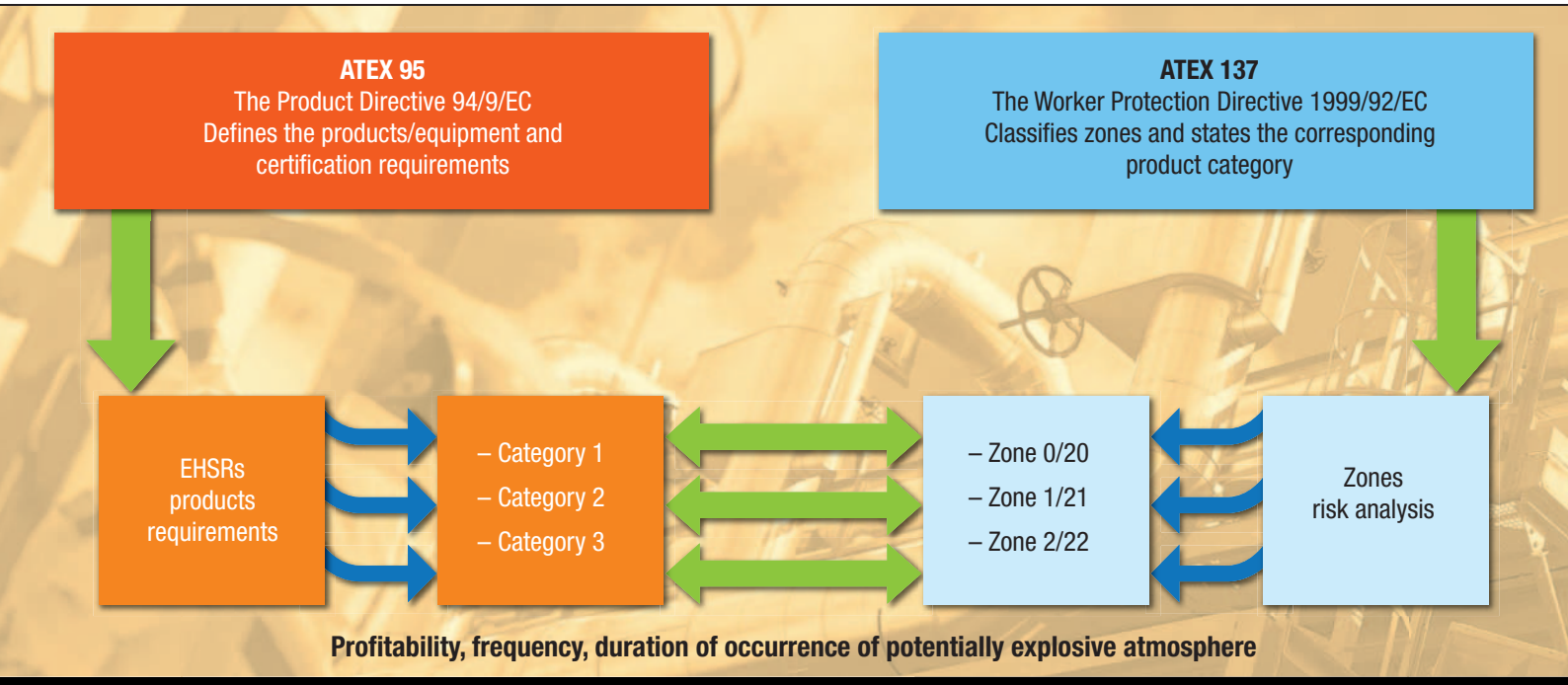


Running motors and low voltage ac drives on plants with dusty environments has been regulated under the ATEX directives since 2006. Steve Ruddell revisits the detail

Dust

Prior to ATEX, the use of hazardous area motors in sectors other than oil and gas was limited. However, the explosion and subsequent collapse of a 40 meter high grain silo in France, in 1997, woke the industry up to the hazards of combustible dust. The investigation concluded that the most likely source of ignition was either a malfunctioning fan on the centralised dust collection system or auto-ignition caused by dust overheating. The explosion travelled from the handling tower along a gallery, penetrating the open silos and producing a further violent explosion.

In the wake of this accident, regulations tightened. Fast forward to today and the ATEX directives, which have been in force since 2006, now regulate the use of electric motors and low voltage ac drives in areas with combustible dust – recognising that these environments can be just as hazardous as combustible gases.

Combustible dust is an insidious hazard, not least because substances such as flour, sugar, plastic, wood and even metals, including aluminium and aluminium alloys, are not generally regarded as potentially problematic – so they can be ignored. However, the fact is that, when reduced to dust, such materials have a very large surface area and can burn extremely rapidly.

Preventing accidents

Like all explosions, dust explosions require fuel, oxygen and an ignition source to get started. In addition, though, they need one of two more components – dispersion or confinement. Dispersed in the air, dust can create a rapidly burning fireball. When the dust is confined inside a building or an item of equipment, an explosion can occur.

Yet dust fires are completely preventable. Hence the relevance of both legs of the ATEX regulations – ATEX 95, controlling product safety, and ATEX 137, covering worker protection.

ATEX 95 deals with the safety requirements for equipment capable of causing an explosion, as a result of its own potential sources of ignition. The directive guides manufacturers to prepare classifications of equipment, as well as instructions for its installation and use, leading to certification of the equipment and its production.

Safety can never be contracted out

Safe operation of equipment in any environment, including hazardous dusts, is invariably the result of co-operation between the manufacturer, the end user and the contractor. However, responsibility for explosion protection can never be contracted out.

So says Steve Ruddell pictured above. Thus, while the manufacturer is responsible for the equipment being safe when it leaves the factory, it is the end user who is responsible for ensuring that the product is installed, maintained and operated so that it does not pose a danger of explosion.

The end user must also define the hazardous area zone, temperature and preferred protection class applicable. This is important, because the manufacturer proposes the equipment to be used, based on this specification.

Steve Ruddell is head of global marketing at ABB Motors & Generators

Meanwhile, ATEX 137 covers minimum requirements for improving health and safety protection of workers operating in potentially explosive atmospheres. The directive requires a consistent assessment of all measures to prevent risks of explosions and injuries, both inside and outside the plant.

Zones and categories

Hazardous areas are classified in 'zones', based on the frequency and duration of explosive atmospheres occurring. Areas where explosive atmospheres with dust are present continuously, for long periods or frequently, due to malfunctions, are classified as Zone 20 – corresponding to Zone 0 for conventional gas-based hazardous atmospheres.

Moving on, areas where a dust-based explosive atmosphere is likely to occur, due to expected malfunctions in normal operation, are classified as Zone 21 (corresponding to Zone 1 for gas). And areas where an explosive atmosphere with dust are unlikely to occur or, if they do, are likely to be short and not in normal duty, are classified as Zone 22 (Zone 2 for hazardous atmospheres with gas).

Equipment is then arranged into 'categories', as defined in ATEX 137. Essentially, the zone indicates which category of equipment must be used and it is the end user's duty to select the right product. Category 1 equipment is for zone 0 or 20; category 1 or 2 for zone 1 or 21; and category 1, 2 or 3 for zone 2 or 22. Motors for areas with hazardous dust are known as Ex tD motors, which are split into two categories: category 2D for zone 21 and 3D for zone 22. No motors can be used in zone 20 or zone 0.

Category 2 motors must be certified by a notified body, but, for category 3 motors, self-declaration of conformity by the motor manufacturer, based on internal quality control, is judged sufficient.

Motors and drives

Ex tD motors must be used in atmospheres where explosive dust surrounds the motor or where dust settles on the motor – with dust being measured as a cloud or layer. Ignition temperatures for different materials can be obtained from commercially available reference tables and, in general, these must be at least 50% above the motor's marking temperature. However, the ignition temperature of a 5mm layer of dust must be at least 75°C above the marking temperature, and it remains the user's responsibility to schedule maintenance to ensure the dust layer does not build up beyond 5 mm.

As for low voltage ac drives, usually installed to improve power and control, these must be in the safe area, and plant engineers need to be cognisant of the effects they have on the motor – mainly to prevent motor surface over-temperature. Motor temperature can be controlled using a temperature signal from the motor to initiate shutdown above a threshold. Equally, it is possible to monitor energy transferred to the motor, using, for example, an ABB low voltage ac drive with DTC (direct torque control).

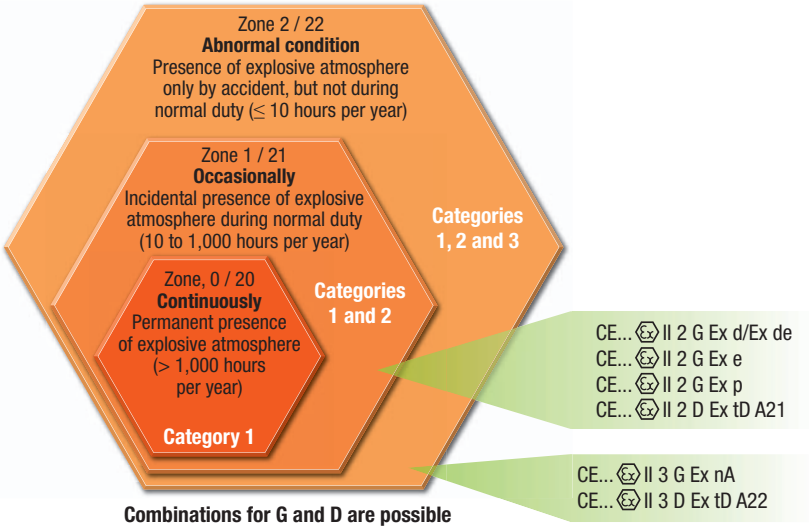
Alternatively, a combined test with the motor and low voltage ac drive is necessary to ensure that the motor surface temperature will not exceed limits. It is also possible to purchase an ATEX approved package, including motor and low voltage drive.

Appropriately protected equipment at a UK grain mill

explosion

ATEX requires users to draw up an 'explosion protection document', which determines whether hazardous area motors are needed – assessing each area of the plant for gases or dust and dividing it into the aforementioned zones. An area can be declared safe only as the result of a risk assessment.

Once the plant is correctly zoned, equipment for each can be selected. Note that, while it may be tempting to simplify your risk assessment by using blanket zones, this could be an expensive mistake. Over-protected equipment will have to be bought, installed and inspected. Also, maintenance and repair obligations under ATEX depend on the category of equipment, not the zone. PE



Combinations for G and D are possible