Approvals

The smart choice of Fluid Control Systems

bürkert
Fluid Control Systems

Contents

1. Safety included

By its very nature, technology which serves man and society must comply with special guidelines concerning safety and environmental compatibility. Regulations which rank as legislation very precisely regulate what applies to all suppliers on the relevant market and at the same time, regulate the basis for standardized production conditions.

The term “approvals” covers all standards for specific products with which every manufacturer, in particular every operator of technical installations, must comply. Depending on the particular situation and country, this may imply efforts, complexity or expenses which, quite simply, can be better regulated with the competence of the manufacturer.

Standard, law or recommendation?

Due to legislative stipulations, directives and standards are lent the character of a national law or, in some cases, internationally valid law as well. In cases in which the legislature prescribes a notified body, we speak of an approval and of a Declaration of Conformity, in which the manufacturer itself confirms compliance with specific standards. Moreover, there are institutions which issue only recommendations, but whose significance not infrequently corresponds to that of a law.

Bürkert meets its customers’ requirements with coordinated services focusing on an extremely wide variety of approvals and, in addition to providing competent consulting, offers approval testing by approval agencies, for example full implementation of CSA approvals in our laboratory, which has been authorized for this purpose.

One special aspect relates to the operators of machines or installations subject to mandatory monitoring. In general, they are requested by supervisory bodies, such as the German Employers’ Liability Insurance Association in Germany, to use only approved equipment complying with the given safety requirements in their installations.

This scenario merely touches on the national aspects for approvals. And, as is normally the case, the devil is in the detail here as well. The list of special approvals would fill volumes – and is a very good argument for ensuring that you enlist the services of Bürkert.

What global players need to consider

European countries have developed very close ties regarding free trade and the associated unification of standards relating to technical safety requirements. Here as well, exceptions prove the rule that identical requirements apply in all EU countries.

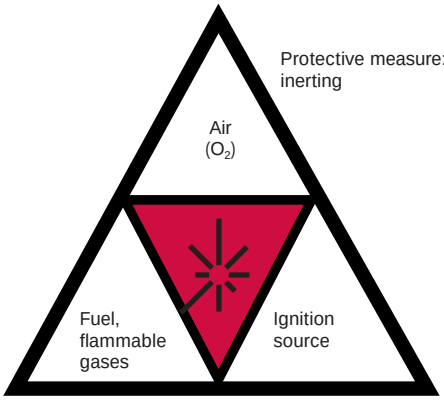
The situation is different in North American countries such as the USA or Canada. Those who export to these countries must also comply with the criteria applicable there. Thus, the US Department of Occupational Safety and Health Administration (OSHA) requires electrical installations and equipment to bear the test mark of the NRTL (National Registered Test Laboratory) and stipulates that production must be audited four times per year. Aggravating the situation is that these supra-regional regulations are complicated with regional specifications in each case.

Furthermore, as concerns the “jungle” of differentiated regulations prevailing in the growth markets of the Far East or Russia, you will be on the safe side if you let our trained experts assist you in obtaining worldwide approvals for your products.

The smart choice of Fluid Control Systems

Bürkert guarantees you the right choice. And not only in technical respects. Our components and systems comply with the most stringent safety standards worldwide. We will be pleased to assist you in procuring appropriate approvals for your installations. If it is possible, it is possible with Bürkert. Worldwide.

2. Explosion protection



2.1. Preconditions for an explosion

By the term “explosion”, we mean an exothermic reaction of a combustible substance or a hazardous, potentially explosive atmosphere with oxygen involving the release of a great quantity of energy. Depending on the speed of the combustion process, we talk of deflagration, explosion or detonation. The hazard increases in proportion to the speed of propagation and is greatest in the case of a detonation.

Wherever flammable gases, vapors or dusts occur and mix with air or oxygen, there is a risk of an explosion. This does not only concern installations in the chemical industry and mining industry; a bottling plant for high-proof liquor or a grain silo also represent a potential source of explosion. Every unintentional explosion poses a hazardous risk to the health, life and limb of persons and generally leads to major property damage.

Combustible substances present in the form of gases, vapors, hazes, mists or dust in conjunction with oxygen, i.e. which are finely distributed, form a hazardous, potentially explosive atmosphere which, if ignited, can be hazardous to humans or the environment. The required ignition energy may differ greatly from substance to substance.

Ignition sources

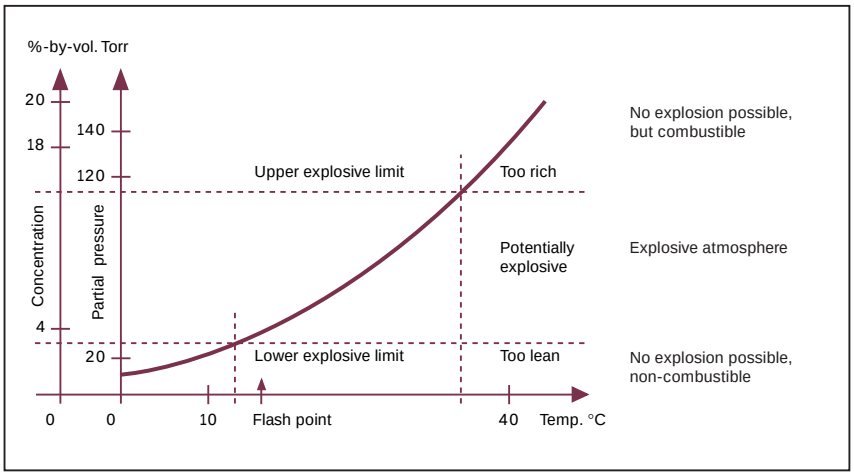
To ignite a potentially explosive atmosphere, an ignition source with the minimum energy required for ignition is required. Ignition sources may be:

- Electrical sparks and arcs
- Hot surfaces
- Electrostatic discharge phenomena
- Atmospheric discharge phenomena (lightning flashes)
- Mechanical friction and impact sparks
- Electromagnetic radiation
- Ultrasound
- Adiabatic compression (shock waves)
- Ionizing radiation
- Optical radiation
- Chemical reactions
- Open flames

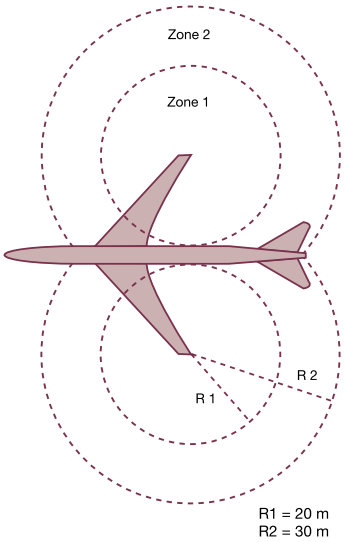
Secondary explosion (Ex) protection counteracts these sources.

Mixtures

The ratio between the combustible substance and the air available is considered hazardous as long as it lies in the potentially explosive range. The limits to this are referred to as the upper and lower explosive limits. Explosion cannot occur outside of these limits.



Vapor pressure diagram of ethyl alcohol



Zones

The explosion-hazard areas are classified into zones depending on the frequency and duration of the occurrence of hazardous, potentially explosive atmospheres. For these defined zones, requirements are stipulated for the equipment permitted in these zones and the method for verifying compliance with these minimum requirements is defined. In EC Directive 1999/92/EC, the zones are defined as follows:

The probability of an explosive atmosphere decreases with increasing distance from the danger source. Consequently, the area adjoining Zone 0 is always Zone 1 and the area adjoining Zone 1 is always Zone 2. This is clarified by using the example of aircraft refueling. The fuel tanks of the aircraft are located in the wings. This is Zone 0.

A distinction is made between gases and dusts in the zone classification chiefly because dusts form isolating layers if they are deposited on the equipment and these layers may allow the operating temperature of a device to rise to a hazardous level. US standard NEC 500 also distinguishes between gases and dusts and, in addition, on the basis of fibers. However, this is clearly illustrated by the further classifications into Classes I, II and III.

Classification and designation of danger zones in accordance with the various standards

Explosive atmosphere...	IEC, EN, NEC 505 Danger due to gases	IEC bzw. EN Danger due to dusts	NEC 500
present for long periods or	Zone 0	Zone 20	Division 1
frequently present during normal operation, or	Zone 1	Zone 21	Division 1
occasionally anticipated only in the event of a fault	Zone 2	Zone 22	Division 2

2.2. Measures to prevent an explosion

Primary explosion protection
Explosion protection (in the following referred to as Ex protection) is aimed at preventing an explosion.

The term “primary explosion protection” means all measures taken to prevent a hazardous, potentially explosive atmosphere from even occurring in the first place. These measures are generally taken by the operator of an installation and comprise the following points:

- Cooling flammable liquids to below their flash point
- Avoiding combustible materials (replacing them with non-hazardous alternatives)
- Inerting (addition of nitrogen or carbon dioxide etc. in order to displace the oxygen from the process)
- Concentration outside of the critical limits (see potentially explosive mixture)
- Natural or technical ventilation.

Secondary explosion protection
If explosion risks cannot be precluded or can only be incompletely precluded by primary explosion protection measures, measures must be taken to prevent the ignition of potentially explosive atmospheres. This can be done by:

- Avoiding ignition sources
- Avoiding hot surfaces
- Rules of conduct for employees and staff (bans on open flames, smoking, working with angle grinders or welding equipment).

Positioner of intrinsically safe design for use in Zone 1 or Zone 2

Tertiary explosion protection
If the possibility of both ignition sources and explosive mixtures cannot be precluded, it is necessary to permit an explosion or attempt to burn off the flammable gases before they reach hazardous quantities. In order to prevent injury to persons, it is necessary:

- to preclude the presence of persons in this area,
- to take special structural measures, and
- to ensure that the explosion process is a controlled process (e.g. in a pressure-encapsulated area).

In the Middle Ages, miners regularly burnt off gases before they reached excessively large quantities. Persons frequently lost their lives when doing this.

3/2-way solenoid valve with encapsulated coil for use in Zone 1 or Zone 2

Remote I/O system for connection of 4 binary, intrinsically safe actuators and 8 binary sensors to Foundation field bus H1

2.3. European approvals for explosion protection

ATEX directive and standards

For many years now, there has been cooperation between European States with the aim of harmonizing or standardizing the widely differing national standards. The CENELEC (Comité Européen de Normalisation Electrotechnique) is the authoritative body in conjunction with explosion protection.

Within the European Union, all directives (EC Directives) passed by the Council of European Communities must be converted to national laws on the basis of the European Treaty. It is thus ensured that the same legal stipulations apply in all member states. This greatly simplifies and facilitates the situation for manufacturers, dealers and importers.

Common standards have been elaborated for the explosion protection of electrical installations as well, and these have then been implemented as nationally valid standards. Directive 94/9/EC ATEX 100a, Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres, was put in force in 1996 and since that time, has also been taken into account at Bürkert when obtaining new approvals.

As of July 01, 2003, the previous Directives 76/117/EEC, 79/196/EEC and 82/130/EEC with the last amendment are to be replaced and invalidated by Directive 94/44/EC. The transitional period during which both procedures were valid will thus have elapsed and the new directives (94/9/EC, 99/92/EC and other enacted) relating to explosion protection must be applied.

This means that starting July 01, 2003, it is permitted to “market” equipment which is subject to the directive only with the new approval. “Marketing” indicates a manufacturer or importer making products available either subject to charge or not subject to charge for the purposes of sale and/or use for the first time in the EU. Moreover, a retention of acquired rights applies to installed installations and equipment. Even equipment which is not ATEX-approved may be placed back into operation after repair if it fails after July 01, 2003 and has to be repaired.

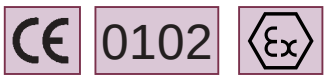
The essential differences between the new ATEX Directive and the earlier directives are as follows:

- Applicability both to mining and to all other explosion-hazard areas
- Fundamental safety requirements are stipulated
- Applicability for complete protection systems
- Dust explosion protection is included
- Equipment is subdivided into categories which, in turn, may be used in corresponding zones
- The quality system of the manufacturer has to comply with the precise guidelines and must be certified by a testing facility (ISO 9001 does not suffice)
- New marking with the CE mark
- Non-electrical equipment is included in the scope of validity

CE 0102 Ex II 2G EEx ed IIC T4 PTB 03 ATEX 1030 X

Classification and marking

In accordance with the ATEX Directive, each device receives a marking indicating for what applications the device is suitable or may be used. A series of abbreviations and code numbers are used for this. For this reason, the marking will be described here in detail using the example below.



CE
The CE mark means that the device was manufactured in compliance with European Standards. This mark alone is encountered very frequently without it always being clear to the reader/user what directive or standard it is based on. It is only the manufacturer's EC Declaration of Conformity that clarifies the standards this product complies with. This may then certainly relate to several standards simultaneously, e.g.: Low Voltage Directive, Directive on Electromagnetic Compatibility or Medical Device Directive...

0102: Notified body
The number which follows is the code for the notified body which certifies and regularly audits the manufacturing process for the devices in accordance with the ATEX Directive. Each of the notified bodies is appointed by the European Court of Justice in Brussels and is thus frequently referred to as the "notified body". In conjunction with the CE mark, the "regulated area" is also spoken about. Certain notified bodies are listed below:

LCIE	France	0081
INERIS	France	0080
BAM	Germany	0589
DMT	Germany	0158
DQS	Germany	0297
FSA	Germany	0588
IBExU	Germany	0637
PTB	Germany	→ **0102**
TÜV H.	Germany	0032
KEMA	The Netherlands	0344
SP	Sweden	0402
LOM	Spain	0163
BASEEFA	UK	0600

Ex
The "Hexagon Ex" used in everyday language indicates that the component marked with it can be used "to prevent explosions".

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II: Device group
Device group I: electrical equipment for firedamp-proof mine constructions. With Group I electrical equipment (mining), it is assumed that only methane occurs as flammable gas, but in conjunction with coal dust. This application is very specific and thus also requires very rugged construction of the components. The approval modalities are also specifically aimed at this.

Device group II: electrical equipment for all other explosion-hazard areas. Greatly differing substances may occur in these areas. Consequently, a further subdivision into explosion groups A, B or C is made for Group II.

2G: Category
The term “category” was only introduced in the ATEX Directive. A device may be approved for a specific category. This category indicates in what zone the device may be used. This is a crucial advantage over the old marking which did not clearly indicate this.

Category 1: use in Zone 0, 1, 2, 20, 21 or 22
Category 2: use in Zone 1, 2, 21 or 22
Category 3: use in Zone 2 or 22

In addition, a distinction is made based on whether the device is approved for explosion-hazard areas which are hazardous due to gases, vapors, hazes or mists (letter G) or for dust explosion protection (letter D). This results in the following categories, which must be complied with for use in the various zones:
Zone 0: Category 1 G
Zone 1: Category 2 G (in this case, a Category 1 G device may also be used)
Zone 2: Category 3 G (in this case, a Category 1 G or 2 G device may also be used)
Zone 20: Category 1 D
Zone 21: Category 2 D (in this case, a Category 1 D device may also be used)
Zone 22: Category 3 D (in this case, a Category 1 D or 2 D device may also be used).

There are also devices which carry both the 2G and 2D markings and which thus may be used in Zones 1, 2, 21 and 22.

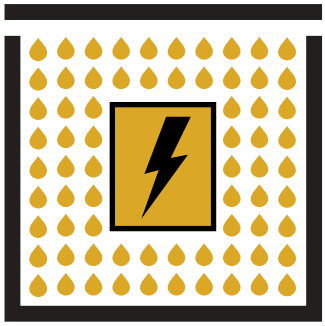
EEX: Euro EX
The Euro Ex – as with the Hexagon Ex – clearly indicates that the device is a device for preventing explosions for the European market. In North America, marking takes place in accordance with NEC 505. analogous to this with AEx.

CE 0102 Ex II 2G EEx ed IIC T4 PTB 03 ATEX 1030 X

	IEC	Europe	Germany
Electrical equipment for explosion-hazard areas: General provisions	60079-0	EN 50 014	DIN EN 50 014, VDE 0170/0171 Part 1
Oil immersion “o“	60079-6	EN 50 015	DIN EN 50 015, VDE 0170/0171 Part 2
Pressurized enclosure “p“	60079-2	EN 50 016	DIN EN 50 016, VDE 0170/0171 Part 3
Powder filling “q“	60079-5	EN 50 017	DIN EN 50 017, VDE 0170/0171 Part 4
Flameproof enclosure “d“	60079-1	EN 50 018	DIN EN 50 018, VDE 0170/0171 Part 5
Increased safety “e“	60079-7	EN 50 019	DIN EN 50 019, VDE 0170/0171 Part 6
Intrinsic safe “i“	60079-11	EN 50 020	DIN EN 50 020, VDE 0170/0171 Part 7
Type of protection “n“	60079-15	EN 50 021	DIN EN 50 021, VDE 0170/0171 Part 8
Encapsulation “m“	60079-18	EN 50 028	DIN EN 50 028, VDE 0170/0171 Part 9

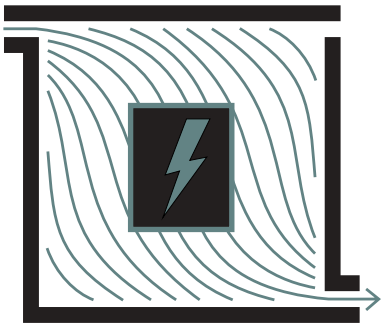
ed: Types of ignition protection
The Euro Ex provides an indication of the type of ignition protection according to which the device was designed or tested. The above-mentioned standards have now been passed in regards to types of protection.

With the exception of types of protection n and i, all the aforesaid types of protection are equivalent. That means that no statement can be made as to the particular applications for which a device is suitable or unsuitable on the basis of these types of protection. Several different types of protection may also be used on one device for its components. The coil and terminal box of our valve are designed, for example, with increased safety and the integrated bridge-connected rectifier features a flameproof enclosure. This means that the marking covers “ed”. The modes of action of the individual types of protection are described below.



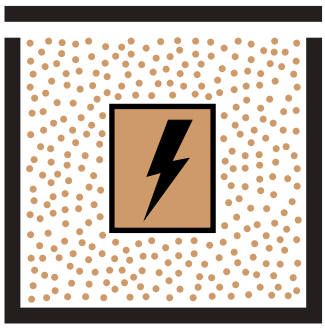
Oil immersion “o”
Basic principle: type of protection in which the electrical equipment is made safe by immersing in it oil so that a potentially explosive atmosphere cannot be ignited above the oil surface or outside of the enclosure. The equipment can, in practical terms, be used only while stationary. Maintenance of the oil level, contamination of the system by the oil, poor working conditions in the case of a repair and the installation position resulting from the oil level, etc. have led to discontinuation of this type of protection.

CE 0102 Ex II 2G EEx ed IIC T4 PTB 03 ATEX 1030 X

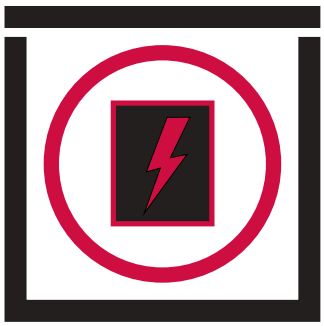


Pressurized enclosure “p”
Basic principle: type of protection on which the penetration of an explosive atmosphere into the enclosure is prevented by an inert gas being maintained inside at a pressure above atmospheric pressure. The pressure above atmospheric pressure is maintained with or without constant flushing. Air or another inert gas is used as the protective gas. Equipment with this type of protection is generally manufactured in the following versions:

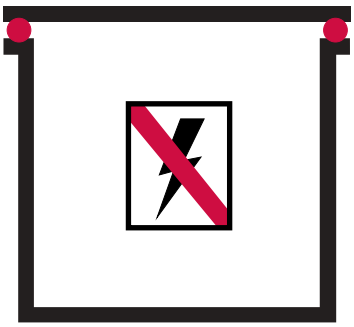
- constant flushing
- maintenance of gauge pressure by replacement of leakage losses



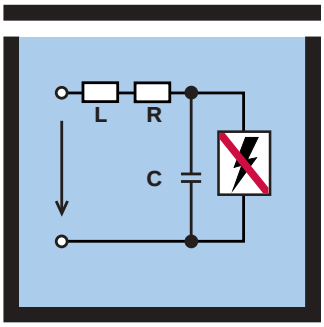
Powder filling “q”
Basic principle: type of protection which is achieved by filling the enclosure of an item of electrical equipment with a finely grained filling material. Neither an ignition as the result of flames nor an ignition as the result of increased temperature on the enclosure surface may occur. Very small glass balls are primarily used as the filling material. This is also the reason why moving parts cannot be a component or used with this type of protection.



Flameproof enclosure “d”
Basic principle: type of protection with which an explosion can occur inside the enclosure but whose pressure is withstood by the enclosure (between 5 bar and 10 bar) and with which transfer of the explosion to the potentially explosive atmosphere surrounding the enclosure is prevented. Such abrupt loads can be coped with, and only with difficulty, by enclosures. Consequently, these enclosures are not constructed gas-tight, but have arc-proof gaps. The hot gases occurring must cool down to such a level in the gaps so that they neither reach minimum ignition temperature nor minimum ignition energy outside the enclosure.

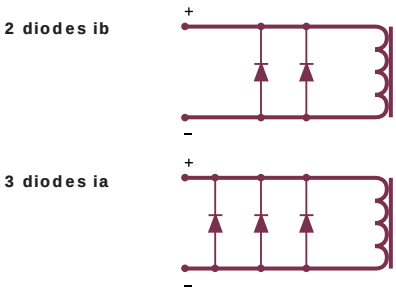


Increased safety “e”
Basic principle: type of protection with which measures are taken to prevent the possibility of inadmissibly high temperatures and the occurrence of arcs inside or on external parts of electrical equipment with an increased level of safety. The cabling leading to equipment in the intrinsically safe area is generally designed with enhanced safety.

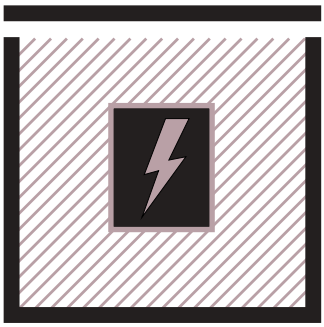


Intrinsic safety “i”

Basic principle: intrinsically safe circuit. A circuit in which sparks and thermal effects cannot occur. Unlike the other types of protection, intrinsic safety does not refer only to one component that has been designed “safe”, but to the entire circuit, consisting of current source, cabling and the actual terminal device. It is the only type of protection with which it is possible to install electrical components as far as Zone 0. In this case, even “small” sparks are permitted during operation of the installation, e.g. when working on the electrical components. However, the ignition energy is limited to such an extent that no ignition can occur. A distinction is made in the case of the components of this type of protection on the basis of “ia” (also for Zone 0) and “ib” (only for Zone 1, 2). “ib” means double safety. A fault may occur and the device is still safe. “ia” means triple safety: 2 faults may occur and the device is still safe.



Freewheeling diodes which destroy the energy stored in the inductor within the device so that ignition cannot occur due to “contact-breaking sparks”.



Encapsulation “m”

Basic principle: type of protection with which the parts that could ignite a potentially explosive atmosphere due to sparks or heating are embedded in a potting compound. The encapsulation cannot have any cavities and must feature a minimum wall thickness. Most explosion-protected components manufactured by the Bürkert company are “made safe” today using this method.

Type of protection “n”

The scope of application of this type of protection is limited to use in Zone 2 or 22. The basic principle of this type of protection is as follows: parts which cause arcs, sparks or hot surfaces during regular operation and which are capable of igniting a surrounding potentially explosive atmosphere must usually be protected against this by one or more of the following measures.
Ignition of the potentially explosive mixture is prevented by:

- enclosed break device “nC”
- non-incentive component “nA”
- hermetically sealed device “nC”
- sealed device “nC”
- encapsulated device “nC”
- energy-limited equipment and circuits “nL”
- restricted-breathing enclosure “nR” or
- simplified pressurized enclosure “nP”.

In addition to the above-listed types of protection, there are other, standardized types of protection (EN 50 033, 50 039, 50 050, 50 053). These types of protection currently do not apply to Bürkert products. A precise consideration would exceed the scope of this publication.

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IIC: explosion groups
The explosivity and spark ignition capability of a potentially explosive mixture are typical properties of the various substances. The gases and vapors are subdivided into explosion groups. The criteria for the subdivision are the maximum experimental safe gap and the minimum ignition current. The maximum experimental safe gap (MESG) and minimum ignition current (MIC) are determined for various gases and vapors under precisely defined test conditions. The maximum experimental safe gap is the gap width that just prevents a flame puncture of the mixture in a test vessel with a 25-mm gap length (IEC 60079-1A).

The minimum ignition current is defined with reference to the minimum ignition current for laboratory methane (IEC 60079-3).

The table below shows an overview of the maximum experimental safe gaps and minimum ignition currents for the various explosion groups.

The hazard posed by the gases increases from explosion group II A to II C. Accordingly, the requirements applicable to electrical equipment for these explosion groups become more stringent. Consequently, a device's designated explosion group may need to be specified on the electrical equipment. Electrical equipment approved for II C may also be used for all other explosion groups.

In accordance with the presently applicable standards, a distinction must currently be made based on explosion groups A, B or C only for types of ignition protection "i" and "d". Currently, certain requirements are being revised (chiefly relating to electrostatic charging). The maximum permitted surfaces are differently limited on the basis of groups A, B or C and, consequently, this distinction will probably soon have to be specified for other types of ignition protection.

Explosion group	Maximum experimental safe group	Minimum current ratio reference to methane
II A	> 0.9 mm	> 0.8
II B	0.5 mm to 0.9 mm	0.45 to 0.8
II C	< 0.5 mm	< 0.45

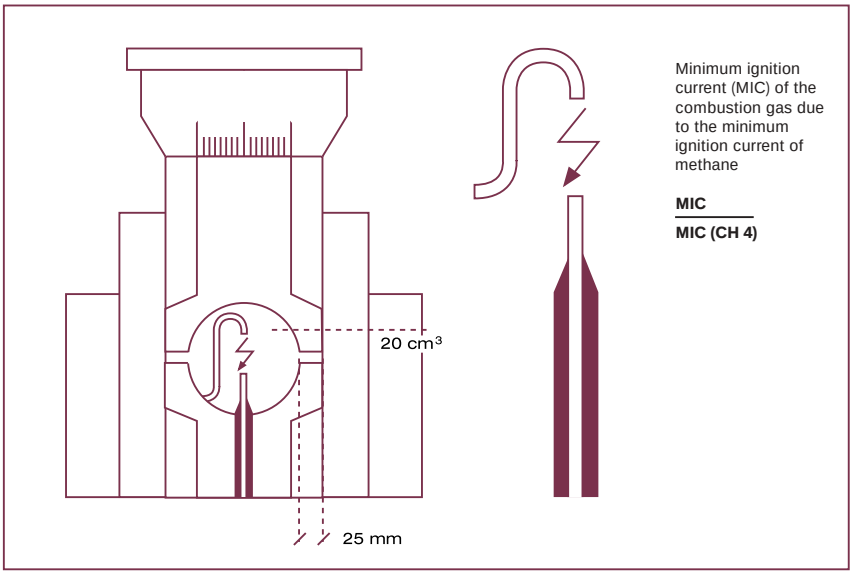

Figure on left:
Ignition test for determining the maximum experimental safe gap for a specific mixture

Figure on right:
Ignition test for determining the minimum ignition energy for a specific mixture

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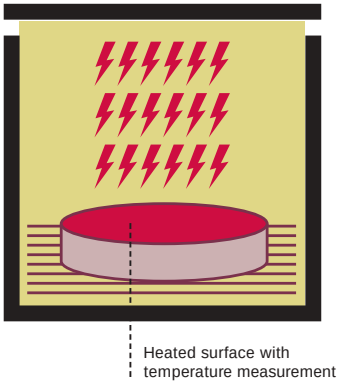
T4: Temperature classes
The ignition temperature of a flammable gas or flammable liquid is the lowest temperature at which ignition of the gas/air or vapor/air mixture occurs on a heated surface. It is determined in a defined test set-up (IEC 60079-4) and represents the lowest temperature value at which a hot surface can ignite the corresponding, potentially explosive atmosphere.

Temperatures in accordance with IEC 6009/ EN 50014	Maximum permitted surface temperature of the equipment (°C)
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

Temperature classes

Ignition test for determining the maximum surface temperature for a specific mixture



The maximum surface temperature of an item of electrical equipment must always be lower than the ignition temperature of the gas/air or vapor mixture in which it is used. Of course, items of equipment which comply with a higher temperature class (e.g. T5) are also permitted for applications on which a lower temperature class is required (e.g. T2 or T3). In North America, there is a system with a further subdivision into temperature sub-classes.

PTB
Notified body that drew up the type examination certificate.

03
Year in which the type examinations were conducted.

ATEX
Directive on the basis of which the approval was issued.

1030
Document number under which this transaction can be found at the notified body.

X
This X indicates special conditions related to operation of the equipment. These special conditions can be found in the operating instructions and in the approval of the device. This refers to important safety-relevant information, such as:

- Fuse ratings for fusing the device
- Installation information with type of protection IP20
- Differing temperature classes as a function of the method of installation.

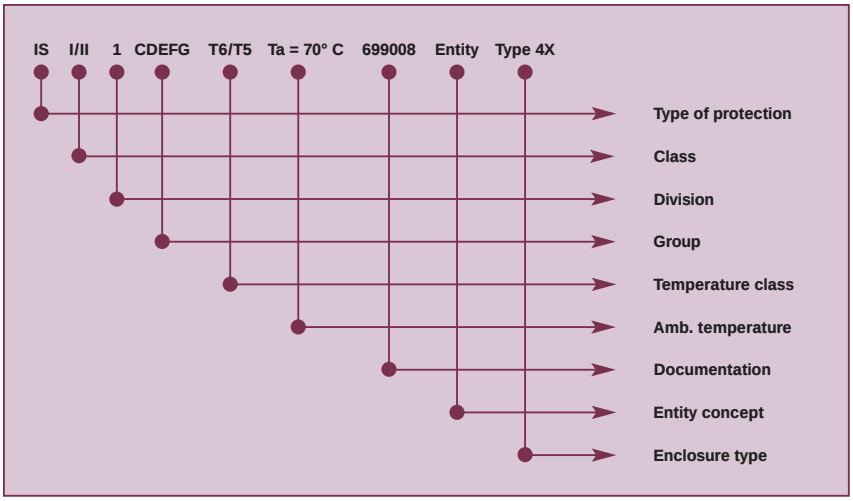
EEx approvals at Bürkert
In Europe, only the solenoid coils must be approved as electrical equipment for use of the solenoid valves in explosion-hazard areas. At Bürkert, these components are approved in accordance with type of protection “m”, “e”, “ia” or “ed” and “em”. Most of the coils with EEx-ed approval were now approved as EEx-m coils by virtue of the ATEX approval. Almost all solenoid valves can be configured as explosion-protected equipment with the EEx-approved solenoid coils designated as types of protection EEx ia, EEx ed, EEx m and EEx em. In addition, several electronic control units are approved as intrinsically safe equipment EEx i. You can find an overview of the approved types on Page 34.

2.4. North American Ex approvals

The USA and Canada both belong to the IEC but, unlike Europe, only recently implemented the IEC Recommendations related to the Ex area (Hazardous Locations) in a national law. This means that two different standard systems are currently valid. The installation code of practice is stated in the relevant national regulations (NEC = National Electrical Code for USA or CEC = Canadian Electrical Code for Canada). The essential differences with respect to the European regulations are the subdivision of the Ex area into the "divisions" and the requirement that the electrical connection be made with a conduit (tubes in which the electrical cables are laid). The regulations valid since then have been implemented in NEC Article 500, and the new IEC Recommendations have been implemented in NEC Article 505. We will distinguish between these different articles in order to simplify our considerations:

NEC Article 505
This allows usage of the same types of protection as in the IEC Standard Series 60079, which are also used and approved in Europe. However, in addition to the resultant design requirements, the electrical connection must be made by means of a conduit (intrinsic safety is an exception to this). This conduit connection must withstand the explosion pressure dependent on the group. In view of this, the design is very sturdy and the manufacturing costs are high. Accordingly, two different designs will be used for Europe and North America for the foreseeable future. Otherwise, the same stipulations apply as those listed in Point 4 in this brochure. In terms of marking, we must point out that an AEx is used in place of the EEx.

NEC Article 500
This Article does not approve the same types of protection as in Europe. In addition, it must be mentioned that the potentially explosive mixture may also be present in the conduit connection (electrical connection, generally with 1/2" NPT internal thread) and these conduit connections must withstand an explosion pressure of up to 415 bar dependent on approval class. This explains the, in some cases, very rugged design of these connections. The marking and classification of the equipment will be explained using the following example.



IS I, II 1 CDEFG T6, T5 Ta = 70°C 699008 Entity Type 4X

Types of protection	
XP	Explosion-proof
IS	Intrinsically safe apparatus
AIS	Associated apparatus with intrinsically safe connections
ANI	Non-incentive field wiring circuit
PX,PY,PZ	Pressurized
APX,APY,APZ	Associated pressurization systems/ components
NI	Non-incentive
DIP	Dust-ignition-proof
S	special protection

Explosion-proof (XP)
This can be equated with flameproof enclosure. However, it is also assumed that the air/gas mixture may be present in the conduit. Consequently, the explosion pressure, which will differ depending on mixture (see Group above), must also be allowed for. This pressure is 415 bar for the application in Group A or B.

Intrinsically safe (IS)
This is comparable with intrinsic safety in Europe. An extremely great advantage of this type of protection is that it does not prescribe a conduit as the type of electrical connection. Consequently, this is the only type of protection in accordance with which one and the same design of solenoid valves and other approved electrical equipment can be approved both in Europe and in the USA. On the basis of the European approval of the coil, the Entity System must be used for the American approval. The approval refers to the system. For this purpose, a circuit diagram or control drawing specifying the corresponding limit values must be enclosed with the devices. In addition, approval of the entire solenoid valve is required in the USA but only approval of the coil is required in Europe. This can be explained with the safety requirements as well as in respect to the medium.

Pressurized type X, Y or Z
This type of protection is comparable with pressurized enclosure. The excess pressure present in the enclosure ensures that a potentially explosive air/ gas mixture cannot penetrate it. A distinction is also made on the basis of type X, Y and Z, whereby X and Y must be used for Division 1 and Z must be used for Division 2.

Dust-ignition-proof (DIP)
This type of protection relates to dust explosion protection and indicates that corresponding design measures preclude the possibility of dust penetrating the enclosure. Types of protection XP, IS, type PX and PY are stipulated for use in Division 1 and 2 Groups A – D and Type PZ is stipulated for use in Division 2 of Groups A – D. Type of protection DIP is prescribed for use in dust explosion protection (Group E – G) of Division 1 and 2.

Non-incentive (NI)
This type of protection is intended for use in Division 2 and consequently does not have the stringent requirements of the aforesaid types of protection. It indicates that sparks and excessively hot surface temperatures cannot occur in normal operation. It is comparable with type of protection “n” in accordance with EN 50021.

IS I, II 1 CDEFG T6, T5 Ta = 70°C 699008 Entity Type 4X

I, II: Subdivision into classes
Mining: air/methane mixture and coal dust
Class I: air/gas mixtures
Class II: air/dust mixtures
Class III: air/fiber mixtures

1: Subdivision on the basis of divisions
Division 1
Areas in which potentially explosive atmospheres consisting of flammable gases, dusts or liquids are constantly present or frequently present under normal operating conditions. Division 1 is comparable with Zones 0 and 1 or 20 and 21.

Division 2
Areas in which potentially explosive atmospheres consisting of flammable gases, dusts or liquids cannot be anticipated under normal operating conditions. This is comparable with Zone 2 or Zone 22.

CDEFG: Subdivision on the basis of groups
The subdivision on the basis of groups (hazardous substance groups) approximately corresponds to the European subdivision into explosion groups, but also refers to dusts.
Group A:
air/gas mixture with acetylene
Group B:
air/gas mixture with hydrogen
Group C: air/gas mixture with ethylene
Group D: air/gas mixture with propane
Group E: air/metal dust mixture
Group F: air/coal dust mixture
Group G: air/grain dust mixture

T5, T6 Ta = 70°C: Subdivision into temperature classes
With regards to temperature classes, the same limits are used as in Europe, but an even finer subdivision is used.

Temperature class	Maximum permitted surface temperature of the equipment °C	Ignition temperatures of the combustible substances	Temperature class NEC 500-3
T1	450	>450	T1
T2	300	>300 <450	T2
	280	>280 <300	T2A
	260	>260 <280	T2B
	230	>230 <260	T2C
	215	>215 <230	T2D
T3	200	>200 <300	T3
	180	>180 <200	T3A
	165	>165 <180	T3B
	160	>160 <165	T3C
T4	135	>135 <200	T4
	120	>120 <135	T4A
T5	100	>100 <135	T5
T6	85	> 85 <100	T6

Subdivision of the temperature classes

IS I, II 1 CDEFG T6, T5 Ta = 70°C 699008 Entity Type 4X

699008
Documentation number of the NRTL.

Entity Concept
Since this example involves an intrinsically safe item of equipment (type of protection IS), parameters of the entire circuit must be considered. The “maximum safety-engineering ratings” must be complied with so that, ultimately, the entire circuit is “safe”. (See also example application “Intrinsically safe circuit”.)

Type 4x: Protection of the enclosure
Enclosure types (NEMA 250-1997) describe the ruggedness or sensitivity and design of a device with respect to:

- Protection of electrically live internal components against electric shock hazard
- Dust, fluff, slush and dirt
- Water (steam/rain/water jet/ submersion...)
- Corrosive additives
- Snow and ice formation
- Penetration by insects

The Ingress Protection System, better known as the IP Code System, which classifies the components in a somewhat simpler manner, is widespread in Europe.

Valve terminal with intrinsically safe valves for use in Division 1 or 2

Intrinsically safe solenoid valve for use in Division 1 or 2

Namur valve with conduit connection for control of pneumatic actuators in Division 1 or 2

2.5. Other national approvals for explosion protection

For several years now, the IEC Ex scheme has existed, with which several countries are cooperating in the area of Ex protection. This Ex scheme is aimed at ensuring that standard protective measures are used in all countries. The approvals are then also recognized everywhere. Currently, several IEC study groups are working on this and at present, readers should refer to the corresponding IEC documents in order to obtain the current information. In addition to the European and North American Ex approvals, Bürkert also has approvals in many other countries. We shall mention a few of them below:

- Eastern European countries such as Poland, Slovakia, Hungary and Croatia
- Russia
- Ukraine
- Japan
- Australia.

The Ex approval in these countries is based on the European EEx approval. However, the procedure is different. But exchange of the approval documents from the PTB to the corresponding national agencies always forms the basis for the approval. In some cases, a few measurements, explanations or translations are also required.

Upon request, we will be glad to provide you with further details of the approvals.

Excerpt from approvals. Their validity is time-limited.
Please contact one of our staff in order to obtain current and detailed information.

Type	Russia	Ukraine	Japan	Australia
0590	•	•	•	•
64X	•	•	•	•
65X	•	•		•
74x /75x	•	•		
78X	•	•	•	•
5281	•	•	•	•
5282	•	•	•	•
5404	•	•	•	•
5411	•	•	•	•
5413	•	•	•	•
5420	•	•	•	•
5470	•	•	•	•
6013/4	•	•	•	•
6022	•	•	•	•
6516/6517	•	•		
6518/6519	•	•	•	•
6520/21	•	•		
6524-7	•	•		
8642/IO box	•	•		
8631/Control head	•	•		
8635/Positioner	•	•		

2.6. Application Ex-i circuit

Task

3/2-way pneumatic valves are to be used to control process valves in the explosion-hazard area by hydrogen (Zone 1). Since short cycle times are required, pilot valves are to be mounted directly on the pneumatic actuators. The distance between control and process valves is 200 meters.

For the application described, we require a component designated as category 2, group II, explosion group IIC and temperature class T1. In order to minimize the cabling complexity within the explosion-hazard area, preference is given to intrinsically safe valves. However, an intrinsically safe device may be controlled only by “associated apparatus”. This is because voltage, current and power are limited in an intrinsically safe circuit. This allows the possibility of ignition of the mixture to be reliably precluded even if the electrical cables are damaged.

Valve

The valve has a coil resistance of R_{20} = 310 Ohm, R_{75} = 378 Ohm and requires a minimum current of I_{min} = 29 mA in order to function correctly. In accordance with the type-examination certificate, this valve may be operated only on approved barriers, power supply modules or remote IO systems with the following safety-engineering ratings:
Ui = 35 V
Ii = 0.9 A
Pi = 1.1 W
It has no relevant internal inductors or capacitors.

Isolating module

The isolating module selected has the following certified maximum ratings for the intrinsically safe output:

Uo = 25.4 V	maximum no-load voltage
I0 = 93 mA	maximum short-circuit-current
P0 = 0.59W	maximum output power

For use in explosion group IIC, the inductors and capacitors connected may not, in total, exceed the values
L = 4.3 mH
C = 0.107 µF.

The specified operating data is minimum output voltage U_{min} = 22,8 V and maximum internal resistance R_{max} = 303 Ohm.

Solution

Since, in this case, all three maximum ratings of the isolating module lie below those of the valve, the valve may be operated on it.

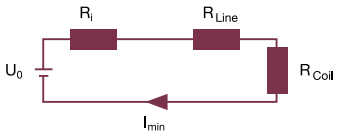
Isolating module	Valve
Uo = 25.4 V	< Ui = 35 V
I0 = 93 mA	< Ii = 0.9A
P0 = 0.59W	< Pi = 1.1 W

The capacitance and inductance of the valve are lower than the maximum ratings of the isolating module. Thus, the isolating module may be operated together with the valve.

L = 4.3 mH	> L = 0 H
C = 0.107 µF	> C = 0 F

The capacitance and inductance of the cabling depend on the cable type and cable length and must always be taken into account!

At this point, it is still unclear whether the valve functions with the isolating module, i.e. whether it is powered with the minimum current of 29 mA. In order to answer this, we must consider the closed circuit under worst-case conditions.
The line resistance can be estimated at approx. 15 Ohm with a length of 200 m and cross-section of 0.5 mm².



U_o = no-load voltage

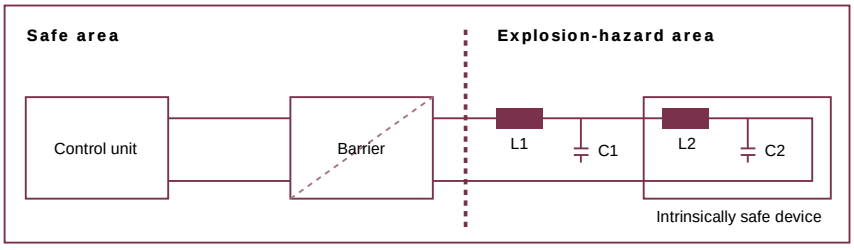
Total resistance =

R_{tot} =	internal resistance of the isolating module	303 Ohm
+	internal resistance of the coil in hot condition	378 Ohm
+	line resistance	15 Ohm

R_{tot} = 691 Ohm

I = 22.8 V /691 Ohm = 33 mA

It is thus ensured that the solenoid valve will function correctly.



3. European approvals

In addition to the above-described approvals for use in explosion-hazard areas, there are other European approvals as well. The European approvals and the CE mark must be considered jointly. The CE mark serves as a "passport" within those European states that are members of the European Free Trade Association (EFTA). The products marked with the CE mark comply with the stipulated safety regulations for the product and must be accepted in all states which are members of the EU and EFTA. The CE mark may be attached only to products covered by the scope of validity of a directive. Responsibility for attaching the CE mark lies with the manufacturer or with the authorized representative of the manufacturer with seat in the EU. CE marking must be separated into the regulated area and the unregulated area. The existing quality system also plays an essential role in all approvals.

3.1. Certified quality system

The quality system used is approved in accordance with Standards ISO 9000 – 9004, dependent on scope, and covers the QA system from development through production to final inspection of the products with approval in accordance with ISO 9001 (highest requirements). In the case of the European approvals, this approval serves as a very important module. Compliance with or application of these modules is frequently an unavoidable requirement for an approval. In the case of directives specified for the regulated area, the certification of the QA system in accordance with ISO 9001, which Bürkert possesses, does not suffice. The additional requirements specified in the aforesaid Directives must also be complied with. This is also monitored by a notified body. For ATEX Directive, the EN13980, "Explosion-Hazard Areas – Application of Quality Management Systems" standard has been elaborated at European level and has been available since last year.

3.2. Regulated area

Approvals that must be granted in accordance with specified EC Directives are covered by the regulated area. The scope of validity is stipulated. The requirements may necessitate that an "EC type examination" be conducted by an independent third-party agency. With this type examination, the products are tested for compliance with the standards specified in the directives. In this case, the number of the notified body that certifies and audits the manufacturer's QA system must be specified after the CE mark. On the EC Declaration of Conformity to be issued by the manufacturer, a reference is made to the standards applied and the EC type examination. It also specifies the number of the notified body issued the EC type-examination certificate. The following directives may apply to Bürkert products depending on individual application:

- Pressure Equipment Directive
- Gas Appliances Directive
- ATEX Directive.

3.3. Unregulated area

In the unregulated area, the CE mark is attached to the product. The manufacturer specifies the standards applied in the EC Declaration of Conformity, which can be requested if required. In this case, no independent third-party agency needs to be involved. The following directives may apply to Bürkert products, depending on individual application:

- Low Voltage Directive
- Directive on "Electromagnetic Compatibility"
- Vehicle Directive
- Medical Device Directive.

The Machinery Directive does not apply to our devices, which, as components, are not covered by the scope of validity of that directive. The stipulated risk considerations must, however, be applied.

3.4. Existing approvals at Bürkert

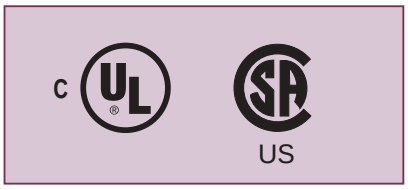
Here as well, we distinguish between the regulated and unregulated area.

Regulated area
In addition to EEx-approved devices, we also offer several solenoid valves which are approved either pursuant to the Pressure Equipment Directive or pursuant to the Gas Appliances Directive.

Unregulated area
The CE mark attached to Bürkert products refers to electromagnetic compatibility and, provided the voltage lies within the scope of validity of the Low Voltage Directive, to that directive as well. This scope of validity is
75 - 1500 V for DC voltages or
50 - 1000 V for AC voltages.

4. North American approvals

The approval stipulations have a very similar structure in the USA and Canada and the approval authorities are able to grant approvals not only for their own country, but also for the neighboring country (UL for Canada and CSA for USA).



Therefore, we will explain the interrelationships at this point by using the USA as an example.

OSHA (Occupational Safety & Health Administration, U.S. Department of Labor) elaborated the OSHA Regulations several decades ago. The Standard for Electrical Installations or Equipment (29 CFR) requires that only those installations or devices which have been tested by an NRTL (National Registered Test Laboratory) in line with the stipulated safety requirements and whose production is regularly audited by the NRTL may be fitted.

- Underwriters' Laboratories (UL)
- Factory Mutual Research Corporation (FMRC)
- Electrical Testing Laboratory (ETL)
- Canadian Standards Association (CSA)

Moreover, the regional authorities frequently issue City Electrical Codes, which precisely stipulate which of the aforementioned approvals must be available. Regions which accept only UL-approved components are frequently encountered.

4.1. Fundamental safety considerations

In regards to solenoid valves from our product range, which are to be approved in North America, three different safety considerations apply with respect to:

- Fire risk.
  The device could cause a fire. Consequently, the materials used are considered on the basis of their flammability.
- Risk of electric shock to the user.
  In this case, the protection and insulation of electrically live components are inspected, similar to the European VDE regulations.
- Risk due to fluid in the valve.
  In terms of this risk, special requirements apply to the tightness and pressure resistance of a valve.

Direct-acting 3/2-way valve with CSA and UL approval

Servo-assisted 5/2-way valve with CSA and UL approval

4.2. Approvals from Underwriters' Laboratories

In the case of UL, there are three different types of approval:

- UL-listed
- UL-recognized or
- UL-classified.

UL-listed
This UL approval is a "complete device approval" and thus refers to a connection-ready device, including its operating instructions. The required tests arise from the risk analysis, which determines the potential danger sources and the resultant safety requirements.

After positive testing of the devices in the laboratory, the manufacturer and product are published by the UL.

UL-recognized
This type of UL approval is a component approval with the same safety considerations as UL-listed and is practical for components used in machine construction/mechanical engineering. If machines are constructed which are ultimately to be UL-listed, non-approved, UL-recognized or UL-listed components may theoretically be used. However, for UL testing of the machine, the non-approved devices would have to be removed in order to conduct the required tests. Since this effort makes no sense, every mechanical engineer should, right from the onset, only use UR or UL-tested devices.

UL-classified
A classification may be issued for equipment, industrial or commercial product ranges with

- specific characteristics and related risks (fire protection equipment),
- for specially stipulated applications (trucks), or
- stipulated national or international standards.

Besides the UL classification mark, which may be attached to the device after the test has been passed, the manufacturer also receives a corresponding certificate from UL.

4.3. Factory Mutual Research Corporation

In addition to being a registered laboratory (NRTL), USA-based FM is also an insurance company. FM's work primarily focuses on approvals of explosion-protected devices.

4.4. Canadian Standards Association

The same requirements as in the USA apply in Canada. CSA approvals are equivalent to a UL approval. With CSA, a distinction is also made between component approvals and device approvals, but the marking on the rating plate is always identical.

Category Certification
Along with providing product approvals, CSA also offers a production approval called a "Category Certification". This means that the approved company may independently test its products on the basis of CSA criteria and attach the CSA mark.

This Category Certification also includes the option of allowing independently conducted approvals for "Ordinary Locations" (non-Ex) in addition to the advantage of allowing required audits to be conducted internally and on-site by appointed persons. For this purpose, the appointed persons must provide corresponding proof of qualification. The test facilities are subject to a calibration cycle and existing qualification of the QA system in accordance with ISO 9001 is very helpful.

Bürkert has this approval and offers a service that involves acting as an agent for other companies. The complete CSA approval, from the measurements to be conducted through preparation of the documents, can be performed by Bürkert.

5. Other national approvals

National approvals are approvals for which no European Directive is yet available. The standards to be applied for this may be national DIN Standards or European EN Standards. The particular application must be precisely specified and there are approvals or recommendations for these applications. The following examples illustrate approvals that may apply to solenoid valves:

5.1. VDE approval as water valve for domestic use

The regulations to be complied with for this approval are defined in EN Standard 60730, Part 8-2, which has also been implemented as national standard DIN VDE 0631, “Automatic Electrical Regulation and Control Devices for Domestic Use and Similar Applications”. The most important requirements are:

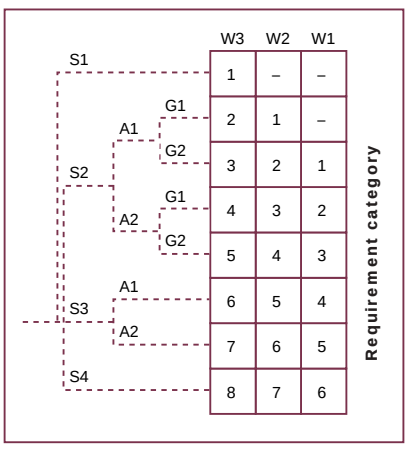
- electrical safety requirements;
- stipulated function behavior;
- compliance with the maximum stipulated water hammer;
- impermeability; and the
- mechanical strength of the fluidic components.

The VDE mark is attached to the approved product as a marking.

5.2. Germanischer Lloyd

Approvals by Germanischer Lloyd do not only apply to ships and ship equipment. GL, as an independent non-profit organization, also operates in the sectors of wind power generation, pipeline technology, power station engineering and many others. However, it always deals with safety and quality. Many Bürkert solenoid valves have GL type approval in accordance with corresponding “Environmental Categories”, confirming the

- stipulated function behavior;
- mechanical ruggedness; and
- electrical safety.



Risk graph in accordance with DIN 19250

5.3. Safety valves in accordance with DIN 19250 and 19251

The risk of injury and damage to the environment when operating a machine or installation is classified in the area of protection equipment. This involves consideration of both the nature and the magnitude of the possible damage or injury (from slight injury through death to catastrophe) and the probability of damage or injury. Other important factors are the time in which persons may spend in the danger zone and the possibilities of averting danger. However, the following rule of thumb applies:

The greater the possible damage or injury and the higher the risk, the higher the resultant requirement category.

- Extent of damage or injury
  S 1: Slight injury
  S 2: Serious, irreversible injury to one or more persons or death of a person
  S 3: Death of several persons
  S 4: Catastrophic effect, very many deaths
- Length of time persons remain in the area
  A 1: Rarely to frequently
  A 2: Frequently to permanently
- Averting danger
  G 1: Possible under specific conditions
  G 2: Hardly possible
- Probability of occurrence of the undesirable event
  W 1: Very low
  W 2: Low
  W 3: Relatively high

6. Approvals for flammable gases and liquids

6.1. Gas appliances for Europe (former DVGW approval)

The Gas Appliances Directive RL90/396/EEC has applied in the EU since December 31, 1995. This also covers components of gas appliances, such as solenoid valves, unless they are used in commercial or industrial sectors for process firing or in building piping. Among others, the following approval criteria apply in this case

- Safe functioning
- Compliance with leakage rate limits.

Although the aforesaid directive has given the approval a different name, it is still possible to apply for approval to the “Deutscher Verein des Gas- und Wasserfaches” (German Gas and Water Association) as the certification body. Marking is done with the CE mark, with the code of the notified body and the product ID No., e.g.: CE-0085 AS03791.

6.2. Gas appliances for North America

In North America, of course, the basis for a gas solenoid valve is a safety consideration of the UL or CSA approval, which also requires a conduit as the electrical connection. The stringent device reliability requirements applicable to this specific application can be found in the corresponding ANSI Standards.

6.3. Approval as safety shut-off valve

The European Standard EN 264 “Safety Shut-Off Devices for Combustion Plants using Liquid Fuels” is specified as the test regulation for this. As the result of the adoption as DIN EN 264, this European Standard has been implemented in a national standard. Stringent requirements such as

- stipulated function behavior;
- continuous loading capability;
- electrical safety requirements;
- impermeability; and
- mechanical strength of the fluidic components

are tested by a test laboratory (e.g. TÜV Südwest – German Technical Inspection Authority South West) and a report is drawn up by this laboratory. A test number, which is attached to the product, is then issued by the DIN CERTCO and the product is thus registered.

7. Approvals and recommendations in the hygiene sector

Water is one of the most important aspects of everyday life. In many countries, water is unrestrictedly available to everyone. The importance of water is realized only if there is a lack of water or if the quality of the water has declined greatly. For this reason, water quality is monitored worldwide by organizations, state institutions or independent institutes.

7.1. KTW Recommendation

For the plastics used within the drinking water sector in Germany, compliance with the KTW Recommendation is also required for applications involving solenoid valves with VDE approval. These recommendations are stipulated by the Federal Health Agency (Bundesgesundheitsamt) and have been in effect since 1958. The task of enforcing these "Plastics Regulations" was transferred in 2002 to the Federal Risk Assessment Institute (Bundesinstitut für Risikobewertung – BfR). The database information can be found on the Internet. A combination of VDE approval and compliance with the KTW Recommendation suffices for use of solenoid valves in the corresponding terminal devices.

7.2. FDA and NFS approvals

FDA stands for the United States Food and Drug Administration, deals with even more than the quality and safety of foodstuffs and medications for humans and animals. The scope of responsibility of this state authority also comprises cosmetics, vaccines, medical devices and devices which emit microwaves or nuclear radiation. The ongoing goal is to protect the health of consumers and users. Around 75 % of the foodstuffs consumed in the USA are subject to monitoring by the FDA.

NFS International, "The Public Health and Safety Company", is a non-profit organization which devotes its work to the development of technical standards in the sector of health and environmental protection. This organization is accredited by the

- American National Standards Institute (ANSI);
- Occupational Safety and Health Administration (OSHA);
- Standard Council of Canada (SCC);

and offers services in the sectors of

- quality assurance;
- training;
- chemical, physical, microbiological and toxicological testing and examinations; and
- certification.

In Bürkert's service spectrum, the aforementioned authorities, offices and agencies are encountered only in conjunction with the sealing materials used in our devices, which have been granted the approval, depending on type.

7.3. 3-A approval

3-A stands for a combination of the 3 areas involved in elaboration of the standards:

- Users (dairies and industrial farming)
- Equipment manufacturers (manufacturers of components)
- Foodstuff monitoring agencies (hygiene institutes).

These standards are generally required in dairy sector and place stringent requirements on the

- materials used (chemical resistance also to hot cleaning agents);
- surface condition of the elements (surface peak-to-valley heights); and
- design (low dead volumes).

The 3-A symbol may be attached to the product together with the corresponding approval standard only after approval, which is valid for one year.

7.4. EHEDG European Hygienic Equipment Design Group

For several years now, certain foodstuff manufacturers and machine and equipment manufacturers from the European area have been cooperating together to elaborate standards for hygiene in foodstuff production, similar to the 3-A Standard in North America. These very stringent standards are now established and are considered to be state-of-the-art in design, materials selection and surface treatment of devices and machines for the foodstuffs industry. As with 3-A, it is also necessary in this case to apply for an annual extension of the approval.

8. Approvals by UL, CSA and FM

Type	CSA-approved	UL - recognized	UL-listed CSA-approved FM Ex NI/I/2/ABCD FM Ex S/II,III/2/FG	CSA & FM Ex XP/I/1/ABCD T4 DIP/II, III/1/EFG T4	Ex CSA, FM XP/I/1/ABCD T6 DIP/II, III /1/EFG T6	Ex FM Intrinsically Safe IS/I, II, III/1/ ABCD,EFGT6
121	•	•				
124	•	•				
131	•	•				
142	•					
181	•	•				
200/201	•	•				
211/212	•	•	•	•	•	
221	•	•				
223	•	•				
253	•	•	•			
255	•	•	•			
256	•	•	•			
280	•	•	•	•		
281	•	•	•	•		
282	•	•	•	•[1]		
287	•	•				
290	•	•	•			
300/301	•	•				
311/312	•	•	•	•	•	
313	•	•				
323	•	•				
330/331	•	•	•	•[1]		
340	•	•	•	•[1]		
353	•	•	•			
355	•	•	•			
375	•	•				
404	•	•	•	•		
406	•	•	•			
407	•	•	•			
411	•	•	•	•	•	
413	•	•	•	•	•	
420	•	•	•	•	•	
581				•		
1066	•					
1067	•					
1078	•					
2508	•	•				
2509	•	•				
2512	•	•				
2821	•	•				
2832	•	•				
2834	•	•				

CSA-Type	UL - approved	UL-listed recognized	CSA & FM Ex CSA-approved FM Ex NI/I/2/ABCD FM Ex S/II,III/2/FG	Ex CSA, FM XP/I/1/ABCD T4 DIP/II, III/1/EFG T4	Ex FM XP/I/1/ABCD T6 DIP/II, III /1/EFG T6	Intrinsically Safe IS/I, II, III/1/ ABCD,EFGT6
5281	•	•	•	•	•	
5282	•	•	•	•[1]		
5404	•	•	•	•		
5411	•	•	•			
5413	•	•	•			
5420	•	•	•		•	
5470	•	•				•
6011	•	•				
6012	•	•				
6013	•	•	•	•	•	•
6014	•	•	•	•	•	•
6021	•	•				
6022	•	•		•		
6023	•	•				
6038	•	•	•			
6104	•	•				•
6106	•	•				•
6125	•	•				
6126	•	•				
6211	•	•				
6212	•	•				
6213	•	•	•	•		
6221	•	•	•			
6222				•		
6223	•	•				
6510	•	•				•
6511	•	•				•
6516	•	•				•
6517	•	•				•
6518	•	•	•		•	•
6519	•	•	•		•	•
6524	•	•				W
6525	•	•				W
6605	•	W				
6606	•	W				
8630	•					
8631	•					
8640	•					
8644	•	•				

W We are currently working on [1] CSA certification, only for Division 2 (Code PD45)

Many of the “intrinsically safe electrical devices” approved at Bürkert have been granted the EEx approval by the PTB (Physikalisch-Technische Bundesanstalt – German National Standards Laboratory) and the American approval by FM (Factory Mutual Research). These devices can thus be utilized with identical design in both explosion-hazard areas. In addition, Bürkert has been granted FM and CSA approval for many of the items in the standard equipment range, with protection type XP and DIP for use in Division 1. All devices featuring the UL-listed approval also feature the FM approval with protection level NI and can thus be used in Division 2.

9. Explosion-protected devices with European approval

Danger/Hazard due to	Gases/vapors			Dusts		Temperature classes*		
	Zone 1	Zone 1	Zone 2	Zone 21	Zone 22			
Type	(intrinsic. safe)					T4	T5	T6
121		X4	X3		X3	779	789	
124		X4	X3		X3	778	788	
125		X4	X3		X3	778	788	
211		X6	X3		X3	641	651	
212		X6	X3		X3	642	652	
243		X8	X3		X3	721		731
253		X6	X3		X3	648	658	
255		X7	X3		X3	742	752	
256		X7	X3		X3	741	751	
311		X6	X3		X3	643	653	
312		X6	X3		X3	644	654	
330		X4	X3		X3	770	780	
331		X4	X3		X3	770	780	
340		X4	X3		X3	776	786	
343		X4	X3		X3	777	787	
344		X4	X3		X3	775	785	
353		X6	X3		X3	649	659	
355		X7	X3		X3	744	754	
450	X5;X9	X1	X2	X1	X3		450/650	450
590	X5	X1	X2	X1	X3	•	•	•
641-649		X6	X3			•		
651-659		X6	X3				•	
725		X7/X8	X3			•		
741-742		X7	X3			•		
751-752		X7	X3				•	
770-779		X4	X3			•		
780-789		X4	X3				•	
1058		X16						
2200		X8	X3		X3	•		
2400		X8	X3		X3	•		
2832		X6	X3		X3	•		
2834		X8	X3		X3	•		
5281		X1	X2	X1	X3	•	•	
5282		X4	X3		X3	•	•	
5404		X1	X2	X1	X3	•		
5411		X1	X2	X1	X3	•	•	•
5413		X1	X2	X1	X3	•	•	•
5420		X1	X2	X1	X3	•	•	•
5470	X9						•	•
5686		X1	X2	X1		•		
6013/4	X5	X1	X2	X1	X3	•	•	•
6041		X4	X3		X3	•	•	

Danger/Hazard resulting from	Gases/vapors			Dusts				
	Zone 1	Zone 1	Zone 2	Zone 21	Zone 22	Temperature classes*		
Type	(intrinsic. safe)					**T4**	**T5**	**T6**
6103/4	X10						•	•
6105/6	X9						•	•
6115	X11							•
6213			X2		X3	•		
6222		X1/X6	X2	X1	X3	•		
6510/1	X10						•	•
6516/7	X9						•	•
6518/9	X5	X1	X2	X1	X3	•	•	•
6520/1	X11							•
6524/5	X10						•	•
6526/7	X9						•	•
8631	X17							•
8635Hart/PA	X18/X19							•
8642	X12							•
8643		X13				•		
8644			X14			•		

*) The type number also changes with the approval for certain types!

X1	⟨Ex⟩ II 2G EEx m/em II T4 T5 T6 PTB 00 ATEX 2129 X and II 2D IP65 T 85°C; 100°C; 135°C	(AC10 coil)
X2	⟨Ex⟩ II 3G EEx nA II T4 T5 T6 PTB 99 ATEX 2187	(AC10 coil)
X3	⟨Ex⟩ II 3G/D CE 0102 Declaration of Conformity	
X4	⟨Ex⟩ II 2G EEx ed IIC T4 T5 PTB 03 ATEX 1030X	(pivoted armature coil)
X5	⟨Ex⟩ II 2G EEx ia IIC T5 T6 PTB 01 ATEX 2101	(AC10 coil)
X6	⟨Ex⟩ II 2G EEx m/em II T4 T5 PTB 02 ATEX 2094 X	(32x32 coil)
X7	⟨Ex⟩ II 2G EEx m/em II T4 T5 PTB 02 ATEX 2173 X	(40x40 coil)
X8	⟨Ex⟩ II 2G EEx m/em II T4 T5 PTB 00 ATEX 2202 X	(49x49 coil)
X9	⟨Ex⟩ II 2G EEx ia IIC T5 T6 PTB 01 ATEX 2175	(AC21 coil)
X10	⟨Ex⟩ II 2G EEx ia IIC T5 T6 PTB 01 ATEX 2173	(G1 642735 coil)
X11	⟨Ex⟩ II 2G EEx ia IIC T6 PTB 01 ATEX 2194 X	(Piezo)
X12	⟨Ex⟩ II 2 (1) G EEx ia IIC T6 PTB 99 ATEX 2035	I/O box
X13	⟨Ex⟩ II 2 (1) G EEx [ia] me IIC T4 PTB 00 ATEX 2160	P-I/O box
X14	⟨Ex⟩ II 3G EEx nA II T4 PTB 02 ATEX 2048	AirLINE
X16	⟨Ex⟩ II 2G EEx m II PTB 01 ATEX 2064 U	1058
X17	⟨Ex⟩ II 2G EEx ia IIC T6 PTB 00 ATEX 2077X	8631
X18	⟨Ex⟩ II (1) 2G EEx ia IIC T6 TÜV 99 ATEX 1492	8635/Hart
X19	⟨Ex⟩ II (1) 2G EEx ia IIC T6 TÜV 00 ATEX 1534	8635/PA

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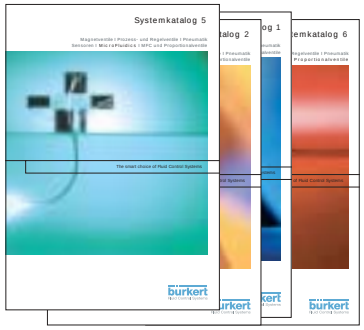

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