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IEC 60079-5 Ed.4.0 (2015)

AS/NZS 60079.5:2015

Australian/New Zealand Standard™

Explosive atmospheres

Part 5: Equipment protection by powdered filling 'q'

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EL-014, Equipment for Explosive Atmospheres. It was approved on behalf of the Council of Standards Australia on 20 October 2015 and on behalf of the Council of Standards New Zealand on 22 October 2015.
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AS/NZS 60079.5:2015

Australian/New Zealand Standard™

Explosive atmospheres

Part 5: Equipment protection by powdered filling 'q'

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-014, Equipment for Explosive Atmospheres, to supersede AS/NZS 60079.5:2007.

The objective of this Standard is to set out the requirements for the construction, testing and marking of electrical equipment, parts of electrical equipment and Ex components in the type of protection powder filling ‘q’, intended for use in explosive gas atmospheres.

This Standard is identical with, and has been reproduced from IEC 60079-5 Ed.4.0 (2015), *Explosive atmospheres,* Part 5*: Equipment protection by powder filling "q".*

This Standard is to be read in conjunction with AS/NZS 60079.0, *Explosive atmospheres,* Part 0: *Equipment—General requirements*. Changes to the Standard introduced by this edition are listed in the IEC Foreword.

As this Standard is reproduced from an International Standard, the following applies:

(a) In the source text ‘this part of IEC 60079’ should read ‘this Australian/New Zealand Standard’.

(b) A full point substitutes for a comma when referring to a decimal marker.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

Reference to International Standard		*Australian or Australian/New Zealand Standard*	
IEC		AS/NZS	
60079	Explosive atmospheres	60079	Explosive atmospheres
60079-0	Part 0: Equipment—General requirements	60079.0	Part 0: Equipment—General requirements
60079-7	Part 7: Equipment protection by increased safety "e"	60079.7	Part 7: Equipment protection by increased safety ‘e’
60079-11	Part 11: Equipment protection by intrinsic safety “i”	60079.11	Part 11: Equipment protection by intrinsic safety ‘i’
60529	Degrees of protection provided by enclosures (IP Code)	60529	Degrees of protection provided by enclosures (IP Code)
61558	Safety of power transformers, power supplies, reactors and similar products	61558	Safety of power transformers, power supplies, reactors and similar products
61558-1	Part 1: General requirements and tests	61558.1	Part 1: General requirements and tests
61558-2-6	Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers	61558.2.6	Part 2.6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers

Only normative references that have been adopted as Australian or Australian/New Zealand Standard have been listed.

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IEC FOREWORD

This edition includes the following significant technical changes with respect to the previous edition:

NOTE The technical changes referred to include the significant technical changes in the revised IEC standard, but they do not form an exhaustive list of all modifications from the previous edition. More guidance may be found by referring to the redline version of the IEC standard, if available.

		Type		
Significant changes	**Clause/subclause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Specific references to IEC 60079-0 have been reworded so the references to IEC 60079-0 can be non-dated references	4.1.3 4.8 4.8.3	X		
The “housing” surrounding the powder filled equipment or Ex Component has been redefined as a “container” to avoid confusion with the “enclosure” requirements of IEC 60079-0	4.1	X		
A relaxation has been introduced to permit reduced distances through filling material for instances where there is no adjacent gap in the container	4.3.1		X	
A relaxation has been introduced to permit the use of creepage dimensions per IEC 60079-7 where CTI is better than 175	4.8.3		X	
An evaluation of joints employed when the reduced distances according to Table 1 are applied, has been added.	5.1.1		X	
Text for determination of maximum temperature clarified with respect to overloads and malfunctions	5.1.4	X		
A batch routine test has been introduced	5.2.1		X	

AUSTRALIAN/NEW ZEALAND STANDARD

Explosive atmospheres

Part 5:
Equipment protection by powdered filling 'q'

1 Scope

This part of IEC 60079 contains specific requirements for the construction, testing and marking of electrical equipment, parts of electrical equipment and Ex components in the type of protection powder filling “q”, intended for use in explosive gas atmospheres.

NOTE 1 Electrical equipment and Ex components protected by powder filling “q” can contain electronic circuits, transformers, protection fuses, relays, intrinsically safe electrical apparatus, associated electrical apparatus, switches, etc.

NOTE 2 Type of protection powder filling “q” provides Equipment Protection Level (EPL) Gb or Mb.

This standard supplements and modifies the general requirements of IEC 60079-0. Where a requirement of this standard conflicts with a requirement of IEC 60079-0, the requirement of this standard takes precedence.

This standard applies to electrical equipment, parts of electrical equipment and Ex components with:

– a rated supply current less than or equal to 16 A;
– a rated supply voltage less than or equal to 1 000 V;
– a rated power consumption less than or equal to 1 000 W.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-7, *Explosive atmospheres – Part 7: Equipment protection by increased safety "e"*

IEC 60079-11, *Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i"*

IEC 60127 (all parts), *Miniature fuses*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61558-1, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*

IEC 61558-2-6, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers*

ISO 2859-1, *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 3310-1, *Test sieves – Technical requirements and testing – Part 1: Test sieves of metal wire cloth*

ISO 3310-2, *Test sieves – Technical requirements and testing – Part 2: Test sieves of perforated metal plate*

ISO 2591-1, *Test sieving – Methods using test sieves of woven wire cloth and perforated metal plate*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60079-0 as well as the following apply.

NOTE Additional definitions applicable to explosive atmospheres can be found in IEC 60050-426.

3.1
powder filling “q”
type of protection in which the parts capable of igniting an explosive gas atmosphere are fixed in position and completely surrounded by filling material to prevent the ignition of an external explosive gas atmosphere

Note 1 to entry: The type of protection may not prevent the surrounding explosive gas atmosphere from penetrating into the equipment and components and being ignited by the circuits. However, due to the small free volumes in the filling material and due to the quenching of a flame which may propagate through the paths in the filling material, an external explosion is prevented.

3.2
filling material
solid quartz or solid glass particles

3.3
container (for filling material)
housing immediately surrounding the electrical equipment protected by and containing the filling material

Note 1 to entry: The container may, in some cases, also be the external enclosure.

4 Constructional requirements

4.1 Containers

4.1.1 Closing and sealing

4.1.1.1 General

Containers of electrical equipment, parts of electrical equipment or Ex components protected by powder filling ”q” shall be filled and sealed at the time of manufacture. The closing and sealing shall be the methods of 4.1.1.2 or 4.1.1.3.

4.1.1.2 Containers permanently sealed at the time of manufacture

The container shall be permanently sealed at the time of manufacture and shall not be capable of being opened without leaving visible evidence that the container has been opened. The container shall be marked in accordance with Clause 6, item a).

NOTE Suitable techniques that can provide visible evidence of containers being opened are, for example, welding, soldering, cemented joints, rivets, cementing of screws, or lead-seal safety-wiring of screws.

4.1.1.3 Containers intended to be opened for repair

Electrical equipment, parts of electrical equipment, or Ex components that are designed to be repaired shall incorporate sealing methods that are capable of being renewed without damage to the container when the equipment is repaired, re-filled, and re-sealed. The container shall be marked in accordance with Clause 6, item b).

4.1.2 Pressure test of container

The electrical equipment, parts of electrical equipment or Ex components protected by powder filling “q” shall meet the pressure test requirements specified in 5.1.1.

4.1.3 Degree of protection of the container

The container of the electrical equipment, parts of electrical equipment, or Ex components protected by powder filling “q”, in their normal service condition, i.e. with all openings closed as in normal use, shall comply at least with the degree of protection IP54 as defined in IEC 60529. If the degree of protection is IP55 or higher, and the container is not hermetically sealed, the container shall be provided with a breathing device. The container with the breathing device in place shall comply at least with the degree of protection IP54 according to IEC 60529. The test shall be conducted on an empty container without the powder filling installed. At the end of any water ingress tests, no water shall be visible inside the container.

NOTE 1 As the container may need to be destroyed in order to determine the entrance of dust or water, two separate test samples could be required for the two ingress tests.

NOTE 2 When the container is also the external enclosure, the tests of enclosures requirements of IEC 60079-0 apply.

The ingress protection of containers or parts of electrical equipment protected by powder filling “q”, intended for use only in clean, dry rooms, may be reduced to degree of protection IP43. The certificate number of this equipment shall include the "X" suffix in accordance with the marking requirements of IEC 60079-0, and the Specific Conditions of Use listed on the certificate shall detail the restrictions of use.

When Ex components protected by powder filling “q” are intended to be mounted inside another enclosure complying with IEC 60079-0, this outer enclosure shall have a degree of protection of at least IP54. The IP rating of the inner container does not need to be specified provided that the Ex component is mounted in a position where it is unlikely to be contaminated by any small amounts of water that may enter the outer enclosure.

NOTE 3 The impact and drop tests of enclosures from IEC 60079-0 do not generally apply to Ex Components intended to be mounted inside another enclosure complying with IEC 60079-0, as the external enclosure provides the protection against impact and drop.

The maximum gap of a container protected by powder filling “q” shall be at least 0,1 mm smaller than the specified smallest dimension of the filling material.

NOTE 4 The restriction on the size of the gap is intended to reduce the escape of filling material.

4.1.4 Filling procedure

Filling shall be carried out so as not to leave any void within the filling material (for example by shaking down). The free space within electrical equipment, parts of electrical equipment or Ex components protected by powder filling “q” shall be effectively filled with filling material (see also 4.3.2).

4.1.5 Containers that are not external enclosures

The container of type of protection “q” equipment or Ex Component that is installed or intended to be installed internal to another enclosure is considered the same as that of an Ex Component.

4.2 Filling material

4.2.1 Material specification

The material shall be quartz or solid glass particles.

The material specification shall state that, determined in accordance with the ISO 2591-1 procedure for dry materials, the size of particles are within the following sieve sizes:

– 1 mm nominal aperture sieve in accordance with ISO 3310-1 or ISO 3310-2

– 500 μm nominal aperture sieve in accordance with ISO 3310-1.

4.2.2 Documentation

The documents prepared by the manufacturer in accordance with IEC 60079-0 shall include the specification of the particle material, the size range of the particles, as well as the filling process and the measures taken to ensure proper filling.

NOTE It is not a requirement of this standard that conformity to the specification of the particle material and size range of the particles needs to be verified.

4.2.3 Testing

The filling material shall be subjected to the dielectric strength test specified in 5.1.3.

4.3 Distances

4.3.1 Distances through filling material

Except where specified otherwise in this standard, the minimum distance through the filling material between electrically conducting parts of the equipment and the container shall comply with Table 1 and Figure 1. This does not apply to conductors used for field wiring connections which penetrate the wall of the container.

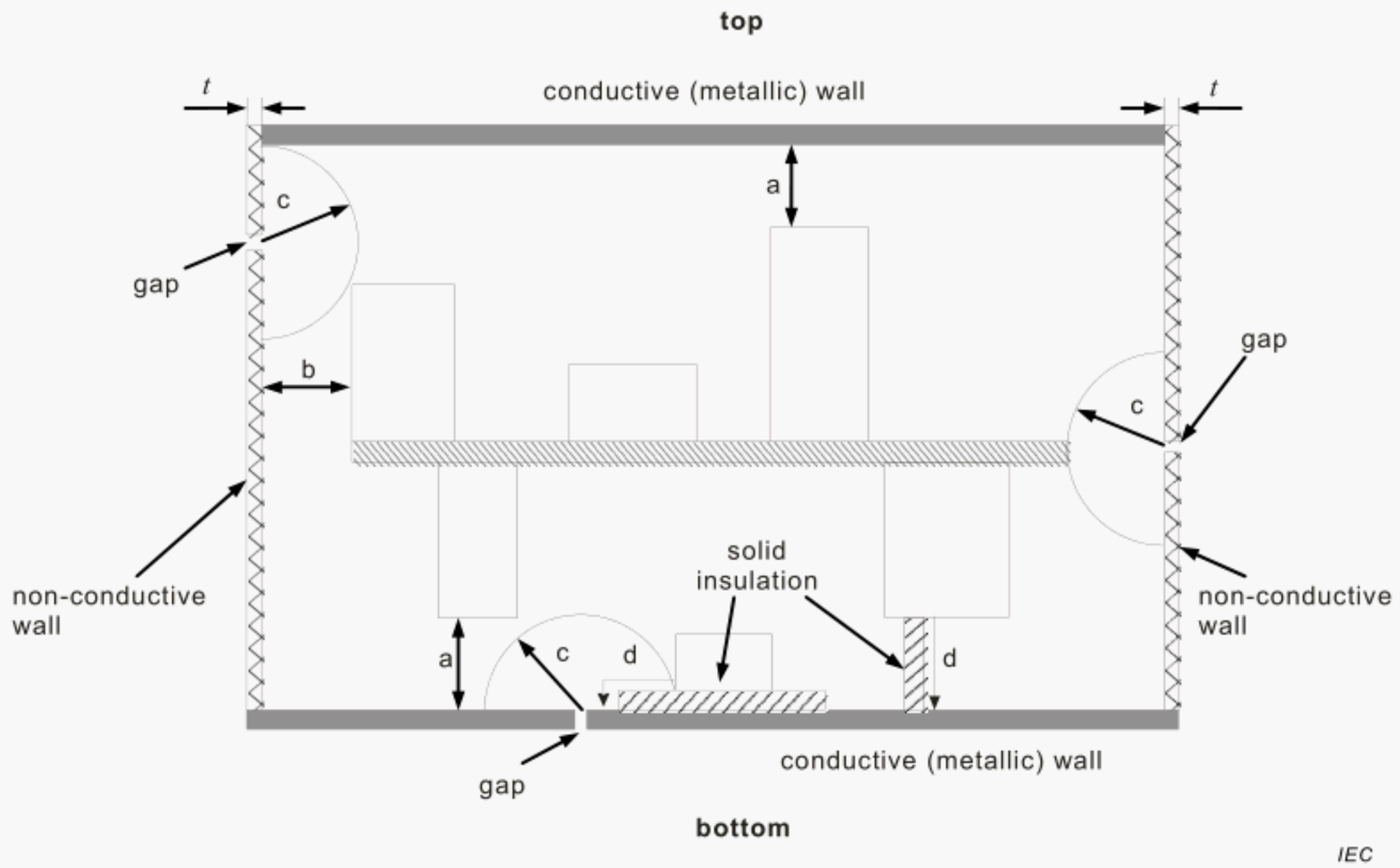
Table 1 – Distances through the filling material

Voltage[a] a.c. r.m.s. or d.c. V	Minimum distance mm	Reduced distance [b] mm
$U \leq 80$	5	1,5
$U \leq 100$	5	2
$U \leq 125$	5	2
$U \leq 160$	5	2
$U \leq 200$	5	3
$U \leq 250$	5	3
$U \leq 400$	6,3	3
$U \leq 500$	8	3
$U \leq 800$	10	5
$U \leq 1\,000$	14	5
$U \leq 1\,600$	16	10
$U \leq 2\,500$	25	10
$U \leq 3\,200$	32	10
$U \leq 4\,000$	40	14
$U \leq 5\,000$	50	14
$U \leq 6\,300$	63	25
$U \leq 8\,000$	80	25
$U \leq 10\,000$	100	40

[a] When determining the required values for creepage and distance, the working voltage may be higher than the voltage in the table by a factor of 1,1 (see Note).

NOTE The factor of 1,1 recognizes that at many places in a circuit, the working voltage equals the rated voltage and that there are a number of rated voltages in common use that can be accommodated by the 1,1 factor.

[b] To ensure that there is a sufficient path length through the filling material to provide quenching of a flame from the inside to the outside of the container, the reduced distances shown are permitted only when there is no adjacent gap in the container that could permit a flame to exit. See Figure 1.



Key

[a] distance to conductive wall according Table 1, reduced distance

[b] distance to non conductive wall with thickness t ; $b \geq$ (distance according Table 1) – t

[c] distance to gap, minimum radius according Table 1, no reduced distance

[d] creepage distance according Table 2

Figure 1 – Distances through filling material

Malfunction conditions according to 4.8 shall be considered when determining the working voltage.

NOTE While this standard is applicable to equipment with a rated supply voltage not exceeding 1 000 V, Table 1 takes into account working voltages greater than 1 000 V which can be developed or generated within the equipment or Ex Component. A typical example is a fluorescent luminaire ballast with a rated voltage of 240 V, but with an arc initiation voltage of approximately 2 000 V.

4.3.2 Distances surrounding free space

If electrical equipment contains components which have an enclosed free space not filled with the filling material (e.g. a relay), the following requirements apply:

– if the enclosed free space of the component is less than 3 cm^3, the minimum distance through the filling material between the component wall and the inner surface of the container shall comply with Table 1. The reduced distances are not permitted;

– if the enclosed free space of the component is between 3 cm^3 and 30 cm^3, the minimum distance through the filling material between the component wall and the inner surface of the container shall comply with Table 1 but with a minimum of 15 mm;

– the component shall be fixed, so that movement nearer to the wall of the container is not possible;

– the free volume shall not exceed 30 cm^3;

– the enclosure of the component shall resist the thermal and mechanical stresses to which it will be subjected even under malfunction conditions according to 4.8. There shall be no damage or distortion which could reduce the protection provided by the filling material.

4.4 Connections

4.4.1 Equipment

Cables used for the entry of electrical conductors into a powder filled “q” container shall be an integral part of the equipment and shall be protected and sealed as specified in 4.1.1. The clamping means shall comply with the cable gland requirements of IEC 60079-0 and shall not be capable of being removed without obvious damage to the powder filled “q” container.

4.4.2 Ex Components

Connection to powder filled “q” Ex Components shall comply with the connection facilities and termination compartments requirements of IEC 60079-0.

4.5 Capacitors

The total stored energy of all capacitors in an enclosure of electrical equipment, part of electrical equipment or Ex component protected by powder filling “q” shall not exceed 20 J in normal operation.

4.6 Cells and batteries

Enclosures for powder filled “q” electrical equipment, parts of electrical equipment or Ex components that contain cells or batteries shall incorporate a breathing device to the surrounding atmosphere (see 4.1.3) unless the batteries or cells:

a) have a capacity of 1,5 Ah or less, or

b) do not release gas under normal operating conditions, and comply with the requirements for primary and secondary batteries with a capacity up to 25 Ah, of IEC 60079-7, for level of protection “eb”.

NOTE Sealed gas-tight cells do not release gas under normal operating conditions.

4.7 Temperature limitations under overload conditions

Each electrical equipment, part of electrical equipment or Ex component protected by powder filling “q” shall be protected against overload prescribed in the relevant product standard specified by the manufacturer so that the temperature class is not exceeded inside the filling material at a depth of 5 mm from the wall of the container. If the reduced dimension of Table 1 has been applied and results in a distance less than 5 mm, the reduced distance shall be used in place of the 5 mm shown. The effectiveness of the protection shall be confirmed by the test of 5.1.4.

NOTE It is often difficult to limit the temperatures with only a fuse, and an internal thermal protective device is often necessary to comply with the maximum temperature requirements of 5.1.4.

4.8 Temperature limitations under malfunction conditions

4.8.1 General

The container shall not be damaged and the temperature class shall not be exceeded even in the case of malfunctions as detailed in 4.8. The effectiveness of the temperature protection shall be confirmed by the test in 5.1.4.

4.8.2 Fuse

Unless the equipment supply is protected by a fuse rated at not more than 170 % of the maximum normal current, the equipment shall be subjected to any single internal electrical malfunction which may cause either an overvoltage or overcurrent, for example:

– short-circuit of any component;

– open circuit due to any component failure;

– malfunction in the printed circuitry.

Fuses, if employed, shall have a voltage rating not less than that of the circuit and shall have a breaking capacity not less than the prospective fault current of the circuit.

If a malfunction can lead to one or more subsequent malfunctions, for example overloading of a component, the primary and subsequent malfunctions are considered to be a single malfunction.

Where there is no product standard, the overloads to be considered are those specified by the manufacturer.

The voltage U_n shall be assumed to be applied to the supply terminals when considering malfunction conditions and malfunction exclusions.

When the fuse is not integral to the electrical equipment or parts of electrical equipment, the certificate number shall include the "X" suffix in accordance with the marking requirements of IEC 60079-0 and the Specific Conditions of Use listed on the certificate shall detail the required fuse.

When the fuse is not integral to an Ex component, the certificate number shall include the symbol "U" in accordance with IEC 60079-0 and the schedule of limitations shall detail the required fuse.

4.8.3 Malfunction exclusions

The following malfunctions need not be considered.

a) Resistance values lower than the rated values for:
   – film type resistors,
   – wire wound resistors and coils with a single layer in helical form,

   when they are used at no more than 2/3 of their rated voltage and rated power at the maximum service temperature as specified by the manufacturer of the respective components.

b) Short-circuit conditions for:
   – plastic foil capacitors,
   – ceramic capacitors,
   – paper capacitors,

   when they are used at no more than 2/3 of their rated voltage as specified by the manufacturer of the respective components.

c) Insulation failure of:
   – galvanically separating components (e.g. optocouplers and relays) designed for segregation of different circuits,

   when the sum U of the r.m.s. values of the maximum voltages of the two circuits is not more than 1 000 V and the rated voltage of the component between the two different circuits is at least 1,5 times U.

   NOTE Galvanically separating components providing double or reinforced insulation according to a product standard are considered to meet the requirements of IEC 61140, e.g. IEC 60747-5-5 for photo coupler.

d) Transformers, coils and windings, which:
   – comply with Level of Protection “eb” in IEC 60079-7, or
   – comply with the requirements for mains transformers, Level of Protection “ia” or “ib”, in IEC 60079-11, or
   – comply with IEC 61558-2-6, or

– provide a double or reinforced insulation between the circuit per IEC 61558-1.

It is not necessary to consider the possibility of a short circuit if the distances or creepage distances between bare live parts or printed tracks are at least equal to the values of Table 2 (for methods of measuring creepage distances see IEC 60079-7 and IEC 60079-11).

The maximum voltage between the parts shall be used to determine the distances according to Table 2. If the parts are electrically isolated, the sum of the maximum voltages of the two circuits shall be considered as the voltage. The maximum voltage shall be assessed taking into account normal operating conditions (transients being disregarded) and malfunction conditions as specified in this standard.

For distance under a coating according to Table 2, the following conditions apply:

– a conformal coating shall have the effect of sealing the conductors in question against ingress of moisture;
– it shall adhere to the conductive parts and to the insulation material;
– if the conformal coating is applied by spraying, then two separate coats are to be applied;
– other methods of application require only one coat, for example, dip coating, brushing, vacuum impregnating, but the intention is to achieve an effective, lasting, unbroken seal;
– a solder mask is considered as one of the two coatings, provided it is not damaged during soldering.

Conductive parts protruding from the insulation (including soldered component pins) shall not be considered as coated unless special measures have been applied to obtain an effective unbroken seal.

Where bare parts of energized circuits emerge from the coating, the comparative tracking index (CTI) in Table 2 applies to both insulation and conformal coating.

Table 2 – Creepage distances and distances through filling material

Voltage[a] a.c. or d.c. $U_{r.m.s.}$ V	Creepage distance [b] mm	Minimum value CTI	Distance under coating mm	Distance through filling material mm
$U \leq 10$	1,6	_ [c]	0,6	1,5
$U \leq 12,5$	1,6	100	0,6	1,5
$U \leq 16$	1,6	100	0,6	1,5
$U \leq 20$	1,6	100	0,6	1,5
$U \leq 25$	1,7	100	0,6	1,5
$U \leq 32$	1,8	100	0,7	1,5
$U \leq 40$	3	100	0,7	1,5
$U \leq 50$	3,4	100	0,7	1,5
$U \leq 63$	3,4	100	1	1,5
$U \leq 80$	3,6	100	1	1,5
$U \leq 100$	3,8	100	1,3	2
$U \leq 125$	4	175	1,3	2
$U \leq 160$	5	175	1,3	2
$U \leq 200$	6,3	175	2,6	3
$U \leq 250$	8	175	2,6	3
$U \leq 320$	10	175	2,6	3
$U \leq 400$	12,5	175	3,3	3
$U \leq 500$	16	175	5	3
$U \leq 630$	20	175	6	5
$U \leq 800$	25	175	6	5
$U \leq 1\ 000$	32	175	8,3	5
$U \leq 1\ 250$	32	175	12	10
$U \leq 1\ 600$	32	175	13,3	10
$U \leq 2\ 000$	32	175	13,3	10
$U \leq 2\ 500$	40	175	13,3	10
$U \leq 3\ 200$	50	175	16	14
$U \leq 4\ 000$	63	175	21	14
$U \leq 5\ 000$	80	175	27	14
$U \leq 6\ 300$	100	175	33	25
$U \leq 8\ 000$	125	175	41	25
$U \leq 10\ 000$	160	175	55	40

[a] When determining the required values for creepage and distance, the working voltage may be higher than the voltage in the table by a factor of 1,1 (see Note).

NOTE The factor of 1,1 recognizes that at many places in a circuit, the working voltage equals the rated voltage and that there are a number of rated voltages in common use that can be accommodated by the 1,1 factor.

[b] If material with higher CTI value is used, the use of the Level of Protection “eb” creepage distances given for that CTI in IEC 60079-7 is permitted.

[c] At 10 V and below, the value of CTI is not relevant.

4.8.4 Protective devices for temperature limitation

Temperature limitation may be achieved by an internal or external, electrical or thermal, protective device. The device shall not be self-resetting.

Where integral fuses are used as protective devices, the fusing element shall be of the enclosed type, for example, in glass or ceramic.

Over-current devices shall have a voltage rating not less than that of the circuit and shall have a breaking capacity not less than the prospective fault current of the circuit.

4.8.5 Power supply prospective short-circuit current

Electrical equipment, parts of electrical equipment and Ex components protected by powder filling “q”, with a rated voltage of not greater than 250 V a.c., shall be suitable for operation from a supply system with a prospective short-circuit current of 1 500 A unless the marking includes the value of the permitted prospective short-circuit current. Higher prospective currents than 1 500 A could be present in some installations, for example at higher voltages.

If a current limiting device is necessary to limit the prospective short-circuit current to a value not greater than the rated breaking capacity of the fuse, this device shall be a resistor according to 4.8.3 a) and the rated values shall be:

– current rating 1,5 × 1,7 × I_n of the fuse;
– externally applied maximum voltage U_m;
– power rating 1,5 × (1,7 × I_n of the fuse)^2 × resistance of limiting device.

If the manufacturer does not provide a required short-circuit protective device, the certificate number for the electrical equipment or parts of electrical equipment shall include the "X" suffix in accordance with the marking requirements of IEC 60079-0 and the Specific Conditions of Use listed on the certificate shall detail the short-circuit protective devices required.

5 Verifications and tests

5.1 Type verifications and tests

5.1.1 Pressure type test of container

The pressure tests shall be conducted on the samples subjected to the tests of enclosures in IEC 60079-0. Irrespective of its volume, the container samples shall be subjected to a pressure type test with an over-pressure of 50 kPa without the occurrence of permanent deformation exceeding 0,5 mm in any of its dimensions. The pressure shall be applied for at least 10 s.

For containers without breathing or degassing openings, which contain capacitors other than plastic foil, paper or ceramic type and where the volume of the filling material is lower than eight times the volume of the capacitors, the pressure type test with an overpressure of 1,5 MPa shall be applied for at least 10 s.

Where the reduced distances have been applied (4.3.1), the pressure test shall be conducted hydraulically. There shall be no drops of water to blotting paper placed under the sample from any of the joints of the sample not identified as a “gap” for the purposes of employing the reduced distances.

NOTE 1 The test samples used for this test normally have the “gaps” sealed to allow the evaluation of the joints without the drops of water expected to come from the “gaps”.

Tests may be conducted without the filling material present.

NOTE 2 When the container is also the external enclosure, the tests of enclosures requirements of IEC 60079-0 apply.

NOTE 3 The impact and drop tests of enclosures from IEC 60079-0 do not generally apply to Ex Components intended to be mounted inside of another enclosure complying with IEC 60079-0, as the external enclosure provides the protection against impact and drop.

5.1.2 Verification of the degree of protection of the enclosure

The degree of protection of the enclosure shall be verified in accordance with the method specified in IEC 60529. Any breathing devices shall be in place. This test shall be carried out after the pressure type test in 5.1.1 on any one of the samples.

NOTE 1 When the container is also the external enclosure, the tests of enclosures requirements of IEC 60079-0 apply.

NOTE 2 The impact and drop tests of enclosures from IEC 60079-0 do not generally apply to Ex Components intended to be mounted inside of another enclosure complying with IEC 60079-0, as the external enclosure provides the protection against impact and drop.

5.1.3 Dielectric strength test of the filling material

The insulating properties of the filling material shall be tested prior to the filling process using a sample of the filling material. For this purpose, the electrode arrangement shown in Figure 2 shall be used. The electrodes shall be covered by the filling material in all directions with a thickness of at least 10 mm.

The sample shall be conditioned for at least 24 h at a temperature of (23 ± 2) °C and relative humidity of between 45 % and 55 %. A test voltage of 1 000 V d.c. $^{+5}_{0}$ % shall then be applied to the electrodes.

The filling material complies with the requirements if the leakage current does not exceed 10^{-6} A. If the material fails to comply, further conditioning and retesting are not permitted.

5.1.4 Maximum temperatures

Where current dependent fuses in accordance with IEC 60127 are used as protective devices for temperature limitation, the maximum temperature under overload conditions shall be measured with a continuous current of at least 1,7 times the fuse rating. If other fuses are employed, the test current shall be based on the non-fusing current rating of the fuse.

Where items other than current dependent fuses are used as protective devices for temperature limitation, the equipment shall be tested to verify that the temperature class is not exceeded when those protective devices operate.

When required by 4.8.3 to consider a malfunction, any malfunction which could increase heat dissipation but not cause a current dependant fuse to disconnect immediately shall be considered. (Malfunctions that will cause immediate rupture of the fuse do not need to be considered.) The malfunction assessed as most likely to affect the temperature class shall be simulated as closely as possible, particularly in respect of the spatial relationship between the container wall and the source of the heat.

NOTE 1 To simulate overload conditions or malfunctions which may cause higher temperatures than in normal operation, it is often convenient to use power components mounted in the equipment and subject to the maximum available power. Such components are normally chosen and located in the equipment so that they are representative of the thermal characteristics of the components they represent.

NOTE 2 The term “overload” also applies to the situation where the Ex “q” equipment (or component – such as a solid state relay or a luminaire ballast) controls rather than consumes power and the temperature rise is, at least partly, related to the external load. In such cases, where the equipment is protected by a fuse rated at not more than 170 % of the maximum normal current, the external load is adjusted to achieve the maximum current through the fused circuit, but no more than 1,7 times the fuse rating. Internal malfunctions are not applied as they are not considered to result in an “overload”.

5.2 Routine verifications and tests

5.2.1 Routine pressure test of container

Each container having a volume greater than 100 cm^3 shall be subjected to a routine pressure test with an overpressure of 50 kPa or 1,5 MPa, as applicable (See 5.1.1) without the occurrence of permanent deformation exceeding 0,5 mm in any of its dimensions. The pressure shall be applied for at least 10 s.

Tests shall be carried out under normal conditions of the equipment, but may be done without the filling material present.

The routine pressure test may be waived where the container has passed a type test with four times the test pressure (50 kPA or 1,5 MPa) in 5.1.1.

The routine overpressure testing can be replaced by a batch test according to the following criteria based on ISO 2859-1:

- For a production batch up to 100, 8 samples need to be tested at 1,5 times the routine test pressure with no failures.
- For a production batch from 101 to 1 000, 32 samples need to be tested at 1,5 times the routine test pressure with no failures.
- For a production batch from 1 001 up to 10 000, 80 samples need to be tested at 1,5 times the routine test pressure with no failures.

Batches above 10 000 shall be subdivided into smaller batches.

In many cases, the routine pressure test cannot be conducted without modifying the container so significantly that it is no longer representative of the equipment and could no longer be completed as the equipment. In these cases, neither the type test nor the batch routine test provide reasonable alternatives. In some cases, the samples for the batch routine overpressure test also have to be significantly modified to be able to conduct the test. In these cases, the satisfactorily tested samples are discarded and only the remaining untested samples of the batch released.

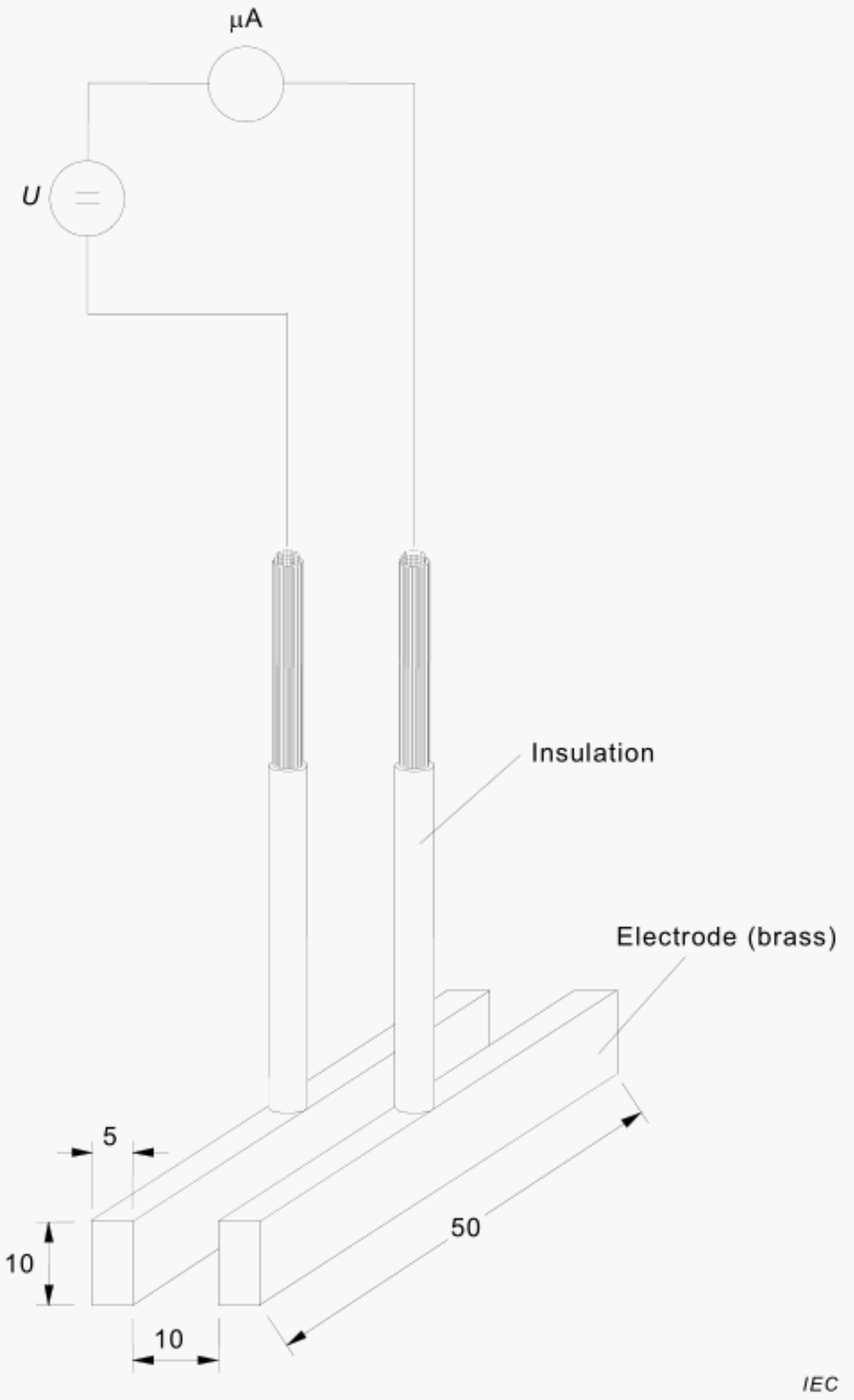
5.2.2 Dielectric strength test of the filling material

The insulating properties of each lot of the filling material shall be tested prior to the filling process using a sample of the filling material. For this purpose, the electrode arrangement shown in Figure 2 shall be used. The electrodes shall be covered by the filling material in all directions with a thickness of at least 10 mm. The test voltage shall be 1 000 V d.c. $^{+5}_{0}$ % under the following climatic conditions:

– temperature (23 ± 2) °C;
– relative humidity 45 % to 55 %.

The filling material complies with the requirements if the leakage current does not exceed 10^{-6} A.

If the filling material does not initially comply with these requirements, the lot may be dried and retested.



Dimensions in millimetres with a tolerance of ±1,0 mm

Figure 2 – Test arrangement for the dielectric strength test of the filling material

6 Marking

Electrical equipment, parts of electrical equipment, and Ex Components of powder filling “q” shall be marked in accordance with IEC 60079-0, with the following additional marking, as appropriate:

a) “This container has been permanently sealed and cannot be repaired”.

b) “This container is factory sealed – consult manufacturer’s instructions for repair”.

c) Each connection facility for external connection shall be marked with an identification of rated voltage and rated current (“24 V d.c., 200 mA”, “230 V, 100 mA”).

d) External fuse data if the type of protection depends upon such a fuse, “Required external fuse: 315 mA”;

e) Permitted prospective short-circuit current of the supply system if the equipment is designed for a short-circuit current less than 1 500 A, according to 4.8.5, for example “Permitted supply short-circuit current: 35 A”.

f) Optionally, permitted prospective short-circuit current of the supply system if the equipment is designed for a short-circuit current of 1 500 A or more, according to 4.8.5, for example “Permitted supply short-circuit current: 3 500 A”.

Any of these markings may be replaced by technically equivalent information.

7 Instructions

The instructions prepared in accordance with IEC 60079-0, shall also include the following:

– Where permitted by the manufacturer, details on the re-filling, re-sealing, and re-testing requirements for powder filled “q” equipment that has been opened for repair.

– Where the container is permanently sealed and repair is not permitted by the manufacturer, this shall be stated clearly in the instructions.

Bibliography

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at http://www.electropedia.org)

IEC 60050-426, *International Electrotechnical Vocabulary (IEV) – Part 426: Electrical apparatus for explosive atmospheres*

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