ATEX

Your Reliable Partner for Maximum Explosion Protection

In order to apply a single level for health and safety requirements and to overcome barriers of trade within Europe, national regulations for explosion prevention were harmonised in 1975 with the European Frame Directive 76/117/EEC.

The EC-Directive 94/9/EG was valid from 1994 until 2016 and was replaced through the new EU-Directive 2014/34/EU. This Directive is widely known as “ATEX” – which derives from the original working title “ATmosphère EXplosible”.

In addition to Directive 2014/34/EU, which is concerned with the requirements of equipment and protective systems another directive – 1999/92/EC exists. This is concerned with the requirements for the erection, installation and operation of systems.

How can explosions occur?

Explosive atmospheres (Ex areas) are prerequisite for an explosion and can be found where a mixture of air, flammable gases, vapours or dusts are being produced, transformed or stored in the presence of oxygen.

Typical sources of Ignition

- Hot Surfaces
- Flames and Hot Gases
- Mechanically Generated Sparks
- Electrically Generated Sparks
- Electro-statically Generated Sparks
- Adiabatic Compression
- Electro-Magnetic Radiation
- Ionising Radiation
- Chemical Reactions
- Ultra-sound
- Flashes

How can an explosion be prevented?

Most important is the prevention of the formation of an explosive atmosphere. If this is not possible, potential sources of ignition must be avoided.

Ignition protection categories

For **electrical equipment** for use with gases, vapours and mists special design methods are described in comprehensive works standards and are assigned to “ignition protection categories”. Several ignition protection categories can be combined in one unit.

The methods of protection with explosive dusts concentrates mainly on the sealing of the housing (IP protection).

Principles and requirements for non-electrical equipment for use in explosive areas are described in the EN 13463-1. (This standard is only valid until the end of 2019 and is replaced by ISO EN 80079-36.)

Measures that can be taken to reliably exclude potential sources of ignition, depend upon the equipment category required. In the foreground is usually the consideration of the permissible light metal alloys, electrostatic charge, possible sparks caused by impact or friction and heat due to friction.

Which certificates are required?

A Declaration of Conformity must be provided by the manufacturer for each product. The Declaration of Conformity explains how the manufacturer fulfils all the relevant safety requirements. The CE mark is subsequently attached to the product.

For electrical equipment in Category 1 and 2, an EU Type Examination Certificate issued by a notified body is required. For non electrical equipment an EU Type Examination Certificate is only required for Category 1.

These Declarations of Conformity are also obligatory for non-electrical equipment.

However, if the risk analysis of explosion hazards show that no potential sources of ignition exist, the item does not fall under the ATEX directive in which case a Declaration of Conformity and Ex marking is not required. This may apply to products used in purely pneumatic systems, i.e. for valves, service units, sound absorbers.

Figure 1

Figure 2

Figure 3

Figure 1
EU Declaration of Conformity for valve solenoids

Figure 2
EC-Type examination certificate for a solenoid valve series

Figure 3
Certificate for the Quality Assurance System

Prevent explosions with IMI Precision Engineering ATEX approved equipment

As a manufacturer of pneumatic equipment, IMI Precision Engineering offers an extensive range of certified devices in Categories 1, 2 and 3 for use in areas with potentially explosive atmospheres containing gases and dusts:

> Solenoid valves, solenoids (Type of protection Ex m, Ex me, Ex md,Ex d, Ex ia, Ex nA)

> Pressure switches (Type of protection Ex de, Ex nAC)

> Valves, cylinders, (Type of protection Ex c)

Marking of electrical devices in potentially explosive atmospheres

CONDITIONS IN HAZARDOUS AREAS					
FLAMMABLE SUBSTANCES	TEMPORARY BEHAVIOUR OF FLAMMABLE SUBSTANCES IN HAZARDOUS PLACES	SUBDIVISION OF HAZARDOUS PLACES	REQUIRED MARKING FOR INSTALLATION		
			CLASSIFICATION OF HAZARDOUS AREAS	EQUIPMENT CATEGORY	EQUIPMENT PROTECTION LEVEL (EPL)
gases, vapours	is present continuously or for long periods or frequently	zone 0	II	1G	Ga
	is likely to occur in normal operation occasionally	zone 1	II	2G or 1G	Gb or Ga
	is not likely to occur in normal operation but, if it does occur, will persist for a short period only	zone 2	II	3G or 2G or 1G	Gc or Gb or GA
dusts	is present continuously or for long periods or frequently	zone 20	II	1D	Da
	is likely to occur in normal operation occasionally	zone 21	II	2D or 1D	Db or Da
	is not likely to occur in normal operation but, if it does occur, will persist for a short period only	zone 22	II	3D or 2D or 1D	Dc or Db or Da

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TYPE OF PROTECTION	PRINCIPLE OF PROTECTION	APPLICATION	MARKING	MAY BE USED IN ZONE	IEC	CENELEC
general requirements	–	all applications	–	–	IEC 60079-0	EN 60079-0
flameproof enclosure	a propagation of an explosion inside to the outside is excluded	control stations, motors, fuses, switchgear, power electronics	Ex d	1 or 2	IEC 60079-1	EN 60079-1
increased safety	avoidance of arcs, sparks and excessive temperature	installation materials, motors, luminaries	Ex e	1 or 2	IEC 60079-7	EN 60079-7
intrinsic safety	limitation of energy and through that prevention of ignitable sparks	measurement and control, automation technology, sensors, actuators	Ex ia	0, 1 or 2	IEC 60079-11	EN 60079-11
			Ex ib	1 or 2	IEC 60079-11	EN 60079-11
pressurisation	ex-atmosphere can't enter through the overpressure	switch- and control cupboards, analyse-apparatus, computers	Ex p	1 or 2	IEC 60079-2	EN 60079-2
encapsulation	ex-atmosphere can't enter through the potting material	coils of motors or relays, solenoid valves	Ex ma	1 or 2	IEC 60079-18	EN 60079-18
			Ex mb			
oil immersion	ex-atmosphere can't enter through the oil	transformers, relays, control stations, magnetic contactors	Ex o	1 or 2	IEC 60079-6	EN 60079-6
powder filling	an propagation of an ignition inside to the outside is excluded	capacitors, transformers	Ex q	1 or 2	IEC 60079-5	EN 60079-5
non sparking	avoidance of ignitable sparks in normal operation	sensors, solenoids, pressure switches	Ex n	2	IEC 60079-15	EN 60079-15

EXPLOSION GROUP		
MARKING	EXAMPLE	PERMISSIBLE EQUIPMENT GROUP
IIA	propane	IIA or IIB or IIC
IIB	ethylene	IIB or IIC
IIC	hydrogen	IIC

TEMPERATURE CLASS (GASES)			
TEMPERATURE CLASS (GASES)	MAX. SURFACE TEMPERATURE OF THE EQUIPMENT	PERMISSIBLE TEMPERATURE CLASSES OF THE EQUIPMENT	EXAMPLE
T1	450°C	T1 to T6	town gas
T2	300°C	T2 to T6	ethylene
T3	200°C	T3 to T6	gasoline fuels
T4	135°C	T4 to T6	acetaldehyde
T5	100°C	T5 to T6	-
T6	85°C	T6	carbon disulfide

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NOTIFIED BODY FOR THE EQUIPMENT APPROVAL	SHORT NAME	CODE NUMBER	COUNTRY
TÜV NORD CERT GmbH	TÜV	0044	Germany
INSTITU NATIONAL DE L´ENVIRONNEMENT INDUSTRIEL ET DES RISQUES	INERIS	0080	France
Physikalisch Technische Bundesanstalt	PTB	0102	Germany
TÜV SÜD Product Service GmbH	TPS	0123	Germany
DEKRA EXAM GmbH	BVS	0158	Germany
DEKRA Certification B.V.	DEKRA/KEMA	0344	Netherlands
SIRA CERTIFICATION SERVICE	SIRA	0518	UK
SGS BASEEFA LIMITED	BASEEFA	1180	UK

RESTRICTION FOR USING APPARATUS	
REQUIREMENTS	MARKING
without restriction	–
special condition should be noted	X
Ex-component, which is not intended to be used alone and requires additional certification. CE-Conformity is declared by the manufacturer if the part is fitted into a complete equipment.	U

In dust atmospheres

II 2D Ex tb IIIC T 90°C Db

TYPE OF PROTECTION	MARKING	MAY BE USED IN ZONE	STANDARD
Flameproof enclosures	Ex d	1 or 2	IEC EN 60079-1
Increased safety	Ex e	1 or 2	IEC EN 60079-7
Intrinsic safety	Ex ia	0 or 1 or 2or 20 or 21 or 22	IEC EN 60079-11
	Ex ib	1 or 2 or 21 or 22	
	Ex ic	2 or 22	
Encapsulation	Ex ma	0 or 1 or 2or 20 or 21 or 22	IEC EN 60079-18
	Ex mb	1 or 2 or 21 or 22	
	Ex mc	2 or 22	
„n“ type of protection	Ex n	2 or 22	IEC EN 60079-15
Protection by enclosure	Ex ta	20 or 21 or 22	IEC EN 60079-31
	Ex tb	21 or 22	
	Ex tc	22	

Max. surface temperature of the equipment

EXPLOSION GROUP (DUSTS)			Permissible equipment group
MARKING	Type of Dust	Example	
IIIA	combustible flyings	cotton	IIIA or IIIB or IIIC
IIIB	non-conductive dust	grain	IIB or IIIC
IIIC	conductive dust	aluminium dust	IIIC

SIL and IEC 61508 - The international functional safety standard

1. Risk and functional safety

> Safety can be defined as “freedom from unacceptable risk”.

> Industrial processes are never completely free of risks. Functional safety can be used to evaluate and reduce residual risk to an acceptable level.

2. Risk assessment

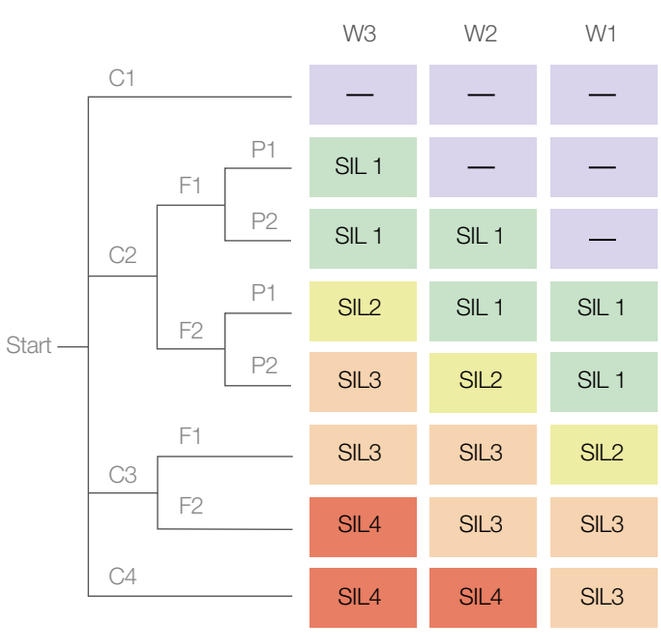
> The risk of an industrial process is evaluated by the plant operator using a risk graph (see picture 1) for example.

> The risk graph rates the possible threat for people and environment and determines the required level of risk reduction.

> This required level of risk reduction is called safety integrity level (SIL). An industrial process with a demand of SIL4 represents the highest hazard level.

Risk-graph and requirement classes according to: IEC 61 508 / 61 511

C= Extend of damage
C1: slight injury of a person
C2: severe, irreversible injury of one or several persons
C3: death of several persons
C4: catastrophic implication with many death persons
F= Duration of stay
F1: rarely or more often
F2: frequently up to permanent
P= Hazard prevention
P1: possible under certain conditions
P2: rarely possible
W= Probability with which undesirable incidents happen
W1: very low
W2: low
W3: relatively high
— = No safety requirement



3. Safety instrumented system

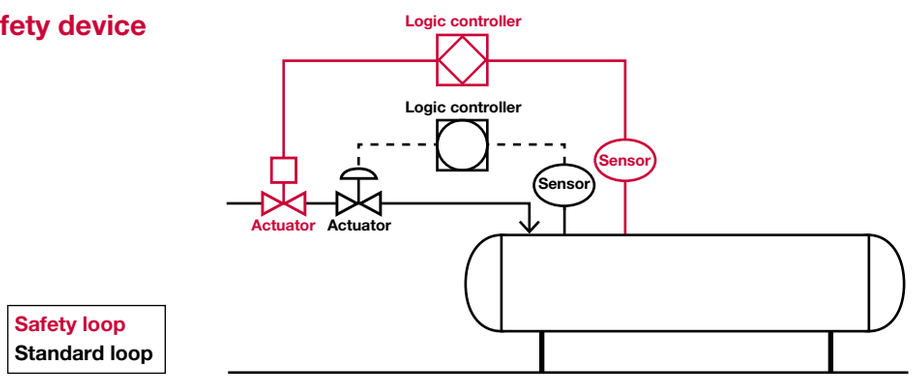
> The reduction of the evaluated risk is performed by a safety instrumented system (SIS). The plant manufacturer needs to ensure that all components meet the requirements of the IEC61508 for the respective SIL.

> The SIS needs to be independent from the standard loop and consists of sensor, logic and actuator (see picture 2). Control valves are part of the actuator.

> IMI Precision Engineering developed control valves that are evaluated and certified according to the requirements of the IEC61508.

> These control valves are successfully used in safety instrumented applications since many years.

SIS example: Overfill safety device



4. SIL certification

> All components of the SIS will be evaluated by manufacturer according to the requirements of the IEC 61508 and certified by independent organizations (e.g. TÜV).

> The certification according to SIL covers aspects of systematic and statistical suitability.

> Systematic suitability is proved by a certified product development and quality management process. Potential faults are identified and avoided by FMEAs.

> Statistical suitability is done by confirmation of a low failure probability of the components. This evidence was provided by a long-term test under worst-case conditions and confirmed by field data.

> In the Low Demand Mode (LDM; Safety requirements < 1 operations / year) the probability of failure is stated as Probability of Failure on Demand (PFD). The calculation is based on the failure rate (λ) and the test interval (T).

> In the High Demand Mode (HDM; Safety requirements > 1 operations / year) the probability of failure is stated as Probability of Failure per Hour (PFH). PFH corresponds to the failure rate (λ).

> The achievable level of risk reduction (SIL 1 … 4) is based on systematic and statistical suitability.

> The control valves developed by IMI Precision Engineering can be used in both LDM and HDM.

> They are certified for service life up to 12 years and meet the requirements for SIL2 as a single-channel design and SIL3 in a multi-channel design of the SIS.

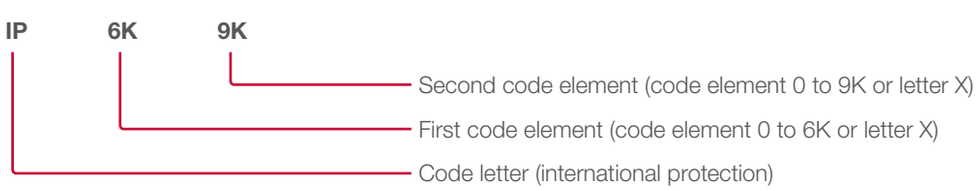
IP-Protection classes International Standard ISO20653 Degrees of protection (IP code)

The international standard ISO20653 describes the degree of protection of electrical equipment against foreign objects, water and access.

The international standard specifies the following:

- Designations and definitions of types and degrees of protection provided by enclosures of electrical equipment for the:
  - protection of electrical equipment within the enclosure against ingress of foreign objects, including dust (protection against foreign objects)
  - protection of persons against access to hazardous parts inside the enclosure (protection against access)
  - protection of electrical equipment inside the enclosure against effects due to ingress of water (protection against water)
- Requirements for each degree of protection
- Tests to be carried out in order to confirm that the enclosure complies requirements of the relevant degree of protection

The international standard specifies the following:



(Where no code element is given, the letter “X” shall be substituted.)

The table contains an overview of the IP code elements:
(Extract from the standard)

ELEMENT	IP	MEANING FOR THE PROTECTION OF ELECTRICAL EQUIPMENT	MEANING FOR THE PROTECTION OF PERSONS
		Against foreign objects (including dust):	Against access:
First code element	0	not protected	not protected
	1	with diameter ≥ 50 mm	with back of hand
	2	with diameter ≥ 12,5 mm	with finger
	3	with diameter ≥ 2,5 mm	with tool
	4	with diameter ≥ 1,0 mm	with wire
	5K	dust-protected	with wire
	6K	dust-tight	with wire

ELEMENT	IP	MEANING FOR THE PROTECTION OF ELECTRICAL EQUIPMENT	MEANING FOR THE PROTECTION OF PERSONS
		Against water:	
Second code element	0	not protected	Not applicable
	1	vertical water drips	
	2	water drips (15° inclination)	
	3	water spray	
	4	splash water	
	4K	splash water with increased pressure	
	5	high-velocity water	
	6	strong high-velocity water	
	6K	strong high-velocity water with increased pressure	
	7	temporary immersion	
	8	continuous submersion	
	9K	high-pressure/steam-jet cleaning	

Examples for the use of letters in the IP code:

IP6K9K > protection against dust (dust-tight) and protection against water (high-pressure/steam-jet cleaning)

IPX6 > protection against water (strong high-velocity water)

Lean Manufacturing the IMI Way

IMI Precision Engineering are dedicated to Lean Manufacturing and Continuous Improvement to improve the quality and delivery of our products and customer service by increasing value and reducing waste.

We follow key lean principles to ensure we focus on our customers needs and optimise our products, processes and services to provide the following benefits to our customers:

- Increased manufacturing efficiency
- Reduced unplanned downtime and shutdowns
- Reduced lead times and inventory
- Optimised new product development
- Agile engineering partnerships

Benefits for the customer

- Increase of plant efficiency and life time
- Cost reduction due to less unplanned downtime and shutdowns
- Optimal realization of new product designs — in time, on cost, at quality
- Short reaction- and lead times supporting on time availability of planned and unplanned orders
- Customized transport– and packaging solutions reducing stock receipt time and increase environment protection
- Innovative solutions based on cooperative and agile engineering partnerships

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