Construction materials which react hazardously with the substances being handled shall be avoided.

For protective measures against hazards due to impact and friction involving rust and light metals (e.g. aluminium, magnesium, or their alloys), see 6.4.

NOTE Materials not normally pyrophoric can become pyrophoric under certain conditions, e.g. in the storage of sulphur containing petroleum products or milling of light metal in inert atmosphere.

7 Additional considerations

7.1 Dust deposits and other material in the gap of moving parts

The ignition hazard assessment shall consider the ignition risk that arises from dust or other material trapped between two moving parts or a moving part and a fixed part. If dust or other material remains in contact with the same moving part for a long period, it can heat up and can cause a burning deposit of dust or other material which can later ignite an explosive atmosphere. Even slow moving parts can cause a large rise in temperature.

In certain types of powder handling equipment, this type of ignition risk cannot be avoided. In this case, one or more protective measures shall be used.

7.2 Dust deposits and other material in the flame arresters incorporated in the equipment

The ignition hazard assessment shall consider the ignition risk that arises from dust or other material trapped or coated between the fixed components of flame arresters.

NOTE Autonomous flame arresters are defined by ISO 16852.

7.3 Opening times of enclosures

Enclosures which can be opened more quickly than the time necessary for an ignition source to become non-effective, (e.g. to allow the cooling of enclosed hot parts to a surface temperature below the marked temperature class or the marked maximum surface temperature of the equipment) shall be marked with the warning in b) of <u>Table 11</u>. Alternatively the equipment may be marked with the warning in c) of <u>Table 11</u>.

NOTE The above marking information is also required to be included in the instructions by <u>10</u>.

7.4 Non-metallic enclosures and non-metallic parts of the equipment

7.4.1 General

7.4.1DV DE Modification of Clause 7.4.1 to replace with the following:

The following requirements for non-metallic enclosures and non-metallic parts of the enclosures in UL 60079-0, and also those the tests of 8.3, shall apply to non-metallic enclosures and non-metallic parts of the equipment which are relevant, according to the ignition hazard assessment, for the explosion protection, e.g. plastic parts, glass windows, etc. and to non-conductive layers on metal parts.

7.4.2 Specification of the materials

7.4.2DV DE Modification to delete Clause 7.4.2. This requirement is covered by the modified 7.4.1.

Materials shall be specified and documented according to <u>9.1</u>. This specification shall include the material specification details shown for non-metallic enclosures and parts of enclosures in IEC 60079-0.

7.4.3 Thermal endurance

7.4.3DV DE Modification to delete Clause 7.4.3. This requirement is covered by the modified 7.4.1.

Plastic materials shall have a temperature index TI of at least 20 K greater than the maximum service temperature (see IEC 60079-0).

As an alternative to the TI, the relative thermal index (RTI – mechanical) may be determined in accordance with ANSI/UL 746B.

Elastomers shall have a continuous operating temperature (COT) range that includes a minimum temperature that is below, or equal to, the minimum service temperature and a maximum temperature that is at least 20 K above the maximum service temperature.

7.5 Removable parts

It shall be ensured that parts necessary for maintaining the level of explosion protection cannot be unintentionally or inadvertently removed. This may be achieved by, for example, the use of fasteners that need a tool or key to remove them.

7.6 Materials used for cementing

Where safety or a type of protection depends on materials used for cementing, requirements of IEC 60079-0 apply.

7.7 Light transmitting parts

For Group I equipment, Group II equipment EPL Ga and Gb and Group III equipment EPL Da and Db, light transmitting parts, whose integrity is of relevance for the ignition protection shall be capable of passing the relevant tests according to <u>8.3.1</u> or provided with a cover or permanent guard that is capable of passing the relevant test.

NOTE Sight glasses are commonly used to check the status (e.g. level, quality) of lubricating agents used for equipment with rotating parts.

Before a decision on testing is made, it shall be checked whether the damage of a sight glass is likely to occur, depending on its location and mounting position, and whether the damage can result in:

a) a loss of liquids that can lead to spontaneous dry run and cannot be detected within routine maintenance cycle or;

b) an auto-ignition of the leaking product because it comes into contact with hot surfaces and thus can act as an ignition source for the explosive atmosphere.

If a loss of liquid is not dangerous according to a) or auto-ignition is not relevant according to b) a damaged sight glass is not deemed to be critical for the type of protection and an impact test according to <u>8.3.1</u> need not to be applied.

7.8 Stored energy

When equipment is designed to be de-energised when an explosive atmosphere is detected, the instructions shall include guidance on:

• reduction of the risk of ignition in the period from the detection of the explosive atmosphere and the deenergisation of the equipment,

• avoidance of ignition hazards that might be caused as a result of the de-energisation.

8 Verification and tests

8.1 General

The prototypes or samples shall be tested in accordance with the requirements for type tests of this standard and of the specific standards for the Types of Protection concerned. However, certain tests judged to be unnecessary, may be omitted from the testing programme. A record shall be made of all tests carried out and of the justification for those omitted.

It is not necessary to repeat the tests that have already been carried out on an Ex Component.

NOTE Due to the safety factors incorporated in the types of protection, the uncertainty of measurement inherent in good quality, regularly calibrated measurement equipment is considered to have no significant detrimental effect and need not be taken into account when making the measurements necessary to verify compliance of the equipment with the equipment requirements of the relevant part of ISO 80079.

8.2 Determination of the maximum surface temperature

8.2.1 General

The maximum surface temperature shall be determined under the most adverse conditions at the most unfavourable load defined by the manufacturer and according to the EPL. The determination of the maximum surface temperature shall take account of normal operation for EPL Gc and Dc equipment, expected malfunction for EPL Gb and Db equipment and of both expected and rare malfunctions for EPL Ga and Da equipment and any additional measures to control or limit the maximum surface temperature.

The adverse conditions defined by the manufacturer, shall consider the duty cycle and/or the maximum continuous overload that can occur without overload protection devices activating.

Similarly for Group I, EPL Mb the determination of the maximum surface temperature shall take account of those expected malfunctions that cannot be disregarded by virtue of the equipment being designed to be de-energised in the event of an explosive atmosphere.

The measurement of the surface temperatures and temperatures of other parts as prescribed in this standard and the specific standards for the types of protection concerned shall be made in still air, with the equipment mounted in its normal service position. Air movement due to the function of the equipment is

permitted. The temperature of the hottest point of the equipment in contact with the explosive atmosphere shall be determined resulting in the highest surface temperature.

8.2.1DV.1 DE Modification of Clause 8.2.1, fifth paragraph to replace with the following:

For equipment which can be normally used in different positions, the temperature in each position is to be determined and the highest temperature is to be considered. When the temperature is determined for certain positions only, this shall be specified in the test report and instructions. The equipment shall also be marked – by including the symbol "X" marking as detailed in <u>11.2</u> I).

NOTE 1 The above marking information is also included in the instructions as required by <u>10</u>.

The measuring devices (thermometers, thermocouples, contactless temperature measuring device, etc.) and the connecting cables should be selected and so arranged that they do not significantly affect the thermal behaviour of the equipment.

The final temperature is considered to have been reached when the rate of rise of temperature does not exceed 2 K/h or after operation of any temperature limiting device forming part of the equipment.

Where there is no temperature limiting device, the result shall be corrected for the maximum ambient temperature specified in the rating by adding the difference between the ambient temperature used in the test and the rated ambient temperature to the measured temperature.

The highest surface temperature measured shall not exceed:

a) for Group I equipment, those values as given in 6.2;

b) for Group II EPL Ga equipment, 80 % of the marked maximum surface temperature or 80 % of the maximum surface temperature corresponding to the marked temperature class or 80 % of the auto-ignition temperature in °C of the substance name shown in the marking;

NOTE 2 This increased safety factor for mechanical EPL Ga equipment compared to electrical equipment is necessary as rare mechanical malfunctions that need to be considered for EPL Ga equipment cannot easily be represented by surface temperature determination.

c) for Group II EPL Gb and EPL Gc equipment:

• where each manufactured equipment is subjected to routine testing for maximum surface temperature, the temperature as marked on the equipment;

• where the equipment is subjected to type testing for maximum surface temperature, the marked maximum surface temperature, or the temperature class limit:

i) less 5 K for temperature classes T6, T5, T4 and T3 (or marked maximum surface temperatures \leq 200 °C), and

ii) less 10 K for temperature classes T2 and T1 (or marked maximum surface temperatures > 200 °C),

d) for Group III equipment: the marked maximum surface temperature on the equipment, which shall be the actual maximum surface temperature.

Where direct measurement of surface temperature is not practical, other methods can be applied, e.g. calculation.

8.2.2 Hot Surface Ignition Test

8.2.2.1 General

In special cases, the above temperature limits may be exceeded, if there is documented evidence, that the explosive atmosphere cannot be ignited by the hot surface under consideration.

The sample shall be tested to demonstrate that it does not cause auto-ignition of a flammable mixture when tested in the presence of a specified gas/air mixture as described in <u>8.2.2.2</u>.

The assessment shall include conditions according to the EPL required as given in 8.2.1.

Ignition tests are carried out to determine the temperature at which auto-ignition occurs or to determine the maximum temperature at which no auto-ignition occurs. The following safety margins are then applied to this temperature:

a) 25 K for T4, T5 and T6 and Group I;

b) 50 K for T1, T2 and T3.

These safety margins shall be ensured by experience of similar parts or by tests of the equipment itself in representative mixtures for the specific temperature class.

8.2.2.2 Procedure

The test shall be carried out with the part of the equipment either:

a) mounted in the equipment as intended and precautions shall be taken to ensure that the test mixture is in contact with the part which is intended to be tested, or

b) mounted in a model which ensures representative results. In this case, such a simulation shall take into account the effect of other parts of the equipment in the vicinity of the part being tested which affect the temperature of the mixture and the flow of the mixture around the part being tested as a result of ventilation and thermal effects.

The part of the equipment shall be tested under normal operation, or under the malfunction conditions specified in the standard for the type of protection which produces the highest surface temperature. The test shall be continued either until thermal equilibrium of the component and the surrounding parts is attained or until the component temperature drops. Where component failure causes the temperature to fall, the test shall be repeated five times using five additional samples of the component. Where, in normal operation or under the malfunction conditions specified in the standard for the type of protection, the temperature of more than one part exceeds the temperature class of the equipment, the test shall be carried out with all such parts at their maximum temperature.

The safety margin required by <u>8.2</u> shall be achieved either by raising the ambient temperature at which the test is carried out or, where this is practical, by raising the temperature of the component under test and other relevant adjacent surfaces by the required margin.

For Group I, the test mixture shall be a homogeneous mixture between 6,2 % and 6,8 %, v/v methane and air.

For T4 temperature classification, the mixture shall be either:

a) a homogeneous mixture of between 22,5 % and 23,5 % v/v diethyl ether and air, or

b) a mixture of diethyl ether and air obtained by allowing a small quantity of diethyl ether to evaporate within a test chamber while the ignition test is being carried out.

For other temperature classifications, a suitable test mixture shall be selected.

8.2.2.3 Acceptance criteria

The appearance of a cool flame shall be considered as an ignition. Detection of ignition shall either be visual or by measurement of temperature, for example, by a thermocouple.

8.3 Mechanical tests

8.3.1 Test for resistance to impact

Impact tests of IEC 60079-0 apply.

8.3.1 DV DE Modification of Clause 8.3.1, second paragraph to replace with the following:

When a piece of equipment is submitted to tests corresponding to the low risk of mechanical danger, it shall be marked with the symbol "X" according to <u>11.2</u> I).

Most Group I applications can be considered as high risk, any impact testing should be done at the high risk level, except where the manufacturer clearly specifies the special circumstances that permit low risk levels to be applied.

8.3.2 Drop test

In addition to being submitted to the resistance to impact test according to <u>8.3.1</u>, handheld equipment or equipment carried on the person, ready for use, shall be submitted to the drop tests of IEC 60079-0 with the "electrical equipment" term used by that test to be the "non-electrical equipment" under consideration.

8.3.3 Required results

The resistance to impact and drop tests shall not produce damage which invalidates the level of protection of the equipment.

After testing the equipment, casings and components shall not be displaced or deformed causing rubbing of the moving parts.

8.4 Additional tests of non-metallic parts of the equipment relevant for explosion protection

8.4.1 Test temperatures

8.4.1DV DE Modification of Clause 8.4.1 to replace with the following:

When, according to this standard or to the specific type of protection standards listed in Clause $\underline{1}$, tests shall be made as a function of the permissible upper and lower service temperature, the test temperatures used during the tests shall be:

• for the upper test temperature, the maximum service temperature (see <u>6.2.2</u> <u>3.8</u>) increased by at least 10 K but at most 15 K;

• for the lower test temperature, the minimum service temperature (see $\frac{6.2.2}{3.8}$) reduced by at least 5 K but at most 10 K.

8.4.2 Tests for Group I equipment

The tests shall be made as follows:

• 2 samples shall be submitted to the tests of thermal endurance to heat (see $\underline{8.4.4}$), then the tests of thermal endurance to cold (see $\underline{8.4.5}$), then the mechanical tests (see $\underline{8.4.7}$) and finally to the tests specific to the Type of Protection concerned.

• 2 samples shall be submitted to the tests of resistance to oils and greases (see $\underline{8.4.6}$) then to the mechanical tests (see $\underline{8.4.7}$) and finally to the tests specific to the Type of Protection concerned.

• 2 samples shall be submitted to the tests of resistance to hydraulic liquids for mining applications (see $\underline{8.4.6}$) then to the mechanical tests (see $\underline{8.4.7}$) and finally to the tests specific to the Type of Protection concerned.

The objective is to demonstrate the performance of the non-metallic material relevant to the level of protection or the type of protection listed in Clause <u>1</u> after exposure to extremes of temperature and harmful substances likely to be met in use. In an attempt to keep the number of tests to a minimum it is not necessary to perform all of the tests specific to the Type of Protection on every sample if it is obvious that a sample has not been damaged in such a way as to impair the Type of Protection offered. Similarly, the number of samples can be reduced if it is possible for the exposure tests and protection proving tests to be performed in parallel on the same two samples.

8.4.3 Tests for Group II and III equipment

8.4.3DV DE Modification of Clause 8.4.3 to replace with the following:

The tests shall be made on 2 samples which shall be submitted to the tests of thermal endurance to heat (see <u>8.4.4</u>) then to tests of thermal endurance to cold (see <u>8.4.5</u>) then to the mechanical tests (see <u>8.4.7</u>) and finally to the tests specific to the Type of Protection concerned.

Order and condition of tests as described in UL 60079-0, Clause 26.4.1.2.2 apply.

8.4.4 Thermal endurance to heat

8.4.4DV DE Modification of Clause 8.4.4 to replace with the following:

The thermal endurance to heat shall be determined by submitting the enclosures or parts of enclosures in non-metallic materials, on which the integrity of the Type of Protection depends, to tests according to Table 9.

Thermal endurance to heat in UL 60079-0 applies.

Service temperature <i>T</i> s	Test condition	Alternative test condition
<i>T</i> _s ≤ 70 °C	672 ₊₃₀ ⁰ h at (90 ± 5) % RH, at <i>T</i> _s + (20 ± 2) °C (but not less than 80 °C test temperature)	
70 °C < 7 _s ≤ 75 °C	672 ₊₃₀ ⁰ h at (90 ± 5) % RH at T _s + (20 ± 2) °C	504 ₊₃₀ ⁰ h at (90 ± 5) % RH at (90 ± 2) °C followed by 336 ₊₃₀ ⁰ h dry at <i>T</i> _s + (20 ± 2) °C
Τ _s > 75 °C	336 ₊₃₀ ⁰ h at (90 ± 5) % RH at (95 ± 2) °C, followed by 336 ₊₃₀ ⁰ h dry at <i>T</i> _s + (20 ± 2) °C	504 ₊₃₀ ⁰ h at (90 ± 5) % RH at (90 ± 2) °C followed by 336 ₊₃₀ ⁰ h dry at <i>T</i> _s + (20 ± 2) °C
$T_{\rm s}$ is the temperature defined in 3.8 and shall NOT include the increase stated in 8.4.1.		

Table 9 Thermal endurance test

At the conclusion of the test according to <u>Table 9</u>, the enclosures or parts of enclosures in non-metallic materials that were tested shall be subjected to (20 ± 5) °C at (50 ± 5) % relative humidity for 24 $_{+48}$ ⁰ h, followed by the thermal endurance to cold test (<u>8.4.5</u>).

NOTE 1 The test values given in <u>Table 9</u> include two test conditions. The conditions shown in the 2nd column were used in editions of IEC UL 60079-0 prior to Edition 6, and allow previously obtained test results to remain valid for this edition. The conditions shown in the 3rd column have been added to allow testing at temperature/humidity conditions that are more readily achieved, although at an increased test time.

NOTE 2 It is generally acknowledged that glass and ceramic materials are not adversely affected by the thermal endurance to heat test, and testing may not be necessary.

8.4.5 Thermal endurance to cold

8.4.5DV DE Modification of Clause 8.4.5 to replace with the following:

The thermal endurance to cold shall be determined by submitting the enclosures and parts of enclosures of non-metallic materials, on which the type of protection depends, to storage for 24 h $_{+2}^{0}$ in a test temperature corresponding to the minimum service temperature reduced according to $\frac{8.4.1}{1}$.

NOTE It is generally acknowledged that glass and ceramic materials are not adversely affected by the thermal endurance to cold test, and testing may not be necessary.

Thermal endurance to cold in UL 60079-0 applies.

8.4.6 Resistance to chemical substances for Group I equipment

8.4.6DV DE Modification of Clause 8.4.6 to replace with the following:

Resistance to chemical agent test of <u>IEC UL</u> 60079-0 applies <u>to non-metallic materials</u> relevant to the explosion protection that come in contact with the chemical agent, except that the mechanical tests according to <u>8.4.7</u> replace the tests of enclosures in UL 60079-0.

At the end of the test, the enclosure samples concerned shall be removed from the liquid bath, carefully wiped and then stored for (24 ± 2) h in the laboratory atmosphere. Subsequently, each of the enclosure samples shall pass the mechanical tests according to 8.4.7.

8.4.7 Mechanical resistance tests

In the case of non-metallic parts of the equipment relevant to the level of protection mechanical tests according to 8.3 shall be carried out.

The following detailed conditions shall be observed:

a) Test for resistance to impact:

• The places of impact shall be on the external parts potentially exposed to impact. If the enclosure of non-metallic material is protected by another enclosure, only the external parts of the assembly shall be subjected to the resistance to impact tests.

• The test shall first be made at the highest test temperature, then at the lowest test temperature, according to <u>8.4.1</u>.

b) Drop test.

The drop test for equipment which is held in the hand or carried on the person, shall be made at the lowest test temperature, according to $\frac{8.4.1}{1}$.

8.4.8 Surface resistance test of non-conductive parts of the equipment relevant for explosion prevention and protection

Surface resistance test of IEC 60079-0 applies.

8.4.9 Thermal shock test

Thermal shock test of IEC 60079-0 applies.

9 Documentation

9.1 Technical documentation

The manufacturer shall prepare documents that give a full and correct specification of the explosion safety aspects of the equipment.

This documentation shall include ignition hazard assessment report and when necessary according to this report, the following:

- description of the equipment;
- · design and manufacturing drawings as far as required by ignition hazard assessment;
- all descriptions and explanations necessary for the understanding of drawings;
- · material certificates if necessary;
- reports of tests described in Clause 8;
- instructions specified in Clause 10.

9.2 Conformity with the documentation

9.2DV DE Modification of Clause 9.2 to replace with the following:

The manufacturer shall carry out the verifications or tests necessary to ensure that the non-electrical equipment produced complies with the technical documentation <u>prepared</u> <u>per 9.1</u>.

It is not the intent of this subclause to require 100 % inspection of parts. Statistical methods may be employed to verify compliance.

9.3 Certificate

9.3DV DR Modification of Clause 9.3 to replace with the following:

The manufacturer shall prepare, or have prepared, a certificate confirming that the equipment is in conformity with the requirements of this standard along with its other applicable parts and additional standards mentioned in Clause <u>1</u>. The certificate can relate to Ex Equipment or an Ex Component.

NOTE Although the certificate could be prepared by a first, second or third party, Listing by an OSHA Nationally Recognized Testing Laboratory is also considered to meet the requirements of a "Certificate".

An Ex Component certificate (Identified by the symbol "U" suffix to the certificate number) is prepared for parts of equipment that are incomplete and require further evaluation prior to incorporation in Ex Equipment. The Ex Component certificate shall include a Schedule of Limitations detailing specific additional evaluation required as part of incorporation into Ex equipment. An Ex Component certificate shall clarify that it is not an Ex Equipment certificate.

9.4 Responsibility for marking

By marking the equipment in accordance with Clause <u>11</u>, the manufacturer attests on his own responsibility that the equipment has been constructed in accordance with the applicable requirements of the relevant standards in safety matters.

10 Instructions

The documentation prepared as required by 9.1 shall include instructions which provide the following particulars as a minimum:

• a recapitulation of the information with which the equipment is marked, except for the serial number (see Clause <u>11</u>), together with any appropriate additional information to facilitate maintenance (for example, address of the importer, repairer, etc.);

• instructions for safety, i.e.

- putting into service;
- use;
- assembling and dismantling;
- maintenance;
- installation;
- adjustment;
- where necessary, training instructions;

- details which allow a decision to be made as to whether the equipment can be used safely in the intended area under the expected operating conditions;

- relevant parameters, maximum surface temperatures and other limit values;

- where applicable, Specific Conditions of Use including remaining hazards identified in the ignition hazard assessment report that require additional protective means by the installers or users;

10DV DE Modification of Clause 10, third bulleted item to replace with the following:

• where applicable, any additional Specific Conditions of Use, including particulars of possible reasonably foreseeable misuse, which experience has shown might occur;

• where necessary, the essential characteristics of tools which may be fitted to the equipment;

• a list of the standards, including the issue date, with which the equipment is declared to comply. The certificate can be used to satisfy this requirement;

• a summary of the relevant ignition hazards identified and the protective means implemented.

11 Marking

11.1 Location

The equipment shall be legibly and indelibly marked on a main part on the exterior of the equipment and shall be visible prior to the installation of the equipment.

NOTE 1 It is useful for the marking to be visible after installation of the equipment.