Standards' evolution

Estellito Rangel Jr and Carlos A. Sanguedo review some of the situations that can arise for "Ex professionals" when new standards are introduced that can often conflict with previous editions

Professionals dealing with electrical installations in explosive atmospheres face a difficult battle in their careers, as they need to be kept updated and standards change very fast.

Sometimes changes arise in new standard editions that seem contradictory to what was written previously, often leaving readers confused.

This paper will discuss just some requirements given by the newest standards editions, commenting on them from an end users point of view. Topics were selected from different standards, to show how users, manufacturers and test organisations are affected when incomplete information is included in a technical standard.

The examples given are just a sample of some conflicting points, and in the end some suggestions are presented.

Harmonised definitions are very important in order to establish communication among professional partners

Area classification distances for dust atmospheres

The IEC 60079-10-2 cancels and replaces IEC 61241-10, stating that in considering a Zone 22, a distance of 3m (previously 1m by IEC 61241-10) beyond zone 21 and around the source of release is "often sufficient" (with a vertical downwards extension to the ground or to the level of a solid floor).

The text also stresses that "In many explosion prevention documents this was often 1m and so the standard is recommending a benchmark of 3m."

The reasons for adopting these new 3x bigger distances are not clarified in the standard. Do we need to consider that the old approach is unsafe? What criteria and conditions were used to define the new "benchmark"?

The text highlights that proper testing and dispersion modelling will determine "the required extent of Zone 22". If this is considered valid, it is not clear from where the "benchmark of 3m" came.

Non-harmonised definitions

The IEC 60050-426 is the vocabulary standard for explosive atmospheres, where a definition for "associated electrical apparatus" is given as: "electrical apparatus which contains both intrinsically safe circuits and non-intrinsically safe circuits and is constructed so that the non-intrinsically safe circuits cannot adversely affect the intrinsically safe circuits".

But, IEC 60079-2 introduced an alternative to "associated apparatus", not encompassed by the current definition, as found not in its terms and definitions clause, but in 18.6: "A pressurization system with a separate certificate is marked as associated apparatus".

Harmonised definitions are very important in order to establish communication among professional partners.

Area classification distances for gas atmospheres:

The IEC 60079-10-1 highlights that Vz (hypothetical volume) is not the classified location volume. The meaning of Vz is that, at the extremities of the hypothetical volume estimated, "the concentration of gas or vapour would be significantly below the LEL, i.e. the volume where the concentration is above the LEL would be less than Vz".

Additionally, the standard says that "the volume of hazardous area from a given source of release will generally be several or even many times larger than the hypothetical volume Vz."

But some papers indicate that Vz calculations under IEC 60079-10-1 formulae are 1 to 2 orders of magnitude conservative. This means that Vz volume is in fact 10 to 100 times bigger than those calculated under Computerised Fluid Dynamics (CFD) simulations.

Therefore when Vz is calculated under IEC 60079-10-1 formulae is not a good hypothesis because it is not related with real conditions.

No references about the origin of such formulae are given, nor its valid conditions limits.

Considering that there are even more nonelectrical issues that require special knowledge (ventilation, gas dispersion, etc.) the area classification study is clearly not related with the electrical engineers' knowledge. So, IEC, as an organization not dedicated to fluid dynamics, does not seem to be the adequate forum to issue such matters.

Permissible explosions

The introduction of EPL (equipment protection level) was done simultaneously in all IEC 60079 parts, as an Annex titled as "Introduction of an alternative risk assessment method encompassing "equipment protection levels" for Ex equipment".

The concept tries to promote more "flexibility" to designers and users, but the examples given do not seem to be sound enough.

The text has the following phrase: "It is reasonable for the owner of a remote, well secured, small pumping station to drive the pump with a "zone 2 type" motor, even in zone 1, if the total amount of gas available to explode is small and the risk to life and property from such an explosion can be discounted."

This sounds as an "authorisation" to explode some selected installations, especially when considering that in real life there is no way to guarantee that "the total amount of gas will be always small".

Even "unmanned" units need technicians to perform periodic maintenance and inspections services, and legally speaking, it is not allowed for anyone to permit "small explosions" to happen.

It is necessary to emphasise that even "small explosions" can promote ambient disasters by a "domino effect" and so, using inadequate equipment for the zone seems to be not complying with the legal requirements regarding environment and workers safety.

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Users, manufacturers and test organisations are affected when incomplete information is included in a technical standard

Thermal tests characteristics

The IEC 60079-0 requires for the temperature measurement test that the final temperature shall be considered to have been reached when the rate of rise of temperature does not exceed 2 K/h.

But some testing labs point out that the 2 K/h rate of rise of temperature seems to be too high. Especially when measuring the service temperature of non-metallic parts in large equipment, it can happen that the rate of rise is below 2 K/h from the very beginning of the measurement but the final temperature can be quite high if measurement is continued long enough.

A minimum measuring time should be determined for those parts with a small but steady temperature rise, as it is known that this phenomenon may occasionally occur with "large" samples.

Electrostatic issues

The IEC 60079-0 defines general design requirements to avoid build-up of electrostatic charge on Group I or Group II electrical equipment, as surface resistance of selected material and limitation of the surface area of non-metallic parts of enclosures.

But IEC 60079-0 also says that "for the purposes of this standard, the sheaths of cables used for the connection of external circuits are not considered non-metallic enclosures or parts of enclosures as described by Clause 7 and need not be assessed against those requirements".

The 60079-0 clause 16.6 has the "NOTE: The electrostatic risk of cables is addressed by IEC 60079-14." But in 60079-14 clause 6.4.1 it is written that "steps shall be taken to reduce to a safe level the effects of static electricity, but cables are exempted from this clause."

It is important to note that for long cables the exposed surface area can be very big.

Regarding the electrostatic phenomenon, the location where the equipment and the cables are installed is a critical point. Is there any kind of process or influences that can generate electrostatic charges on the Ex equipment installed there? Is the electrostatic charges generation process, faster than the dissipative characteristics of the equipment material? Will the generated charge reach a value high enough to promote an ignition risk?

These topics need to be assessed with care, and it does not seem safe to exclude cables from the analysis.

Conduit systems

The IEC 60079-14 ed 3 stated that: "Stopping boxes shall be provided in the enclosure, on the wall or not more than 50 mm from the wall of flameproof enclosures to limit the pressure piling effect and to prevent hot gases from entering the conduit system from an enclosure containing a source of ignition".

Ed 4 changed the requirement to: "Conduit sealing devices shall be provided, either as part of the flameproof enclosure or immediately or as close as practical to the entry to the flameproof enclosure using a minimum number of fittings".

No information was given explaining why 50mm was defined as the "maximum allowable distance", nor why "as close as practical" can result in a safe installation.

Thermal tests on cable glands

The IEC 60079-0 ed 5 states that "the complete cable gland and mandrel assembly shall be subjected to the thermal endurance tests, if applicable. The maximum service temperature shall be considered to be 75 °C unless otherwise specified by the manufacturer."

Changes were made on the ed. 4 ageing test for material used for elastomeric sealing rings. The new method allows a high humidity environment which is easier for elastomeric sealing rings to pass the test.

Locked rotor test

The IEC 60079-15 ed. 3 required an ignition test, filling the machine with an explosive gas atmosphere comprised of hydrogen and air, and a note highlighted that "Compliance with this test does not guarantee that the motor may not produce sparks under severe environmental and operation conditions."

In the ed. 4 that note was removed from the text and "starting (acceleration) of electrical machines was excluded as part of "normal" operation under duty S1 or S2".

Some testing stations registered ignitions during this test on Ex-n motors, so the risk is confirmed and needs to be assessed. It is important to say that if the motor is expected to start more than one time per week the ignition risk is necessary to be assessed.

Hard work is required to produce standards. Everything takes a long time and meanwhile plants operate without explosions being caused by out of date certified and/or uncertified electrical equipment, but occasionally exploding for other reasons.

To provide confidence to users, it is suggested that all requirement changes involving test acceptance criteria be validated by testing labs before they are included as a requirement in a new standard edition.

Regarding equations, considering that they are expressed under a mathematical model, it is recommended that every new equation included in a standard is linked to a publication described in the Bibliography section, to allow users to understand the applicable conditions and restrictions for the specific model adopted by the standard.

Per ISO/IEC Directives "standard" is defined as: "document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context", and the key recommendation is that "Standards should be based on the consolidated results of science, technology and experience, and aimed at the promotion of optimum community benefits".

It seems that we will never achieve a perfect solution, but it is necessary to improve the process, with focus on harmonisation, proven results and clear texts, in order to offer reliable standards used to promote safety to users' installations and employees.

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