An Introduction to ATEX -
Meeting the Challenges of European Directive 94/9/EC (ATEX 95)

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1: Introduction

Directive ATEX 94/9/EC
(ATEX 95)
Originally identified in mining applications, Hazardous Environments are those containing explosive mixtures of gases or dusts. In response to Essential Health & Safety concerns, standards for electrical equipment intended for use in these environments were developed. Several Directives were introduced starting in 1975. Although useful tools for manufacturers, these rules were not mandatory until the introduction of the “New Approach” Directive 94/9/EC.
1.1 Objectives of Explosion Protection

General objective:
- To keep technical processes and equipment as safe as possible when handling flammable substances in mixtures with oxidants and with self decomposable substances in order to reduce the remaining explosion risk to an acceptable minimum.

Measures of explosion protection:
- a) Primary explosion protection: Avoid or reduce the creation and the propagation of potentially explosive mixtures

- b) Secondary explosion protection: Avoid or reduce the effectiveness of ignition sources

- c) Tertiary or design explosion protection: Limit an explosion technically (e.g. explosion-/or flameproof enclosures) to protect persons and property from its consequences
Comments:

- The first objective should always be the primary explosion protection (a.)

- If this is not practicable, (a.) and (b.) should be combined.

- Thereby the scope of the primary explosion protection determines the remaining potentially explosive hazardous zones from where the necessary secondary explosive protection measures for devices and equipment shall be determined to avoid potential ignition sources.
European Directive for Explosion protection acc. To art.100a, 95

- Standard framework conditions have been set for explosion protection in all European Member States for handling of potentially explosive atmosphere by creating the:
  - Directive 94/9/EC of the Council on 23rd. of March 1994 and the

Remark: The Directive 99/92/EC handles minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres and is not part of this presentation.
1.2 European Directive for Explosion Protection

European Directive for Explosion Protection according to article 100a, 95 (cont.)

- The Directive 94/9/EC is a “product design and construction directive” which establishes explosion, technical and process specific minimum requirements to match the objective of freedom of movement for equipment, components and protective devices (briefly called products) for operation in potentially explosive atmospheres.

- Both directives (94/9/EC & 99/92/EC) applied simultaneously lead to explosion protection in potentially explosive areas with explosive atmospheres.

- The Directive 94/9/EC, also called “ATEX-product directive” or “ATEX 95”*) (ATEX = “Atmosphères Explosibles”), based on the article 100a of the EC treaty, regulates the “product safety” within explosion protection.
Potentially Explosive Atmosphere
‘The Hazardous Area – Zone’

- ATEX 137 1999/92/EC
  - Employees, Workplace Owners, & Land Lords
  - DIRECTIVE
    - Define areas (Zones)
    - Risk Assessments
    - Control
    - Mitigation
    - Safety Arrangements
    - Training

- ATEX 100a 1994/9/EC
  - Manufacturers
  - DIRECTIVE
    - Compliant Equipment for defined zone.
    - i.e.
      - Pumps
      - Sensors
      - Cabinets
      - Enclosures

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2.1 Objectives of the Directive

- Removing the trade barriers within the European Community

- Creating freedom of movement for the explosion proof equipment and components and protective systems (called products)
2.1 Objectives of the Directive (cont.)

Aspects:

1) Establish the minimum requirements for health and safety which should be applied in all Member States, in order to ensure free movement of the product.

2) Product/equipment manufacturing and placing on the market in compliance with the essential requirements

* the article numbers of the EC treaties have changed due to amendment and the Directive 94/9/EC is now called ATEX 95 (old: ATEX 100a)

3) Free movement and putting into service of products/equipment within the boundaries of the member states (1st. of March 1996)

* the equipment is divided in groups and categories (see Article 1 (3) and Article 8 (1) of the Directive).
2.2. European harmonized standards

• The Directive 94/9/EC is a harmonized Directive.


• A harmonized Standard is a “technical specification” (European Standard or harmonization document), adopted by CEN and/or CENELEC

• From the 1st of July 2003 forward, the provisions of Directive 94/9/EC have replaced existing divergent national and European legislation on this subject.
2.2. European harmonized standards (cont.)

- The provisions of Directive 94/9/EC are laid down with respect to risks of explosions for electrical and also for non-electrical equipment and protective systems.
  
  - Remark: This is an essential increase in scope compared to existing national regulations.

- The Directive is valid for equipment and protective systems intended for use in potentially explosive areas caused by air/gas and air/dust mixtures.
2.2.1 For the electrical sector

- There are existing standards for the electrical sector of explosion protection (EN 60079-xx).

- The Standards have been formally adapted to the directive 94/9/EC.

- Example for Classification according to ElexV (German Law) and EN 1127-1 and the connection to ATEX (see 2.4 – classification)
2.2.2 For the non-electrical sector

There are also existing standards for the non-electrical sector of explosion protection (EN 13463-xx).

Consideration must be given to:
   a) Design, manufacturing and testing of equipment, protective systems and devices
   b) Essential Health and Safety Requirements with regard to conformity assessment procedures.

These standards (for example: flame arresters, explosion suppression systems, explosion pressure-relief systems, rotary valves), are similar to standards for electrical explosion protection.
2.2.2 For the non-electrical sector (cont.)

- With regard to size of factories and number of employees, the manufacturing base for non-electrical equipment cannot be compared to the electrical industry.

- For flame arresters, there is the EN 12874 standard which regulates the essential conditions for blowers and vacuum pumps of category 1.

- In the absence of harmonized standards, the manufacturer must take self responsibility for any step he deems necessary in order for his equipment and protective systems to meet the Essential Health and Safety Requirements (94/9/EC).
2.2.2 For the non-electrical sector (cont.)

- For products that have to be attested to an EC-type examination by a notified body according to the Directive 94/9/EC Annex III, and in the absence of harmonized standards, the notified body has to carry out the examination responsibly in a way to fulfill the explosion protection criteria in the sense of the Essential Health and Safety Requirements.

- Notified bodies have been given high levels of responsibilities and decision-making.

- This can be a benefit to the manufacturer for the interpretation of the explosion protection requirements, however the responsibility for compliance still rests with the manufacturer.
2.3 Definitions

Definition of equipment, protective systems and components for intended use in potentially ex. atmospheres

- To be within the scope of the directive, a product has to be:
  - **Equipment**, as defined in Article 1.3.(a); or
  - a **Protective system**, as defined in Article 1.3.(b); or
  - a **Component**, as defined in Article 1.3.(c); or
  - a **Safety, controlling or regulating device** as defined in Article 1.2.
2.3 Definitions.

Definition of equipment, protective systems and components for intended use in potentially ex. atmospheres. (Cont.)

- **Equipment is defined as:**
  a) Machines
  b) Apparatus
  c) Fixed or mobile devices
  d) Control components and instrumentation
  e) Detection or prevention systems

  - Separately or jointly, intended for the generation, transfer, storage, measurement, control and conversion of energy for the processing of material and which are capable of causing an explosion through their own potential sources of ignition.

  - Equipment is therefore not only single apparatus, such as electric motor or fan for example, but also the combination of several of these items to an assembly, for example a vacuum pump with its explosion protection requirements for the pumping of explosive atmosphere (internal area) and the use in external potentially explosive atmospheres.

  - The Directive does not restrict the definition “equipment”. Equipment could be an entire industrial processing system as well.
Protective Systems are defined as:

- Design units which are intended to halt internal explosions immediately and/or to limit the effective range of explosion flames and explosion pressures.

- Protective systems may be integrated into equipment or separately placed on the market for use as autonomous systems.

- Protective systems are for example: Flame arrester, explosion suppression systems, explosion pressure-relief systems.
Components are defined as:

- Any item essential to the safe functioning of equipment and protective systems without autonomous function.

- Components are “Ex-assembly parts” (e.g. acc. to EN 60079), which are incorporated into equipment or protective system. They cannot be hazardous themselves prior to their incorporation.

- Components are for example thermo-switches, terminals, pressure sensors, floaters for level indication device.
2.4 Classification in equipment groups and categories

General:

• Equipment is classified in groups and categories. The group is related to the use of the equipment.

• Group I is for the mining (underground parts and surface installations as well).
  
  – Within Group I, equipment is classified according to the required level of safety into categories M1 and M2. The category M1 is the one with the highest required level of protection.

• Group II is for all other places (business trade, industry...).
2.4 Classification (cont.)

Equipment Group I (mining):

• Category M1
  – Intended for use in underground parts for mines as well as those parts of surface installations of such mines endangered by firedamp and/or combustible dust. Equipment in this field is required to remain functional, even in the event of rare incidents relating to equipment, with an explosive atmosphere present, and is characterized by means of protections such as:

  a) in the event of failure of one mean of protection, at least an independent second means provides the requisite level of protection.
  b) the requisite level of protection is assured in the event of two faults occurring independently of each other.

• Category M2
  – Intended for use in underground parts of mines as well as those parts of surface installations of such mines likely to be endangered by firedamp and/or combustible dust.
  – The equipment is intended to be de-energized in the event of an explosive atmosphere.
Example of Area Classifications

- **Zone 0**
- **Zone 1**
- **Zone 2**

Ex

Area
Equipment Group II:

Categories 1, 2, and 3

Equipment is designated as Categories now.

- Category 1 is the one with the highest required levels of protection (comparable with the former requirements for apparatus for the intended use in zone 0).

- Equipment of the category 3 would be comparable to the apparatus for intended use in zone 2.
2.4 Classification (cont.)

Equipment Group II (continued):

• Category 1

  – Intended use in places in which explosive atmospheres, consisting of a mixture of air and gases, vapors or mists, or air/dust mixtures are present continuously, for long periods or frequently.

  – Equipment in this category must be designed to ensure a very high level of protection, even in the event of a disturbance relating to equipment, and is characterized by means of protection such that:

    a) in the event of failure of one means of protection, at least an independent second means provides the requisite level of protection;

    b) the requisite level of protection is assured in the event of two faults occurring independently of each other.
2.4 Classification (cont.)

Equipment Group II cont.

• Category 2

  – Intended for use in places in which explosive atmospheres caused by gases, vapors or mists or air/dust mixtures are likely to occur

  – Provides the requisite level of protection, even in the event of frequently occurring disturbances or equipment failures that normally have to be taken into account.
2.4 Classification (cont.)

Equipment Group II (cont.)

• Category 3

  – Intended for use in places in which explosive atmospheres caused by gases, vapors or mists or air/dust mixtures are unlikely to occur or if they do occur, not frequently and only for a short period of time.

  – Provides the requisite level of protection during normal operation.
2.4 Classification (cont.)

E.g.: Classification according to ElexV (German Law) and EN 1127-1 for **Equipment Group II**

<table>
<thead>
<tr>
<th>for Category</th>
<th>for Zones</th>
<th>In explosive atmospheres of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1G 0, 1, 2</td>
<td>Gases, Steams, Fogs</td>
</tr>
<tr>
<td></td>
<td>1D 20, 21, 22</td>
<td>Dusts</td>
</tr>
<tr>
<td>2</td>
<td>2G 1, 2</td>
<td>Gases, Steams, Fogs</td>
</tr>
<tr>
<td></td>
<td>2D 21, 22</td>
<td>Dusts</td>
</tr>
<tr>
<td>3</td>
<td>3G 2</td>
<td>Gases, Steams, Fogs</td>
</tr>
<tr>
<td></td>
<td>3D 22</td>
<td>Dusts</td>
</tr>
</tbody>
</table>
2.5 Conformity Assessment Procedures

- With the essential requirements of the directive, procedures have been set up for assessing the conformity of equipment, components and devices in potentially explosive atmospheres, taking into account the hazards related to their use.

- The conformity assessment procedure is dependent upon the hazard level of equipment or components and/or how a device is supposed to protect its direct environment. Therefore, each conformity category of equipment has to be completed by an appropriate conformity assessment procedure.
2.5 Conformity Assessment Procedures (cont.)

- The procedures are harmonized with the provisions 93/68/EEC concerning the modules and regulations to apply within the different conformity assessment procedures in order to affix and use the CE marking in accordance with the technical harmonized standards.
2.6 Mandatory type examination by a notified body
(Equipment categories, components and protective systems)

• For Protective systems
  
  – They do not belong to any category. In a case of emergency, a protective system must remain operative, with or without an explosive atmosphere.

• For Equipment, components and safety, control and regulation devices in the category M1 and 1 (former zone 0 devices)

• For Electrical equipment, electrical components (former zone 1 devices) and eventually safety, control and regulation devices and internal combustion engines in the category M2 and 2
• All other products in the category M2 and 2 (as seen before) do not require an EC-type examination through a notified Body.

• These products are subject to an internal control of production by the manufacturer according to Annex VIII.

• The manufacturer shall produce the technical documentation [TCF] necessary to match explosion protection.
• Keep the documentation at his disposal and at the disposal of a notified body for a period of at least 10 years after the last piece of equipment was manufactured ("testament deposit")

• Alternatively, a single certification can be carried out by a notified body according to Annex IX

• The manufacturer has the sole responsibility and liability for the fulfillment of proper explosion protection.
# Application of conformity assessment procedures

<table>
<thead>
<tr>
<th>Equipment Group</th>
<th>Equipment Category</th>
<th>Combination of the conformity assessment procedure according to the modules of Annexes III to IX</th>
<th>Application Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>I and II</td>
<td>M1 and 1</td>
<td>EC-Type Examination acc. to Annex III Additionally: PQA ¹ acc. to annex IV or Product verification to Annex V Alternative: EC unit verification to Annex IX</td>
<td>All equipment And eventually safety/control and regulation devices And components ² And protective systems ³</td>
</tr>
<tr>
<td>I and II</td>
<td>M2 and 2</td>
<td>EC-Type Examination acc. to Annex III Additionally: PQA ¹ acc. to annex VII or Conformity of Type to Annex VI Alternative: EC unit verification to Annex IX</td>
<td>Electrical equipment And eventually safety/control and regulation devices And components ² And internal combustion engines</td>
</tr>
<tr>
<td>II</td>
<td>3</td>
<td>Internal control of production to Annex VIII Additionally: Technical documentation to notified body Alternative: EC unit verification to Annex IX</td>
<td>Remaining products And components ²</td>
</tr>
</tbody>
</table>

¹) Production Quality Assurance ²) Without CE marking ³) Protective systems are not related to any category
EC-type examination certificate with ATEX-number

For products manufactured and placed in the market in accordance with product quality assurance, the notified body has the sole responsibility for the fulfillment of explosion protection according to the Directive.

Non electrical products in Cat. 2 and products in Cat. 3 do not require an examination by a notified body!

The manufacturer has to carry out an internal control of production according to Annex VIII.
2.7 Other options

- If - for the purpose of legal safety, the manufacturer also likes to have non-electrical products in category 2 tested by a notified body in view of their conformity with the directive 94/9/EC.

- Then - this would be possible on a voluntary basis. The manufacturer is given a test report and in the case of successful testing will receive a certificate from the notified body;

- But he cannot receive an EC-type examination certificate.
Equipment of groups I & II
Categories M 1 & 1*
and autonomous protective systems
(Zone 0/20)

EC-type examination
(Annex III)

NoBo
and

Production QA
(Annex IV)

or

Product Verification
(Annex V)

Equipment of groups I & II
Categories M 2 & 2*
(Zone 1/21)

Internal combustion engines
Electrical devices

yes

no

EC-type examination
(Annex III)

NoBo
and

Internal control of production
(Annex VIII)

Communicate technical
documentation to NoBo

NoBo

NoBo

Conformity of type
(Annex VI)

Product QA
(Annex VII)

NoBo

NoBo

Equipment of groups I & II und autonomous protective systems

NoBo

Unit verification
(Annex IX)

Equipment of group II
Category 3
(Zone 2/22)

Internal control of production
(Annex VIII)

Source: ATEX guidelines
2.8 Placing on the market

Freedom of movement and putting into service

• **Freedom of movement!**

• The member States shall not prohibit, restrict or impede the placing on the market and the putting into service in their territory of equipment, protective systems and devices which comply with the Directive 94/9/EC.

• For products with declaration of conformity and CE marking (except components)

• Also valid for components without autonomous function but necessary for the safe functioning of equipment and protective systems.
2.9 Restrictions to freedom of movement

- For products endangering the safety of persons, domestic animals or property.
- Member states shall take all appropriate measures to withdraw such products from the market.
- Member states shall prohibit the placing on the market, putting into service or the use thereof.
- Member states shall restrict free movement thereof.
2.9 Restrictions to freedom of movement

Member States shall immediately inform the commission about:

1. Failure to satisfy the essential requirements referred to in article 3
2. Incorrect application of the standards referred to in article 5 (2)
3. Shortcomings in the standards referred to in article 5 (2)
• To simplify the applications of the directive 94/9/EC (ATEX 95), a brochure (ATEX guidelines) has been prepared by the directorate General Enterprise of the European Commission.

• Objective: clarify and define certain issues and procedures referred to in Directive 94/9/EC

• This document is not a legally binding interpretation of the Directive.

General:

- The Standard EN 1127-1 has been prepared under a mandate given to CEN (European Committee for Standardization) by the European Commission and the EFTA (European Free Trade Association) to fulfill:
  
  - The Council Directive on the approximation of the laws of the member states relating to machinery (consolidated version Directive 2006/42/EC) which demands in Annex I section 1.5.7 that machinery shall be so designed and constructed, to avoid any risk of explosion.

The EN 1127-1 has been prepared based on above mentioned Directives and Directive 99/92/EC (ATEX 137) for:

- Uniform risk assessment procedures when handling substances which may cause explosive atmospheres.

- The selection and the implementation of protection measures The EN 1127-1 describes the fundamental concepts and the methodology of the explosion protection.
• The EN 1127-1 describes the fundamental concepts and the methodology of the explosion protection.

• It represents the connecting link between ATEX 95 and ATEX 137 and was set up to assist designers, manufacturers and other interested bodies to interpret the essential safety requirements of explosion protection in order to achieve conformity with European legislation.
3.1 Objectives of the Standard

- Specifies methods for the identification and assessment of hazardous situations leading to explosions
- Specifies design and construction measures appropriate for the required safety.
3.1 Objectives of the Standard (cont.)

3.1.1 Hazard identification:

- Risk assessment
- Determination of occurrence and amount of explosive atmospheres
- Determination of Category of equipment

- Ignition Hazard Assessment
- Determination of the presence of ignition sources

- Determination of the possible effects (damages) of an explosion
- Risk evaluation
- Consideration of risk limitation measures
3.1.2. Avoidance or limitation of risks:

(fundamental principles of explosion protection)

a.) **Avoidance of explosive atmospheres** (e.g. by means of non-flammable substances, concentrations outside of the explosion range, limitation of oxygen concentration)

b.) **Avoidance of effective ignition sources**

c.) **Limitation of the possible effects of an explosion to an acceptable extend by constructional protective measures**
3.2 Explosion protection concept

• In the planning and implementation of explosion protection, consideration shall be given to normal operation, which includes start-up and shut-down of a system, but also to possible malfunctions and foreseeable misuse.

• Chapter 6.1. of the EN 1127-1 states:

The application of explosion protection measures requires a thorough knowledge of the facts and sufficient experience. It is thus highly recommended to look for expert guidance.
3.3 Safety of equipment, protective systems and components

• Will be achieved by removal of hazards and/or limiting the risk!
  – By design
  – By safeguarding
  – By communication if necessary to convey information to the user
  – By other precautions
• The EN 1127-1 also deals with aspects linked to the intended handling of substances.

• The EN 1127-1 is one of the essential Standards for the provision of explosion protection measures.

• Its minimum requirements are laid down in the Directive 94/9/EC (ATEX 95) and in the Directive 99/92/EC (ATEX 137).
4. Interpretation of the fundamental terminology: explosion protection

- Fundamental explosion protection terminology must be clearly defined to avoid misunderstandings and communication difficulties.

- It is important to focus on unequivocal terminology!

- Not clearly defined terminology will lead to different interpretation of the users.

- A European work committee has been created to deal with the standardization of terminology.
4.1 Explosive or potentially explosive

Atmosphere - atmospheric conditions

- Both explosion protection Directives, 94/9/EC and 99/92/EC are exclusively valid for explosive atmospheres.

- They are not valid for other explosive mixtures.

- The term explosive atmospheres is defined identically:
4.1 Explosive or potentially explosive atmosphere

Atmospheric conditions (cont.)

• **Definition:**

  • An explosive atmosphere is “a mixture with air, under atmospheric conditions, of flammable substances in the form of gases, vapors, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture”

  • With this, the term explosive atmosphere is clearly defined, but the definition of atmospheric conditions is not.

  • Thus both Directives have a “legally open” status.
Atmospheric conditions (cont.)

According to explosion protection regulations valid up until now:
Total pressures of 0.8 bar up to 1.1 bar and mixture temperatures of -20°C and +60°C are considered here as atmospheric conditions.

note: refers to the German EX-regulations (EX-RL)
The notified bodies have all agreed to use the values given in the German EX-regulations (EX-RL) for the definition of atmospheric conditions.
4.2. Explosion Protection

• The term explosion protection is not defined in either explosion protection Directives; it can be derived only indirectly from the content of the Directives!

• Explosion protection comprises all measures for the protection against hazards caused by explosions.

• All definitions given apply to protective measures against explosions from explosive atmospheres and not from explosive mixtures, explosive substances and self decomposable substances.
4.3 Explosion

- The EN 1127-1 defines explosion as follows:

  An abrupt oxidation or decomposition reaction producing an increase in temperature, pressure or in both simultaneously!

To describe this general definition, these explosions can be divided in deflagrations and detonations

- Deflagration:

  - A deflagration is an explosion where the flame front is propagating in the torrential mixture with a flame velocity (do not mix with combustion velocity) in the range of up to some m/s in ultrasonic sphere.

- Detonation:

  - A detonation is an explosion where the explosive mixture is ignited by an intensive shock wave and where the flame front is propagating at ultrasonic velocity and is characterized by a shock wave.
4.5 Basic concept of explosion protection

• Basic concepts for safety techniques have to be adopted based on level of risk.

• An area where large quantities of potentially explosive mixtures are likely to accumulate, for example, is also considered as a potentially explosive area even if the remaining risk in this particular area is acceptably small due to protective measures already applied.
5. Quality System

The Quality System is based upon the Elements of ISO 9001:2000

*In addition to ISO 9001:2000, EN 13980 needs to be addressed*

Therefore, when notified bodies assess the quality systems of manufacturers this document is intended to be the basis of the initial assessment and subsequent visits.
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