Assessing Non-Electrical Equipment for Explosion Safety and ATEX Certification
Synopsis

Non-electrical equipment can cause explosion by friction, impact, static, hot surfaces and many other methods – therefore all equipment designed to be used in Explosive Atmospheres should be risk assessed to ensure that such an explosion can not happen. In Europe it is the law that this must be done (under the ATEX Directive) and the methodology for doing the assessment and protecting ignition capable parts has been well defined in the form of ‘Standards’.

Many manufacturers buy ‘certified’ ATEX electrical equipment and assemble rigs, skids or systems that also include non-electrical potential ignition sources (these can even be the materials of construction such as plastic or metals with high magnesium content). All of these factors must be assessed when CE Marking the package under the ATEX Directive.

This paper provides an overview of the methodology and requirements for non-electrical safety and approval.

Overview of the ATEX DIRECTIVE 94/9/EC for non-electrical equipment

If you design, manufacture or sell any equipment or protective system intended for use in potentially explosive atmospheres you will need to comply with the ATEX Directive 94/9/EC and the CE Marking Directive.

Directive 94/9/EC has been adopted by the European Union (EU) to facilitate free trade in the EU by aligning the technical and legal requirements in the Member States for products intended for use in potentially explosive atmospheres. However the Directive also specifically identifies excluded equipment which may include some types of Fluid Machinery.

Manufacturers will need to examine the areas of applicability and exclusions before determining whether or not the product is subject to the Directive 94/9/EC. It will then be necessary to categorise the product by level of risk.

It should be noted that Directive 94/9/EC provides - for the first time - Essential Health and Safety Requirements for non-electrical equipment intended for use in potentially explosive atmospheres. It also outlines requirements for:

- equipment intended for use in environments which are potentially explosive due to dust hazards
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- protective systems and for devices intended for use outside explosive atmospheres which are required for /or contribute to the safe functioning of equipment or protective systems with respect to risks of explosion

This is an increase in scope compared to existing national regulations.

**Essential health and safety requirements**

Equipment, protective systems and safety devices must satisfy the relevant essential health and safety requirements set out in Annex C of Directive 94/9/EC. The requirements take into account the intended use of the products and changes in technological knowledge as far as possible, with immediate utilisation.

They include general measures requiring manufacturers to take steps to prevent the formation of explosive atmospheres by the equipment, protective system or safety device to prevent the ignition of an explosive atmosphere by electrical and non-electrical sources and to ensure that, should an explosion occur, it can be halted immediately or limited in range.

Other aspects covered include:
- the materials used
- design and construction
- mechanical hazards and vibrations
- safe opening
- electrostatic hazards
- hazards arising from external effects
- the integration of safety requirements

In general it is the manufacturer’s responsibility to take those measures necessary to verify conformity to the EC Directive 94/9/EC. This implies a risk assessment for the equipment and in some cases instigation of procedure relating to product quality assurance.

For clarification the original text of the Directive 94/9/EC, Article 8.1.(b).(ii) for Category 2 Zone 1 Equipment is added at this point…

“(ii) in the case of other equipment in these groups and categories, the manufacturer or his authorized representative established in the Community must, in order to affix the CE mark, follow the procedure relating to internal control of production (referred to in Annex VIII) and communicate the dossier provided for in Annex VIII, paragraph 3, to a notified body, which shall acknowledge receipt of it as soon as possible and shall retain it.”

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For clarification the original text of the Directive 94/9/EC, Annex VIII MODULE: Internal Control of Production (3.) for Category 2 Zone 1 Equipment is added at this point…

“technical documentation shall enable the conformity of the equipment with the relevant requirements of the Directive to be assessed. It shall, to the extent necessary for such assessment, cover the design, manufacture and operation of the product. It shall contain:”

1. a general description of the equipment
2. conceptual design and manufacturing drawings and schemes of components, sub-assemblies, circuits, etc.
3. descriptions and explanations necessary for the understanding of said drawings and schemes and the operation of the equipment
4. a list of the standards applied in full or in part, and descriptions of the solutions adopted to meet the safety aspects of the Directive where the standards have not been applied
5. results of design calculations made, examinations carried out, etc.
6. test reports

Non-Electrical Technical Construction File Content

Over the past five years Intertek has compiled a number of ATEX Non-Electrical Technical Files for a variety of components and systems. Working in partnership with manufacturers and suppliers we have decided to develop an ATEX Non-Electrical Compliance format which would enable all parties to work with an agreed format (Reference: Table 2 Intertek Non-Electrical Technical Construction File Content)

The technical file is divided into three main groups, each group representing the different stages of the assessment and certification process. Each group is then further subdivided into the documentation heading which relates to the process.
Information required to initiate assessment:

Certification Strategy:

This document sets out to confirm the global specification & environment for where the equipment will be used and in what environments (E.g Zone, Gas Group, T Class, and Ambient Temperature).

Table 1 - Example certification Strategy Document, “Establish operating & environmental parameters”.

<table>
<thead>
<tr>
<th>Information required</th>
<th>Example</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Zone Requirement</td>
<td>II A,B,C Temperature and zone</td>
<td></td>
</tr>
<tr>
<td>Internal Zone* (POE)</td>
<td>Material, %- Classification</td>
<td></td>
</tr>
<tr>
<td>Environmental Contamination</td>
<td>Ingress, chemical attack, corrosion</td>
<td></td>
</tr>
<tr>
<td>Ambient Range of Environment</td>
<td>Low and high temperatures expected, icing etc.</td>
<td></td>
</tr>
<tr>
<td>Vibration</td>
<td>Undue vibration</td>
<td></td>
</tr>
<tr>
<td>Operating Conditions</td>
<td>Type of facility</td>
<td></td>
</tr>
<tr>
<td>Level of maintenance available</td>
<td>Skill level and frequency</td>
<td></td>
</tr>
<tr>
<td>Level of supervision available</td>
<td>Skill level and frequency</td>
<td></td>
</tr>
<tr>
<td>Monitoring</td>
<td>Continuous, automatic or intermittent</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Other relevant information</td>
<td></td>
</tr>
</tbody>
</table>

Equipment Schedule:

Depending on the apparatus being certified the equipment schedule can vary from a few components to a few thousand. It is critical when compiling this schedule that all items are correctly identified and categorized. The equipment schedule we use is divided into five discrete sections, these being: Electrical, Mechanical, Hydraulic, Pneumatic, Lubricants & Fluids.

Instructions & Certification Drawings:

The initial package for review should contain the instructions and diagrams necessary for ‘putting into service’, maintenance, inspection, checking of correct operation and, where appropriate, repair of the equipment.

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Once the risk assessment has been performed additional documentation will need to be added which gives a full and correct specification of the explosion safety aspects of the equipment.

**Results of Verification & Tests:**

Verifications and tests are intended to verify that the equipment conforms to the relevant requirements of the applied European Standard for the type of ignition protection concerned. In the initial stages of the assessment we are generally only concerned with the maximum surface temperature of the equipment in relation to the parameters agreed in the Certification Strategy Document (T Class, Ambient Temperature). Tests may be omitted if it is judged to be unnecessary, in which case the justification for its omission shall be recorded in the technical file.

**Ignition Hazard Assessment:**

The EU Council Directive on the Approximation of the Laws of the member states relating to Machinery (89/392/EEC) demands in its Annex I Section 1.5.7 that “Machinery shall be so designed and constructed to avoid any risk of explosions”.

The ATEX Non-Electrical Standard (EN13463-1) also states that “All equipment and all parts of it shall be subjected to a formal documented hazard analysis that identifies and lists all of the potential sources of ignition by the equipment and the measures to be applied to prevent them becoming effective.”

To demonstrate compliance with the above we use EN1127-1 as the reference Standard. This Standard describes the basic concepts and methodology of explosion prevention and protection.

In order that we may conduct the required risk assessment as detailed in EN1127-1 we must first establish where the equipment will be used and what safety factors need to be applied. When this has been established, a detailed and formal hazard identification can be conducted (an example of the more common ignition hazards are listed in Table 2) and suitable protective measures applied as appropriate. It should be noted that where safety devices or protective systems are used to prevent hazards occurring, appropriate safety integrity level (SIL) methodologies should be employed.

Apparatus is divided into Equipment groups: I for mining and II for surface industries and into categories M1 and M2 for mining and category 1, 2 and 3 for all other industries. The categories provide respectively, very high, high and normal
levels against ignition. The categories should be viewed as delivering the level of priority which is obtained by applying the existing protection techniques (Ex ‘c’, Ex ‘k’ etc.) together with such new concepts and engineering judgement that will be made by the manufacturers in the design and construction of the apparatus and by the ‘Notified’ (certification) bodies.

The categories in practice are equated to the suitability for Zones. Apparatus will be marked with the grouping and category in addition to the marking required by the individual protection.

Category 1 Equipment (Zone 0)

Must not have ignition sources that can become effective even in the event of a rare malfunction. Equipment in this category is intended for use in areas in which explosive atmospheres caused by mixtures of air and gases, vapours or mists or by air/dust mixtures are present continuously for long periods or frequent use.

Category 2 Equipment (Zone 1)

May have effective ignition sources (with a malfunction applied) protected by a concept listed in EN13463-1. Equipment in this category is intended for use in areas in which explosive atmospheres caused by gases, vapours, mists or air/dust mixtures are likely to occur.

Category 3 Equipment (Zone 2)

Must also be protected by a concept when ignition capable (relative to the gas or dust) in normal operation. Equipment in this category is intended for use in areas in which explosive atmospheres caused by gases, vapours, mists or air/dust mixtures are not likely to occur.
New Developments & Further Reference;

EN 15198:2007 Methodology for the risk assessment of non-electrical equipment and components for intended use in potentially explosive atmospheres:

EN 15198 specifically describes a series of logical steps that enable designers and safety engineers to examine in a systematic way, the function of equipment or components arising from its use in a potentially explosive atmosphere, and to decide whether protective measures and/or type of protection are needed. The objective is to achieve an adequate level of safety.

EN13463-6 Non-Electrical equipment for use in potentially explosive atmospheres, Protection by control of ignition source ‘b’:

To prevent potential ignition sources becoming effective it is possible to incorporate sensors into the equipment to detect impending dangerous conditions and initiate control measures at an early stage of deterioration before the potential sources are converted into effective sources. The control measures applied, may be initiated automatically, via direct connections between the sensor and the ignition prevention system, or manually, by providing a warning to the equipment operator, (with the intention of the operator applying the ignition prevention measure e.g. by stopping the equipment). Therefore to comply with the requirements of this standard the equipment supplier is required to perform both the ignition hazard assessment (EN1127 & EN15198), and additionally, an evaluation to determine the ignition prevention level (IPL) necessary to ensure that the sensors / ignition prevention system function when they are called upon to contain the ignition risk within tolerable limits.

EN 15233:2007 Methodology for functional safety assessment of protective systems for potentially explosive atmospheres:

The EN15233 assessment is a series of logical steps that enable designers and safety engineers to examine in a systematic way, the function of a protective system or part of it. The objective shall be to achieve an adequate level of functionality and reliability according to the state of the art and technical and economic requirements at the time of consideration. Decisions in functional safety assessments must be supported by qualitative methods complemented, where appropriate, by quantitative methods.

PD CLC/TR 50404:2003 Electrostatics – Code of practise for the avoidance of hazards due to static electricity:
This particular code of practice gives information about the product and process properties necessary to avoid electrostatic hazards as well as operational requirements to be written in the user’s manual to ensure safe use of the product or process. This document is mainly written for designers of process, manufacturers and test houses. Appropriate information about the procedures necessary to avoid electrostatic hazards shall be written in the user’s manual or on the product to ensure safety.

How Intertek can help

Intertek offer a complete range of services to assist manufacturers with non-electrical approval, approval of skids, rigs and plant.

- ATEX Notified Body for Non-Electrical Approval (Zone 0)
- ATEX Notified Body for Technical File Holding (Zone 1)
- Design Reviews
- ATEX Non Electrical Risk Assessment
- Technical File reviews
- Technical File construction
- Systems drawings construction
- Complete package Approval

For more information on specific testing and certification, please contact Intertek at 1-800-WORLDLAB, email icenter@intertek.com, or visit our website at www.intertek-etlsemko.com.
### Table 2

<table>
<thead>
<tr>
<th>BS EN 1127-1 Ignition Hazard Assessment</th>
<th>Occurrence Without Protection</th>
<th>Measure applied to prevent the Ignition Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential Ignition Source</td>
<td>Comments</td>
<td>Normal Operation</td>
</tr>
<tr>
<td>5.3.2 Hot Surfaces</td>
<td></td>
<td></td>
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<td>5.3.3 Flames &amp; Hot Gases</td>
<td></td>
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<td>5.3.4 Mechanical Generated Sparks</td>
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<td>5.3.5 Electrical Apparatus</td>
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<tr>
<td>5.3.6 Stray Electric Currents &amp; Cathodic Corrosion</td>
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<td>5.3.7 Static Electricity</td>
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<tr>
<td>5.3.8 Lightning</td>
<td></td>
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<tr>
<td>5.3.9 Radio Frequency 10(4)Hz to 3 x 10(12)Hz</td>
<td></td>
<td></td>
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<tr>
<td>5.3.10 Electromagnetic 3 x10(11)Hz to 3 x 10(15)Hz</td>
<td></td>
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<tr>
<td>5.3.11 Ionizing radiation</td>
<td></td>
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<tr>
<td>5.3.12 Ultrasonics</td>
<td></td>
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<tr>
<td>5.3.13 Adiabatic Compression &amp; Shock Waves</td>
<td></td>
<td></td>
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<tr>
<td>5.3.14 Exothermic Reactions, Self Igniting Dusts</td>
<td></td>
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