Improving Safety by Conforming to Industry Standards and Certifications

Jerry Alley, Systems Manager
Detector Electronics Corporation
Presented at ISA Analysis Division Symposium 2009

Abstract

Globally, safety standards play a key role in designing and executing gas and flame detection projects. How can these standards, which might seem cumbersome at times, help users make informed decisions? What information can be used to assist in conforming to standards and maximizing safety?

This paper will analyze standards from an end-user view, will consider standards' importance in flame and gas detection, and will assess the value of third-party certifications to those standards.

The paper will consider the following classifications:

- Hazardous Location
- Ingress Protection
- Performance
- Safety Integrity Level (SIL)

Defining Standards

A standard can be described as a consensus document that defines minimum criteria for determination of good engineering practice. Standards vary by world area and by industry. This paper will look at the standards as they relate to analytics and specifically to flame and gas detection devices and systems.

The different standards place varying degrees of importance on given environmental, performance, and risk factors. For example, some standards deal mainly with hazardous locations, while others are concerned with how devices perform given tasks in defined environments.

In general, four classifications of standards are most relevant to the areas of analytics and specifically of flame and gas detection devices and systems:

- Hazardous Location
- Ingress Protection
- Performance
- Safety Integrity Level (SIL)

Hazardous Location

To determine that a device safely operates in a given location, hazardous location standards define area classifications and set requirements for devices that operate in those areas. Specific standards are defined by two ratings: Explosion Proof and Intrinsically Safe.

The ratings first determine if an area has a certain hazard present at all times, sometimes, or rarely. Then the ratings set levels of technical requirements for devices in those conditions.

In short, an intrinsically safe device must never generate the minimum energy required to ignite an explosive atmosphere. An explosion-proof device is designed to contain any source of ignition from escaping the device housing.

Other determining factors to certify devices to the standards include segregation from flammable gas, and non-incendive circuits and field wiring.

For example, a user might be required to use a UV/IR flame detector with an explosion-proof rating in a gas-fume-filled petroleum loading station. In that environment, a spark emitted within or from such a device might cause a deadly explosion. Therefore, the design of the detector housing must provide enough mechanical strength to withstand an explosion inside it and enough engineering to cool any internal explosion or flame.

Ingress Protection

Ingress protection (IP) sets the degree of environmental protection that a given device possesses. Used mostly in Europe, but also in the US, IP sets levels describing how well a device resists solid bodies, liquid, or other environmental factors that make their way into the device housing and affect device operation.

EN 60529 (IEC 60529) defines the "IP" rating. For example, a device listed as IP 66 (Figure 1) indicates that a device, such as an IR gas detector, is dust-protected and will be protected against heavy seas during operation. This rating is achieved via a robust mechanical design. To be certified, the device must be immersed and continue to function after it dries naturally. In many cases, to achieve a detector that survives the tests, device designers ensure the physical seal is impermeable by using an o-ring seal with cemented joints in the windows and serviceable areas.

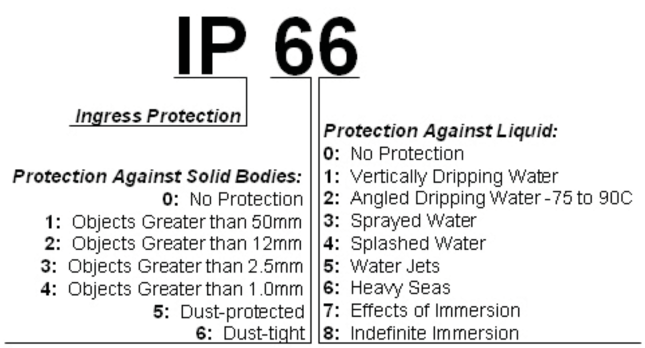

Figure 1. A device listed as IP 66 indicates that a device is dust-protected and will be protected against heavy seas during operation.

Performance

Set by industry organizations, performance standards help users determine to what extent a device operates as expected per defined requirements. The standards define the environmental settings of the test, such as the operating temperature and the operating pressure. Standards also set the level to which a device must operate for defined functions.

Flame detection is set in ANSI FM3260. One standard for safety systems is IEC61508.

Assessment Criteria	FMEDA only	IEC 61508 Certification
Detail analysis of hardware failure modes	X	X
Detail Analysis of hardware diagnostic capability	X	X
Analysis of hardware useful life		X
Analysis of proof test effectiveness		X
Assessment of operational hours based on manufactured units		X
Assessment of Configuration Management system per requirements of IEC 61508		X
Assessment of Field Failure Return System - field failures corrected		X
Assessment of Field Failure Return System - notification to users of safety issues		X
Assessment of design revision history - few revisions based on design faults		X
Assessment of hardware design process		X
Assessment of hardware testing techniques		X
Assessment of software requirements		X
Assessment of software criticality		X
Assessment of software design tecxhniques		X
Verification of Safety Manual per IEC 61508		X
Assessment of software testing techniques		X
Assessment of product testing techniques including environmental testing		X
Assessment of manufacturing process		X

Figure 2. Full certification of SIL includes the hardware and the software.

For example, when certifying a hydrogen sulfide gas detector, an agency testing to ISA-92.0.01, Part 1-1998 will look for the sensor to provide an accuracy of less than or equal to 2 ppm (+/- 10%) for a hydrogen sulfide level of 25ppm.

Safety Integrity Level (SIL)

The Safety Integrity Level (SIL) is set to indicate the probability of failure on demand. The level encompasses a complete process rather than individual devices.

Full certification of SIL includes the hardware and the software (Figure 2). Testing includes Failure Modes Effects and Diagnostics Analysis (FMEDA) and IEC61508 certification. FMEDA performs a detailed analysis of hardware failure modes. But the IEC61508 analysis goes further to assess the field failure return system to notify users of safety issues.

Detector Electronics Corporation
T: 952.941.5665 or 800.765.3473
F: 952.829.8750
www.det-tronics.com

Four risk parameters determine the SIL rating: the consequence of the risk, the frequency and risk of exposure, the possibility of failing to avoid the risk, and the probability of occurrence.

Standards/Locations/Agencies

As Table I shows, the Approval Agencies provide approvals to different standards. For example, ISA 12.22.01 provides certification for explosion and flameproof ratings.

Different countries, shown in Table II, have their own approval agencies as well and each certifies to various standards. For example, FM Global, a company in the United States, tests to all of the standards, except EMC.

Table I. Approval Agencies.

Protection Type	IEC	CENELEC	SAA	ISA	U.S.	Canada	Russia
General Requirements	60079-0	EN 50014	AS 2380.1	12.0.01	FM 3600 or UL 698	C22.2 #0	GOST 22782.0
Explosion- / Flame-proof	60079-1	EN 50018	AS 2380.2	12.22.01	FM 3615 or UL 1203	C22.2 #30	GOST 22782.6
Dust Ignition-proof	1241-3	---	AS 2236	---	FM 3615 or UL 1203	C22.2 #25	---
Intrinsic Safety	60079-11	EN 50020, EN 50039	AS 2380.7	12.2.01	FM 3610 or UL 913	C22.2 #157	GOST 22782.5
Increased Safety	60079-7	EN 50019	AS 2380.6	12.16.01	ISA-12.16.01	---	GOST 22782.7
Nonincendive/Type N	60079-15	EN 50021	AS 2380.9	12.12.01	FM 3611 or UL 1604	C22.2 #213	GOST 22782.5
Encapsulation	60079-18	EN 50028	AS 2431	12.23.01	ISA-12.23.01	---	GOST 22782.3
Purge/ Pressurized	60079-2	EN 50016	AS 1021, 1482, 1825	12.4.01	FM 3620	NFPA 496	GOST 22782.4
Powder Filled	60079-5	EN 50017	---	12.25.01	ISA-12.25.01	---	GOST 22782.2
Oil Immersion	60079-6	EN 50015	---	12.26.01	ISA-12.26.01	---	GOST 22782.1
Flame Performance	---	EN 54-10	AS 4428	dS87	FM 3260	---	GOST 27990
Combustible Gas Perf.	61779-1 to 61779-5	EN 61779-1 to 61779-5	AS 2275.1 AS 2275.2	12.13.01	FM 6310/6320	C22.2 #152	GOST 13320
Toxic Gas Perf.	---	---	---	92.0.01 to 92.06.01	FM 6341 (draft)	---	GOST 13320

Benefits/Requirements to Conform

The standards work together to protect people and property by verifying operations to varying degrees. Taken individually, the standards are valuable. But assessed as a group, one can see that the standards complement each other to consider the safety of a complete industrial area.

Hazardous location standards show that a given device can endure and operate in a defined environment. Ingress protection shows that the device is protected from its environment and continues to operate.

Table II. Countries and approval agencies.

Region	Agency	Elec. Safety	EMC	Haz. Loc.	Flame Perf.	Comb. Gas Perf.	Toxic Gas Perf.	SIL
Australia	SIMTARS	x		x				
	SSL				x			
	TestSafe	x		x				
Brazil	CEPEL	x		x				
Canada	CSA	x		x		x		
	ULC	x			x			
China	CQSTEx			x				
	NEPSI/SIPAI			x				
	SBTS					x		
	NSTCFEPQ				x			
Croatia	EUROCONTROL			x	x	x	x	
Czech Republic	FTZU			x				
European Union	DEMKO	x	x	x		x		
	DMT/BVS	x	x	x		x		
	DNV	x	x	x	x	x		
	LPC	x	x		x			
	SIRA	x	x	x		x		
	TUV	x	x					x
	VdS	x	x		x			
Hungary	BKI			x				
India	GOI	x		x				
Japan	TIIS	x		x				
Poland	CNBOP	x	x	x	x			
	BARBARA	x		x		x		
Russia	GOSSTANDART					x	x	
	VNIIFTRI	x		x				
	VNIIPO		x		x			
South Africa	SABS	x		x				
United States	CNY/MEA	x		x	x	x	x	
	CSFM	x		x	x			
	ITS/ETL	x	x	x				
	FM	x		x	x	x	x	x
	UL	x		x				

Performance testing verifies that the operating device truly performs as it is designed. And finally, the SIL rating shows that devices, orchestrated together, function as planned in the likelihood of a hazard.

Recognizing the standards' common appeal to safety, the standards now are required by several groups, depending on the location of the hazardous area. For example, in the US, the Occupational Safety and Health Administration (OSHA) requires that industries follow certain standards. Several European directives also now require standards to be met. Check your local codes for requirements.

But beyond the requirements to safety dictated by organizations, many companies internally now have standards compliance groups. Some of these groups are required by company insurers. Regardless of the organization requiring them, the standards help companies take the safety precautions deemed best practice by the industry and gives better assurance that the facility will be safe as it operates.

The standards also provide policies for correct procedures to maintain the safety equipment and in some cases show methods to improve the procedures.

Benefits of Third-Party Certification to Standards

Many companies test their own devices and self-certify to standards. Other companies call upon unbiased third-party testing agencies or insurance companies to verify operation of the devices. These third-party testers provide documentation of the testing process and results.

The third-party testing is completed by experts in the certification process and in reliability engineering. Of course, although the manufacturers know their devices and are experts in their field, third-party testing provides a third-eye into the design. In addition, the testing agencies maintain a high level of expertise in the most current standards and best testing procedures.

In the case of SIL testing, the third-party agencies document the design of the process. Not only is the hardware tested, but also the software. Without looking at the software, one does not see the whole picture where errors can be introduced.

A product that has undergone third-party SIL certification has had reliability calculations performed and reliability statistics determined and verified by a third party with expertise in SIL certification and reliability engineering. The results are available for the Safety Instrumented System (SIS) designer to derive the Safety Instrumented Functions (SIF) SIL number. This can significantly cut lead times in the implementation of a SIS.

Each certified product carries with it a certification report from the certifying body. This report contains important information ranging from restrictions of use, to diagnostics coverage within the certified device, to reliability statistics. Additionally, ongoing testing requirements of the device are clearly outlined and include:

- Restrictions of use
- Diagnostics coverage within the certified device
- Reliability statistics
- Ongoing device testing requirements

Summary and Conclusions

When understood and used to their best advantage, standards around the world can be used to advance safety in facilities. Because each standard is mostly concerned with its own section of a given process – from setting the location of a device to assessing its performance – companies can use the standards in concert to create a safer environment for workers and the community.

In addition, when tested by an expert third party, device performance and entire safety functions can be verified to provide additional confidence that safety standards are being met satisfactorily.

References

International Electrochemical Commission, “Degrees of protection provided by enclosures (IP Code)”, IEC 60529, Geneva, Switzerland, 2008.

International Electrochemical Commission, “Functional safety of electrical/electronic/programmable electronic safety-related systems”, IEC 61508, Geneva, Switzerland, 2006.

American National Standard, Instrumentation, Systems, and Automation Society, “Performance Requirements for Toxic Gas-Detection Instruments: Hydrogen Sulfide”, ISA–92.0.01, Part I–1998, North Carolina, USA, 1998.

American National Standard, Instrumentation, Systems, and Automation Society, “Electrical Apparatus for Use in Class I, Zone 1 Hazardous (Classified) Locations Type of Protection — Flameproof D”, ANSI/ISA–12.22.01–2002, North Carolina, USA, 1998.

International Electrochemical Commission, “Electrical apparatus for explosive gas atmospheres”, IEC 60079, Geneva, Switzerland, 2005.

Detector Electronics Corporation
T: 952.941.5665 or 800.765.3473
F: 952.829.8750
www.det-tronics.com

DET-TRONICS®
A UTC Fire & Security Company