Explosion Protected Electrical Apparatus in the Russian Federation
Adaptations of National Standards to International Standards, deviations and peculiarities

by Vitaly Lipavskiy

1. Status of application of explosion protected electrical apparatus in the Russian Federation

The industrial branches that are traditionally highly developed in Russia, such as those dealing with production, transport and processing of oil and gas, the petrochemical industry, and a number of other industries in which explosive atmospheres may occur, demand the use of explosion protected electrical equipment in certain areas.

Since these industrial branches are currently undergoing greater development and modernisation, there is a high demand for more modern, state-of-the-art designs owing to the fact that it is necessary to replace the technically outdated explosion protected apparatus in use. In order for explosion protected electrical apparatus to be used in Russian plants, such apparatus must have been approved by a recognised testing and certification authority of the Russian Federation confirming compliance with the requirements of Russian Standards.

This article outlines the fundamentals of Russian Standards in the sector of explosion protection of electrical apparatus and compares the Russian Standards with the corresponding IEC Standards. In addition, it explains essential national deviations from the International Standards in respect to the requirements applicable to explosion protected electrical apparatus, in particular with regard to marking and classification of the hazardous areas.

2. Harmonisation of Russian Standards with International Standards

A new series of Standards regulating construction of explosion protected electrical apparatus, classification of the hazardous areas and application of explosion protected apparatus of different protection levels in hazardous areas has been in force in Russia since January 1, 2001. One of the chief tasks when elaborating on these Standards was to harmonise them with the International Standards of Series IEC 60079. Table 1 provides an overview of the Standards currently in force in Russia together with the corresponding Standards of Series IEC 60079. Remarks further to Table 1:

- In the case of most Russian Standards, there are national deviations from International Standards. These deviations are discussed in Sections 3 and 4.
- Table 1, as from listing the new GOST R 51330 Standards, also lists the old Standard relating to installation –Rules for electrical installations in hazardous areas, abbreviated to-ПУЭ (Правила устройства электроустановок).

This document was the only applicable regulation until the Standards of Series GOST R 51330-99 were introduced and stipulated classification of the hazardous areas into Zones and selection of the explosion protected equipment that may be used in the various Zones. This previous Standard has not yet been withdrawn and applies parallel to the new requirements pursuant to...
GOST R 51330.9-99: Electrical apparatus for explosive gas atmospheres, Part 10: Classification of the hazardous areas.

Section 5 explains where the requirements differ, when apparatus must be selected in accordance with the zone classification pursuant to GOST R 51330.9-99 and when devices must be selected on the basis of the zone classification pursuant to the old Installation Regulations.

3. The most significant deviations in Russian Standards from existing International Standards

GOST R 51330.0-99: General Requirements

The term explosion protection level of electrical apparatus has been introduced – a grading of the explosion protection measures of the electrical apparatus under the conditions stipulated in the Standard. All explosion protected electrical equipment is split into three groups depending on the extent of the explosion protection level.

» Protection Level 2
Electrical equipment ensuring a normal level of protection (the number 2 for apparatus of Group II and the combination of Cyrillic letters РВ for Group I are added in the explosion protection marking). This relates to explosion protected electrical apparatus for which explosion protection is guaranteed under normal operating conditions. This explosion protection level can be guaranteed by the following types of protection: ia, ib, ic, px, q, e, m, d, o, s

» Protection Level 1
Explosion protected electrical equipment ensuring a high level of protection (The number 1 for electrical apparatus of Group II and the combination of Cyrillic letters РП for Group I are added in the explosion protection marking). The means of protection related to this equipment ensures the requisite level of protection, even in the event of frequently occurring disturbances or equipment faults which normally have to be taken into account. This explosion protection level may be guaranteed by the following types of protection: ia, ib, px, d, s

» Protection Level 0
Special explosion protected electrical equipment with a very high level of protection (the number 0 for electrical apparatus of Group II and the combination of Cyrillic letters РО for Group I are stated in the explosion protection marking). This relates to explosion protected electrical apparatus on which additional protection measures are taken using a standardised type of protection. This explosion protection level may be guaranteed in the case of the following types of protection: ia, s. Alternatively, it is possible to use two independent explosion protection measures, e.g. confinement of the parts generating sparks in the event of a fault by encapsulation with a moulding compound, or by immersion in a liquid or bulk insulation material or by mounting in a flameproof enclosure or by a combination of a flameproof enclosure with the type of protection Pressurization – p.
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<td>GOST R 51330.0-99: Electrical apparatus for explosive gas atmospheres Part 0: General requirements</td>
<td>IEC 60079-0-98</td>
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<td>3</td>
<td>GOST R 51330.3-99: Electrical apparatus for explosive gas atmospheres Part 2: Pressurized enclosures  »p« - Ex px, Ex py, Ex pz</td>
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<td>GOST R 51330.9-99: Electrical apparatus for explosive gas atmospheres Part 10: Classification of the hazardous areas</td>
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<td>9</td>
<td>GOST R 51330.10-99: Electrical apparatus for explosive gas atmospheres Part 11: Intrinsic safety »i« – Ex ia, Ex ib, Ex ic</td>
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<td>GOST R 51330.11-99: Electrical apparatus for explosive gas atmospheres Part 12: Classification of mixtures of gas and vapours with air according to their maximum experimental safe gaps (MESG) and minimum ignition currents (MIC)</td>
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<td>GOST R 51330.13-99: Electrical apparatus for explosive gas atmospheres Part 14: Electrical installations in hazardous areas (other then mines)</td>
<td>IEC 60079-14-98</td>
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<td>13</td>
<td>GOST R 51330.14-99: Electrical apparatus for explosive gas atmospheres Part 15: Type of protection »n« – Ex n</td>
<td>IEC 60079-15</td>
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Table 1: Explosion Protection Standards of the Russian Federation by comparison with the IEC Standards
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<td>GOST R 51330.15-99: Electrical apparatus for explosive gas atmospheres Part 16: Artificial ventilation for the protection of analyser(s) houses</td>
<td>IEC 60079-16-90</td>
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<td>GOST R 51330.16-99: Electrical apparatus for explosive gas atmospheres Part 17: Inspection and maintenance of electrical installations in hazardous areas (other than mines)</td>
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<td>16</td>
<td>GOST R 51330.17-99: Electrical apparatus for explosive atmospheres Part 18: Encapsulation Ex → Ex m</td>
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<td>17</td>
<td>GOST R 51330.18-99: Electrical apparatus for explosive gas atmospheres Part 19: Repair and overhaul for apparatus used in explosive atmospheres (other than mines or explosives)</td>
<td>IEC 60079-19-93</td>
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<td>18</td>
<td>GOST R 51330.19-99: Electrical apparatus for explosive gas atmospheres Part 20: Data for flammable gases and vapours, relating to the use of electrical apparatus</td>
<td>IEC 60079-20-96</td>
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<td>19</td>
<td>GOST R 51330.20-99: Electrical apparatus for explosive gas atmospheres, Insulating properties (comparative tracking indices), Clearances and creepage distances, requirements and test methods</td>
<td>IEC 60079-7-90 IEC 60019-79</td>
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<tr>
<td>20</td>
<td>GOST R IEC 61241-1-1-99: Electrical apparatus protected by enclosures and limitation of surface temperature. Construction and testing.</td>
<td>IEC 61241-1-1-99</td>
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<td>22</td>
<td>GOST R IEC 61241-1-3-99: Electrical apparatus for use in the presence of combustible dust Part 3: Classification of areas where combustible dusts are or may be present</td>
<td>IEC 61241-3-97</td>
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<tr>
<td>24</td>
<td><em>Rules for electrical installations in hazardous areas, 6th revised and supplemented edition, bibliography (Правила устройства электроустановок)</em></td>
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Editor's Note:
The term “explosion protection level” basically corresponds to the stipulation regarding the Equipment Category in European Directive 94/9/EC but with different numbering, a different assignment of the types of protection, and a different grading in the underground sector. Neither is there a direct assignment of level of protection 0, 1 and 2 to Zone 0, 1 and 2. The GOST R 51330.12-99 Installation Regulations define the types of protection to be used in the particular Zone. This corresponds to the stipulation in IEC 60079.

Materials containing light metal alloys are not to be used to produce housings or enclosures unless measures have been taken to prevent possible formation of friction or impact sparks. This can be achieved by a suitable protection coating.

GOST R 51330.5-99
Ignition Temperature
(Winter) Diesel fuel is classified to Explosion Group II B und Temperature Class T3.

GOST R 51330.6-99
Powder Filling
The housings or enclosures must be designed to prevent escape of the powder in operating position if the covers are removed. Only dry silica glass or hard glass particles with no metallic admixtures are approved as filling.

Requirements applicable to Ex i circuits

- Intrinsically safe circuits and non-intrinsically safe circuits connected electrically to them must be electrically isolated from the circuits with a higher energy level than the general mains (e.g. for motors and lighting installations).
- When earthing intrinsically safe circuits, the connection to earth is to be made only at one point.
- The capacitance, the inductance and the resistance of the line must be taken into consideration in an intrinsically safe circuit routed via an external line.
- The mains voltage must be considered allowing for the permitted mains voltage tolerance.
- Soldering points and welds inside an item of apparatus must be protected with insulating enamel.
- Fuses must be provided in mains systems with non-earthed neutral conductors: in two phases in three-phase systems, and in one phase in the case of single-phase systems on din one phase in the case of single-phase.
- Fuses must be provided in each conduc-
tors in mains systems with earthed neutral conductor. However, if measures to safely prevent an interturn fault of the transformer are taken in single-phase systems, one fuse in the non-earthed line will suffice.

GOST R 51330.11-99
Classification of the Flammable Substances into Explosion Groups
Substances which may form an explosive atmosphere and which are used frequently in industrial production in the Russian Federation, including (winter) diesel fuel, Group IIB, have been adopted in the listing (Annex A).

GOST R 51330.12-99
Pressurised Enclosures
Electrical apparatus which remains electrically live if the protective gas supply fails must be designed as explosion protected and must comply with the requirements of the area’s hazard-zone.

Before commissioning the electrical apparatus, a check of the safety-related parameters and systems must be conducted, including: inert gas parameters, minimum over pressure, purging, function of the switch-off devices and signalling devices.

GOST R 51330.13-99
Electrical Installations
The Operating Instructions for the electrical equipment must precisely specify the explosion protection measures and the measures taken to maintain this level of explosion protection during installation, operation and repair.

Rotary electrical machines with type of protection Increased Safety ➞e‹ may only be used if no heavy starting, frequent starts or changes of direction occur.

GOST R 51330.17-99
Encapsulation
The documentation of the electrical apparatus must state the maximum permissible continuous operating temperature of the encapsulation compound.

The maximum temperature occurring if a fusible link blows may exceed the permissible continuous operating temperature of the compound providing the type of protection Encapsulation-mi is not impaired.

4. Marking the explosion protected electrical apparatus
The explosion protected electrical apparatus is marked in accordance with Standard GOST R 51330.0-99 and the Standards for the individual types of protection.

The explosion protection marking contains
- the explosion protection level
- the Ex symbol
- the symbols of the types of protection that are in use
- the groups (I, II or IIA, IIB, IIC)
- the temperature class
- the letter X if special conditions in relation to safe use must be complied with or U if the product is an Ex-component

Examples of explosion protection markings:
1 Ex d II B T4, 0 Ex ia II C T6, PB Exd[b] I,
1 Ex d II B T4/H, for associated electrical apparatus: [Exib]II C

Figure 1: Assessment of hazardous areas in the Russian Federation
5. Hazardous areas

All hazardous areas in which explosive mixtures of gases, vapours and air or combustible dusts or fibres may occur in air are assessed in respect to their risk potential on the basis of two aspects:

- The likelihood of occurrence (frequency and duration) of an explosive atmosphere in the relevant area.
- Safety characteristics of the substances, gases, vapours or dusts used, in addition to the ignition sources occurring.

Figure 1 shows the safety assessment parameters of hazardous areas currently conventional in Russia.

The safety parameters of the explosion protected apparatus must be matched to the characteristics of the possible, explosive atmosphere in this installation area when assessing the options for using explosion protected apparatus in an installation.

In this connection, it is necessary to classify the hazardous area into Zones on the basis of the likelihood of the existence of hazardous, explosive atmospheres.

Two classification options currently apply parallel to one another in Russia: the new classification pursuant to GOST R 51330-999 and the old classification in accordance to the old rules for electrical installation in hazardous areas. The reason for this relates to the many years of use of the classification of the Ex zones on the basis of the previously valid Standard. Thus, this classification applies not only in many currently existing plants but also to installations currently undergoing conversion. Figure 2 shows the relationships of the conditions in the Zones on the basis of both methods and, by way of comparison, with respect to the USA’s NEC System.

6. Concluding remarks

A range of -20 °C ... +40 °C is specified as the normal ambient temperature range both in the Russian Standards and in the International Standards. On the other hand, temperatures down to -40 °C may occur in the wintertime in moderate latitudes in Russia, temperatures down to -50 °C may occur in the northern territories with temperatures as low as even -55 °C possibly occurring in these northern areas. Consequently, the test certificate for apparatus scheduled for use outdoors or use in unheated rooms must specify the ambient temperature range in which operation is possible.

The following Russian documents are required for use of electrical apparatus in hazardous areas:

- Certificate of Conformity, which confirms the compliance of the apparatus with Russian Explosion Protection Standards, and
- Approval of the Federal Technology Supervisory Authority for use of the explosion protected electrical apparatus in hazardous areas.