enhanced customer support and improved efficiency.

Lifecycle services are: selection and dimensioning, installation and commissioning, training and learning, technical support and remote services, maintenance, spare parts, repair, retrofits, replacement and recycling.
Services

**Installation and commissioning**

ABB’s professional start-up service uses certified engineers to install and adjust the drive according to the application requirements, as well as to instruct the user on how to operate the drive. All start-up information and the production parameters are saved, should the engineer need to restore any information at a later date.

**Training and e-learning**

ABB offers dedicated drives training for service and operating personnel to acquire the skills to use ABB drives correctly and safely. The training is available via the internet and in local training centers.

**Technical support**

Technical support services provide accurate, consistent and responsive information and support to all ABB customers.

**Maintenance and repair**

ABB recommends regular preventive maintenance throughout the lifetime of its AC drives.

Maintaining drives in accordance with the maintenance schedules, ensures maximum availability, minimum repair costs, optimized performance and extended lifetime of the drive.
Maintenance can be performed on a contract basis.

Preventive maintenance (PM) of drives consists of annual drive inspections and component replacements according to the product specific maintenance schedules using PM kits which contain all the service parts and materials defined for a certain preventive maintenance.

ABB’s certified engineers provide maintenance and repair services on site and in authorized ABB drive service workshops.

**Drive service workshops**

- Maintenance and repair service - instead of performing maintenance or repair on site, drives or drive modules can be sent to an ABB drive service workshop. It is often practical to perform preventive maintenance at the same time.

- Exchange unit service - a convenient and fast way to fix a problem with a drive is to order an exchange unit. A reconditioned drive is immediately shipped to the customer (subject to availability).

**ABB Ex motor workshops**

ABB is the world’s first motor manufacturer to receive certification for its own qualification program for Ex service facilities. The certificate has been granted by BV-LCIE, a leading certification body for the electrical and electronics sectors.

This recognition allows ABB to issue certificates of authorization to Ex workshops or repair facilities that comply with the ABB qualification program which also includes the strict requirements of IEC/EN 60079-19 and ATEX directive 94/9/EC (ATEX 95).
Services

An ABB certificate of authorization confirms that the workshop in question has been audited by ABB and it guarantees that ABB Ex motors repaired or overhauled there are safe and that their original ABB Declaration of Conformity remains valid. The certified workshop, therefore, is qualified to operate under ABB responsibility.

Spare part services

Genuine ABB factory-certified drive parts are delivered quickly worldwide. They guarantee full compatibility and are available throughout the drive lifetime following the drive lifecycle model.

Spare part services include:

- Parts OnLine - a web-based spare part information system. Address: www.abb.com/partsonline
- Conventional spare and maintenance part service - parts available through your local ABB representative.
- 24-hour emergency spare part service - provides spare parts 365 days a year.

- Inventory Access - an ABB owned and maintained spare part inventory at the disposal of a customer. This spare part inventory is usually located at the customer’s site or at an ABB location. This service provides the customer with up-to-date spare parts with no capital investment for a fee that is based on the inventory value and duration of the contract commitment.

Upgrade and retrofit

Drives upgrade and retrofit offerings are designed for improved performance and extending the lifecycle, resulting in the best possible return on your drive assets.

Replacement and recycling

ABB’s replacement drive scheme provides a correctly dimensioned drive, while disposing of old equipment. The scheme covers any drive or motor, regardless of the original manufacturer.

More information of parts available via Parts OnLine.
ABB in chemical, oil and gas

ABB provides a diverse range of products and solutions for the chemical, oil and gas sectors. ABB can take on different scopes to bear the overall responsibility as described below.

Main Automation/Electrical Contractor (MAC/MEC)

A MAC/MEC provides project management and the supply of a composite scope of expertise, products, systems and services. It also provides interface management of the engineering suppliers to ensure commonality of supply and takes responsibility for the data transmission between parties. Initial concept design and FEED (front-end engineering design) studies can be undertaken to rationalize process requirements with practical, optimal solutions, thereby reducing costs and changes during project implementation.

Main Instrument Vendor (MIV)

A MIV supplies the instrumentation, analyzers, valves and associated scope along with the engineering design. The MIV takes responsibility for the instrumentation, meeting the measurement and control needs of the process as well as being compatible with, and interfacing to, the control and safety systems.

Unrivalled in its scope and applications expertise, ABB instrumentation is a global leader with solutions certified to international standards, and a worldwide network of manufacturing plants and strategically situated calibration labs.

ABB instrumentation provides a wide variety of FOUNDATION Fieldbus, PROFIBUS and HART enabled instrumentation.

- Analytical instruments
- Flow measurement products
- Temperature measurement products
- Recorders and controllers
- Process analytics
- Pressure measurement products
- Device management and fieldbus

Main Automation Vendor (MAV)

A MAV supplies the automation system and associated scope along with the engineering design and responsibility for ensuring compatibility and interfacing of the automation system with interconnected devices and intelligent systems.

ABB’s control systems and products portfolio ranges from Programmable Logic Controllers (PLCs), small to large Distributed Control Systems (DCS), and TÜV certified Safety Instrumented Systems.
ABB in chemical, oil and gas

(SIS), to Collaborative Process Automation Systems (CPAS) for an extended automation scope, as well as a wide range of control products that can be used individually or in combination. ABB offers a complete set of Industrial IT automation solutions to meet the entire plant automation needs.

- Extended Automation System 800xA - Scalable extended automation system for process and production control, safety and production monitoring
- Freelance 800F - Compact Distributed Control System (DCS) for small to medium size applications
- Compact products - A wide range of process PLC products for open automation solutions

Main Electrical Vendor (MEV)

The supply and engineering of an integrated electrical scope and the automation centers /system as required to provide advanced operations.

- Medium voltage power distribution
  - Circuit breakers and contactors
  - Fuses and cutouts
  - Modular systems
  - Protection and control
  - Transformers
  - Surge arresters
  - Switchgear and motor control
  - Voltage indicators
  - Current limiters and arc suppressors
  - Instrument transformers and sensors
  - Switches and disconnectors
- Low voltage power distribution
  - Circuit breakers
  - Control products
  - Industrial plugs and sockets
  - Switchboards
  - Intelligent MCCs (Motor Control Centers)
  - Power Distribution Units
  - Modular DIN rail products
  - Wiring accessories
  - Connection devices
  - Enclosures
  - Switches and fusegear
  - Drives and motors
- Power Management System (PMS)
ABB in chemical, oil and gas

### Telecommunications

The supply and engineering of an integrated telecoms scope and the integration to the operational centers for integrated visibility within the automation system.

- Networks for management and automation systems
- Internal communication systems
  - PA systems etc.
- External communication systems
  - radio/satellite, WAN
- Security - networks/IT infrastructure, CCTV
- Access control

### Management

- Lifecycle management
  - Supporting the entire instrumentation, automation and electrical installation throughout each phase of its use
- Project management
  - Providing the best engineering resource to oversee all phases of the main automation design, installation and commissioning
- Interface management
  - Data flow management between client and package sub-suppliers
- Full Service™
  - Full outsourced maintenance management of the automation, electrical and telecoms assets
ABB’s worldwide presence is built on strong local companies working together with the channel partner network. By combining the experience and know-how gained in local and global markets, we ensure that our customers in all industries can gain the full benefit from our products.

For further details about all our low voltage AC drives and services please contact your nearest ABB office or ABB drives channel partner or visit the websites www.abb.com/drives and www.abb.com/motors&generators and www.abb.com/partsonline.