ASPECTS REGARDING CERTIFICATION COMPLIANCE OF THE CONVEYOR BELTS WITH THE DIRECTIVE ATEX 94/9/EC REQUIREMENTS

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ABSTRACT: Belt conveyors have been used for a long time in most of the industrial branches, as well as in places where the likelihood of explosive atmospheres occurrence exists. Unlike normal environments, where there is an environment with potentially explosive atmospheres fire/explosions hazards occur as consequence of various technological processes or accidental leaks.
Therefore, the use of conveyor belts in hazardous environments requires fulfilling certain requirements, very important for the safety level to be provided, to prevent ignition sources.
In order to mitigate explosion risk in environments with potentially explosive atmospheres, both equipment and its component (conveyor-transportation belt) must be of a special construction so as not to generate electric sparks, mechanical impact or friction sparks, static electricity, hot surfaces or any other energy sources that could ignite the atmosphere.
This paper highlights the main aspects related to assessment of explosion risk when using conveyor belts and certification of belt conformity with the applicable essential health and safety requirements performed by a third party body.

Key words: explosive mixture, explosion risk, conveyor belt, conveyer, risk assessment.

АСПЕКТИ, СВЪРЗАНИ СЪС СЕРТИФИЦИРАНЕТО НА ГУМЕНО-ЛЕНТОВИ ТРАНСПОРТЬОРИ ЗА СЪОТВЕТСТВИЕ С ИЗИСКВАНИЯТА НА ДИРЕКТИВА ATEX 94/9/ЕС

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РЕЗЮМЕ: Гумено-лентовите транспортьори се използват от дълго време в много промишлени производства, както и на места, където съществува възможност от възникването на експлозии. За разлика от обикновените места, там където има потенциални възможност за взрив, възниква опасност от пожар или експлозия като следствие от различни технохологични процеси или инцидентни течове.
Следователно, употребата на ГЛТ в опасни среди изисква изпълнението на определени изисквания, които са много важни за осигуряването на безопасност и предотвратяването на източници на възпламеняване.
За да се намали риска в потенциално експлозивни среди, както оборудването, така и ГЛТ, трябва да бъдат със специална конструкция, така че да не генерират електрически искри, искри, предизвикани от механичен удар или търкане, статично електричество, горещи повърхности или други източници на енергия, които биха могли да се възпламенят.
Този доклад очертава основните аспекти, свързани с оценка на риска от експлозия, когато се използват ГЛТ, както и необходимото сертифициране на лентите в съответствие с важни изисквания за здраве и безопасност, което се извършва от трета страна.

Ключови думи: смес от експлозиви, риск от експлозия, гумено-лентов транспортьор, оценка на риска.

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Introduction

Conveyor belts are widely used within various industrial activities, as components of transportation installations and systems for solid materials.

The field of use of conveyor belts is a wide one, as these can be employed both in underground and surface conveying installations of many applications.

At the same time, conveyor belts can be used in environments where potentially explosive atmospheres are present or likely to occur, generated either by the conveyed material or other external sources.

Generally, in industrial areas where combustible /flammable/ substances are processed during normal operation, due to technological processes or accidental leakages or releases, explosive mixtures of gas, vapors, mists or powders and air are likely to occur. To mitigate explosion risks in these industrial environments with potentially explosive atmospheres, broadly

named "Ex Zones", the equipment employed shall be made as a special construction for explosive atmosphere that shall not generate energy sources that could initiate an explosion.

Thus results that the conveyor belts used in various transportation installations have to fulfill the essential safety requirements regarding explosion dangers that aims on one side to prevent formation of an explosive atmosphere around the installation and, on the other side avoidance of sources of ignition of the explosive atmosphere, as for example the ignition sources of electrostatic nature or due to hot surfaces and incandescent particles which might occur due to friction.
The essential safety and health requirements are transposed in a series of European standards with provisions related to construction, testing and marking of conveyor belts for potentially explosive atmospheres.

Conveyor belts testing for certification is of a particular importance having in view the existing explosion risk that has to be minimized in order to ensure life safety and human health and in order to prevent goods and environment damages, as well as for a free circulation of products when they fulfill the essential safety requirements at European level.

Ignition risk assessment related to fulfilling the essential safety and health requirements in the ATEX Directive for conveyor belts and belt conveyors

Assessment of the ignition risk when using equipment, protective systems and components in environments with flammable substances that could generate fires and explosions has a special importance when aiming to ensure workers safety and health. According to the legislation in force, responsibility for risk assessment and adopting the adequate protective measures to ensure an acceptable safety level, belongs both to equipment manufacturers aiming to place on the market products with a certain level of protection, and to employers which have to select equipment adequate to the risk of explosive atmospheres occurrence in the areas where these are placed for operation.

The protection concepts have in view firstly making use of some equipment that can ensure protection by preventing intrinsic ignition sources, and second, if necessary, additional protective devices and maintenance /use/ of measures specific to the foreseeable field of use.

Concerning to this, not only conveyor belts but also belt conveyors operating in environments with potentially explosive atmosphere and all their components have to be submitted to an official risk analysis well documented, that aims to identify and list all potential ignition sources in the equipment and the measures to be applied to prevent them from becoming efficient. Examples of such sources include: hot surfaces, open flames, hot liquids /gases/, mechanically generated sparks, alumino-thermal reactions, auto-ignition of dusts, electric arcs and static electricity discharges.

For explosion prevention and protection there are protective measures that have to be applied both in order to prevent explosive atmospheres and to avoid ignition sources.

The explosion protection principle can be expressed as: the likelihood that an ignition source occurs at the same time with an explosive atmosphere should be reduced to a minimum. As case might be, measures for explosion mitigation could be required. Thus, specific requirements are set out for equipment and protective systems of specific fields of use.

In order to apply this principle, the Ex dangerous areas others than mine undergrounds and those parts of surface mines that could be endangered by grizu firedamp mixture are divided into zones according to the likelihood and duration of an explosive atmosphere (Zones 0, 1 and 2 for gas and Zones 20, 21 and 22 for combustible dusts in air) and equipment is divided into categories according to the level of protection assured by avoidance of ignition sources during normal operation, during foreseeable malfunctions or during rare malfunctions.

Equipment in the ATEX field is divided into groups and categories as follows in Table 1.

Table 1.

Explosion group	Equipment category acc. ATEX Directive	Acc. new regulations (standard series: ISO 80079, EN 60079)
Group I (mining)	M1	
	M2	
Group II (A, B, C) Gas, vapors, mists - surface	1G	
	2G	
	3G	
Group II dusts	1D	Group III (A, B, C) dusts and fibers
	2D	
	3D	

The new standards have introduced the term level of protection of the equipment (Equipment Protection Level: Ga, Gb, Gc - for equipment intended to be used in potentially explosive atmospheres generated by gas, and Da, Db, Dc - for equipment intended to be used in potentially explosive atmospheres generated by combustible dusts in air) as equivalent to ATEx categories (1G, 2G, 3G).

Starting from the explosion protection principles above stated in the Table 2 are resumed the requirements for equipment according to its intended use.

Table 2.

ZONE	Presence of explosive atmosphere	Ignition sources avoidance	Level of protection required	Group II category	EPL
2	Accidentally or only on a short period of time	During normal operation	NORMAL	3G	Gc
1	Likely to occur during normal operation	During foreseeable malfunctions (one fault)	HIGH	2G	Gb

0	Continuously, on long periods of time or frequently	During rare malfunctions (two independent faults)	VERY HIGH	1G	Ga
USERS		**MANUFACTURERS**			
European Directive 1999/92/EC (GD no. 1058/2006)		European Directive 94/9/EC (Government Decisions GD: no. 752/2004, no. 461/2006).			

Until recently both equipment for explosive atmospheres generated by gas and these generated by combustible dusts were included in Group II. The new specific standards have separated the equipment for environments with combustible dusts in Group III.

The conveyor belts, according to European Directive 94/9/EC represent components "U". As any other component it has to be comprised in an equipment or protective system by its manufacturer / user, taking into account the manufacturer instructions.

Aiming to place it on the market, the conveyor belt has to fulfill the applicable essential safety and health requirements, supplemented with the technical and constructional requirements. In order to fulfill the applicable essential safety and healh requirements the conveyor belt shall be designed and manufactured following a risk analysis regarding the posibility of igniting explosive mixtures by its intrinsic ignition sources.

The following hazards have to be taken into consideration when analyzing the risks generated by the conveyor belt itself regarding its intrinsice ignition sources.

- electrostatic energy build up / discharges that may ignite the flammable atmosphere or may induce electric shocks to personnel;
- local heating by friction, due either to a driven rotary motion and a blocked belt, or a blocked drive and a moving belt, which might ignite the belt or the flammable atmosphere or the combustible dust;
- ignition of a conveyor belt by a small heat source as an open flame, blocked rollers or friction between belt and supports or support adjacent structure;
- flame propagation along a belt in fire. This ignition may be caused by a local small source as roller overheating or by a much more intense fire fed by other equipment or materials in the mine working. The fire amplitude increases together with the surrounding rocks temperature and pressure, with the length of the evacuation way and in case when there is a high amount of plastic materials in the mine working.

Once these dangers had been identified, each of them may be assessed in a satisfying manner based on laboratory tests performed according to standardized methods provided in series standards (SR EN 1554:2012, SR EN ISO 284:2013, SR EN 12881-1:2014, SR EN ISO 340:2013).

In order to ensure an acceptable protection level against these dangers, as soon as when designing and manufacturing the conveyor belt, choosing and selecting component materials is taken into consideration, to be able to grant different protective performances to the conveyor belts.

Thus, according to its intended use and protection performances provided the specific standards (SR EN 12882:2009, SR EN 14973:2008) address several classes / categories of conveyor belts.

Certification of conveyor belts as an ATEX component assumes attesting the protective performances to burning, burning propagation and static electricity.

When the conveyor belt is integrated into a belt conveyor that have to assure a certain protection level according to its intended use, if required, may need certain additional protective measures.

Additional protective devices refer to detecting dangerous situations and alarming or automatic stopping the conveyor. If needed, as provided in SR EN 620:2011, conveyors may be provided with the following types of automatic malfunction detection devices, to lower the hazards:

- belt decentration detection devices;
- conveyor chutes, hoppers overload / blockage detection devices;
- shafts rotation detectors;
- belt velocity surveillance devices;
- thermal detectors;
- height and / or width detectors.

Belt conveyor conformity assessment with the essential health and safety requirements provided in the European Directive ATEX implies an explosion risk assessment that has to take into account potential ignition sources that may occur during normal operation and also during foreseeable malfunction and rare malfunction.

In practice two cases may be encountered, as follows:

- the conveyor as a whole or as an assembly of several components is placed on the market by a manufacturer, situation when the manufacturer has to perform the risk analysis which will be part of the technical file; he also has to assess product conformity with the ATEX requirements by applying applicable procedures according to product category.
- the conveyor is assembled or upgraded by user by assembling conveyor's already certified components. In this case the responsibility for ignition risk assessment incumbent is on the user, who shall assume the manufacturer's obligations and responsibilities and it will be comprised either in the self-assessment technical file when the user is considered as manufacturer, or in the safety and health Document (see the Explosion Protection Document - directive 1999/92/CE), as applicable.

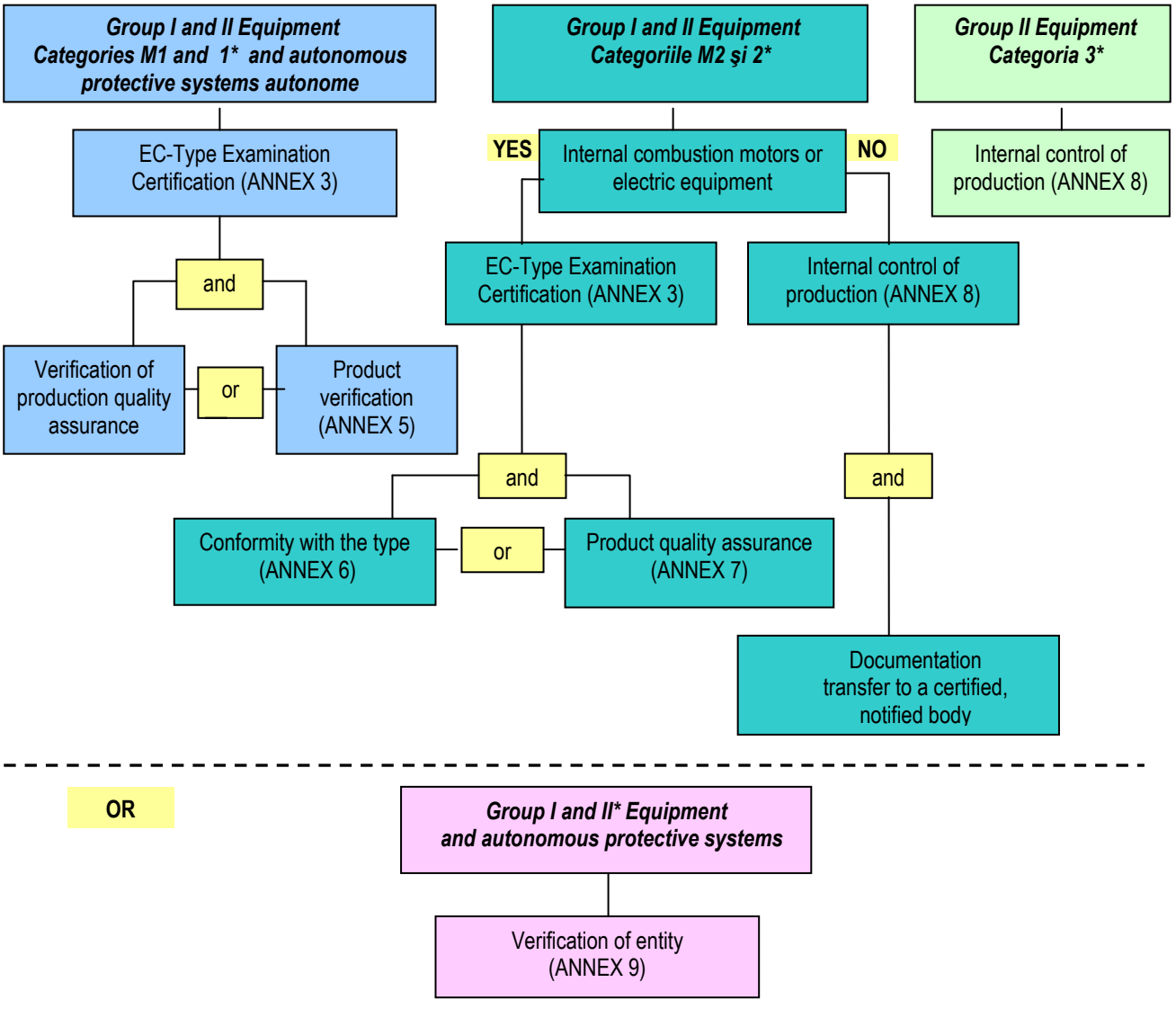
Conveyor belt conformity certification with the ATEX directive requirements

The 94/9/CE directive, transposed in Government Decision - GD no.752/2004 and GD no.461/2006 *concerning the conditions for placing on the market of equipment and protective systems intended for use in potentially explosive atmospheres* regulates equipment manufacturers obligations regarding conformity assessment according to category, see figure 1.

The previously mentioned modules describe the procedure by which the manufacturer ensures and declares his equipment or protective system is in conformity with the requirements of the 94/9/CE directive, transposed in GD 752/2004 and GD 461/2006. These procedures are founded on conformity assessment of equipment or protective system with the 94/9/CE directive; the difference between the procedures is that in case the procedure of *internal control of production* assessment is performed by the manufacturer as first-party assessment (self-certification), and in case the procedure of *EC product unit verification* assessment is performed by a notified body as a third-party assessment/certification.

The declaration of conformity and the supportive technical documentation that have to be drawn up by the manufacturer are essential for conformity attestation with the specific requirements in the regulated field.

The content of declaration of conformity and technical documentation is given in the directive. Moreover, in order to clarify the issues, especially in case of product self-certification, the following standards had been drawn up: *SR EN ISO/CEI 17050-1 Conformity assessment. Declaration of conformity issued by the provider. Part 1: General requirements* and *SR EN ISO/CEI 17050-2 Conformity assessment. Declaration of conformity issued by the provider. Part 2: Supportive documentation.*



(*) and their components if these had been individually certified

Fig. 1. The logic diagram of conformity assessment for equipment, components and protective systems

Conclusions

The conveyor belt as a component to be incorporated into an equipment (conveyor) with its intended use in environments with potentially explosive atmospheres shall fulfill the essential safety and health requirements regarding explosion prevention and protection.

In order to assess conveyor belt conformity with the applicable safety requirements, laboratory tests are required, as provided in the applicable standards.

Assessment for conformity certification of conveyor belts with the ATEX directive requirements is particularly important

having in view the existing explosion hazard that has to be minimized in order to ensure safety of human life and health and to prevent goods and environment damage, as well as for a free circulation of products when they fulfill the essential safety requirements on European level.

To ensure a high safety level against explosions, additional to ignition hazards showed by conveyor belts, belt conveyors used in these environments and their components have to be submitted with a well documented official risk analysis, that should identify and list all potential ignition sources in the equipment and the measures to be applied in order to prevent potential ignition sources from becoming efficient.

References

* * *, SR EN 12882:2009, *Benzi de transport de uz general. Cerinţe de securitate electrică şi de protecţie împotriva inflamabilităţii.*

* * *, SR EN 14973 + A1:2008, *Benzi transportoare pentru utilizare în instalaţii subterane. Cerinţe de securitate electrică şi de inflamabilitate.*

* * *, SR EN 12881-1:2014, *Benzi transportoare. Încercări de simulare a inflamabilităţii. Partea 1: Încercări cu arzător cu propan.*

* * *, SR EN 1554:2012, *Benzi transportoare. Încercări la frecare ale tamburului.*

* * *, SR EN ISO 340:2013, *Benzi transportoare. Caracteristici de inflamabilitate la scară de laborator. Cerinţe şi metodă de încercare.*

* * *, SR EN ISO 284:2013, *Benzi transportoare uşoare. Conductibilitate electrică. Specificaţie şi metodă de încercare*

Lupu L., Proiect program NUCLEU *„Dezvoltarea metodelor de evaluare pentru instalatiile de transport cu banda destinate utilizării în minele subterane grizutoase – echipament neelectric de grupa I – METBEN”*, 2010-2011.

Păun F. A., Proiect Program NUCLEU *„Dezvoltarea facilităţilor de cercetare privind riscul sau frecvenţa probabilă de producere a unor fenomene periculoase în funcţie de circumstanţele specifice ale aplicaţiilor din atmosfere cu pericol de explozie a benzilor transportoare (DFCBT)”*, 2010-2011.

Păun F. A., *Proiect Program NUCLEU, faza V/2012 „Tehnologie pentru încercarea benzilor transportoare la ardere la scară mică în conformitate cu standardul european”*, 2012.

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