

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

AMENDMENT 1  
AMENDEMENT 1

Explosive atmospheres –  
Part 6: Equipment protection by liquid immersion "o"

Atmosphères explosives –  
Partie 6: Protection du matériel par immersion dans le liquide "o"

IEC 60079-6:2015/AMD1:2020  
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IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

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## FOREWORD

This amendment has been prepared by IEC technical committee 31: Equipment for explosive atmospheres.

The text of this amendment is based on the following documents:

FDIS	Report on voting
31/1517/FDIS	31/1526/RVD

Full information on the voting for the approval of this amendment can be found in the report on voting indicated in the above table.

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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## 1 Scope

*Delete the Note.*

*Add, after the fourth paragraph of Clause 1, the following new text:*

Additionally, for Level of Protection "oc", Annex D applies where the rated voltage exceeds 15 kV AC RMS or DC and up to 245 kV AC RMS or DC.

Annex D applies specifically to liquid immersed transformers and reactors, and other liquid immersed equipment such as swivels for off-shore platforms, power regulators, tap changers and earthing/switching resistors.

## 2 Normative references

*Add the following new references:*

IEC 60071 (all parts), *Insulation co-ordination*

IEC 60076-3, *Power transformers – Part 3: Insulation levels, dielectric tests and external clearances in air*

IEC 60079-1, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"*

IEC 60079-2, *Explosive atmospheres – Part 2: Equipment protection by pressurized enclosure "p"*

IEC 60079-33, *Explosive atmospheres – Part 33: Equipment protection by special protection 's'*

IEC 60137, *Insulated bushings for alternating voltages above 1000 V*

IEC 62770, *Fluids for electrotechnical applications – Unused natural esters for transformers and similar electrical equipment*

### 3 Terms and definitions

*Add the following new terms and definitions:*

#### 3.11

##### **oil-immersed swivel for HV connections**

oil filled equipment to transfer power with coupling between two parts enabling one to revolve and the other to remain stationary (fixed)

#### 3.12

##### **oil-immersed earthing resistor**

equipment intended for system neutral earthing

#### 3.13

##### **oil-immersed switching resistor**

equipment intended for inrush current limitation

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Insert the following new Annex D after Annex C:

## **Annex D** (normative)

### **Supplementary requirements for electrical equipment with Level of Protection "oc" for voltages greater than 15 kV and up to and including 245 kV**

#### **D.1 General**

Annex D supplements and modifies the requirements of this document. Subclauses 4.3, 4.4 and 4.6 do not apply to equipment covered by this Annex.

The voltage of explosion protected electrical equipment was limited for Level of Protection "oc" up to 15 kV RMS AC or DC. Application of higher voltages exists to supply offshore plants that are a long distance from the coast. Voltage levels up to 245 kV AC<sub>RMS</sub> or DC are needed to allow power transmission up to some hundred kilometres from shore to offshore or between locations on shore/offshore. This Annex can be applied to liquid immersed transformers, reactors, power regulators, tap changers and other liquid immersed HV electrical equipment without dedicated IEC standards such as oil-immersed swivels for HV connections, oil-immersed earthing resistors and oil-immersed switching resistors.

#### **D.2 Additional requirements**

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##### **D.2.1 Safety devices**

For Level of Protection "oc" the requirements in 4.7.3 for Level of Protection "ob" apply for equipment or components according to this Annex.

Each individual liquid filled compartment shall have its own safety devices.

A pressure relief device shall be provided that automatically disconnects the power when the pressure relief device activates. The electrical equipment or system associated with the pressure relief device to activate the automatic disconnection shall be suitable for EPL Gc. If the pressure relief device itself is not directed downward a guide system, e.g. a pipe, shall be provided. The dimensioning of this guide system shall not compromise the functionality of the pressure relief.

##### **D.2.2 Protective liquid specification**

In addition to 5.1, natural ester insulating liquids in accordance with IEC 62770 may be used in higher voltage equipment along with the insulating liquids already identified in this document.

NOTE Natural ester liquids per IEC 62770 are proven up to 245 kV considering the ambient temperature limitation.

##### **D.2.3 Liquid immersion depth**

Instead of Table 2, the required minimum liquid immersion depths necessary shall be specified by the manufacturer and verified by high voltage tests as specified in D.4.7. The tests shall be done with the minimum liquid level.

#### D.2.4 Connections

Cables for field wiring connections greater than 15 kV shall be shielded to mitigate external arcs and sparks caused by an external dielectric field. All HV cables above 15 kV shall be armoured and shielded. Considerations shall be made to avoid circulating currents and external arcs and sparks during energizing operation (Refer to the requirements of IEC 60079-0 for circulating currents in enclosures).

The termination of the HV cable may be within enclosures using other Types of Protection such as flameproof “d”, pressurization “p” or special protection “s”.

In the case of an enclosure in accordance with IEC 60079-1 Level of Protection “db” the interface to the liquid immersion shall withstand the overpressure test of IEC 60079-1.

Termination in pressurized enclosures in accordance with IEC 60079-2 shall be Level of Protection “pxb” or “pzc”.

Special protection “s” shall be in accordance with IEC 60079-33.

When bushings are used, the requirements of IEC 60137 apply.

#### D.2.5 On-load tap-changer (OLTC)

The on-load tap-changer shall be of type which does not produce arcs and sparks during switching.

DC switching is not permitted.

NOTE OLTC according IEC 60214 can make switching operations up to several MVA/phase without sparking in liquid when vacuum tap changers are applied. In a vacuum tap changer current switching takes place inside a closed vacuum bottle and the current is limited by transition resistor or reactor during the switching.

#### D.2.6 Containment solutions

The liquid containment enclosure shall be sealed from the ambient environment in accordance with 4.5.2.

Unsealed enclosures of 4.5.3 are not permitted.

NOTE 1 Sealing can be achieved by diaphragm/bladder/bag in conservator tank between the liquid and air or by closed gas cushion (usually nitrogen) or by flexible fully filled tank (flexible corrugations or radiators).

NOTE 2 Because mineral oil, esters and silicone oil are hygroscopic, a sealed design in HV liquid insulated equipment is considered as the only practical choice to increase maintenance intervals and reduce failure risks. Expansion vessels with membrane are considered sealed.

#### D.2.7 Routine tests

##### D.2.7.1 Dielectric tests

Transformers and reactors test methods and voltages are given in IEC 60076-3. Test voltages for transformers may be applied to other oil-immersed HV equipment or IEC 60071 may be applied where there is no industrial standard for the type of equipment.

The following routine dielectric tests apply:

- a) The test for phase to earth shall be conducted in accordance with the requirements of IEC 60076-3 or IEC 60071.
- b) The test for phase to phase shall be conducted in accordance with the requirements of IEC 60076-3.

- c) The test of partial discharge measurement for long duration with pre-stress voltage and measurement level shall be conducted in accordance with IEC 60076-3. The acceptance criteria shall be applied.
- d) The test for lightning impulse given in IEC 60076-3 is applicable for transformers and reactors, and for other equipment according to IEC 60071.

Tests a) and b) shall be a routine test for all equipment. Test c) and Test d) shall be an additional routine test for all equipment above 72,5 kV.

The Tests of c) and d) may apply with a voltage level lower than 72,5 kV as agreed between the manufacturer and the purchaser.

The tests of a), b), c) and d) shall be done with the manufacturer's specified minimum liquid level.

There shall be no breakdown during the tests of a), b) and d).

#### **D.2.7.2 Sealed enclosures**

For Level of Protection "oc", a pressure equal to 1,5 times the pressure relief device setting shall be applied internally to the sealed enclosure. If necessary, the expansion tank and other optional attached equipment may be tested separately. The period of application of the pressure shall be at least  $(60^{+10}_{-0})$  s.

The pressure relief device entry shall be sealed for the duration of the test.

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#### **D.2.8 Selection and erection requirements**

Annex A applies.

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#### **D.2.9 Maintenance**

Annex B applies.

#### **D.2.10 Repair and overhaul**

Annex C applies.

### **D.3 Additional considerations**

In the application of this equipment it is recommended that the following items are considered

- Short circuit fault levels at the connection point in the hazardous area should be assessed
- Circulating currents are not considered in this Annex D and should be taken into account during the initial hazard assessment
- High voltage installation rules referred in IEC 61936-1 are recommended to be used in addition to IEC 60079-14.



## Bibliography

*Insert the following new references in the Bibliography:*

IEC 60214 (all parts), *Tap-Changers*

IEC 61936-1, *Power installations exceeding 1 kV a.c. – Part 1: Common rules*

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