ATEX-Compliant In-Line Inspection Services

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Introduction

The origins of explosion protection in Europe go back to the advent of industrialization, notably mining, in the 19th century. The emerging chemical and manufacturing industries too necessitated more or less systematic explosion prevention and the development of various ignition protection types for devices. These origins are still reflected in the distinction between Type I devices for mining and Type II for all other explosive areas in the ATEX 95 device directive. However, the most important requirements on explosion protection are derived from the occupational safety directive ATEX 137 and its transpositions into national law, for example the Ordinance on Industrial Safety and Health in Germany. Explosion protection is subdivided into three fundamental measures:

- Primary explosion protection:
  avoiding explosive atmospheres
- Secondary explosion protection:
  avoiding effective ignition sources
- Tertiary explosion protection:
  mitigating the effects of an explosion

According to ATEX 95, explosion-proof devices, including inspection tools and their equipment, come under secondary explosion protection. They are used in conditions where primary explosion prevention is not feasible. Devices are selected on the basis of the defined Ex zone and the gas composition of the explosive atmosphere.

Launcher- / Receiver Facilities and Ex Zones

Areas with a potentially explosive atmosphere, so-called Ex zones, must generally be identified by the facility operator. Classification into the Zones 0, 1 and 2 is essentially determined by the duration of the presence of a potentially explosive atmosphere, whereas its dimensions depend on the local conditions. Defining the zones can be a very complex task. It is not very helpful to simply assign the highest Zone 0 to as large an area as possible assuming that this will guarantee maximum safety. In the Ex zones, the probability that a potential ignition source becomes active must be reduced. In Zone 2, the devices must not contain any ignition sources used for normal operational purposes, whereas in Zone 1 this even applies if a malfunction is assumed. The devices for Zone 0 must not constitute an ignition source even in case of rarely occurring malfunctions, the regulatory requirements being correspondingly strict here. It is difficult to obtain devices and protective equipment for Zone 0 and to take and document the appropriate explosion prevention measures. As a general rule, Zone 0 only exists within pipes and containers, e.g. tanks. The motto “more is better” does not apply when it comes to Zone classification.

Zone classification	Ignition sources must be avoided under all circumstances in the following situations:
0	• trouble-free operation (normal operation) • foreseeable malfunctions and • rarely occurring malfunctions
1	• trouble-free operation (normal operation) and • foreseeable malfunctions
2	• trouble-free operation (normal operation)

Table 1: Extent of protective measures in dependence of zone classification [1]

At least in Germany and Great Britain, the operators of tool launchers and receivers must follow strict rules in classifying zones. In Germany, the technical rule for pipelines (Technische Regel für Rohrfernleitungen, TRFL) defines Zone 1 as the "area [in the vicinity] of pipeline opening fixtures such as tool launchers and receivers" [2]. In justified cases, deviations from this technical rule in assigning zones to areas are tolerated. The selection of devices and protection systems too is precisely laid down in the regulations, although operators may "on the basis of the results of their risk assessment" take other precautions. This means that operators may, in individual cases, be exempt from the specifications and use devices which do not comply with the ATEX 95 directive, for example if the type of inspection requires a special tool which does not feature Ex protection. This flexibility is permitted by ATEX 137 [3], "if suitable organizational measures ensure safe operation for the whole period in which the mobile equipment is used in a hazardous place" [1]. Such safe operation cannot be achieved without trained personnel specializing in this area. All implemented measures should be documented in the work authorization or in the explosion protection document (see below). So-called zone shifting, i.e. temporarily overcoming an explosive atmosphere through suitable measures such as inertization or ventilation, is one possibility for working with potential ignition sources in these areas.

In Great Britain, the Area Classification Code for Installations Handling Flammable Fluids (IP 15) [4] not only defines Zone 1 but even describes the sizes of the different zones. These specifications make zone classification easier for operators.

In-Line Inspections – The Fruit of Close Cooperation between the Operator and the Service Provider

In order to ensure optimal explosion protection during the inspection of pipelines, coordination of activities and exchange of information between all parties involved is indispensable, over and above the fact that this is an explicit ATEX 137 requirement. Careful coordination between the operator, the service provider and other independent task forces is essential in preventing potentially dangerous situations. Information on specific forms of conduct, the use of work tools, and on wearing personal protective equipment can be essential.

Generating an explosion protection document in accordance with ATEX 137 is an important instrument assisting operators in doing their tasks and duties to ensure the safety of explosive areas within their assets. The document should contain the following information [1]:

- Description of the workplace and work areas
- Description of the various procedural steps and / or activities
- Description of the substances used (gas class, temperature class)
- Results of the risk assessment
- Technical and organizational explosion protection measures and their implementation

This information allows the service provider to select trained personnel with the relevant skills and to have the required work tools and protection equipment ready. If the necessary work tools are not available, it is possible to determine, on the basis of a jointly conducted risk assessment, whether additional safety measures need to be taken, e.g. inertization.

Implementation of an ATEX-Compliant Concept for In-Line Inspections

The inspection of pipelines necessitates customized technical solutions to ensure that the specific requirements of the task in hand are optimally met. In particular, the tool must be individually equipped with the required measurement technology and adjusted to the environmental conditions i.e. the medium, pressure, temperature, run duration, and wall thickness etc. It is not uncommon for a tool to be used in a specific configuration only once before being altered again. The device directive requires manufacturers to be extremely careful in the development and production process and to document all aspects of it. The ATEX quality standard EN 13980 which is based on ISO 9001 lays down additional requirements in a number of chapters dealing with standards with the aim of ensuring that the products match the certified types.

How can the operationally necessary flexibility be reconciled with the regulatory requirements of ATEX 95? ROSEN's response is an ATEX safety concept comprising the entire tool fleet from 6" to 56" which makes possible a high degree of flexibility through individual configurations. At the heart of this concept is the separation of a tool into two parts: constantly active and temporarily inactive electronic components (figure 1). When the tool is in the Ex zone during launching and / or receiving, the entire electronic inspection measurement technology is turned off. The power supply from batteries and the tool status transmitter continue to be electronically active devices and are therefore Ex-protected by a type of ignition protection which complies with a harmonized ATEX standard. This concept can be applied both in small multi-body and large single-body tools.

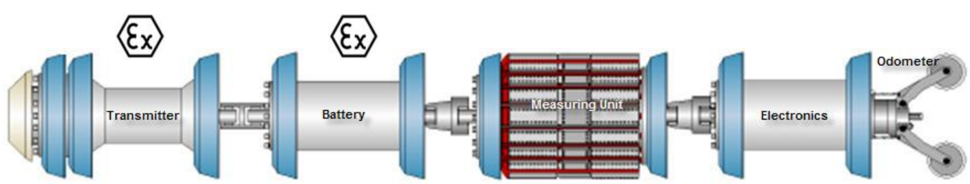

Figure 1: Ex-protected segments of a multipart inspection tool

Since the measurement technology does not need to be changed, there are virtually no functional constraints, meaning that the usual standards of inspection quality can be maintained. However, preparation of the tool has been extended to include ATEX-specific procedural steps in order to be able to guarantee ignition protection. In the Ex zone, the status of the tool is permanently monitored by means of an intrinsically safe electronic status monitor. Of course, not only the tool itself must meet all explosion protection standards, but all required supporting equipment too must be tested for its suitability for use in Ex zones and subjected to a risk assessment.

When launching and receiving tools, there is a peculiarity which is not covered by either of the ATEX directives: both directives only refer to the atmospheric conditions with a pressure of between 0.8 and 1.1 bar and an ambient temperature range between -20 °C and 60 °C [5].

However, it is precisely when the tool is launched, i.e. just after the launcher has been closed and the flammable medium has been let in, that an explosive mixture is likely created, if the launcher was not rinsed beforehand with nitrogen or another inert gas. In such a situation, the pressure quickly rises above the atmospheric pressure, so that the conditions are outside of the application range specified in the ATEX directives. Needless to say that the responsibility of the operator of the facilities and the manufacturer of the inspection tools does not end simply because a pressure range is exceeded. Rather, a comprehensive safety concept must include and assess all (known) risks. The phase of pressure increase during launching is explicitly part of a safety concept and must be taken into account in ensuring Ex protection for the tools. Interpreting the safety concept accordingly, ROSEN has obtained confirmation of the concept's operational functionality by an external notified body. The measurement technology of the tool is switched on only once the atmospheric oxygen concentration in the launcher has dropped to a degree where the gas / air mixture is no longer flammable. The switch-on pressure for gas of Gas Group IIB must be interpreted on the basis of the most unfavorable ratio between the medium and oxygen which is still capable of being ignited. Gas Group IIB comprises the gases by far most commonly found in pipelines.

Devices for Zone 1 must not constitute an ignition source even in case of (foreseeable) malfunctions. This aspect too is taken into account by the ROSEN safety concept for higher pressure levels: it provides, for example, for the possibility of an explosive gas mixture entering the tool enclosure through holes or gaps. The specially developed status monitor provides reliable information on maintaining ignition protection and on safe turning on and off of the tool during the launching and receiving process.

The question what measures need to be taken if the status monitor indicates that ignition protection is no longer guaranteed can only be answered jointly by the asset and tool operators. These explanations make it abundantly clear that explosion protection requires effective communication between all parties involved in tool operation in explosive areas and that ensuring the safety and security of personnel and assets is a task that goes far beyond zone classification and device category.

Conclusion

As adumbrated above, the ROSEN safety concept also complies with the requirement of the POF specifications [6] which lay down that the non-atmospheric conditions must be taken into account when launching and receiving tools. Since explosion protection transcends mere compliance with the ATEX directives, operators must take a holistic view of asset integrity. Explosion prevention requires adequate personnel training, judicious selection of devices and work tools, consistent implementation of specific procedural steps in launching and receiving tools and, last but not least, transparent communication between all parties involved.

References

[1] **European Commission.** Non-binding Guide to Good Practice for Implementig Directive 1999/92/EC "ATEX". April 2003.

[2] **Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit.** Bekanntmachung der Technischen Regel für Rohrfernleitungen nach § 9 Absatz 5 der Rohrfernleitungsverordnung. 08. März 2010. S. 9.

[3] Directive 1999/92/EC of the European Parliament And of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres.

[4] **Energy Institute.** Area Classification Code for Installations Handling Flammable Fluids. 3rd Edition Juli 2005. S. 69.

[5] **European Commission.** Guidelines on the Application of Directive 94/9/EC. 3rd Edition June 2009.

[6] **Pipeline Operators Forum.** Specifications And Requirements for Intelligent Pig Inspection of Pipelines. 2009. pp. 11-12.