

NOTE 2 A system may be "ib" in normal operation with external power, but when power is removed under defined safety circumstances (ventilation failure) then the system could become "ia" under back up battery power. The level of protection will be clearly defined for foreseeable circumstances.

Clause 13 contains details of the required assessment.

### **6.2 Level of protection "ia"**

Where the requirements applicable to electrical apparatus of level of protection "ia" (see 5.2 of IEC 60079-11) are satisfied by an intrinsically safe system or part of a system considered as an entity, then that system or part of a system shall be placed in level of protection "ia".

### **6.3 Level of protection "ib"**

Where the requirements applicable to electrical apparatus of level of protection "ib" (see 5.3 of IEC 60079-11) are satisfied by an intrinsically safe system or part of a system considered as an entity, then that system or part of a system shall be placed in level of protection "ib".

### **6.4 Level of protection "ic"**

Where the requirements applicable to electrical apparatus of level of protection "ic" (see 5.4 of IEC 60079-11) are satisfied by an intrinsically safe system or part of a system considered as an entity, then the system or part of the system shall be placed in level of protection "ic".

## **7 Ambient temperature rating**

Where part or all the intrinsically safe system is specified as being suitable for operation outside the normal operating temperature range of  $-20\text{ }^{\circ}\text{C}$  and  $+40\text{ }^{\circ}\text{C}$ , this shall be specified in the descriptive system document.

## **8 Interconnecting wiring / cables used in an intrinsically safe electrical system**

The electrical parameters of the interconnecting wiring upon which intrinsic safety depends and the derivation of these parameters shall be specified in the descriptive system document. Alternatively, a specific type of cable shall be specified and the justification for its use included in the documentation. Cables for the interconnecting wiring, shall comply with the relevant requirements of 9.

Where relevant, the descriptive system document shall also specify the permissible types of multi-core cables as specified in 9, which each particular circuit may utilize. In the particular case where faults between separate circuits have not been taken into account, then a note shall be included on the block diagram of the descriptive system document stating the following: "where the interconnecting cable utilizes part of a multi-core cable containing other intrinsically safe circuits, then the multicore cable shall be in accordance with the requirements of a multicore cable type A or B as specified in Clause 9 of IEC 60079-25".

A multicore cable containing circuits classified as level of protection 'ia' or 'ib' shall not contain both intrinsically safe and non-intrinsically safe circuits.

A multicore cable containing circuits classified as level of protection 'ic' shall not contain both intrinsically safe and non-intrinsically safe circuits except that they are permitted to share cables with circuits assessed as 'nL' according to IEC 60079-15.

Multi-core cables may contain more than one intrinsically safe 'ia', 'ib' or 'ic' circuit subject to the applicable faults specified in 13.

NOTE Multicore cables not complying with Type A or B are permitted if the specific combination of circuits is examined against the requirements IEC 60079-11.

Intrinsically safe 'ic' circuits shall only be run together with intrinsically safe 'ia' and 'ib' circuits provided they are run in a multi-core cable of type A or type B specified in 9.5.

## 9 Requirements of cables and multi-core cables

### 9.1 General

The diameter of individual conductors or strands of multi-stranded conductors within the hazardous area shall not be less than 0,1 mm.

The radial thickness of the insulation of each core shall be appropriate to the conductor diameter and the nature of the insulation with a minimum of 0,2 mm.

Only insulated cables with insulation capable of withstanding a dielectric test of at least 500 V a.c. or 750 V d.c. shall be used in intrinsically safe circuits.

NOTE This clause is not intended to prevent the use of bare conductors in a signalling system and these should be considered as simple apparatus and not interconnecting wiring.

### 9.2 Multicore cables

Multi-core cables shall be capable of withstanding a dielectric test of at least;

- a) 500 V r.m.s. a.c. or 750 V d.c. applied between any armouring and/or screen(s) joined together and all the cores joined together.
- b) 1000 V r.m.s. a.c. or 1500 V d.c. applied between a bundle comprising one half of the cable cores joined together and a bundle comprising the other half of the cores joined together. This test is not applicable to multi-core cables with conducting screens for individual circuits.

The dielectric strength test shall be carried out in accordance with an appropriate cable standard or 10.3 of IEC 60079-11.

### 9.3 Electrical parameters of cables

The electrical parameters ( $C_c$  and  $L_c$  or  $C_c$  and  $L_c/R_c$ ) for all cables used within an intrinsically safe system shall be determined according to a), b) or c):

- a) the most onerous electrical parameters provided by the cable manufacturer;
- b) electrical parameters determined by measurement of a sample, with the method of testing electrical parameters of cables given in Annex G;
- c) where the interconnection comprises two or three cores of a conventionally constructed cable (with or without screen): 200 pF/m and either 1  $\mu$ H/m or an inductance to resistance ratio ( $L_c/R_c$ ) calculated by dividing 1  $\mu$ H by the manufacturers specified loop resistance per meter. Alternatively, for currents up to  $I_o = 3$  A an L/R ratio of 30  $\mu$ H/ $\Omega$  may be used.

Where a FISCO or FNICO system is used, the requirements for the cable parameters shall comply with Annex I.

### 9.4 Conducting screens

Where conducting screens provide protection for separate intrinsically safe circuits in order to prevent such circuits becoming connected to one another, the coverage of those screens shall be at least 60% of the surface area.

## 9.5 Types of multi-core cables

Multi-core cables shall be classified as either type A, type B or type C for the purposes of applying faults and assessing the safety of the cabling within an intrinsically safe system. The cable types are specified below

### 9.5.1 Type A cable

A cable whose construction complies with 9.1, 9.2, 9.3 and 9.4;

### 9.5.2 Type B cable

A cable whose construction complies with 9.1, 9.2 and 9.3, is fixed and effectively protected against damage and does not contain any circuit with a maximum voltage  $U_0$  exceeding 60 V;

### 9.5.3 Type C cable

A cable whose construction complies with 9.1, 9.2 and 9.3,

## 10 Termination of intrinsically safe circuits

Intrinsically safe systems that contain junction boxes or marshalling cubicles where intrinsically safe circuits are terminated shall comply with clause 6.2.1 of IEC 60079-11.

## 11 Earthing and bonding of intrinsically safe systems

In general, an intrinsically safe circuit shall either be fully floating or bonded to the reference potential associated with the hazardous area at one point only. The level of isolation required (except at one point) is to be designed to withstand a 500 V insulation test in accordance with 6.3.12 of IEC 60079-11. Where this requirement is not met, then the circuit shall be considered to be earthed at that point. More than one earth connection is permitted on a circuit, provided that the circuit is galvanically separated into sub-circuits, each of which has only one earth point.

Screens shall be connected to earth or the structure in accordance with IEC 60079-14. Where a system is intended for use in an installation where significant potential differences (greater than 10 V) between the structure and the circuit can occur, the preferred technique is to use a circuit galvanically isolated from external influences such as changes in ground potential at some distance from the structure. Particular care is required where part of the system is intended to be used in zone 0 or zone 20 locations or when the system has a very high level of protection to meet Ma requirements.

The descriptive system document should clearly indicate which point or points of the system are intended to be connected to the plant reference potential and any special requirements of such a bond. This may be achieved by adding a reference to IEC 60079-14 in the descriptive system document.

NOTE IEC 60079-14 does not apply to electrical installations in mines susceptible to firedamp.

## 12 Protection against lightning and other electrical surges

Where a risk analysis shows that an installation is particularly susceptible to lightning or other surges, precautions shall be taken to avoid the possible hazards.

If part of an intrinsically safe circuit is installed in a zone 0 in such a way that there is a risk of developing hazardous or damaging potential differences within the zone 0, a surge protection device shall be installed. Surge protection is required between each conductor of the cable including the screen and the structure where the conductor is not already bonded to the