



MEMORANDUM I.S.

Testing and Certification of Equipment with Intrinsically Safe Circuits for Explosion Protection

(as of August 2009)

This memorandum gives supplementary information to that provided in the memorandum "ATEX" of the Certification Body for Explosion Protection. It is applicable for testing and certification to the Directive 94/9/EC (ATEX 95a).

1 GENERAL

1.1 **Testing** is actually performed in accordance with the European Standards EN 60079-0:2006 and EN 60079-11:2007.

1.2 Application

Please specify in the application the claimed **type of protection** in accordance with the above-mentioned standards, stating the level of protection of the Intrinsic Safety (ia, ib), the Apparatus Group (IIC, IIB, IIA) and the Temperature Class (T1...6). Please specify also the desired "ATEX Category" (e.g. II 2G or II (1) G).

Please nominate a **contact person** in your company.

In the case of correspondence after starting with the application please refer to the **PTB job identification number**.

For supplements please indicate the **EC Type Examination Certificate Number**.

2 DOCUMENTATION

2.1 Brief **functional description** (detailed instructions for operation or setting/calibration s. 2.10) and specification of the ratings of the equipment (range of voltage, current, ambient temperature).

Furthermore, the **type declaration** of the apparatus is important (description, if necessary, type key).

2.2 Description of all **explosion protection measures**.

In this description, the measures taken for explosion protection are to be stated clearly, so that the concept of the safety measures is easy to understand. Part of this description shall be e.g.:

2.2.1 Rating of the intrinsically safe circuits and of the components (also under fault conditions specified in EN 60079-11); comparison between the maximum power, voltage, current etc. and the maximum permissible values regarding the mounting conditions of the components, listing of components with a safety function.

- 2.2.2 Prevention of interference by non-intrinsically safe circuits, statement of electrical segregation of intrinsically safe circuits from non-intrinsically safe circuits; isolation voltages, U_m values.
- 2.2.3 Other measures for the explosion protection of the equipment (e.g. encapsulation, conformal coating, PCB material, CTI value, IP rating).
- 2.3 **Drawings, block and circuit diagrams, component mounting diagrams, layouts**
If possible block diagram (showing the safety relevant components and segregations) with indication of the ratings of the safety components (e.g. permissible power dissipation, current, voltage, tolerances). The names of the circuits (e.g. input circuit, control circuit) as well as the assignment of the terminals, pins etc. are to be specified.
The safety components (e.g. transformers, fuses, zener diodes, resistors) should be indicated in the circuit diagrams.
- 2.4 Test documents according to 2.1, 2.2 and 2.3 please in **two copies, signed with legally binding effect, with firm's stamp and date of signature**. A preliminary set of documents in one copy may be used until the testing is completed.
- 2.5 Technical data always in the form stated under 2.4. Also in the case of subsequent supplements (additional description), **no technical data in the covering letter**. The PTB job identification number is helpful to reference any documentation.
- 2.6 To keep the test documents concise and the testing times short, attention should be paid that the documents submitted are clear and brief and nevertheless offer the required information.
- 2.7 If a meeting is desired or is considered necessary, a date must be agreed beforehand with the responsible test engineer.
- 2.8 The test object (apparatus which is type tested) should be completely documented with each application. Cross-references to descriptions or drawings from other EC Type Examination Certificates are to be avoided (Exceptions: Component Certificates and Module Systems e.g. Remote I/O)
- 2.9 **Test samples**
It is useful to provide test samples as agreed with the test engineer in charge (number, preparation etc.), e.g. two samples: one resin-encapsulated, one non-encapsulated).
- 2.10 **Operating instructions**
Either the complete operating instructions have to be provided with indication of the clauses relevant for explosion protection or the relevant parts in concentrated form giving guidance shall be part of the documentation (as extract of the operating instructions). The documents shall be stamped and signed by the applicant.

3 REQUIREMENTS FOR COMPONENTS ON WHICH INTRINSIC SAFETY DEPENDS (typical examples)

3.1 Current limiting resistors (EN 60079-11, clause 8.4)

If wire-wound resistors are used, the windings must be protected to prevent the wire from running off the coil (e.g. enamelling, resin encapsulation). When the short-circuit current is determined, the internal resistance of semiconductors or fuses are not taken into account. Exception: electronic current limiting devices (see below).

3.2 Electronic current limiting devices (EN 60079-11, clause 7.5.3)

These devices are permitted for category "ib" only if connected in series, and at least two of them must be available. Faults occurring in one of the electronic devices shall not impair the other one. Even if faults according to EN 60079-11 are taken into account, semiconductors shall be operated at not more than 2/3 of their ratings (current, voltage, power) (all data to be stated for the maximum ambient temperature applied for, at least 40 °C).

The dynamic response and the function of the electronic current limiting devices are to be described with the aid of oscillograms (detailed test report). The following data of the semiconductor components must be specified: manufacturer, type, permissible currents, voltages, power (data sheet; equivalent components of the same or of other manufacturers may be used in most cases).

3.3 Voltage limitation

Achieved by zener diodes or electronic devices used as shunt safety assemblies; requirements as under clause 8.6 of EN 60079-11.

3.4 Assessment of intrinsic safety

In accordance with points 2.1 to 2.3, the description must furnish sufficient evidence that intrinsic safety is ensured taking into account the open circuit voltage of the supply and current and voltage limitation (spark ignition) assuming faults as specified in EN 60079-11.

For components for which the rating substantially depends on the mounting conditions (e.g. semiconductors with heat sink), adequate proof of the rating is to be furnished with due regard to the respective data sheet.

3.5 Transformers intended for safe electrical isolation (EN 60079-11, 8.1 and 8.2)

The following documents must be submitted:

- 3.5.1 Drawings in which the safe electrical and spatial separation of the windings and connections can be easily assessed (multi-compartment winding preferably), statement of dimensions of the separating walls of the bobbin, etc.
- 3.5.2 Secondary open-circuit voltage(s), rated secondary currents, number of turns, wire gauge, winding resistances.
- 3.5.3 Rated power
- 3.5.4 Type and maximum service temperature of all insulating materials used (bobbin, windings; to be classified in accordance with IEC 60085).

- 3.5.5 The clearances and the creepage distances must comply with EN 60079-11, Table 5 (also between the windings, depending on the necessary segregation, possibly also between winding and core).
- 3.5.6 The short-circuit and overload protection must be evidenced by a detailed test report (otherwise the test will be done by PTB).
- 3.5.7 Dielectric strength test voltages according to 8.1.4, 8.2 and 10.10 of EN 60079-11.

3.6 **Relays intended for safe electrical isolation (6.3.13, 8.8)**

- 3.6.1 Drawings from which the safe separation of coil circuit and active switch contacts can be assessed (clearances and creepage distances, material data and comparative tracking indices).
- 3.6.2 Data of the coil circuit; active switch contacts: open-circuit voltage, current to be switched and switching capacity, if exceeding 100 VA: doubled clearances and creepage distances in accordance with EN 60079-11, Table 5.
- 3.6.3 The certificate number (component certificate) and the complete type identification of relays are to be stated if they have already been certified.
- 3.6.4 If the switch contacts of the individual circuits are not placed within separate compartments, all switch contacts may be used either to switch only intrinsically safe circuits or only non-intrinsically safe circuits.

3.7 **Opto couplers intended for safe electrical isolation (8.8)**

If opto couplers are used for which a component certificate for safe electrical isolation is not available, detailed data and documents for the design of the opto-coupler (e.g. spacing of semiconductors, materials, comparative tracking indices, data sheet, etc.) are to be submitted.

3.8 **Printed-circuit boards (6.3)**

- 3.8.1 Clearances and creepage distances as well as comparative tracking indices according to EN 60079-11, Table 5 or Annex F.
- 3.8.2 The components which are determining intrinsic safety are to be filed into a printed-circuit board drawing true to scale. For double-sided printed boards or multilayer boards, transparent foils are to be submitted so that the distances can be easily checked (in addition to the drawings, one copy, without stamp and not signed). If possible, the relevant separation distances should be marked (e.g. by means of colour). Infallible connections should also be marked.

3.9 **Plug-in cards and plugs/sockets**

- 3.9.1 For data to be submitted, cf. 3.8.1
- 3.9.2 The contact alignment must be shown in a drawing (socket and plug connectors).

3.9.3 Unused contacts/pins between the connection facilities of intrinsically safe and non-intrinsically safe circuits or non I.S. parts of the same circuits should be removed from the plug connectors or earthed if the required spacings may be impaired when these connections are used (e.g. as soldering terminal).

3.9.4 If the cards may be mixed up when inserted, either explosion protection must be maintained or the cards must be suitably coded.

3.10 **Connection facilities, cable entries (6.2, 6.3, 6.5, 10.9)**

3.10.1 Connection facilities for intrinsically safe and non-intrinsically safe circuits must be spatially separated [50 mm spacing or suitable partition wall (shortest distance (thread measure) also 50 mm)]. The spacing between connection facilities of intrinsically safe circuits must be 6 mm if intrinsic safety is impaired when these circuits are interconnected and a distance of 3 mm for intrinsically safe connection facilities against earth (all distances minimum values).

3.10.2 Intrinsically safe circuits require a separate cable entry.

3.10.3 The marking of connection facilities for intrinsically safe circuits must be such that it can be easily seen from outside without the clearances and the creepage distances at the terminals being affected (e.g. blue colour coding).

3.11 **Degree of protection provided by the enclosure**

Enclosures of intrinsically safe and associated apparatus shall be at least of the degree IP 20 according to EN 60529 (representation by drawing). Degree of protection IP 20 is also required for connection facilities (if the degree of protection is to be achieved during the installation, this has to be specified in the operating instructions).

4 **INTRINSICALLY SAFE APPARATUS**

4.1 **Supply data**

If it is intended to connect the intrinsically safe apparatus to active intrinsically safe circuits, the maximum values for open-circuit voltage U_i , short circuit current I_i and, if needed, power P_i are to be stated.

4.2 **Internal inductance, internal capacitance of intrinsically safe apparatus**

4.2.1 The maximum internal inductance and the maximum internal capacitance are to be considered as appearing at the terminals of intrinsically safe circuits, with consideration also to be made to fault conditions.

4.2.2 The effective inductance can be reduced by duplicated or triplicated shunt components connected in parallel with the coil if these components meet the requirements of point 3.3; one of the parallel components shall be sufficient for the inductance to become inactive.

4.3 **Surface temperature**

For all components of the intrinsically safe apparatus it is necessary to consider the maximum surface temperature, allowing for the maximum permissible ambient temperature (normal maximum 40°C, other limits if applied for) , also in the case of faults. The proof can be furnished either by calculation on the basis of the maximum power and the thermal resistance of the component to the ambient, or by measurement (test report to be submitted, look for the required safety margin!). According to clause 5.5 of EN 60079-0, for intrinsically safe apparatus of temperature classes T1 to T4, less rigorous requirements for the surface temperature of small components may be applied.

4.4 **Enclosures and parts of enclosures**

4.4.1 Light metal

If light metal is used, the magnesium content must not exceed 6% (to be stated in the test documents).

4.4.2 Plastic enclosures

Plastic enclosures for equipment to be used in hazardous areas are subject to limitations with respect to electrostatic charging (cf. clause 7.3 of EN 60079-0).

5 **MARKING**

The marking shall be in accordance with EN 60079-0 and EN 60079-11 (drawing of the label stating kind and place of fixing as well as material).

6 **EQUIPMENT OF CATEGORY 1G (ZONE 0 EQUIPMENT)**

Intrinsically safe equipment intended for use in areas where an explosive atmosphere is present continuously or for long periods (zone 0) require specific protective measures. For such apparatus, EN 60079-26 applies in addition to EN 60079-0 and 60079-11. Special requirements e.g. for electrostatic charging of plastic materials as well as partition walls and the mounting of the apparatus are specified in this standard. According to EN 1127-1, temperatures shall not exceed 80% of the limit temperature of the temperature class.