5 Marking of Devices

Equipment for explosion protected areas must be clearly marked. There are two different types of marking. According to CENELEC marking of an apparatus conforming to EN 50014/20 must provide the following information:

- manufacturer’s name or trademark
- part number
- EEx-symbol
- ignition category (e. g., „ia”)  
- designated group together with the respective subdivision (e. g., IIC)
- temperature class or maximum surface temperature (for group II devices only)
- serial number (may be omitted if space is restricted)
- test authority, date and file number
- „x” after the test certificate number indicates that special conditions must be met (see certificate for special conditions)

An intrinsically safe apparatus could have the following marking:

EEx ia IIC T6

PTB Nr. Ex-85.B.2128X
PTB Nr. authorised body
Ex- explosion protected apparatus
85. year of issue
B. generation indicator
2128 serial certificate number
X special conditions

According to ATEX marking must be as follows:

PTB 97 ATEX 2128X
PTB authorised body
97 year of issue
ATEX accord. to 94/9/EC
2128 serial certificate number
X special conditions

Associated equipment is identifiable by round brackets enclosing the device category:

II (1) G

may not be installed in hazardous areas

6 Manufacturer Obligations

Certificates of Conformity and EC Type Test Certificates

An authorised body is entitled to test and certify that devices are suited for use in explosion hazardous areas and comply with the relevant regulations and standards.

Previous regulations required the manufacturer to submit a test sample to the test body and to ensure compliance with existing regulations. The authorised test body then issued the certificate of conformity and passed it on to the manufacturer. The certificate of conformity contains all relevant data associated with explosion protection.

Here, the ATEX directive also implements a change. The manufacturer is requested to supply a type test sample to an authorised inspection body, which draws up a test report to be submitted to the notified body entitled to issue the EC type examination certificate after verifying conformity. Notified bodies and external inspection bodies are registered centrally. The EC type examination certificate contains all data relevant for explosion protection.

The obligation to keep a copy of this certificate is the responsibility of the manufacturer of the device. Along with the certificate, the manufacturer provides an instruction manual with all relevant Ex data. In addition, the manufacturer issues a declaration of conformity, stating that all applicable standards and directives are met. The user needs these documents to document compliance of the system installation correctly.
Introduction

Explosion Protection

CE Marking of Equipment

Devices for use in explosion hazardous area are equipped with the CE marking and the identification code of the testing authority. The assessment procedure for CE marking is clearly defined and depends on the device category. The example shown relates to device category 1, featuring the highest safety level. The applicable annexes of the directive 94/9/EC are also shown.

Assessment of the Quality Assurance System

The manufacturer of intrinsically safe devices, categories 1 and 2, must have an approved quality management system. This approval is needed to ensure that the manufacturer produces the devices according to the test type sample and that conformity to relevant protection regulations is given. Assessment of the quality assurance system is carried out by a notified body. Assessment can be achieved in two different ways:

- Assessment and certification can be done directly within the frame of certification according to ISO 9000ff. Approval of those fields associated with explosion protection is accomplished in cooperation with an expert of the notified body. If the ISO certificate has already been granted, it is possible to certify those parts relating to explosion protection subsequently within the frame of an additional audit.

- An "Ex" auditor is involved in the QM system certification assessment procedure. The governing regulations cover installation of intrinsically safe circuits, mounting to external connections, cable characteristics and cable installation. Cables and terminals with intrinsically safe circuits must be marked and separated from non-intrinsically safe circuits or feature appropriate isolation (> 1.500 VAC). Following an excerpt from the requirements according to EN 60079-14:
  - protection against external electrical or magnetic fields (e.g. power current cables)
  - prevent conductor splicing of fine wires through wire sleeves
  - min. cross section of 0.1 mm (also single wires of a conductor)
  - protection against damaging (mechanical, chemical, thermal...)
  - armouring, metal cladding, shielding of cables and lines
  - common use of single-core non-sheathed cables of intrinsically and non-safe circuits in one line is not permitted
  - separate error assessment when using multi-conductor cables and lines
  - when marking cables by colour, light-blue must be used.

It is required to observe the specified clearances between the intrinsically safe connections of this device and the earthed components and connections of other devices. If intrinsically safe TURCK devices, style multimodul or multisafe® are used, these may be mounted directly next to each other. The required safety distance of 6 mm between intrinsically safe connections is assured by the terminal design. It is further required to observe a safety distance of 3 mm (EN50020, chapter 6.3, table 4) to earthed components, such as covers or side panels of mounting cabinets. A thread measure of 50 mm must be observed between intrinsically safe connections and non-safe connections.

The following illustration shows both possibilities:

The national regulations and standards are the basis for use of devices with intrinsically safe circuits. These must be strictly observed and followed. The user is obliged to inform himself on all revisions. The following guidelines relate to the ATEX (94/9/EG) directive of the member states of the European Union, especially to the field of explosion protection in areas exposed to hazards by gas.

If the device is classified as an associated apparatus equipped with intrinsically safe and non-intrinsically safe circuits it may not be installed in explosion hazardous areas. It is permitted to connect intrinsically safe devices located in the hazardous area to the intrinsically safe connections of this device. With the Turck devices, series multisafe®, multimodul and multicart®, these connections are marked in blue. When interconnecting devices within such an assembly it is mandatory to provide a proof of intrinsic safety (EN 60079-14). It is required to verify that all data related associated to explosion protection of the devices allow mutual operation. Verification must include the internal capacitances and inductances of the cables used. Please refer to section 8.1 on page A-19 for further information.

Intrinsically safe circuits should never be interconnected with non-safe circuits. Even if only interconnected once, it is possible that essential protective elements are damaged without the user being aware of this fact. A simple function test is not suited to verify a damage of this kind. Once intrinsically safe circuits have been connected to the non-intrinsically safe circuit, it is not permitted to use the device subsequently as intrinsically safe equipment.

The following illustration shows both possibilities:

Certification of the QM system according to directive 94/9/EC by notified body

TURCK’s manufacturing sites for explosion protected devices are certified according to ISO 9001 and have a quality system approval.

7 Guidelines for Use of Devices with Intrinsically Safe Circuits

The governing regulations cover installation of intrinsically safe circuits, mounting to external connections, cable characteristics and cable installation. Cables and terminals with intrinsically safe circuits must be marked and separated from non-intrinsically safe circuits or feature appropriate isolation (> 1.500 VAC). Following an excerpt from the requirements according to EN 60079-14:

- protection against external electrical or magnetic fields (e.g. power current cables)
- prevent conductor splicing of fine wires through wire sleeves
- min. cross section of 0.1 mm (also single wires of a conductor)
- protection against damaging (mechanical, chemical, thermal...)
- armouring, metal cladding, shielding of cables and lines
- common use of single-core non-sheathed cables of intrinsically and non-safe circuits in one line is not permitted
- separate error assessment when using multi-conductor cables and lines
- when marking cables by colour, light-blue must be used.

It is required to observe the specified clearances between the intrinsically safe connections of this device and the earthed components and connections of other devices. If intrinsically safe TURCK devices, style multimodul or multisafe® are used, these may be mounted directly next to each other. The required safety distance of 6 mm between intrinsically safe connections is assured by the terminal design. It is further required to observe a safety distance of 3 mm (EN50020, chapter 6.3, table 4) to earthed components, such as covers or side panels of mounting cabinets. A thread measure of 50 mm must be observed between intrinsically safe connections and non-safe connections.
Due to the open construction and the special wiring of Eurocard style devices, the following regulations must be followed when installing multicart® switching amplifiers:

- According to IEC publication 60529, multicart® style devices require a protection of at least IP 20. Generally, this is achieved by installing special partition barriers or special enclosures in the mounting rack.

- Connections for intrinsically safe and non-intrinsically safe circuits must either be separated by a physical barrier so that they are at least 50 mm (thread measure) apart from each other, or each connection must be provided with cable sleeves which cannot slip off and ensure covering of all bare parts. These safety measures are not necessary if crimp snap-in type edge connectors are used.

- All edge connectors on the multicart® devices must be coded by a pin/plug coding to avoid insertion of the wrong module. The coding is prepared by the manufacturer by means of coding pins and holes on the contact strips according to a coding plan.

- Within the mounting rack, the safety distances must also be observed.

A thread measure is defined as the distance between circuits separated by a partition barrier. The reason for this regulation is that it is possible to work with live intrinsically safe circuits; thus it must be avoided that these come into contact incidentally with any non-safe connection components.

This distance is only required for external connections which can be accessed by the user. The minimum distance between two intrinsically safe circuits must be 6 mm and separation from other (earthed) metal parts must be 3 mm.

The approval expires, if the device is repaired, altered or opened by a person other than the manufacturer or an expert unless the device-specific instruction manual explicitly permits such interventions. Only an expert disposes of the information on protection measures needed to assure that the device is still in accordance with the applicable regulations after such an intervention. Visible damages of the device's housing (e.g. black or brown discolouration due to heat accumulation, perforation or deformation) indicate a serious error and the device must be turned off immediately. It is required to check the connected equipment too.

Intrinsically safe circuits with galvanic isolation - as is the case with TURCK devices - should not be earthed, unless not absolutely necessary from a functional point of view.

Circuits without galvanic isolation, e.g. Zener barriers, always require earthing. EN 60079-14 includes the relevant earthing regulations. Within zone 0 earthing of a circuit is not necessary. If earthing is necessary for functional reasons, then it must be carried out in close vicinity of zone 0.

Prior to every initial set-up or after any change of the device interconnection within the assembly, it must be ensured that all applicable regulations, directives and framework directives are met, that all safety regulations are fulfilled and that the device is functioning properly. Only then operation is permitted.

Mounting and connection of the device should only be carried out by qualified and trained staff familiar with the relevant national and international regulations of explosion protection to ensure correct operation.

The system operator must ensure that the system is always in the required safe condition. The system must be inspected continuously and necessary maintenance work must be carried out immediately while observing the safety regulations. The system must be tested in case of need, latest every three years.

Accidents

The operator must report any explosion which could have been caused by the electrical equipment to the supervisory body. The supervisory body is entitled to order an investigation by an expert.
Introduction

Explosion Protection

Safety Barriers

Safety barriers are considered protection devices and their function is to avoid possible errors and faults by preventing the transfer of unsafe levels of energy to the hazardous area. Possible faults are:

- excessive voltage in the hazardous area
- high current levels in the hazardous area (short-circuit)

Because barriers have no galvanic isolation, they require connection to the equipotential connection (PA) leading into the hazardous area to prevent potential variances between conducting constructional parts and the intrinsically safe circuit.

The following parameters must be observed when using safety barriers:

- Zener voltage $U_Z$
- short-circuit current $I_k$
- maximum current $I_m$

In cause of fault, these maximum energy values could reach the hazardous area.

The safety parameters of the barrier are:

- the supply voltage of the barrier should always be lower than the maximum input voltage indicated on the barrier, otherwise any leakage currents occurring during normal operation could flow through the Zener diodes
- total series resistance $R$ of the barrier
- maximum voltage $U_M$ on the hazardous side
- maximum allowable external inductances $L_a$ and capacitances $C_a$

Section 12, 2.4 of EN 60079-14 generally requires intrinsically safe circuits to be earth-free, but for safety and functional reasons earthing is permitted. Due to an earth fault between two different potentials of remote system components, compensation currents may flow in the intrinsically safe circuit. These currents can counteract intrinsic safety, e.g. by causing excessive heat within a cable which originally was rated correctly for the intrinsically safe circuit.

The safest method is an isolated (earth-free) design of intrinsically safe circuits. As a rule, earthing is usually not necessary for functional reasons. Earthing of an intrinsically safe apparatus at one point is permitted and in many cases needed to prevent disturbances. Metal housings of intrinsically safe equipment do not require earthing. Further details on Zener barriers are included in the data sheets available from the respective manufacturers.

Hazardous Area

Non-Hazardous Area
8 Proof of Intrinsic Safety

According to EN 60079-14 a proof of intrinsic safety must be provided to confirm that equipment interconnected within an assembly accords to the requirement of intrinsic safety. In this context there is a clear distinction between two basically different circuits:

1. simple intrinsically safe circuit with a single associated apparatus and at least one intrinsically safe apparatus without additional supply
2. more than one associated apparatus which is capable of supplying electrical energy to the intrinsically safe circuit not only during normal operation but also in a fault condition.

8.1 Simple Circuits

The first definition of a simple intrinsically safe circuit requires to observe all electrical limit values stated in the EC type examination certificate and the power characteristics. If these conditions are met, the user is entitled to keep a proof of intrinsic safety. Inductances and capacitances of the installed cables must be taken into account.

Intrinsic safety of a simple circuit is given, if the limit values are maintained according to the following conditions:

The connection of proximity switches to isolating switching amplifiers, or 2-wire transmitters to isolating transducers, or solenoid valves to a valve control module can be considered as simple circuits.

Example of a “Proof of intrinsic safety”

<table>
<thead>
<tr>
<th>Associated equipment</th>
<th>condition</th>
<th>intrinsically safe apparatus</th>
</tr>
</thead>
<tbody>
<tr>
<td>U₀ ≤ U₁</td>
<td>+cable</td>
<td></td>
</tr>
<tr>
<td>I₀ ≤ I₁</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P₀ ≤ P₁</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L₀ ≥ L₁ + Lₐ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C₀ ≥ C₁ + Cₐ</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The cable characteristics provided by the manufacturer should be used. Should these not be available, it is recommended to use the following typical values (BASEEFA newsletter no. 3, October 1980):

\[ Lₐ = 1 \text{ mH/km} / Cₐ = 110 \text{ nF/km} \]

The limit value indexes of the old certificate of conformity and the new EC type examination certificate differ. In this overview the indexes according to EN 60079-14 are used. Index “o” stands for maximum output values and “i” for maximum input values.

The proof of intrinsic safety should be laid down in a standardised document to facilitate clear documentation.

The document should contain the date, the name of the manufacturer, the circuit type and the type code. A possible form of documentation is shown below.
Introduction

Explosion Protection

8.2 Interconnection/Assembly of Several Devices

The second case considers interconnection of several active associated devices. It differs essentially from the first case. Here it is not permitted to apply the electric limit values of the EC type examination certificate for the proof of intrinsic safety.

Different limit values apply to an assembly of the individual associated apparatus. Such an assembly will always be classified as equipment according to category „ib“, even if the single apparatus accords to category „ia“. An assembly may therefore not be installed in zone 0. A detailed description of interconnection and assembly is beyond the scope of this catalogue. The related calculation methods and an example are contained in annexes A and B of EN 60079-14. Additionally, the ignition curves of IEC 60079-11 are needed. EN 50020 also contains the ignition curves.

8.3 Non-linear Characteristics

When interconnecting associated apparatus whose typical curves are not entirely linear, a special procedure must be applied. This procedure is explained precisely in report number PTB-THEx-10 of the German PTB in Braunschweig (ISBN 3-89701-440-8).

9 Approvals outside the European Union

Equipment certified according to the ATEX directive may be placed on the market, installed and put into service within the member states of the European Union. Even though Switzerland does not belong to the EU, approvals according to ATEX are accepted. An approval by SEV is not required, if the customer provides the mandatory documentation, i.e. the instruction manual, the EC type examination certificate, the CE declaration and the certificate of the quality management audit relating to explosion protection.

Many states outside the European Union explicitly request an own national approval. Therefore TURCK devices feature approvals for many different countries. Own approvals are required e.g. in the USA, Canada, China, Japan, Australia, CIS states, Hungary or in the Czech Republic, whereas other states accept approvals issued by other states. For this reason it is indispensable to be familiar with the national requirements.

In many states approvals are granted for a certain period only. Therefore it is recommended to check if the approval has expired or has been prolonged accordingly. If an approval expires after installation, many countries accept further operation.

Approvals according to ATEX and approvals in the USA and Canada are not subject to a time limit.

Apart from the national approvals there are also specific installation and operation regulations. These are supplied together with devices featuring approvals for the USA and Canada. The TURCK brochure „Understanding Hazardous Area Sensing“ (in English) gives insight into explosion protection in the United States and can be provided on request.

10 Approvals and Certificates of Conformity via Fax-on-Demand and Internet

TURCK enables their customers to view all valid approvals and to download these as PDF files (Acrobat Reader, version 3.0):

www.turck.com

⇒ Worldwide Headquarters Germany
⇒ Support
⇒ Approvals

Fax-on-demand

Use your fax machine to call the number (+49) (208) 49 52-11 50 00. Following you will receive a fax with an overview of the available approvals. This overview contains the individual fax numbers of the obtainable approvals. Select the needed approval, call again and you will receive the required document.