

Non-binding guide to good practice for implementing Directive 1999/92/EC "ATEX" (explosive atmospheres)

Health and safety at work

Non-binding guide to good practice for implementing Directive 1999/92/EC "ATEX" (explosive atmospheres)



Employment & social affairs

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Non-binding guide to good practice for implementing the European Parliament and Council Directive 1999/92/EC

**on minimum requirements for improving the safety and
health protection of workers potentially at risk
from explosive atmospheres**

Employment & social affairs

European Commission
Directorate-General for Employment, Social Affairs
and Equal Opportunities
Unit D.4
Manuscript completed in April 2003

Document drawn up on the basis of COM(2003) 515 final.

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Luxembourg: Office for Official Publications of the European Communities, 2005

ISBN 92-894-8721-6

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Printed in Italy

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Foreword

To create more and better jobs has always been an objective of the European Union. This objective was formally adopted by the Council at the Lisbon European Council in March 2000 and it is one of the key elements to enhance the quality of work.

To confront the new challenges to social policy, resulting from the radical transformation of Europe's economy and society, the European Social Policy Agenda, endorsed by the Nice European Council, is based on the need to ensure a positive and dynamic interaction of economic, social and employment policies. The Social Policy Agenda must strengthen the role of social policy and enable it, at the same time, to be more effective in assuring the protection of individuals, the reduction of inequalities, and social cohesion. The Stockholm European Council addressed quality at work — the desire, not just to defend minimum standards, but to raise them and ensure a more equitable sharing of progress — as a key element in regaining full employment. In this context, safety and health at work constitutes one of the social policy issues on which the European Union has concentrated its efforts.

Fortunately, explosions and flash fire accidents are not the most common causes of accidents at work. However, their consequences are spectacular and dramatic in terms of human lives lost and economic costs.

The need to reduce the incidence of explosions and flash fires at work is prompted by both humanitarian and economic considerations and has led to the adoption by the European Parliament and the Council of the ATEX Directive 1999/92/EC. The humanitarian considerations are obvious: explosions and fires can cause hideous injuries and deaths. The economic considerations are contained in every study into the true costs of accidents, which all show that improved risk (health and safety) management can substantially increase company profits. This latter being particularly true where potential explosions are concerned.

Adoption of legislative measures is a part of the commitment to include health and safety of workers at work in the global approach to well-being at work. The European Commission combines a variety of instruments to consolidate a real culture of risk prevention.

This guide to good practice is one of those instruments, and it was mandated by the European Parliament and the Council in Article 11 of the ATEX directive: that the Commission shall draw up a practical guide of a non-binding nature. It may be used as the base for national guides aimed at helping small- and medium-sized enterprises to improve both their safety and their profitability.

Finally, I would like to use this opportunity to encourage all health and safety actors, and in particular national authorities and employers, to apply with responsibility and firmness this directive in order to avoid, or at least to reduce to the minimum, the risks arising from explosive atmospheres and to create a good working environment.

Odile Quintin
General Director

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Introduction

Explosion protection is of particular importance to safety, since explosions endanger the lives and health of workers as a result of the uncontrolled effects of flame and pressure, the presence of noxious reaction products, and the consumption of the oxygen in the ambient air, which workers breathe.

For this reason, the establishment of a coherent strategy for the prevention of explosions requires that organisational measures be taken at the workplace. Framework Directive 89/391/EEC ⁽¹⁾ requires the employer to implement the measures necessary for the safety and health protection of workers, including prevention of occupational risks, and provision of information and training, as well as provision of the necessary organisation and means.

It must be emphasised that compliance with the minimum requirements set out in the directive does not guarantee compliance with the appropriate national laws. The directive was adopted under Article 137 of the Treaty establishing the European Community, and this article expressly does not prevent Member States from maintaining or introducing more stringent protective measures compatible with the Treaty.

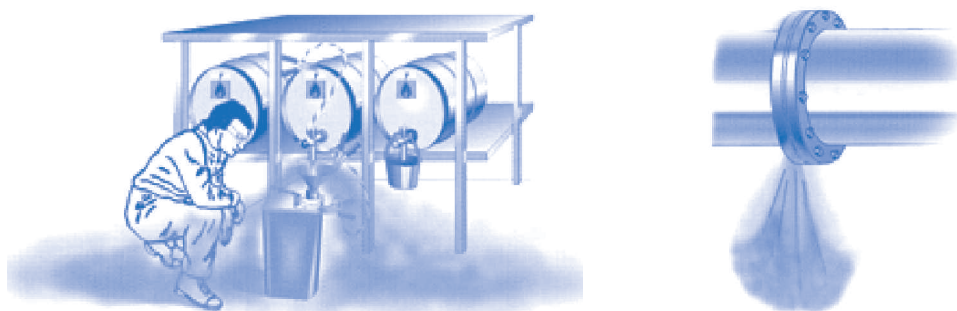
I. How to use this guide to good practice

Explosion hazards may arise in all undertakings which work with flammable substances. These include many input materials, intermediate products, final products and wastes from the routine work process, as shown in Figure I.

This guide to good practice should be used in conjunction with Directive 1999/92/EC ⁽²⁾, the Framework Directive 89/391/EEC and Directive 94/9/EC ⁽³⁾.

Directive 1999/92/EC lays down the minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres. Article 11 of this directive requires the Commission to draw up practical guidelines in a guide to good practice of a non-binding nature.

Figure I.1. Examples of situations in which explosive atmospheres arise ⁽⁴⁾



- (1) Council Directive 89/391/EEC of 12 June 1989, on the introduction of measures to encourage improvements in the safety and health of workers at work, OJ L 183, 29.6.1989, p. 1.
- (2) Directive 1999/92/EC of the European Parliament and the Council of 16 December 1999, on the minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres, OJ L 23, 28.1.2000, p. 57.
- (3) Directive 94/9/EC of the European Parliament and the Council of 23 March 1994, on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres, OJ L 100, 19.4.1994, p. 1.
- (4) From the ISSA leaflet 'Gas explosions', International Section for the Prevention of Occupational Risks in the Chemical Industry, International Social Security Association (ISSA), Heidelberg, Germany.

The guide is primarily intended to assist Member States in drawing up their national policies for the protection of the health and safety of workers.

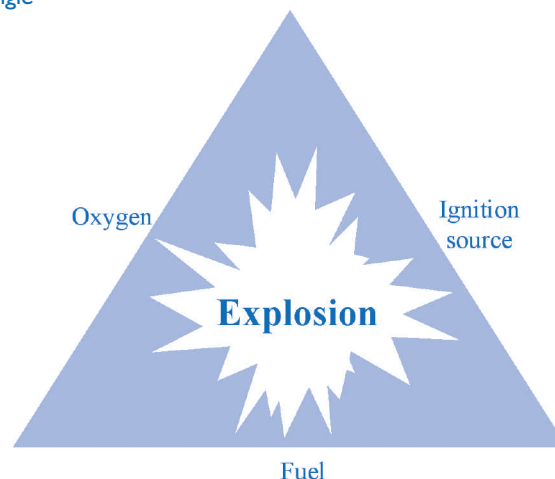
Its aim is thus to enable the employer, particularly in small and medium enterprises (SMEs), to perform the following explosion protection functions:

- to identify hazards and assess the risks;
- to lay down specific measures to safeguard the safety and health of workers at risk from explosive atmospheres;
- to ensure a safe working environment and appropriate surveillance during the presence of workers in accordance with the risk assessment;
- to take the necessary steps and make the necessary arrangements for coordination when several firms are operating at the same workplace;
- to produce an explosion protection document.

Virtually all branches are affected, since hazards from explosive atmospheres arise in a wide range of processes and operations. Examples are given in Table I.1.

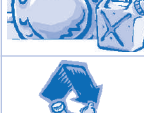
An explosion occurs if a fuel is present in mixture with air (that is, sufficient oxygen) within the explosion limits, together with a source of ignition (see Figure I.2). It is to be noted that the directive has a special definition of 'explosion' that includes those fires where combustion spreads to the entire unburnt mixture.

Figure I.2. Explosion triangle



In the event of an explosion, workers are at risk from uncontrolled flame and pressure effects in the form of heat radiation, flames, pressure waves and flying debris, and from harmful products of reaction and the depletion of the breathable oxygen in the ambient air.

Table 1.1. Examples of explosion hazards in various branches

	Branch	Explosion hazard
	Chemical industry	Flammable gases, liquids and solids are converted and processed in many different processes in the chemical industry. These processes may give rise to explosive mixtures.
	Landfill tips and civil engineering	Flammable landfill gases may arise in landfill tips. Elaborate technical arrangements are needed to avoid uncontrolled gas emission and possible ignition. Flammable gases from various sources may collect in poorly ventilated tunnels, cellars, etc.
	Power generating companies	Lump coal, which is not explosive in mixture with air, may be converted in the conveying, grinding and drying processes into coal dusts capable of forming explosive dust/air mixtures.
	Waste disposal companies	When wastewaters are treated in clarification plants, the gases generated may form explosive gas/air mixtures.
	Gas suppliers	Explosive gas/air mixtures may be formed when natural gas is released, for example, by leakage.
	Wood-working industry	Wood-working gives rise to wood dusts. These can form explosive dust/air mixtures, for example, in filters or silos.
	Paint-spraying operations	The overspray generated in paint spray bays and the solvent vapours released may give rise to explosive atmospheres when mixed with air.
	Agriculture	Biogas production plants are operated on some farms. Explosive biogas/air mixtures may arise if the gas is released, for example, by leakage.
	Metal-working operations	When shaped parts are manufactured from metals, explosive metal dusts may be produced during surface treatment (grinding). This particularly applies to light metals. These metal dusts may give rise to an explosion hazard in dust collectors.
	Food and feedstuffs industry	Explosive dusts may arise during transport and storage of grain, sugar, etc. If they are exhausted and collected by filtering, explosive atmospheres may arise in the filter.
	Pharmaceutical industry	Alcohols are often used as solvents in the production of pharmaceuticals. Agents and auxiliary materials that give rise to dust explosions, such as lactose, may also be used.
	Refineries	The hydrocarbons handled in refineries are all flammable and, depending on their flashpoint, may give rise to explosive atmospheres even at ambient temperature. The area around an oil-processing plant is generally regarded as a place where explosive atmospheres may occur.
	Recycling operations	Processing of waste for recycling can give rise to explosion hazards, for example, from cans or other containers of flammable gases and/or liquids that have not been completely emptied or from paper or plastic dusts.

Examples:

1. An explosion occurred during cleaning in a coal-fired boiler. The two workmen suffered fatal burns. The cause was found to be a lamp with a defective supply lead. The short-circuit ignited coal dust that had been raised into suspension.
2. Solvent-impregnated dusts were being blended in a mixer. The workman did not inert the mixer sufficiently before the start of the process. While the dust was being loaded into the mixer, an explosive mixture of solvent vapour and air was formed, and was ignited by electrostatic sparking generated during the filling process. This workman also suffered severe burns.
3. A fire occurred in a mill building. Ceiling penetrations allowed secondary fires to develop, giving rise to a dust explosion. Four workmen were injured and the whole building destroyed. The material damage amounted to EUR 600 000.

This guide is a non-binding aid to protecting workers' lives and health against the danger of explosion.

1.1. Relationship with Directive 1999/92/EC

In accordance with Article 11 of Directive 1999/92/EC of the European Parliament and of the Council on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres, this guide addresses Articles 3, 4, 5, 6, 7 and 8 and Annexes I and II A of the directive (see Annex 4). Table 1.2 is a concordance of the sections of this guide with the articles of the directive.

Table 1.2. Match between articles of the directive and sections of this guide (Annex 4 contains the original text of the articles of the directive)

Articles of Directive 1999/92/EC	Title	Sections of the guide
Article 2	Definition	Annex I: Glossary
Article 3	Prevention of and protection against explosions	3.1. Prevention of hazardous explosive atmospheres 3.3. Mitigation of effects 3.4. Application of process control engineering 3.5. Requirements for work equipment
Article 4	Assessment of explosion risks	2. Assessment of explosion risks
Article 5	General obligations	4. Organisational measures
Article 6	Duty of coordination	5. Coordination duties
Article 7 Annex I Annex II	Places where explosive atmospheres may occur	3.2. Avoidance of ignition sources
Article 8	Explosion protection document	6. Explosion protection document

For ease of use, the order of sections in this guide diverges from that of the Articles of 1999/92/EC at two points:

1. assessment of explosion risks in Section 2 (Article 4 of the directive) is discussed before explosion protection measures (Articles 3, 5–7 of the directive);
2. means of preventing the ignition of hazardous explosive atmospheres are discussed in Section 3.2 (Article 7, Annex I and II of the directive) as part of the technical explosion protection measures under Section 3 (Article 3 of the directive).

1.2. Scope of the guide

This guide is intended for all undertakings in which working with flammable substances may give rise to hazardous explosive atmospheres and hence explosion hazards. It applies to work under atmospheric conditions. 'Working' includes manufacture, treatment, processing, destruction, storage, readying, trans-shipment and in-house transportation in pipelines or by other means.

NB: In accordance with the legal definition of 'explosive atmosphere' in Directive 1999/92/EC, this guide applies only under atmospheric conditions. The directive and guide thus do not apply under non-atmospheric conditions, but the employer is certainly not absolved of his explosion protection duties under such conditions, to which the requirements of the other worker health and safety legislation continue to apply.

The discussion of the aspects of explosion protection addressed in the various sections is particularly geared to small firms. This guide thus concentrates on conveying basic knowledge and principles, which are illustrated with brief examples. Specimen forms and checklists for firms can be found in Annex 3. Pertinent regulations and further sources of information are listed in Annex 2.

In accordance with Article 1 of Directive 1999/92/EC, this guide does not apply to:

- areas used directly for and during the medical treatment of patients;
- the use of appliances burning gaseous fuels in accordance with Directive 90/396/EEC;
- work with explosive substances or unstable chemical substances;
- mineral-extracting industries covered by Directives 92/91/EEC or 92/104/EEC;
- the use of means of transport by land, water and air to which the pertinent provisions of international agreements (such as ADNR, ADR, ICAO, IMO, RID), and the Community directives giving effect to those agreements, apply. Means of transport intended for use in a potentially explosive atmosphere are not excluded.

Directive 94/9/EC applies to the placing on the market, putting into service and design of equipment and protective systems intended for use in potentially explosive atmospheres.

1.3. Pertinent regulations and further information

Use of this guide does not in itself ensure compliance with statutory explosion protection requirements in the various EU Member States. The authoritative instruments are the rules of law by which the Member States have transposed Directive 1999/92/EC. These may go beyond the minimum requirements of the directive, on which this guide is based.

In carrying out the duties under Article 8 of Directive 1999/92/EC, for example, designing new equipment according to Directive 94/9/EC, consultation of the ATEX 94/9/EC websites is considered useful:

- <http://europa.eu.int/comm/enterprise/atex/index.htm>
- <http://europa.eu.int/comm/enterprise/atex/whatsnew.htm>

As a further aid to implementing the regulations by technical and organisational means, there are European standards (EN), which may be obtained from the national standardisation institutions against payment. A list is provided in Annex 2.2.

Further information can be obtained from the national regulations and standards and the pertinent literature. Annex 2.3 contains references to individual publications by the competent Member State authorities which are regarded as helpful and incorporated into the guide. However, inclusion of a publication in the Annex need not mean that all of its content is entirely consistent with this guide.

1.4. Official and non-official advice centres

Where this guide does not answer questions arising on how to fulfil the explosion protection requirements, the national sources should be contacted directly. They include labour inspectorates, accident insurance agencies or associations and chambers of commerce, industry and craft trades.

2. Assessment of explosion risks

Whenever possible, the employer should prevent the occurrence of explosive atmospheres. In order to comply with this highest priority as defined by Article 3 of Directive 1999/92/EC, the first step in assessing explosion risks is to determine whether a hazardous explosive atmosphere can arise under the circumstances obtaining. It must then be established whether it can ignite.

This assessment process must always relate to the individual case and cannot be generalised. The specific considerations according to Article 4 of Directive 1999/92/EC are the likelihood and duration of the occurrence of a hazardous explosive atmosphere, the likelihood that ignition sources will be present and become active and effective, the installations, substances used, processes, their possible interactions and the scale of the anticipated effects.

NB: Assessment of explosion risks initially focuses on:

- the likelihood that an explosive atmosphere will occur;

and subsequently on:

- the likelihood that sources of ignition will be present and become effective.

Consideration of the effects is of secondary importance in the assessment process, since explosions can always be expected to do a great deal of harm, ranging from major material damage to injury and death. Quantitative approaches to risk in explosion protection are secondary to the avoidance of hazardous explosive atmospheres.

The assessment procedure must be carried out for every work or production process and for every operational status and change of status of a plant. Assessment of a new or existing plant should be based on the following operational statuses:

- normal operating conditions, including maintenance;
- commissioning and decommissioning;
- malfunctions, foreseeable fault conditions;
- misuse which may reasonably be foreseen.

Explosion risks must be assessed overall. Important factors are:

- the work equipment used;
- the building fabric and configuration;
- the substances used;
- work and process conditions;
- their possible interactions with each other and the working environment.

Places which are or can be connected via openings to places in which explosive atmospheres may occur (hereafter 'hazardous places') must also be taken into account in assessing explosion risks.

If an explosive atmosphere contains various flammable gases, vapours, mists or dusts, this must be taken duly into account in assessing the explosion risks. The presence of, for example, hybrid mixtures can considerably increase the effect of the explosion.

Warning: As a general rule, hybrid mixtures of mists or dusts with gases and/or vapours may form an explosive atmosphere when the concentrations of the individual fuels are still below their lower explosion limit. Additionally, the risk that the detection equipment may be adversely affected by one of the phases (for example, the ‘poisoning’ of catalysts by mists), must be evaluated.

2.1. Methods

Suitable methods for assessing the explosion risks associated with work processes or plants are those which lend themselves to a systematic approach to checking plant and process safety. In this context, ‘systematic’ means that the work is done in a structured manner, on an objective and logical basis. An analysis is made of the existing sources of hazardous explosive atmospheres and the effective sources of ignition which could occur at the same time.

In practice, it is usually sufficient to determine and assess the explosion risk by working systematically through a set of focused questions. A simple procedure is described in Section 2.2 below using typical criteria.

NB: Other methods of risk assessment described in the literature, for identifying hazards (such as use of check-lists, failure mode and effects analysis, operating error analysis, HAZOP analysis) or assessing hazards (such as event tree or fault tree analysis), are worthwhile for explosion protection purposes only in exceptional cases, for example, to determine ignition sources in complex plants.

2.2. Assessment criteria

Assessment of the explosion hazard thus does not depend solely on whether sources of ignition are present or may arise.

The following four conditions must be satisfied simultaneously for explosions with hazardous effects to occur:

- a high degree of dispersion of the flammable substances;
- concentration of the flammable substances in air within their combined explosion limits;
- hazardous quantities of an explosive atmosphere;
- an effective source of ignition.

To check whether these conditions are met, explosion risks can, in practice, be assessed by means of seven questions. Figure 2.1 shows the assessment flowchart, with the questions underlined. The criteria for answering them are explained in the sections indicated. The first four questions are used to determine in principle whether there is an explosion risk and whether explosion protection measures are necessary at all. Only if this is the case should the other three questions be considered to determine whether the proposed protective measures limit the explosion risk to an acceptable level. This step must be performed in conjunction with the choice of protective measures in accordance with Section 3 of this guide and repeated if necessary until an overall solution appropriate to the circumstances is found.

For assessment purposes, it must be borne in mind that explosion protection parameters are generally valid only under atmospheric conditions. Under non-atmospheric conditions, the safety parameters may be significantly different.

Examples:

1. The minimum ignition energy can be greatly reduced at elevated oxygen concentrations or temperatures.
2. Elevated initial pressures give rise to higher maximum explosion pressures and rates of pressure rise.
3. The range between the explosion limits is widened at elevated temperatures and pressures. This means that the lower explosion limit may be lower and the upper explosion limit higher.

Figure 2.1. Assessment flowchart for recognition and prevention of explosion hazards

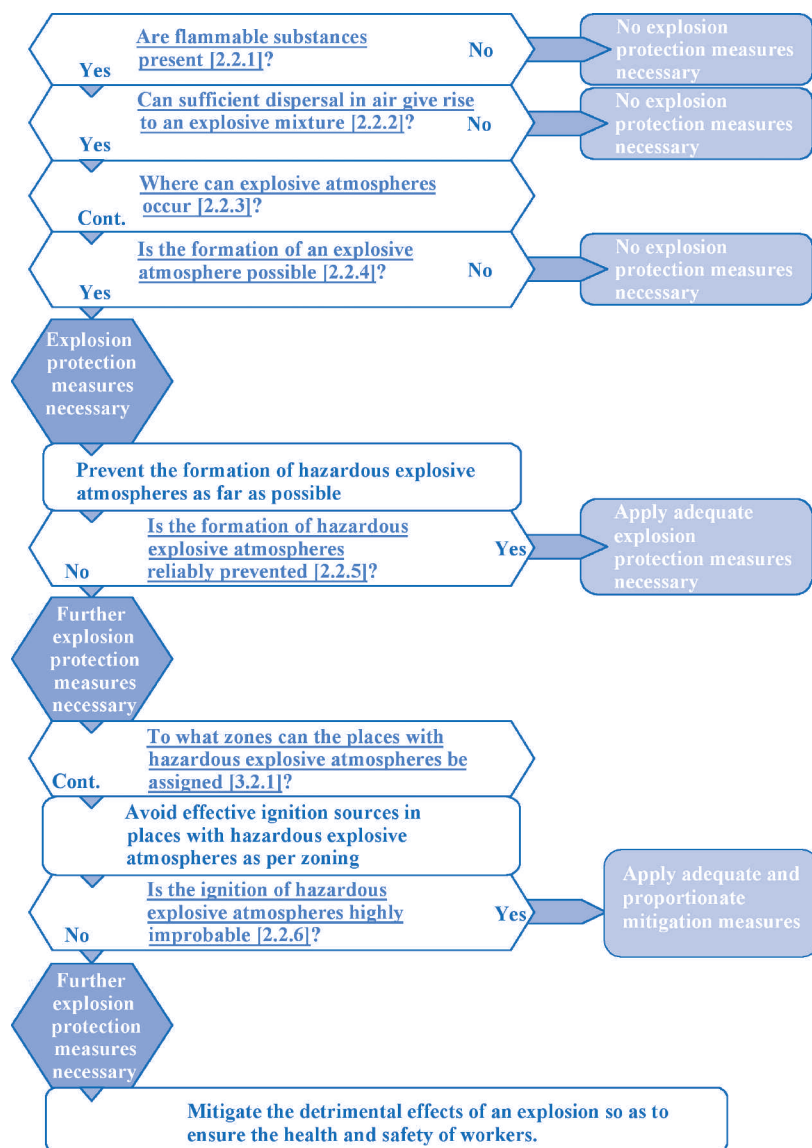


Figure 2.1 contains questions about 'reliable' prevention of the formation of hazardous explosive atmospheres. The answer 'Yes' can be given only if the technical and organisational measures already taken are such that there is no need to take into account the occurrence of an explosion, having regard to all operating conditions and reasonably foreseeable cases of malfunction.

2.2.1. Are flammable substances present?

An explosion will occur only if flammable substances are present in the working or production process. This means that at least one flammable substance is used as a raw or auxiliary material, arises as a waste, intermediate or final product or can be formed in the event of a common operational malfunction.

Example: Flammable substances may also occur accidentally, for example, when weak acids or alkalis are stored in metal containers. In such cases hydrogen may be formed by an electrochemical reaction and accumulate in the gaseous phase.

All substances capable of an exothermic oxidation reaction are to be regarded as flammable. In particular, these include all substances which are already classified and labelled as flammable (R10), highly flammable (F and R11/R15/R17) or extremely flammable (F+ and R12) under the Dangerous Substances Directive 67/548/EEC. However, they also include all other substances and preparations that are not (yet) classified but satisfy the appropriate ignitability criteria or are generally to be regarded as ignitable.

Examples:

1. Flammable gases and gas mixtures, for example, liquefied gas (butane, butene, propane, propylene), natural gas, combustion gases (such as carbon monoxide or methane) or gaseous flammable chemicals (such as acetylene, ethylene oxide or vinyl chloride).
2. Flammable liquids, for example, solvents, fuels, petroleum, heating, lubricating or waste oils, paints, water-insoluble and water-soluble chemicals.
3. Dusts of flammable solids, for example, coal, wood, food and feedstuffs (such as sugar, flour or cereals), plastics, metals or chemicals.

NB: A number of substances are not readily flammable under normal conditions but are explosive when mixed with air if the particle size is particularly small or the ignition energy sufficiently high (for example, metal dusts, aerosols).

Explosion hazards need be further considered only if flammable substances are present.

2.2.2. Can sufficient dispersal in air give rise to an explosive atmosphere?

Whether an explosive atmosphere can form in the presence of flammable substances depends on the ability to ignite of the mixture formed with air. If the necessary degree of dispersion is attained and if the concentration of the flammable substances in air lies within their explosion limits, an explosive atmosphere is present. By their very nature, gases and vapours have a sufficient degree of dispersion.

To answer the above question, one must take into account the following properties of the substances and their possible processing states.

1. Flammable gases and gas mixtures:

- lower and upper explosion limit;
- maximum (sometimes also minimum) concentrations of the flammable substances arising or obtaining during work with them.

2. Flammable liquids:

- lower and upper explosion limit of vapours;
- lower explosion limit of mists;
- flashpoint;

NB: Explosive mixtures are not to be assumed to be present inside containers if the temperature within the container is at all times kept far enough below the flashpoint (by about 5 to 15 °C — see example in Section 3.1.2).

- working or ambient temperatures;

NB: If, for example, the maximum working temperature is not far enough below the flashpoint of the liquid, explosive vapour/air mixtures may be present.

- manner of working with a liquid (for example, spraying, squirting and dispersal of a jet of liquid, evaporation and condensation);

NB: If liquids are dispersed into droplets, for example, by spraying, explosive atmospheres may be formed even at temperatures below the flashpoint.

- use of a liquid at high pressure (for example, in hydraulic systems);

NB: Where there are leaks in the enclosures of high-pressure flammable liquids, the liquid may, depending on size of leak, overpressure and material stability, squirt out and form explosive mists, which may then become explosive vapours.

- maximum (sometimes also minimum) concentrations of the flammable substances arising or obtaining during work with them (only inside apparatus/installations).

3. Dusts of flammable solids:

- presence or formation of dust/air mixtures or dust deposits;

2. Assessment of explosion risks

Examples:

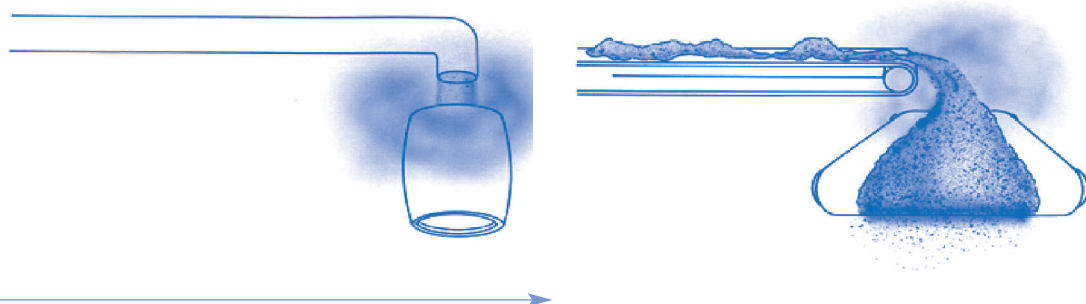
1. grinding or screening;
2. conveying, filling or discharging;
3. drying.

- maximum concentrations of the flammable substances arising or obtaining during work compared to the lower explosive limit;
- lower and upper explosion limit;

NB: In practice, explosion limits are not as useful for dusts as for gases and vapours. The dust concentration can be greatly changed when deposits are raised into suspension or suspended dust settles. Explosive atmospheres may thus arise when dust is raised into suspension.

- particle size distribution (the $< 500 \mu\text{m}$ fines fraction is of interest), moisture, smouldering point.

Figure 2.2. Examples for the formation of dust/air mixtures in filling and transport operations ⁽⁵⁾



2.2.3. Where can explosive atmospheres occur?

If explosive atmospheres can be formed, one must determine where they occur at the workplace or in the plant in order to delimit the potential risk. To this end, the properties of the substances and the plant, process engineering and environmental factors applying must in turn be taken into account.

1. Gases and vapours:

- Density ratio to air – the heavier the gases and vapours are, the faster they sink, mixing progressively with the available air and accumulating in trenches, conduits and shafts.
 - Gases are generally denser than air, for example, propane. Such accumulations tend to sink and spread out, and can also ‘creep’ over long distances and then be ignited.
 - Some gases have approximately the same density as air, for example, acetylene, hydrogen cyanide, ethylene, carbon monoxide. There is little natural tendency for these gases to dissipate, or to sink.
 - A few gases are much lighter than air, such as hydrogen, methane. These gases have a natural tendency to dissipate into the atmosphere unless they are enclosed.

(5) From the ISSA leaflet ‘Gas explosions’, International Section for the Prevention of Occupational Risks in the Chemical Industry, International Social Security Association (ISSA), Heidelberg, Germany.

- Even slight air movements (natural draught, people moving about, thermal convection) may considerably speed up mixture with air.

Figure 2.3. Spread of liquefied gases (example) ⁽⁶⁾



2. Liquids and mists:

- evaporation number, characterising the amount of explosive atmosphere that forms at a particular temperature;
- size of evaporation area and working temperature, such as when liquids are sprayed or squirted;
- overpressure by means of which the sprayed liquids are discharged and form explosive mists.

3. Dusts:

- occurrence of dust raised into suspension, for example, in filters, during transport in containers, at transfer points or inside dryers;
- formation of dust deposits, especially on horizontal or slightly inclined surfaces, and raising of dust into suspension;
- grain size.

Other local and operating conditions must also be taken into account:

- manner of working with substances: under gas-, liquid- or dust-tight enclosure or in open apparatus, for example, charging and discharging;
- possible leakage at valves, pipe connections, etc.;
- ventilation conditions and other spatial factors;
- places which are not ventilated, for example, unventilated below ground-level areas such as trenches, conduits and shafts, are particularly prone to the presence of flammable substances or mixtures.

2.2.4. Is the formation of a hazardous explosive atmosphere possible?

If an explosive atmosphere may occur locally in such quantities as to require special protective measures to maintain the safety and health of the workers concerned, it is described as a hazardous explosive atmosphere and the places in question are classified as hazardous places.

(6) From the ISSA leaflet 'Gas explosions', International Section for the Prevention of Occupational Risks in the Chemical Industry, International Social Security Association (ISSA), Heidelberg, Germany.

Figure 2.4. Evaporation of even small quantities of flammable liquids (such as liquefied propane) may give rise to large quantities of flammable vapours



NB: 1 litre of liquid propane when transformed into gas and diluted in air to the lower explosive limit would give a 13 000 litre explosive atmosphere ⁽⁷⁾.

Once the existence of a potential explosive atmosphere has been established, whether it is a hazardous explosive atmosphere depends on its volume and the harmful consequences of any ignition. In general, however, it can initially be assumed that an explosion will cause substantial harm and that a hazardous explosive atmosphere is present.

Exceptions to this rule may apply to work with very small quantities, for example in laboratories. In such cases, it has to be decided on the basis of local and operational conditions whether the anticipated amounts of explosive atmosphere are hazardous.

Examples:

1. A continuous volume of over 10 litres of explosive atmosphere in a confined space must always be regarded as a hazardous explosive atmosphere, irrespective of the size of the room.
2. A rough estimate can be made by the rule of thumb that, in such rooms, explosive atmospheres must be regarded as potentially hazardous if they occupy more than one 10 000th of the room volume, that is, only 8 litres in a room of 80 m³. However, this does not mean that the whole room is to be regarded as a hazardous place, but only the part in which the hazardous explosive atmosphere can arise.
3. For most combustible dusts, a deposit less than 1 mm deep evenly distributed over the whole floor area is sufficient, if raised into suspension, to fill completely a room of normal height with an explosive dust/air mixture.
4. Where explosive atmospheres are contained in vessels incapable of withstanding the potential explosion pressure, much smaller volumes than indicated above must be regarded as hazardous because of the danger which may arise, for example, from flying debris on rupture. No lower limit for this hazard can be indicated.

A further factor to be taken into account in assessing whether a hazardous explosive atmosphere can arise in a particular situation is the effect resulting from the destruction of nearby items of plant.

(7) From the ISSA leaflet 'Gas explosions', International Section for the Prevention of Occupational Risks in the Chemical Industry, International Social Security Association (ISSA), Heidelberg, Germany.

NB: An explosion may also cause damage in the surrounding area, which in turn causes flammable or other dangerous substances to be released and perhaps ignited.

2.2.5. Is the formation of hazardous explosive atmospheres reliably prevented?

If it is possible for a hazardous explosive atmosphere to be formed, explosion protection measures are necessary. An attempt should first be made to avoid the occurrence of explosive atmospheres. Section 3.1 describes possible technical measures to this end, to be considered in conjunction with organisational measures as described in Section 4.

The effectiveness of the explosion protection measures taken must be assessed. To this end, all operational statuses and all malfunctions (including rare ones) must be taken into account. Only if the occurrence of hazardous explosive atmospheres is reliably prevented is it possible to dispense with further measures.

2.2.6. Is the ignition of hazardous explosive atmospheres reliably prevented?

If it cannot be entirely ruled out that hazardous explosive atmospheres may form, measures to avoid effective ignition sources are necessary. Thus the more likely it is that hazardous explosive atmospheres will arise, the more certain must be the avoidance of such sources. Section 3.2 describes possible technical measures, to be considered in conjunction with organisational measures as described in Section 4.

If it is not highly improbable that hazardous explosive atmospheres and effective sources of ignition will occur simultaneously, explosion mitigation measures must also be taken as described in Section 3.3 in conjunction with organisational measures as described in Section 4. Otherwise proportionate mitigation measures must be taken.

3. Technical measures for explosion protection

'Explosion protection measures' means all measures that:

- prevent the formation of hazardous explosive atmospheres;
- avoid the ignition of hazardous explosive atmospheres;
- mitigate the effects of explosions so as to ensure the health and safety of workers.

3.1. Prevention of hazardous explosive atmospheres

According to Article 3 'Prevention of and protection against explosions' of Directive 1999/92/EC, preventing the formation of hazardous explosive atmospheres must always be given priority.

3.1.1. Use of substitutes for flammable substances

The formation of hazardous explosive atmospheres can be prevented by avoiding or reducing the use of flammable substances. An example is the replacement of flammable solvents and cleaning agents with aqueous solutions. As regards dusts, it is sometimes possible to increase the particle size of the substances used, so that explosive mixtures cannot be formed. Care must then be taken to ensure that further processing does not reduce particle size, for example, through abrasion. A further possibility is to moisten the dust or use paste products, so that they can no longer be raised into suspension.

3.1.2. Limiting of concentrations

Gases and dusts are explosive only within certain limits of concentration in air. Under certain operating and ambient conditions, it is possible to remain outside these explosion limits. If these conditions are reliably assured, there is no explosion hazard.

In closed containers and plant, it is usually fairly easy to keep the concentration of gases and vapours of flammable liquids outside the explosion limits.

Example: The concentration in the headspace above flammable liquids can be guaranteed to remain below the lower explosion limit if the temperature at the surface of the liquid is at all times kept far enough below the flashpoint (a temperature difference of 5° C usually affords adequate safety for pure solvents and 15° C for solvent mixtures). The upper explosion limit is usually exceeded for flammable liquids with a low flashpoint (for example, in a car petrol tank).

Where dusts are concerned, it is harder to avoid explosive mixtures by limiting the concentration. If the airborne dust concentration is below the lower explosion limit, dust deposits form by settlement if there is insufficient air movement. These can be raised into suspension, creating explosive mixtures.

NB: Dust particles are separated in filters, where they form accumulations which may have considerable fire and explosion potential.

3.1.3. Inerting

A hazardous explosive atmosphere can also be avoided by diluting the fuel or the atmospheric oxygen inside plant with chemically non-reactive (inert) materials. This is known as 'inerting'.

To design this measure, it is necessary to know the highest oxygen concentration at which no explosion yet occurs: the limiting oxygen concentration. This is determined experimentally. The maximum permissible oxygen concentration is obtained by deducting a safe concentration margin from the limiting oxygen concentration. If the fuel is diluted with an inert substance, the maximum permissible fuel concentration must be determined in the same way. If the oxygen concentration could vary quickly, or could be very different in different parts of the plant, a large safety margin would be required. Operating mistakes and equipment faults should be considered. A further aspect to be considered is the time required for any protective measures or emergency functions triggered to become effective.

Example: The main inert gases used are nitrogen, carbon dioxide, noble gases, combustion gases and water vapour. Inert dusts include calcium sulphate, ammonium phosphate, sodium hydrogen carbonate, stonedust, etc. In choosing the inert substance, it is important that it should not react with the fuel (aluminium, for example, can react with carbon dioxide).

NB: Dust deposits may give rise to glowing or smouldering fires even at low oxygen or fuel concentrations, well below those which are adequate to ensure reliable avoidance of explosions. A mixture of 95 % wt limestone and 5 % wt coal, for example, can still exhibit a strong exothermal reaction.

Inertisation with gases can generally be practised only in enclosed plant, where it is possible to ensure a fairly low rate of gas replacement. If inert gas is emitted through openings in the plant which are present in normal operation or result from defects, workers may be at risk from oxygen displacement (suffocation). Workers may be poisoned if combustion gases used for inerting are emitted from plant. Openings present in normal operation may, for example, be manual charging ports. If these are opened, it has to be borne in mind that inert gas may be emitted from the plant and atmospheric oxygen may enter it.

3.1.4. Preventing or limiting the formation of explosive atmospheres in the vicinity of plant

Formation of hazardous explosive atmospheres around a plant should be prevented as far as possible. This can be achieved by means of an enclosed plant. The items of the plant must therefore be leak-proof. The plant design must be such that no significant leakage occurs under the foreseeable operating conditions. One of the ways of ensuring this is by regular servicing.

If the release of flammable substances cannot be prevented, forming of hazardous explosive atmospheres can often be prevented by ventilation. The following points must be taken into account in judging how effective ventilation is.

Gases, vapours and mists: to design a ventilation system, one must estimate the maximum amount of gases, vapours and mist that might be released (source strength) and know the source location and dispersion conditions.

Dusts: ventilation generally affords adequate protection only if the dust is exhausted at source and hazardous dust deposits are reliably prevented.

3. Technical measures for explosion protection

In the best case, adequate ventilation can preclude hazardous places. However, because of the limitations mentioned, all that is achieved may be a reduction in the likelihood of hazardous explosive atmospheres or a reduction in the extent of the hazardous places (zones).

It is recommended that spot checks be made of the concentrations arising at different places and times under unfavourable operating conditions.

Figure 3.1. Example of the correct arrangement of ventilation openings for heavier-than air gases and vapours ⁽⁸⁾

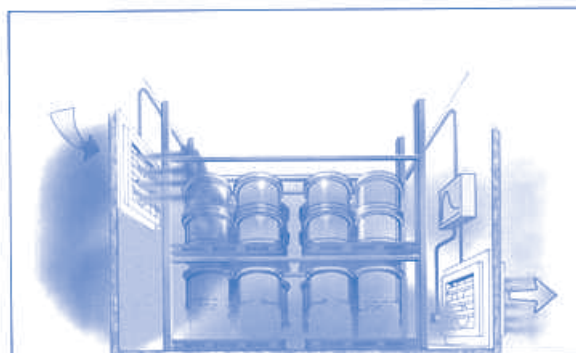


Fig. 7: Use of a gas alarm unit in combination with forced ventilation measures in a solvent store

Removal of dust deposits

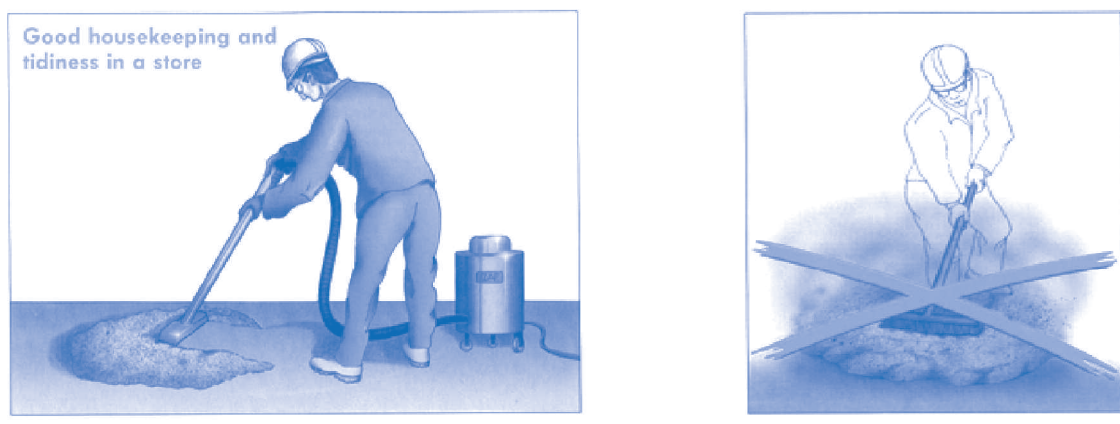
Hazardous dust deposits can be avoided by regular cleaning of work and technical rooms. A proven approach is the use of cleaning schedules prescribing the nature, extent and frequency of cleaning and the responsibilities of those concerned. These instructions can be tailored to the specific case. Particular attention should be paid to (for example, elevated) surfaces which are difficult to inspect or reach, where considerable amounts of dust may be deposited over time. Where appreciable quantities of dust are released as a result of operational malfunctions (such as damage to or bursting of containers, leakage) additional steps should be taken to remove the dust deposits with as little delay as possible.

Wet cleaning and exhausting of dust deposits (using central extraction systems or mobile industrial vacuum cleaners containing no ignition sources) has proved to have safety advantages. Cleaning processes in which dust is raised into suspension should be avoided (see Figure 3.2). It should be borne in mind that wet cleaning can create extra problems of disposal. Where light-metal dusts are collected in wet scrubbers, it must be borne in mind that hydrogen may be formed. The practice of blowing away deposited dust should be avoided.

The cleaning arrangements can be laid down as part of operational instructions for working with flammable substances.

NB: Only vacuum cleaners containing no ignition sources may be used for flammable dusts.

(8) From the ISSA leaflet 'Gas explosions', International Section for the Prevention of Occupational Risks in the Chemical Industry, International Social Security Association (ISSA), Heidelberg, Germany.

Figure 3.2. Removal of dust deposits ⁽⁹⁾

3.1.5. Gas alarms

Concentrations in the vicinity of plant can be monitored, for example by means of gas alarms. Major prerequisites for their use are as follows:

- The substances likely to be present, the location of the sources, maximum source strength and dispersion conditions must be adequately known.
- The instrument performance must be appropriate to the conditions of use, especially as regards response time, alarm level and cross-sensitivity.
- No dangerous conditions may arise on failure of individual functions of gas alarm systems (reliability).
- The number and location of measuring points must be so chosen that the anticipated mixtures can be detected quickly and reliably.
- It must be known what area is at risk until the protective measures triggered by the instrument become effective. In this immediate area — which depends on the above points — sources of ignition must be avoided.
- The protective measures triggered must prevent the occurrence of hazardous explosive atmospheres outside the immediate area with a sufficient degree of certainty and spurious triggering may not give rise to other hazards.

Gas alarms for use in hazardous places must be approved and suitably marked as safe electrical equipment pursuant to the European Directive 94/9/EC.

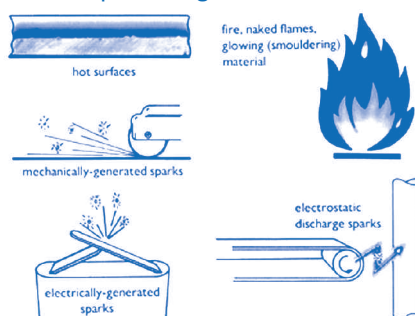
NB: Gas alarms for use as safety, controlling and regulating devices in avoiding ignition sources (for example, to switch off a non-explosion-proof item of equipment on the occurrence of a hazardous explosive atmosphere) must undergo individual or type checks/calibration to ensure their suitability for their intended use. The requirements of the European Directive 94/9/EC must be satisfied (see also 3.4 Application of process control engineering).

(9) From the ISSA leaflet 'Gas explosions', International Section for the Prevention of Occupational Risks in the Chemical Industry, International Social Security Association (ISSA), Heidelberg, Germany.

3.2. Avoidance of ignition sources

If it is not possible to prevent the formation of a hazardous explosive atmosphere, its ignition must be avoided. This can be achieved by protective measures which avoid or reduce the probability of ignition sources. To lay down effective precautions, one must know the various types of ignition source and the ways in which they operate. The probability that a hazardous explosive atmosphere and a source of ignition will be present at the same time and place is estimated and the extent of the measures required is determined accordingly. This is done on the basis of the zone system described below, from which the necessary precautions are derived.

Figure 3.3. Examples of the most common potential ignition sources ⁽¹⁰⁾



3.2.1. Zoning of hazardous places

A hazardous place is a place in which an explosive atmosphere may occur in such quantities as to require special precautions to protect workers against explosion hazards. Such a quantity is termed a hazardous explosive atmosphere. As a basis for determining the extent of protective measures, any remaining hazardous places must be classified in terms of zones according to the likelihood of occurrence of such atmospheres.

Zone 0: A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently.

Example: Zone 0 conditions generally arise only inside containers or plant (evaporators, reaction vessels, etc.), but can also occur near vents and other openings.

Zone 1: A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.

Example:

This may include:

- the immediate vicinity of zone 0;
- the immediate vicinity of feed openings;
- the immediate area around fragile vessels or pipes made of glass, ceramics, and the like, unless the contents are too small to form a hazardous explosive atmosphere;
- the immediate area around inadequately sealed glands, such as at pumps and valves;
- the inside of plant such as evaporators or reaction vessels.

(10) From the ISSA leaflet 'Gas explosions', International Section for the Prevention of Occupational Risks in the Chemical Industry, International Social Security Association (ISSA), Heidelberg, Germany.

Zone 2: A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

Example: Zone 2 may include, for example, places surrounding zones 0 or 1.

NB: Places where flammable substances are transported only in pipes which are durably technically leak-proof are not hazardous places.

Zone 20: A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently.

Example: In general, these conditions arise only inside containers, pipes, vessels, etc., that is, usually only inside plant (mills, dryers, mixers, pipelines, silos, etc.), when explosive dust mixtures in hazardous quantities can form continuously, over long periods or frequently.

Zone 21: A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally.

Example: This zone can, for example, include places in the immediate vicinity of, for example, powder filling and emptying points and places where dust deposits occur and in normal operation give rise occasionally to an explosive concentration of combustible dust when mixed with air.

Zone 22: A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

Example: This zone can include, for example, places in the vicinity of plant containing dust, if dust can escape at leaks and form deposits in hazardous quantities.

Layers, deposits and heaps of combustible dust must be considered, like any other source which can form a hazardous explosive atmosphere.

'Normal operation' means the situation when installations are used within their design parameters.

NB: Deposited combustible dust has considerable explosion potential. Dust deposits may accumulate on all deposition surfaces in a technical room. A primary explosion may raise deposited dust into suspension and initiate a chain reaction, causing many successive explosions with devastating effects.

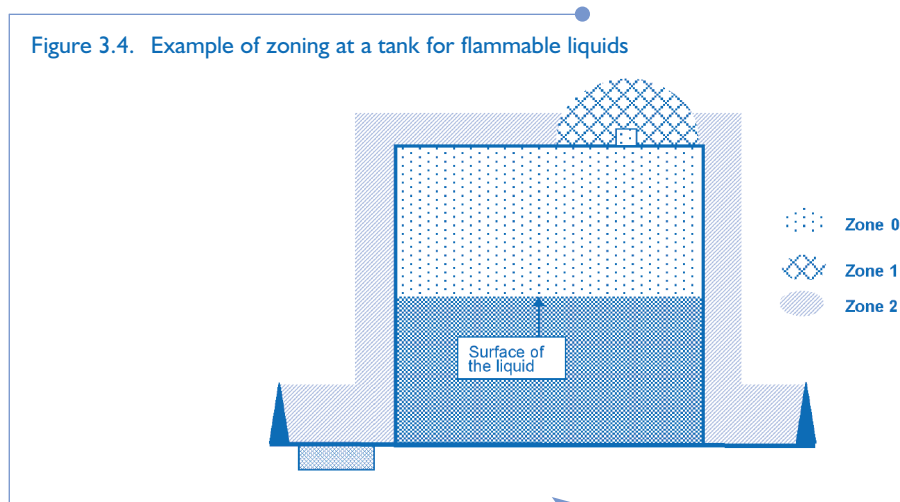
3.2.1.1. Example of zoning for hazardous places resulting from flammable gases

Figure 3.4 shows a tank for flammable liquids. The tank is in the open air, is filled and emptied regularly and is connected to the ambient atmosphere by means of a pressure equalising port. The flashpoint of the flammable liquid is close to the average annual temperature and the density of the resulting vapours is greater than that of air. There is thus a chronic risk of hazardous explosive atmospheres occurring inside the tank. The inside of the tank is therefore classified as zone 0.

Vapours may occasionally be emitted from the pressure equalising port and may form explosive mixtures. The area around the opening is therefore classified as zone 1. Under infrequent adverse weather conditions, the vapours may run down the outside of the tank wall and form a hazardous explosive atmosphere. An area around the tank is therefore classified as zone 2.

The size of the zones outside the tank depends on the anticipated amount of vapour release. This depends on the properties of the liquid, the size of the aperture and the frequency of filling and emptying, as well as the average change in the liquid level. The size of the hazardous places largely depends on the availability of natural ventilation.

Figure 3.4. Example of zoning at a tank for flammable liquids



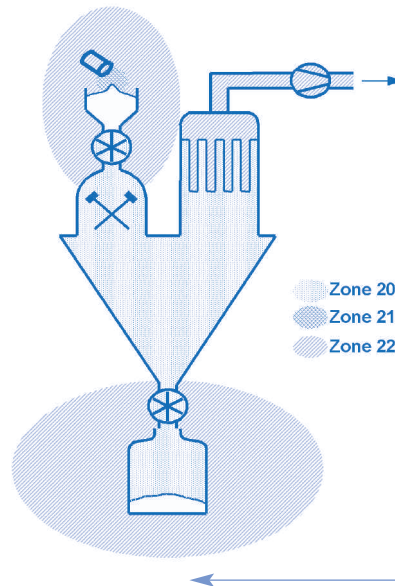
3.2.1.2. Example of zoning for hazardous places resulting from flammable dusts

Figure 3.5 shows a mill with a (manually charged) feed hopper, product discharge and filter. A dust forming, flammable product is loaded by hand from a drum into the hopper.

During the loading process, an explosive mixture of dust and air may occasionally form in the area where the drum is emptied into the loading hopper. This area is classified as zone 21. There are dust deposits in an area around the hopper. These may form a hazardous explosive atmosphere when raised into suspension, which occurs infrequently and briefly. This area is classified as zone 22.

In normal operation, there is a cloud of dust in the mill. A dust cloud is also formed at regular intervals by cleaning of the filter bags. The inside of the mill and the filter are therefore classified as zone 20. The ground product is discharged continuously. A dust cloud consisting of an explosive mixture is thus formed in normal operation in the discharge container, which is therefore classified as zone 20. As a result of leakage, there are dust deposits around the discharge. This area is classified as zone 22. The size of zones 21 and 22 depends on the dusting propensity of the product used.

Figure 3.5. Example of zoning for flammable dusts



3.2.2. Extent of protective measures

The extent of protective measures depends on the likelihood that hazardous explosive atmospheres will arise (zoning) and should therefore be determined in accordance with Table 3.1 below.

Table 3.1. Extent of protective measures in the various zones

Zoning	Ignition sources (*) to be reliably avoided:
0 or 20	• in normal operation (no malfunction)
	• in foreseeable cases of malfunction and
	• in the event of rare malfunctions
1 or 21	• in normal operation (no malfunction) and
	• in foreseeable cases of malfunction
2 or 22	• in normal operation (no malfunction)

(*) In zones 20, 21 and 22, the possibility of deposited dust ignition must also be taken into account.

The table applies to all types of ignition source.

3.2.3. Types of ignition source

Standard EN 1127-1 distinguishes 13 types of ignition source:

- hot surfaces;
- flames and hot gases;
- mechanically generated sparks;
- electrical apparatus;
- stray electrical currents, cathodic corrosion protection;

3. Technical measures for explosion protection

- static electricity;
- lightning;
- electromagnetic fields in the frequency range from 9 kHz to 300 GHz;
- electromagnetic radiation in the frequency range from 300 GHz to 3×10^6 GHz or wavelength range from 1000 μm to 0.1 μm (optical spectrum);
- ionising radiation;
- ultrasonics;
- adiabatic compression, shock waves, gas flows;
- chemical reactions.

The following sections discuss only ignition sources that are of particular importance in operational practice. Further details on the various types of ignition source and their assessment can be found in EN 1127-1.

3.2.3.1. Hot surfaces

Explosive atmospheres can be ignited by contact with hot surfaces, if the temperature of a surface reaches the atmosphere's ignition temperature.

Example: Surfaces which become hot in normal operation are, for example, heating systems, some electrical equipment and hot pipes. Hot surfaces resulting from malfunction are, for example, moving parts which overheat because of inadequate lubrication.

If hot surfaces can come in contact with explosive atmospheres, a safety margin should be ensured between the maximum surface temperature and the atmosphere's ignition temperature. This margin depends on the zoning and is determined in accordance with EN 1127-1.

NB: Dust deposits have an insulating effect and therefore inhibit dissipation of heat into the surrounding atmosphere. The thicker the layer, the less heat dissipates. This can lead to heat build-up and hence to a further rise in temperature. This process can result in ignition of the dust layer. Equipment which according to Directive 94/9/EC can be operated safely in an explosive gas/air atmosphere is thus not necessarily suitable for operation in places where there is a dust/air explosion hazard.

3.2.3.2. Flames and hot gases

Both flames and incandescent solid particles can ignite explosive atmospheres. Even very small flames are among the most effective sources of ignition and must therefore generally be eliminated from hazardous places belonging to zones 0 and 20. In zones 1, 2, 21 and 22, flames should occur only if they are safely enclosed (see EN 1127-1). Naked flames from welding or smoking must be prevented by organisational measures.

3.2.3.3. Mechanically generated sparks

Friction, impact and abrasion processes, such as grinding, can give rise to sparking. Such sparks can ignite flammable gases and vapours and certain mist/air or dust/air mixtures (especially metal dust/air mixtures). In deposited dust, smouldering can be caused by the sparks, and this can be an ignition source for explosive atmospheres.

Ingress of foreign materials, for example, stones or tramp metals, into equipment or items of plant must be considered as a cause of sparking.

NB: Friction, impact and abrasion processes involving rust and light metals (such as aluminium and magnesium) and their alloys may initiate an aluminothermic (thermite) reaction which can give rise to particularly incandive sparking.

Incandive frictional and impact sparking can be limited by choosing suitable material combinations (for example, in fans). The combination of light metal and steel (except stainless steel) must always be avoided at places where friction, impact or abrasion can occur in equipment which in normal operation has moving parts.

3.2.3.4. Chemical reactions

Chemical reactions which develop heat (exothermic reactions) can cause substances to heat up and thus become a source of ignition. Such self-heating is possible if the rate of heat generation exceeds the rate of heat loss to the surroundings. If heat dissipation is impeded or the ambient temperature is high (for example, in storage), the rate of reaction can so increase that the conditions for ignition are attained. Among the decisive parameters are the volume/surface ratio of the reacting system, the ambient temperature and the residence time. The high temperatures developed can lead to the initiation of smouldering and/or burning and also to the ignition of explosive atmospheres. Any flammable substances arising from the reaction (for example, gases or vapours) can in turn form explosive atmospheres with the surrounding air and thus greatly increase the hazardousness of such systems.

In all zones, substances prone to spontaneous combustion should therefore be avoided as far as possible. When it is necessary to work with such substances, the necessary protective measures must be tailored to each individual case.

NB: Suitable protective measures are, for example:

1. inerting;
2. stabilisation;
3. improving heat dissipation, for example, by dividing the substances into smaller portions or providing separating spaces between stored quantities;
4. control of the plant temperature;
5. storage at lowered ambient temperatures;
6. keeping residence times shorter than the time required for dust fires to be initiated.

3.2.3.5. Electrical apparatus

Even at low voltages, electrical sparking and hot surfaces may occur as sources of ignition in electrical apparatus (e.g. on making and breaking circuits and as a result of stray electric currents).

Electrical equipment may therefore be used in hazardous places only if it complies with Annex II to Directive 1999/92/EC. In all zones, new equipment must be selected on the basis of the categories set out in Directive 94/9/EC. In accordance with the explosion protection document the work equipment, including warning devices, must be designed, operated and maintained with due regard for safety.

3.2.3.6. Static electricity

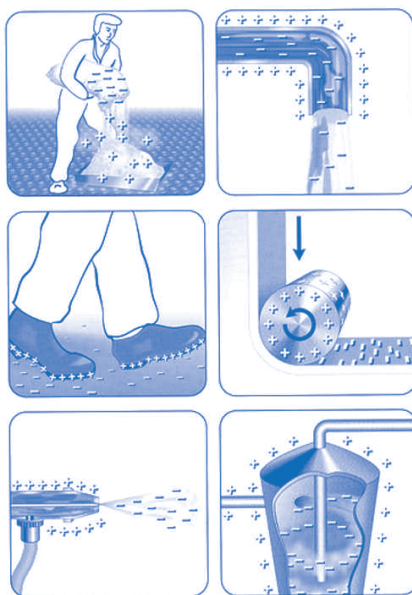
Separation processes involving at least one material with a specific electrical resistance of over $10^9 \Omega\text{m}$ or objects with a surface resistance of over $10^9 \Omega$ may under certain conditions give rise to incendive discharges of static electricity. Figure 3.6 shows various ways in which electrostatic charges may result from charge separation. The following forms of discharge may occur under normal operating conditions:

- spark discharges, which may arise from charge accumulation on unearthed conductive parts;
- brush discharges, which may arise on charged parts made of non-conductive materials, which include most plastics;
- propagating brush discharges, which may occur in fast separation processes, such as films moving over rollers, during pneumatic transport in metal pipes or containers with an insulating coating or on drive belts;
- cone discharges, which may occur, for example, during pneumatic filling of silos.

All the above forms of discharge are to be regarded as capable of igniting most gases and solvent vapours. Mist or dust/air mixtures can also be ignited by these forms of discharge, though brush discharges are to be regarded as merely a possible source of ignition for explosible dusts.

For the necessary assessment and possible protective measures, see Cenelec Report R044-001 'Guidance and recommendations for the avoidance of hazards due to static electricity'.

Figure 3.6. Examples of charge separation which can lead to electrostatic charges⁽¹¹⁾



(11) From the ISSA leaflet 'Gas explosions', International Section for the Prevention of Occupational Risks in the Chemical Industry, International Social Security Association (ISSA), Heidelberg, Germany.

Examples: Important protective measures to be taken, depending on the zone:

1. earthing conductive objects and installations;
2. wearing suitable footwear at all times on suitable floorings, total person-to-earth resistance not to exceed $10^8 \Omega$;
3. avoiding materials and objects of low electrical conductivity;
4. reducing non-conductive surfaces;
5. avoiding the use for dust conveying and filling operations of metallically conducting pipes and containers with an electrically insulating inner coating.

3.3. Mitigation of the effects of explosions (mitigation measures)

In many cases, it is not possible to avoid explosive atmospheres and sources of ignition with a sufficient degree of certainty. Measures must then be taken to limit the effects of an explosion to an acceptable extent. Such measures are:

- explosion-resistant design;
- explosion relief;
- explosion suppression;
- prevention of flame and explosion propagation.

These measures generally relate to mitigation of the hazardous effects of explosions starting within installations. Equipment and protective systems which comply with Directive 94/9/EC are generally used in mitigation measures. Structural measures, for example, blast walls, may also be adopted.

3.3.1. Explosion resistant equipment

Items of plant, such as containers, vessels and piping, are so constructed that they can withstand an internal explosion without rupturing. The initial pressure in the item of plant must be taken into account if it differs from normal atmospheric pressure.

In general, a distinction is made between explosion-resistant designs:

- for the maximum explosion overpressure;
- for the reduced explosion overpressure associated with explosion relief or suppression.

Plant design can be either explosion pressure resistant or explosion pressure shock resistant.

NB: If the inside of a plant is divided into sub-volumes or two tanks are connected by a pipeline, during an explosion in one of the sub-volumes the pressure in the other may be increased and the explosion may thus enter it at an elevated initial pressure. Pressure peaks thus occur which may be higher than the 'maximum explosion pressure' determined for atmospheric conditions. If such arrangements cannot be avoided, appropriate measures should be taken, for example, explosion-resistant design sufficient for the elevated explosion pressure or explosion decoupling.

3.3.1.1. Explosion pressure resistant design

Explosion pressure resistant containers and vessels withstand the expected explosion overpressure without becoming permanently deformed. The design is based on the expected explosion overpressure.

NB: For most gas/air and dust/air mixtures, the maximum explosion overpressure is 8–10 bar, but it may be higher for light-metal dusts.

3.3.1.2. Explosion pressure shock resistant design

Explosion pressure shock resistant containers and vessels are so constructed that, in the event of an internal explosion, they withstand a shock attaining the expected explosion overpressure, but may become permanently deformed.

After explosions, the affected items of plant must be checked for deformation.

3.3.2. Explosion relief

In the broadest sense, 'explosion relief' covers everything that contributes to ensuring that, when an explosion is initiated or propagates to some degree, the originally closed plant within which it is taking place is vented in a safe direction, either briefly or for an extended period, if the actuation pressure of an explosion relief device is attained.

The explosion relief device is intended to ensure that the plant/installation is not subjected to explosion stresses exceeding its strength. A reduced explosion overpressure results.

NB: The reduced explosion overpressure is higher than the actuation pressure of the relief devices.

Bursting discs or explosion doors, for example, can be used as relief devices.

NB: Only tested relief devices which comply with Directive 94/9/EC should be used. Self-made relief devices are often not effective and have in the past led to serious accidents. Unlocked container lids and covers, doors etc. that are placed over the vent openings are usually not suitable. If in-house designs which have proved satisfactory in practice are nonetheless used, their suitability for explosion protection purposes must be demonstrated by a risk assessment, and the result recorded in the explosion protection document. The requirements of Directive 94/9/EC must also be satisfied, where this applies.

The safety-related parameters of the mixture must be known in order to calculate the necessary relief areas for plants.

Explosion relief is not permissible if the vented products can endanger persons or cause harm to the environment (for example, release of toxic substances).

NB: When relief devices are actuated, a great deal of flame and pressure may develop in the direction of discharge. Relief devices must therefore be so installed that the pressure is vented in a safe direction. Venting into workrooms should thus always be avoided. Experience shows that it can be difficult to comply with the necessary safety clearances when retrofitting relief devices in existing plant.

Exception: If 'Q-pipe' systems are used, venting into a room is permissible, since the flame and pressure effects are reduced to such a degree that they are not dangerous. However, the possible release of toxic combustion gases must then be taken into account.

NB: If 'explosion relief' is used as a means of protection, explosion decoupling from upstream and downstream parts of the plant must be ensured.

3.3.3. Explosion suppression

Explosion suppression systems prevent attainment of the maximum explosion pressure by rapidly injecting extinguishing agents into containers and plant in the event of an explosion. The items so protected need thus be designed to withstand only a reduced explosion pressure.

Unlike explosion relief, this ensures that the effects of an explosion are contained within the plant. Depending on design, the explosion overpressure may be reduced to about 0.2 bar.

NB: New explosion suppression systems should be tested and marked as protective systems in accordance with Directive 94/9/EC.

Explosion suppression may also require explosion decoupling from upstream and downstream parts of the plant.

3.3.4. Prevention of explosion propagation (explosion decoupling)

An explosion occurring in one part of a plant can propagate to upstream and downstream parts, where it may cause further explosions. Acceleration caused by plant fittings or propagation in pipes may intensify the explosion effects. The explosion pressures so developed can be much higher than the maximum explosion pressure under normal conditions and may destroy items of plant even if they are of explosion pressure resistant or explosion pressure shock resistant design. It is therefore important to limit possible explosions to single parts of the plant. This is achieved by explosion decoupling.

Explosion decoupling can be performed, for example, by means of:

- rapid-action mechanical isolation;
- flame extinction in narrow gaps or by injection of an extinguishing agent;
- arresting of flame by high counterflow;
- water seals;
- rotary valves.

The following aspects are important in practice.

NB: Since the propagation velocities in explosions of mixtures with air of gases, vapours or mists can sometimes be very high (detonations), active isolation or extinguishing systems are often too slow, and preference is then given to passive systems such as flame arresters, for example, crimped ribbon or water seal arresters.

3.3.4.1. Flame arresters for gases, vapours and mists

Flame arresters can be used to prevent flame transmission in the presence of explosive atmospheres, for example, through piping, breathers and filling and emptying lines that are not full of liquid at all times. If the formation of a hazardous explosive atmosphere cannot be avoided, for example, in a non-explosion-proof container for flammable liquids, arrangements to arrest flame transmission must be made at permanent openings communicating with places where sources of ignition can be expected to occur and allowing an explosion to be transmitted to the container.

NB: This applies, for example, to ventilation devices and reservoir level gauges and to filling and emptying lines, if they are not full of liquid at all times.

Conversely, equivalent measures must be taken to prevent the emission of flame from a vessel into a hazardous place.

The operation of flame arresters essentially depends on one or more of the following mechanisms:

- flame extinction in narrow gaps and channels (e.g. crimped ribbon and sintered metal arresters);
- halting a flame front by discharge of the unburned mixtures at an appropriate velocity (high-velocity valves);
- halting a flame front by means of a liquid seal.

NB: Flame-arresting devices are classified as explosion proof, endurance-burning proof or detonation-proof. Devices which are not endurance-burning proof withstand burning for only a limited time (the fire resistance time) and then lose their flame-arresting capacity.

3.3.4.2. Decoupling devices for dusts

Flame arresters for gases, vapours and mists cannot be used for dusts because of the danger of blockage. The following are of proven practical value in preventing the propagation of dust explosions through connecting pipework, conveying equipment, etc. and the emission of flame from plant.

- Extinguishing barriers: The explosion is detected by sensors. The extinguishing agent is injected from dispersers into the pipework and the flame quenched. This does not affect the explosion pressure developed upstream of the barrier. Pipework and vessels downstream of the barrier, too, must be designed to withstand the expected pressure. The extinguishing agent must be appropriate for the type of dust in question.
- Rapid-action valves or flaps: An explosion travelling through a pipe is detected by sensors. An actuating mechanism closes the valve or flap within milliseconds.
- Quick-acting shut-off valves (explosion isolation valves): When a given flow velocity is exceeded, a valve in the pipe closes. The velocity required for actuation is generated either by the blast wave or a sensor-controlled pilot flow (for example, a jet of nitrogen directed on to the valve cone). The quick-acting shut-off valves so far known may be fitted only in horizontal pipe ranges and are suitable only for pipes with a fairly low dust burden (for example, the exit side of filter units).
- Rotary valves: Rotary valves may be used as 'flame traps' only if their non-transmission of an internal ignition and their pressure resistance have been proven under the service conditions obtaining. In the event of an explosion, a sensor must stop the rotor automatically, so that no burning product is discharged.
- Explosion diverters: An explosion diverter consists of pipe segments joined by a special fitting. The seal to atmosphere is in the form of a venting device (cover plate or bursting disc; actuation overpressure usually $p \leq 0.1$ bar). The aim is to prevent explosion propagation by diverting the flow through 180 degrees while providing explosion relief on opening of the venting device at the point of flow reversal.

Projection of fragments of the venting device must be prevented, for example, by means of a wire guard. Venting must always take place in a safe direction, never into working areas or travelling ways. This means of protection may not be used if persons can be endangered or the environment harmed by the discharge.

Explosion diverters do not always reliably prevent the propagation of explosions. However, development of the flame front is so disrupted that a slowly moving explosion is the worst that is to be expected in the downstream pipe run. Where mixtures at explosive concentrations are not to be expected in the piping, for example, in many dedusting units, it can be assumed that the decoupling effect is adequate.

- **Product barrier choke:** In combination with explosion relief, chokes consisting of an adequate depth of the product being handled (for example, at a silo discharge) are suitable for decoupling parts of a plant. The amount of material must be monitored by level indicators and must be sufficient to ensure that the explosion pressure cannot cause the flame to penetrate through the product.
- **Double valves:** Product discharges from explosion proof vessels can be protected with a double valve system to prevent flame transmission. The valves must be at least as strong as the vessels. They must be controlled to ensure alternating closure such that there is always one valve closed.

NB: All explosion decoupling systems falling under Directive 94/9/EC should be tested and marked as protective systems in accordance with the directive's requirements.

3.4. Application of process control engineering

The explosion protection measures so far described can be kept operational, monitored or triggered by safety, controlling and regulating devices (hereafter referred to as process control engineering — PCE). Generally, PCE devices can be used to prevent the occurrence of hazardous explosive atmospheres or ignition sources or to mitigate the harmful effects of an explosion.

Potential ignition sources, such as a hot surface, can be monitored by PCE devices and controlled to ensure that a safe value is not exceeded. Potential ignition sources can also be switched off when a hazardous explosive atmosphere arises. For example, non-explosion-proof electrical equipment can be made dead when a gas alarm is triggered, if this allows the potential ignition sources within the equipment to be de-energised. The occurrence of hazardous explosive atmospheres can be prevented, for example, by starting a fan before the maximum permissible gas concentration is reached. The use of such PCE devices can reduce the size of hazardous places (zones), make it less likely that a hazardous explosive atmosphere will arise or prevent it from arising altogether. PCE devices in conjunction with devices for mitigating the harmful effects of an explosion are protective systems (for example, explosion suppression systems) and are described under mitigation measures in Section 3.3. The design and scale of such PCE devices and the measures triggered by them depend on the probability of occurrence of a hazardous explosive atmosphere and of effective ignition sources. The reliability of the PCE devices in conjunction with the technical and organisational measures taken must ensure that the danger of an explosion is limited to an acceptable level, under all operating conditions. In certain cases, it can be useful to combine PCE devices for preventing ignition sources with PCE devices for preventing hazardous explosive atmospheres.

The degree of reliability required of PCE devices depends on the assessment of the explosion risks. Reliability of the safety function of PCE devices and their components is achieved by fault avoidance and fault control (having regard to all operating conditions and the planned servicing and/or maintenance arrangements).

Example: If assessment of the explosion risks and the explosion protection strategy leads to the conclusion that there will be a high risk without PCE devices, for example, that hazardous explosive atmospheres are present continuously, for long periods or frequently (zone 0, zone 20) and that an operational malfunction is liable to give rise to an effective ignition source, the PCE devices must be so designed that a single PCE fault cannot make the safety arrangements ineffective. This can be achieved, for example, by redundant use of such devices. A comparable result can be achieved if a single PCE device for avoiding hazardous explosive atmospheres is combined with an independent single PCE device for avoiding effective ignition sources.

Table 3.2 shows approaches to using these devices, instead of or in addition to process engineering measures, in order to avoid effective ignition sources under normal operating conditions and for likely and infrequent malfunctions.

Example: A transmission with several bearings is to be operated in zone I. In normal operation, the temperature of the bearings is reliably below the ignition temperature of the gas/air mixture. In the event of a fault (for example, resulting from a loss of lubricant), the bearing temperature may reach the ignition temperature if no protective measures are taken. An adequate standard of safety can be achieved by monitoring the temperature of the bearings, the unit being shut down if the maximum permissible surface temperature is reached.

The requirements for PCE devices as shown in Table 3.2 can likewise be applied to the prevention of hazardous explosive atmospheres if the likelihood of potential ignition sources is given and it is necessary to ensure that the area in question meets the criteria for a particular zone.

Example: Solvent-covered workpieces are dried in a drying cabinet. In the event of a malfunction, the surface temperature of the heating unit can reach the ignition temperature. A PCE device linked to a fan has to be used to ensure that the solvent concentration does not exceed the limit value (LEL minus safety margin specific to the plant). This fan-linked device must remain effective in the event of a malfunction (e.g. a power cut).

Table 3.2. Use of PCE devices to reduce the probability of effective ignition sources

Hazardous place	Occurrence of ignition sources	Requirements for PCE devices
None	Operationally necessary	None
Zone 2 or zone 22	Operationally necessary	Suitable single device for avoiding ignition sources
	Unlikely in normal operation	None
Zone I or zone 21	Operationally necessary	Two suitable devices for avoiding ignition sources (*)
	Unlikely in normal operation	Suitable single device for avoiding ignition sources
	Unlikely in normal operation or in the event of malfunction	None
Zone 0 or zone 20	Unlikely in normal operation	Two suitable devices for avoiding ignition sources
	Unlikely in normal operation or in the event of malfunction	Suitable single device for avoiding ignition sources*
	Unlikely in normal operation, in the event of malfunction or in the event of rare malfunctions	None

(*) Or an equivalent device tested in accordance with Directive 94/9/EC.

NB:

1. The PCE measures described can be adopted only if the physical, chemical and process parameters relevant to explosion protection can in fact be regulated or controlled, in an acceptably economical way and within a sufficiently short time. Materials properties, for example, generally cannot be influenced by such devices.
2. New PCE devices used for the avoidance of ignition sources, or of an explosive atmosphere arising (without reliably preventing it) in a hazardous zone must conform to European Directive 94/9/EC. Such PCE devices must always be tested to the same category as the equipment to be protected.

3.5. Requirements for work equipment

The employer must ensure that work equipment and all installation materials are suitable for use in hazardous places. In doing so, he must take account of the possible ambient conditions at the workplace in question. The work equipment must be so assembled, installed and operated that it cannot cause an explosion.

3.5.1. Selection of work equipment

Equipment and protective systems in the places where hazardous explosive atmospheres may be present must be chosen in accordance with the categories in Directive 94/9/EC, unless otherwise provided in the explosion protection document on the basis of the risk assessment. Further criteria such as temperature class, type of protection and explosion group must be considered to ensure safe operation of equipment in hazardous places. These criteria depend on the combustion and explosion properties of the substances used.

Work equipment for use in places where explosive atmospheres may occur which is already in use or is made available in the undertaking or establishment for the first time before 30 June 2003 shall comply from that date with the minimum requirements laid down in Annex II, Part A, if no other Community directive is applicable or is so only partially.

Work equipment for use in places where explosive atmospheres may occur which is made available in the undertaking or establishment for the first time after 30 June 2003 shall comply with the minimum requirements laid down in Annex II, Parts A and B.

Although work equipment not falling under the definition of 'equipment' given in Directive 94/9/EC cannot be compliant with this directive, it must nevertheless be compliant with Directive 1999/92/EC.

If the assessment of explosion risks (material properties, processes) indicates that the potential risk to workers and other persons is abnormally high, the equipment and work equipment chosen may have to have a higher degree of protection. If the manner in which mobile work equipment is used may lead to its operation in areas with different hazard potentials (different zoning), it must be selected on the basis of the worst case. If an item of work equipment is used in both zone 1 and zone 2, it must satisfy the requirements for operation in zone 1.

Exceptions are permissible if suitable organisational measures ensure safe operation for the whole period in which the mobile equipment is used in a hazardous place. These measures should be detailed in the Permit to Work, and/or the explosion protection document. Such work equipment may be used only by suitably trained personnel (89/655/EEC).

Table 3.3. Equipment for use in the various zones

Zones	Categories usable without further measures	If designed for
0	II I G	- gas/air mixture - vapour/air mixture - mist
I	II I G or 2 G	- gas/air mixture - vapour/air mixture - mist
2	II I G or 2 G or 3 G	- gas/air mixture - vapour/air mixture - mist
20	II I D	dust/air mixture
21	II I D or 2 D	dust/air mixture
22	II I D or 2 D or 3 D	dust/air mixture

NB: If equipment is to be used in hybrid mixtures, it must be suitable for such use and tested if appropriate. An item of equipment marked II 2 G/D is thus not necessarily suitable and permissible for use in hybrid mixtures.

3.5.2. Assembly of work equipment

Work equipment and connecting devices (such as pipework or electrical connections) must be so assembled that they cannot cause or trigger an explosion. They may be put into service only if the assessment of explosion risks establishes that their operation does not cause ignition of an explosive atmosphere. This also applies to work equipment and associated connecting devices which are not equipment and protective systems within the meaning of Directive 94/9/EC.

In accordance with the European Directive 89/655/EEC (safety and health requirements for the use of work equipment by workers at work) the employer must ensure that the equipment used is suitable for the actual operating and service conditions. When selecting installation materials, work clothing and personal protective equipment, he must likewise ensure that they are suitable.

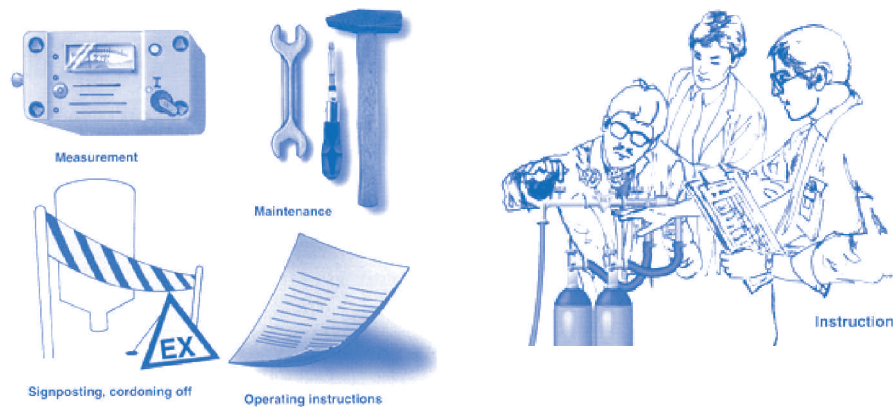
4. Organisational measures for explosion protection

If there is a potential risk of explosion at a workplace, this also implies that the work organisation must meet certain requirements. Organisational measures must be taken where technical measures alone cannot ensure and maintain explosion protection at the workplace. In practice, the work environment can also be made safe by combining technical and organisational measures.

Example: If inert gas is emitted through openings in the plant which are present in normal operation or result from defects, workers may be at risk from oxygen displacement (suffocation). When an item of apparatus has been inerted, for example, it may not be entered until inerting has been discontinued and sufficient atmospheric oxygen supplied, or if proper precautions and breathing apparatus are used.

Organisational measures so arrange the working procedures that workers cannot be harmed by an explosion. Arrangements must also be laid down for inspection, servicing and repair to ensure that technical measures remain operational. Organisational measures must also take account of possible interaction between explosion protection measures and working procedures. These combined explosion protection measures must ensure that workers can perform the work assigned to them without danger to their safety and health or to the safety and health of others.

Figure 4.1. Examples of organisational explosion protection measures ⁽¹²⁾



The following organisational measures must be carried out:

- produce written operating instructions, where required by the explosion protection document;
- instruct workers in explosion protection;
- ensure workers have adequate competence;
- apply a permit-to-work system for dangerous work, where required by the explosion protection document;
- carry out maintenance;
- carry out inspection and surveillance;
- mark hazardous places, where necessary.

The organisational measures taken must be recorded in the explosion protection document (see Section 6). A few examples are shown in Figure 4.1.

(12) From the ISSA leaflet 'Gas explosions', International Section for the Prevention of Occupational Risks in the Chemical Industry, International Social Security Association (ISSA), Heidelberg, Germany.

4.1. Operating instructions

Operating instructions are activity-related binding instructions and rules of conduct issued in writing by the employer to the employees. They describe the workplace-related dangers to human beings and the environment and indicate the protective measures taken or to be observed.

Operating instructions are produced by the employer or a competent person whom he appoints to perform the task and must be observed by workers. They relate to a particular workplace or part of the establishment. Among the matters to be covered by operating instructions for workplaces where there are explosive atmosphere risks are what explosion hazards exist and where, what mobile work equipment may be used and whether special personal protective equipment must be worn.

Example: The operating instructions may include a list of all mobile work equipment permitted for use in the hazardous place in question. They should indicate what personal protective equipment must be worn by persons entering this place.

They must be so worded that all workers can understand and apply them. If the establishment employs workers who do not have an adequate command of the language of the country, the operating instructions must be written in a language that they understand.

It may be appropriate for activity-related sets of operating instructions which describe different hazards or are produced on the basis of different statutory provisions to be combined into a single set of operating instructions, so providing an overall view of the hazards.

It is advisable for the operating instructions in an establishment to have a uniform presentation in order to take advantage of the familiarity effect.

4.2. Worker competence

For every workplace, there should be available a sufficient number of workers with the requisite experience and training to perform the explosion protection tasks assigned to them.

4.3. Training of workers

Employers must provide workers with training which informs them of the explosion hazards at the workplace and the protective measures taken. This training must explain how the explosion hazard arises and in what parts of the workplace it is present. The measures taken should be listed and their operation explained. The correct way of working with the equipment available must be explained. Workers must be instructed in safe work in or near hazardous places. This also involves explaining the meaning of any marking of hazardous places and specifying what mobile work equipment may be used there (see 3.5.1). Workers must also be instructed in what personal protective equipment they must wear at work. The available operating instructions should be covered during the training.

NB: Well-trained workers greatly increase safety at work. Any deviation from the desired process can be detected, and hence corrected, more quickly.

Workers must receive training (89/391/EEC):

- on recruitment (before starting work);
- in the event of a transfer or a change of job;
- when work equipment is introduced for the first time or changed;
- when new technology is introduced.

Training of workers must be repeated at suitable intervals, for example once per year. On completion of training, it can be useful to check on what has been learned.

The duty to provide training also applies to the employees of outside contractors. Training must be given by a competent person. Records should be kept in writing of the date and content of training activities and the participants.

4.4. Worker supervision

In working environments where explosive atmospheres may arise in such quantities as to endanger the safety and health of workers, appropriate supervision during the presence of workers must be ensured, in accordance with the risk assessment, by the use of appropriate technical means.

4.5. Permit-to-work system

If work liable to cause an explosion is to be carried out in or near a hazardous place, it must be authorised by the person with responsibility for this function within the establishment. This also applies to activities which may interact with other work to cause hazards. A system of permits-to-work has proved useful in such cases. This may be implemented by means of a permit-to-work form which all concerned must receive and sign.

Example: The permit-to-work form should indicate at least the following details:

1. where exactly the work is to be carried out;
2. clear identification of the work to be undertaken;
3. hazard identification;
4. precautions necessary, person undertaking the precautions should sign on to show that they have been taken;
5. personal protective equipment needed;
6. when the work will begin and when it is expected to end;
7. acceptance, confirming understanding;
8. extension/shift Handover procedure;
9. handback, plant ready for testing and recommissioning;
10. cancellation, plant tested and recommissioned;
11. report on any anomaly discovered during the work.

Once the work has been finished, a check must be made to establish whether the plant is still safe or has been made safe again. All concerned must be informed when the work is finished.

4.6. Maintenance

Maintenance comprises repair, servicing and inspection. Before maintenance work begins, all concerned must be informed and the work must be authorised, for example, by means of a permit-to-work system (see above). It may be carried out only by competent persons.

Experience shows that a high accident risk attaches to servicing work. Before, during and after completion of the work, care must therefore be taken to ensure that all necessary protective measures are taken.

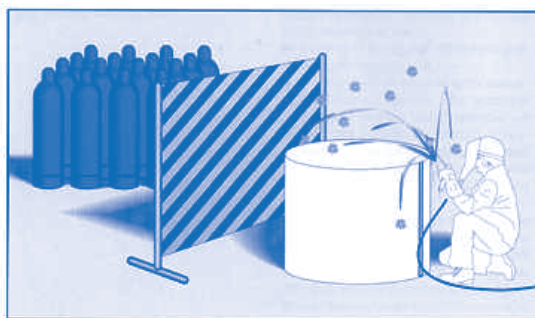
NB: During servicing, items of equipment or plant which could cause an explosion if inadvertently switched on during the work must if possible be mechanically and/or electrically isolated. For example, if open flame operations are carried out in a container, all pipes from which a hazardous explosive atmosphere may be emitted or which are connected to other containers where such an atmosphere could be present must be separated from the container and blinded off or closed by some comparable means.

When maintenance involving a risk of ignition is carried out in a hazardous place, it should be reliably ensured that it will be free of hazardous explosive atmospheres for the duration of the work and if necessary for some time thereafter (for example, to allow cooling).

Except in exceptional circumstances, when other appropriate and adequate precautions have been taken, the items of plant on which work is to be carried out must as necessary be emptied, depressurised, cleaned, purged and must be free of flammable substances. While work is in progress, such substances must not reach the place where it is being carried out.

Where work may give rise to flying sparks (for example, welding, flame cutting, grinding), suitable screening should be provided (see Figure 4.2) and a fire sentry posted if necessary.

Figure 4.2. Example of screening for work giving rise to flying sparks ⁽¹³⁾



Once maintenance has been completed, steps must be taken to ensure that the explosion protection measures required for normal service are again operative before the equipment is restarted. A permit-to-work system (see above) is particularly useful during servicing and maintenance work. It can be useful to use a checklist for the restoration of explosion protection measures.

⁽¹³⁾ From the ISSA leaflet 'Gas explosions', International Section for the Prevention of Occupational Risks in the Chemical Industry, International Social Security Association (ISSA), Heidelberg, Germany.

4.7. Inspection and checking

Before a workplace containing places where hazardous explosive atmospheres may occur is used for the first time, and after any damage or alterations with safety implications, its overall explosion safety must be verified.

The effectiveness of the explosion protection measures taken in a plant must be checked at regular intervals. The frequency of such checks depends on the type of measure. All checks may be carried out by competent persons only.

Competent persons are persons with comprehensive expertise in explosion protection as a result of their professional training, experience and current professional activity.

Example: The performance of gas alarm systems must be verified by a competent person after installation and at suitable intervals, observing any pertinent national regulations and manufacturer's instructions. Where hybrid mixtures could arise, the detectors must be suitable for both phases and be calibrated against the possible mixtures.

Example: Ventilation systems intended to prevent hazardous explosive atmospheres and the associated monitoring systems must be checked by a competent person against the intended duty before they are first brought into service and should be examined at regular intervals. Ventilation systems with adjustable items (for example, regulators, baffles, variable-speed fans) should be examined every time the settings are changed. It is desirable for such items to be locked against interference. Where ventilation systems are adjusted automatically, the examination should cover the entire range of settings.

4.8. Marking of hazardous places

Directive 1999/92/EC stipulates that the points of entry to places where hazardous explosive atmospheres may occur in such quantities as to endanger the health and safety of workers must, where necessary, be marked by the employer with the following warning sign:

Figure 4.3. Warning sign for places where explosive atmospheres may occur



Distinctive features:

- triangular shape,
- black letters on a yellow background with black edging (the yellow part to take up at least 50 % of the area of the sign).

Such marking is required, for instance, for rooms or areas in which a hazardous explosive atmosphere may arise (such as rooms or fenced enclosures where flammable liquids are stored). On the other hand, there is no point in marking an item of plant which is fully protected by mitigation measures. If the hazardous place is not the whole space concerned, but only part of it, that part may be marked by yellow/black diagonal stripes, for example on the floor.

Other details may be added to the warning sign, indicating, for example, the nature and frequency of occurrence of the hazardous explosive atmosphere (substance and zone). It may be desirable to place other warning signs in accordance with 92/58/EEC, such as forbidding smoking, etc.

Workers' attention must be drawn to the sign and its meaning in the course of their training.

5. Coordination duties

Where independent persons or teams are working simultaneously and in proximity to one another, they may inadvertently place each other at risk, particularly since those concerned focus primarily on their own tasks, while nothing or not enough is often known about the commencement, nature or extent of the work being done by others nearby.

Examples: Typical results of poor coordination between the employer's and contractor's staff, giving rise to particular explosion risks, are as follows.

1. The contractor is not aware of the environmental hazard at the firm where it is engaged and the implications for its own work.
2. The in-house departments often do not know that outside staff are working in the establishment and/or what potential hazard is being imported as a result of the work carried out.
3. The house management is not told how it and its staff have to conduct themselves in relation to the contractor.

Even safe working practices within a team do not exclude the possibility that others in the vicinity may be endangered. The only guarantee against hazardous interaction is timely coordination of all involved.

When work is contracted out, the principal and contractor are therefore required to coordinate their activities in order to avoid placing each other at risk. This duty also relates to the requirement of Article 7 (4) of the Framework Directive 89/391/EEC, where several employers' workers are working at the same workplace. For worksites, the pertinent national regulations must also be complied with.

5.1. Coordination arrangements

Where workers from several undertakings are present at the same workplace, each employer is responsible for all matters coming under his control.

Without prejudice to the individual responsibility of each employer under Directive 89/391/EEC, the task of coordination falls to the employer responsible for the workplace in accordance with national law and/or practice shall coordinate the implementation of all the measures concerning workers' health and safety. He has a duty to ensure that operations proceed safely in order to safeguard workers' lives and health. To this end, he must acquaint himself with the explosion hazards, discuss protective measures with the persons concerned, issue instructions and check that they are obeyed. He shall state in the explosion protection document the aim of the coordination and the measures and procedures for implementing it.

The employer responsible for the workplace in accordance with national law and/or practice, is also responsible for coordinating the implementation of all the measures concerning workers' health and safety with all other employers sharing the worksite.

Because of the size of the firm or for other reasons, the employer is not always able to discharge this duty alone. He should therefore appoint suitable persons as managers. These then take over the employer's duties on their own responsibility, coordination duties being taken over by the coordinator.

NB: Specifically as regards work in or in connection with hazardous places or work with flammable substances that may give rise to hazardous explosive atmospheres, hazardous interaction must be assumed even if it is not immediately apparent. In case of doubt, it is therefore suggested that the employer could appoint a coordinator.

In view of his special planning, safety and organisational responsibilities, the employer or coordinator should satisfy the following requirements relevant to explosion protection:

- explosion protection expertise;
- knowledge of the national regulations transposing Directives 89/391/EEC and 1999/92/EC;
- knowledge of the firm's organisational structure;
- leadership qualities to ensure that the necessary instructions are put into effect.

In principle, the task of the employer or his coordinator is to orchestrate the work of the various groups irrespective of the firms they belong to, in order to detect situations in which they may endanger each other and to be able to take any necessary action. He must therefore be informed in good time of the work to be undertaken.

NB: The house staff, the contractor(s) and all others working on the site should provide the employer or his coordinator in good time with the following information:

- work to be undertaken;
- planned start of work;
- anticipated end of work;
- place of work;
- workers assigned;
- planned method of work plus measures and procedures for implementing the explosion protection document;
- name of the person(s) in charge.

More specifically, the duties of the employer or his coordinator comprise site inspections and coordination meetings, as well as planning, supervision and if necessary replanning of work in response to difficulties arising. See checklist A.3.5.

5.2. Protective measures to ensure safe cooperation

In establishments where hazardous explosive atmospheres arise, different groups may work together at various levels and in all departments. In laying down and executing measures to avoid hazardous interaction, it is therefore necessary to consider all cases in which the task to be performed and the way it is carried out may lead to persons working together or in each other's vicinity, or interacting over a distance (for example, when working on the same pipework or electrical circuit in different locations).

In practice, the coordination measures relevant to explosion protection are usually part of the general coordination functions:

- at the planning stage;
- at the execution stage;
- on completion of the work.

At these various stages, the employer or his coordinator must also ensure that the necessary organisational measures are taken to avoid interaction between hazardous explosive atmospheres, ignition sources and operational malfunctions.

Examples:

1. Prevent the formation of hazardous explosive atmospheres around technical plant where ignition sources are to be expected [see 3.1], for example, by using substitutes for solvent-containing cleaning agents, paints, etc. or providing adequate ventilation.
2. Avoid using and creating ignition sources in places where hazardous explosive atmospheres may arise, for example, in welding, cutting, soldering and separation work [see Section 4.4/4.5 and specimen permit A.3.3].
3. Prevent malfunctions arising, for example, from interruption of gas supply, inducing of pressure fluctuations or shutdown of power or protective systems as a result of work in adjacent units.

A checklist can be used as an aid to determining whether the agreed protective measures are carried out during the work and whether the persons concerned have received adequate instruction and duly apply these measures [see Annex 3.4].

NB: Irrespective of individuals' duties, all concerned should:

- seek contact;
- consult;
- show consideration;
- respect what has been agreed.

6. Explosion protection document

6.1. Requirements under Directive 1999/92/EC

As one of his duties under Article 4 of Directive 1999/92/EC, the employer must ensure that an explosion protection document is drawn up and kept up to date.

This document must at least demonstrate:

- that the explosion risks have been determined and assessed;
- that adequate measures will be taken to attain the aims of the directive;
- those places which have been classified into zones;
- those places where the minimum requirements set out in Annex II to the directive will apply;
- that the workplace and work equipment, including warning devices, are designed, operated and maintained with due regard for safety;
- that, in accordance with Council Directive 89/655/EEC, arrangements have been made for the safe use of work equipment.

The explosion protection document must be drawn up prior to the commencement of work and be revised when the workplace, work equipment or organisation of the work undergoes significant changes, extensions or conversions.

The employer may combine existing risk assessments, documents or other equivalent reports and incorporate them into the explosion protection document.

6.2. Implementation

The explosion protection document is intended to provide an overview of the results of the risk assessment and the consequent technical and organisational protective measures for a plant and its working environment.

A specimen layout for an explosion protection document is shown below. It contains points which can be useful in addressing the above requirements and can be used as an aid in producing such documents.

However, this does not imply that all these points must be included. The document must be tailored to conditions in the firm concerned. It should, as far as possible, be well-structured and easy to read and the degree of detail should be such as to allow a general grasp of its content. The amount of documentation should therefore not be excessive. When necessary, the document should be produced in a form that allows additions, for example, as a loose-leaf collection. This is particularly recommended for larger plants or where the plant engineering is frequently changed.

Article 8 of Directive 1999/92/EC expressly allows existing explosion risk assessments, documents or reports to be combined, for example, the safety report under Directive 96/82/EC ⁽¹⁴⁾. An explosion protection document may thus contain references to other documents without explicitly including them in full.

When establishments have several plants containing hazardous places, it can be useful to divide the explosion protection document into a general and a plant-specific part. The general part explains the structure of the documentation and measures applying to all plants, such as training. The plant-specific part describes the hazards and protective measures in the individual plants.

If operating conditions in a plant change frequently, for example as a result of batch processing of different products, the most dangerous conditions should be taken as the basis for assessment and documentation.

(14) Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances, OJ L 10, 14.1.1997, p.13.

6.3. Specimen layout for an explosion protection document

6.3.1. Description of the workplace and working areas

The workplace is divided into working areas. The explosion protection document describes the working areas at risk from explosive atmospheres.

The description may contain, for example, the name of the establishment, type of plant, building/room designation and persons in charge, number of workers employed.

Documentation of the buildings and topography may be in graphic form, for example, site and layout plans, including plans of escape and rescue routes.

6.3.2. Description of the process steps and/or activities

The process should be described in a brief text, perhaps accompanied by a flowchart. This description should contain all information that is important for explosion protection. It should cover the operational steps including start-up and shutdown, an overview of design and operational data (for example, temperature, pressure, volume, throughput, rotational speed, work equipment), the nature and extent of cleaning if relevant, and possibly details of space ventilation.

6.3.3. Description of the substances used/safety parameters

This should in particular indicate what substances form the explosive atmosphere and under what process conditions it arises. At this point, it is useful to list the safety parameters relevant to explosion protection.

6.3.4. Results of the risk analysis

This section should indicate where hazardous explosive atmospheres may arise, possibly distinguishing between the inside of items of plant and their surroundings. Startup and shutdown, cleaning and malfunctions must be taken into account as well as normal operation. The procedure for process or product changes must also be addressed where appropriate. The hazardous places (zones) can be described by means of a text and also represented graphically as a zone plan (see 3.2.1).

The explosion hazards should also be described at this point (see Section 2). It is useful to state the procedure followed in identifying the explosion risks.

6.3.5. Explosion protection measures taken

This section is based on the risk assessment and describes the resulting explosion protection measures. The principle underlying the protective measures should be stated, for example, 'Avoidance of effective ignition sources'. It is useful to distinguish between technical and organisational measures.

Technical measures

- Prevention

As the explosion protection strategy for the plant is based, fully or in part, on preventive measures — avoidance of explosive atmospheres or of ignition sources — the way in which these measures are implemented must be described in detail (see 3.1 and 3.2).

- **Mitigation**
As the plant will be protected by mitigation measures, their nature, manner of operation and location must be described (see 3.3).
- **PCE measures**
If PCE measures are part of the explosion protection strategy, their nature, manner of operation and location must be described (see 3.4).

Organisational measures

The organisational measures must also be described in the explosion protection document (see Section 4).

The explosion protection document must demonstrate:

- what operating instructions have been produced for a workplace or activity;
- what steps are taken to ensure competence of the persons employed;
- the content and frequency of training (and the participants);
- any rules for the use of mobile work equipment in hazardous places;
- what steps are taken to ensure that workers wear only suitable protective clothing;
- whether a permit-to-work system is in place and, if so, how it is organised;
- how maintenance, inspection and checking are organised;
- how the hazardous places are marked.

If forms relating to these points are available, specimens can be attached to the explosion protection document. A list of mobile work equipment authorised for use in hazardous places should be attached. The level of detail should depend on the type and size of the operation, and the degree of risk involved.

6.3.6. Implementation of the explosion protection measures

The explosion protection document should indicate who is responsible for carrying out particular measures or who has been or will be appointed (for example, to produce and update the explosion protection document itself). It should also state when the measures have to be taken and how their effectiveness is to be checked.

6.3.7. Coordination of the explosion protection measures

Where workers from several undertakings are present at the same workplace, each employer is responsible for all matters coming under his control. The employer responsible for the workplace must coordinate the implementation of all the explosion protection measures and state in his explosion protection document the aim of that coordination and the measures and procedures for implementing it.

6.3.8. Annex to the explosion protection document

The annex may contain, for example, EC-type examination certificates, EC certificates of conformity, safety datasheets, operating instructions for plant or equipment. Servicing plans relevant to explosion protection may also be included.

ANNEXES

A.1. Glossary

As an aid to a clear understanding of this guide, some major explosion protection terms are defined below. Sources are quoted for legal definitions taken from the European directives and harmonised standards. Definitions for other terms were taken from the technical literature.

Atmospheric conditions:

Atmospheric conditions are generally understood to mean an ambient temperature between $-20\text{ }^{\circ}\text{C}$ and $60\text{ }^{\circ}\text{C}$ and a pressure range of 0.8–1.1 bar. [ATEX Guidelines, Directive 94/9/EC]

Category:

Classification of equipment according to the required level of protection. [Directive 94/9/EC]

Components:

'Components' means any items essential to the safe functioning of equipment and protective systems but with no autonomous function. [Directive 94/9/EC]

Degree of dispersion:

Measure of the (finest) distribution of a solid or liquid (disperse phase) in another gas or liquid (dispersion medium) without any molecular association, such as an aerosol, emulsion, colloid or suspension.

Effective source of ignition:

Sources of ignition are often underestimated or overlooked. Their effectiveness, that is, the ability to ignite an explosive atmosphere, depends e.g. on the energy of the source and the properties of the atmosphere. Under non-atmospheric conditions, there are changes in the parameters of explosive mixtures that determine whether ignition occurs: for example, the minimum ignition energy of high-oxygen mixtures is reduced by several factors of 10.

Employer:

Any natural or legal person who has an employment relationship with the worker and has responsibility for the undertaking and/or establishment. [Directive 89/391/EEC]

Equipment:

'Equipment' means machines, apparatus, fixed or mobile devices, control components and instrumentation thereof and detection or prevention systems which, separately or jointly, are intended for the generation, transfer, storage, measurement, control and conversion of energy and/or the processing of material and which are capable of causing an explosion through their own potential sources of ignition. [Directive 94/9/EC]

Equipment category:

Equipment and protective systems may be designed for a particular explosive atmosphere. In this case, they must be marked accordingly. [Directive 94/9/EC]

NB: Equipment may also be designed for use in various explosive atmospheres, for example, in both dust/air and gas/air mixtures.

Equipment group:

Equipment group I applies to equipment intended for use in underground parts of mines, and to those parts of surface installations of such mines, liable to be endangered by firedamp and/or combustible dust. Equipment group II applies to equipment intended for use in other places liable to be endangered by explosive atmospheres. [Directive 94/9/EC]

NB: Group I equipment is not relevant for the purposes of this Guide (see 1.2 Scope of the guide).

Explosion:

Abrupt oxidation or decomposition reaction producing an increase in temperature, pressure or in both simultaneously. [EN 1127-1]

Explosion group:

On the basis of their maximum permitted gap (the ability of an explosion flame to be propagated through a defined gap is determined in a standard apparatus) and minimum igniting current (current leading to ignition in a standard apparatus), gases and vapours are divided into three groups (II A, II B, II C – II C being the group with the smallest maximum permitted gap).

Explosion limits:

If the concentration of a sufficiently dispersed flammable substance in air exceeds a minimum value (the lower explosion limit), an explosion is possible. No explosion occurs if the gas or vapour concentration exceeds a maximum value (the upper explosion limit).

Explosion limits change under conditions other than atmospheric. The range of concentrations between the explosion limits widens, for example, generally as the pressure and temperature of the mixture increase. An explosive atmosphere can form above a flammable liquid only if the temperature of the liquid exceeds a minimum value.

Explosion pressure (maximum):

Maximum pressure occurring in a closed vessel during the explosion of an explosive atmosphere, determined under specified test conditions. [EN 1127-1]

Explosion pressure resistant:

Property of vessels and equipment designed to withstand the expected explosion pressure without becoming permanently deformed. [EN 1127-1]

Explosion pressure shock resistant:

Property of vessels and equipment designed to withstand the expected explosion pressure without rupturing but allowing permanent deformation. [EN 1127-1]

Explosion relief:

Protective measure of limiting the explosion overpressure which will prevent a vessel, workplace or building from exceeding its design strength (explosion resistance) by exhausting unburned mixture and products of combustion by opening a given area.

Explosion relief area:

Geometric vent area of an explosion relief device.

Explosion relief device:

Device which closes a vent opening during normal operation and opens it in case of explosion.

Explosive atmosphere:

‘Explosive atmosphere’ means a mixture with air, under atmospheric conditions, of flammable substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture. [Directive 1999/92/EC]

It is to be noted that an explosive atmosphere, as defined by the directive, may not be capable of burning fast enough to produce an explosion, as defined by EN 1127-1.

Explosive mixture:

Mixture of a fuel finely divided in the gaseous phase and a gaseous oxidant in which an explosion can propagate after ignition has occurred. If the oxidant is air under atmospheric conditions, the term explosive atmosphere is used.

Flashpoint:

Minimum temperature at which, under specified test conditions, a liquid gives off sufficient combustible gas or vapour to ignite momentarily on application of an effective ignition source. [EN 1127-1]

Hazardous explosive atmosphere:

Explosive atmosphere present in hazardous quantities.

Hazardous place (place where explosive atmospheres may occur):

A place in which an explosive atmosphere may occur in such quantities as to require special precautions to protect the health and safety of the workers concerned is deemed to be hazardous. [Directive 1999/92/EC]

Hazardous quantities:

Explosive atmosphere in such quantities as to endanger the health and safety of workers or others. [Directive 1999/92/EC]

As little as 10 litres of an explosive atmosphere as a continuous volume must generally be regarded as hazardous in confined spaces irrespective of the size of the space.

Hybrid mixtures:

Mixture of flammable substances with air in different physical states, e.g. mixtures of methane, coaldust and air. [EN 1127-1]

Ignition source:

An ignition source releases to an explosive mixture a quantity of energy capable of causing ignition to spread in this mixture.

Ignition temperature:

The lowest temperature of a heated wall, as determined under specified test conditions, at which the ignition of a combustible substance in the form of a gas, vapour or dust mixture with air will occur. [EN 1127-1]

Intended use:

The use of equipment, protective systems, and devices referred to in Article 1 (2) in accordance with the equipment group and category and with all the information supplied by the manufacturer which is required for the safe functioning of equipment, protective systems and devices. [Directive 94/9/EC]

Limiting oxygen concentration:

Maximum oxygen concentration in a mixture of a flammable substance and air and an inert gas in which an explosion will not occur, determined under specified test conditions. [EN 1127-1]

Lower explosion limit:

The lower limit of the range of the concentration of a flammable substance in air within which an explosion can occur. [EN 1127-1]

Materials which may form an explosive atmosphere:

Flammable and/or combustible substances are considered as materials which may form an explosive atmosphere unless an investigation of their properties has shown that in mixtures with air they are incapable of independently propagating an explosion. [Directive 1999/92/EC]

Non-hazardous place:

A place in which an explosive atmosphere is not expected to occur in such quantities as to require special precautions is deemed to be non-hazardous. [Directive 1999/92/EC]

Particle size:

Nominal diameter of a dust particle.

Protective system:

'Protective systems' means devices other than components of the equipment defined above which are intended to halt incipient explosions immediately and/or to limit the effective range of an explosion and which are separately placed on the market for use as autonomous systems. [Directive 94/9/EC]

NB: The term 'protective systems' also covers integrated protective systems placed on the market in conjunction with an item of equipment.

Q-pipe:

Q-pipes can be placed downstream of explosion relief devices. A special wire mesh arrests the explosion flame, so that it does not spread beyond the Q-pipe.

Smouldering point:

The smouldering point is the temperature above which the decomposition gases evolved must be expected to give rise to an explosive mixture.

Surface temperature, maximum permissible:

Maximum permissible temperature of a surface (for example, of an item of equipment), obtained by deducting a fixed temperature value from the ignition and/or glow temperature.

Technically leakproof:

A subunit is 'technically leakproof' if a leak is not discernible during testing, monitoring or checking for leakproofness by a method appropriate to the application, e.g. using foaming agents or leak searching/indicating equipment, but the possibility of infrequent small releases of flammable substances cannot be excluded.

Temperature class:

Equipment is classified by temperature class according to its maximum surface temperature. Similarly, gases are classified according to their ignition temperatures.

Type of protection:

The special measures applied to equipment to prevent ignition of a surrounding explosive atmosphere. [After EN 50014]

Upper explosion limit:

The upper limit of the range of the concentration of a flammable substance in air within which an explosion can occur. [After EN 1127-1]

Work equipment:

Any machine, apparatus, tool or installation used at work. [Directive 89/655/EEC]

Worker:

Any person employed by an employer, including trainees and apprentices but excluding domestic servants. [Directive 89/391/EEC]

Zones:

See 'Zoning'.

Zoning:

Hazardous places are classified in terms of zones on the basis of the frequency and duration of the occurrence of an explosive atmosphere. [Directive 1999/92/EC]

A.2. Legislation, standards and sources of further information on explosion protection

Annex A.2 lists the EU directives and guidelines and the harmonised European standards in the same language as the national version of the guide. National regulations transposing Directive 1999/92/EC — insofar as they are known at the time of producing this Guide — are given in the language of publication.

The annex contains further sections for completion by the competent national authorities with details of further national regulations, literature and national advice centres.

A.2.1. European directives and guidelines ⁽¹⁵⁾

89/391/EEC	Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work (OJ L 183, 29.6.1989, p. 1)
89/655/EEC	Council Directive 89/655/EEC of 30 November 1989 concerning the minimum safety and health requirements for the use of work equipment by workers at work (second individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC) (OJ L 393, 30.12.1989 p. 13)
90/396/EEC	Council Directive 90/396/EEC of 29 June 1990 on the approximation of the laws of the Member States relating to appliances burning gaseous fuels (OJ L 196, 26.7.1990, p. 15)
92/58/EEC	Council Directive 92/58/EEC of 24 June 1992 on the minimum requirements for the provision of safety and/or health signs at work (ninth individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC) (OJ L 245, 26.8.1992 p. 23)
92/91/EEC	Council Directive 92/91/EEC of 3 November 1992 concerning the minimum requirements for improving the safety and health protection of workers in the mineral-extracting industries through drilling (11th individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC) (OJ L 348, 28.11.1992, p. 9)
92/104/EEC	Council Directive 92/104/EEC of 3 December 1992 on the minimum requirements for improving the safety and health protection of workers in surface and underground mineral-extracting industries (12th individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC) (OJ L 404, 31.12.1992, p. 10)
94/9/EC	Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres (OJ L 100, 19.4.1994, p. 1), last corrigendum on 5 December 2000 (OJ L 304, 5.2.2000, p. 42)
96/82/EC	Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances (OJ L 10, 14.1.1997, p. 13)
1999/92/EC	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 (15th individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC) (OJ L 23, 28.1.2000, p. 57), last corrigendum on 7 June 2000 (OJ L 134, 7.6.2000, p. 36)

(15) The full text of the directives can be consulted free of charge on the EUR-LEX European law website at http://europa.eu.int/eur-lex/en/search/search_lif.html.

2001/45/EC	Directive 2001/45/EC of the European Parliament and of the Council of 27 June 2001 amending Council Directive 89/655/EEC concerning the minimum safety and health requirements for the use of work equipment by workers at work (second individual directive within the meaning of Article 16(1) of Directive 89/391/EEC) (OJ L 195, 19.7.2001, p. 46)
ATEX Guidelines	Guidelines on the application of Council Directive 94/9/EC of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres, May 2000 (published by the European Commission, 2001), ISBN 92-894-0784-0
67/548/EEC	Council Directive 67/548/EEC of 27 June 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances (OJ L 196, 16.8.1967, p. 1), last amended on 6 August 2001 (OJ L 225, 21.8.2001, p. 1)

A.2.2. EU Member States' national regulations transposing Directive 1999/92/EC (to the date of 23 May 2005)

Belgium Arrêté royal du 26 mars 2003 concernant le bien-être des travailleurs susceptibles d'être exposés aux risques présentés par les atmosphères explosives. [*Moniteur Belge* du 5.5.2003 (C-2003/012174)]

Koninklijk besluit van 26 maart 2003 betreffende het welzijn van de werknemers die door explosieve atmosferen gevaar kunnen lopen. [BS van 05/05/2003 (C - 2003/012174)]

Czech Republic Zákon č. 155/2000 Sb., kterým se mění zákon č. 65/1965 Sb., zákoník práce, ve znění pozdějších předpisů, a některé další zákony (Sbírka zákonů ČR z 21/06/2000)

Zákon č. 65/1965 Sb., zákoník práce (Sbírka zákonů ČR z 30/06/1965)

Zákon č. 174/1968 Sb., o státním odborném dozoru nad bezpečností práce (Sbírka zákonů ČR z 27/12/1968)

Zákon č. 356/2003 Sb., o chemických látkách a chemických přípravcích a o změně některých zákonů (Sbírka zákonů ČR z 29/10/2003)

Nařízení vlády č. 11/2002 Sb., kterým se stanoví vzhled a umístění bezpečnostních značek a zavedení signálů (Sbírka zákonů ČR z 15/01/2002)

Nařízení vlády č. 23/2003 Sb., kterým se stanoví technické požadavky na zařízení a ochranné systémy určené pro použití v prostředí s nebezpečím výbuchu (Sbírka zákonů ČR z 11/02/2003)

Zákon č. 124/2000 Sb., kterým se mění zákon č. 174/1968 Sb., o státním odborném dozoru nad bezpečností práce, ve znění pozdějších předpisů, zákon č. 61/1988 Sb., o hornické činnosti, výbušninách a státní báňské správě, ve znění pozdějších předpisů, a zákon č. 455/1991 Sb., o živnostenském podnikání (živnostenský zákon), ve znění pozdějších předpisů (Sbírka zákonů ČR z 12/05/2000)

Nařízení vlády č. 405/2004 Sb., kterým se mění nařízení vlády č. 11/2002 Sb., kterým se stanoví vzhled a umístění bezpečnostních značek a zavedení signálů (Sbírka zákonů ČR z 08/07/2004)

Nařízení vlády č. 406/2004 Sb., o bližších požadavcích na zajištění bezpečnosti a ochrany zdraví při práci v prostředí s nebezpečím výbuchu (Sbírka zákonů ČR z 08/07/2004)

Denmark	Bekendtgørelse om arbejde i forbindelse med eksplosiv atmosfære. (ref.: BEK nr. 478 af 10.6.2003) Bekendtgørelse om klassifikation af eksplosionsfarlige områder. (ref.: BEK nr. 590 af 26.6.2003)
Germany	Verordnung zur Rechtsvereinfachung im Bereich der Sicherheit und des Gesundheitsschutzes bei der Bereitstellung von Arbeitsmitteln und deren Benutzung bei der Arbeit, der Sicherheit beim Betrieb überwachungsbedürftiger Anlagen und der Organisation des betrieblichen Arbeitsschutzes – Betriebssicherheitsverordnung (BetrSichV) (BGBl. 2002 Teil I S. 3777)
Estonia	Töötavishoiu ja tööohutuse nõuded töötamisel plahvatusohtlikus keskkonnas (Elektroniline Riigi Teataja 16.7.2003)
Greece	Νομοθετική πράξη – Εφημερίς της Κυβερνήσεως, ΦΕΚ, τεύχος Α, αριθ. 44, της 21ης Φεβρουαρίου 2002, σ. 493
Spain	Real Decreto 681/2003, de 12 de junio, sobre la protección de la salud y la seguridad de los trabajadores expuestos a los riesgos derivados de atmósferas explosivas en el lugar de trabajo (BOE nº 145 de 18 de junio de 2003, p.23341)
France	Décret n° 2002-1553 du 24 décembre 2002 relatif aux dispositions concernant la prévention des explosions applicables aux lieux de travail et modifiant le chapitre II du titre III du livre II du code du travail (deuxième partie : décrets en Conseil d'État). <i>Journal officiel de la République française</i> n° 303 du 29.12.2002, p. 21939 (NOR: SOCTo211901D). Arrêté du 8 juillet 2003 relatif à la protection des travailleurs susceptibles d'être exposés à une atmosphère explosive. <i>Journal officiel de la République française</i> du 26.7.2003, p. 12667 (NOR: SOCTo310971A). Décret n° 2002-1554 du 24 décembre 2002 relatif aux dispositions concernant la prévention des explosions que doivent observer les maîtres d'ouvrage lors de la construction des lieux de travail et modifiant le chapitre V du titre III du livre II du code du travail (deuxième partie: décrets en Conseil d'État). <i>Journal officiel de la République française</i> n° 303 du 29.12.2002, p. 21940 (NOR: SOCTo211902D). Arrêté du 28 juillet 2003 relatif aux conditions d'installation des matériels électriques dans les emplacements où des atmosphères explosives peuvent se présenter. <i>Journal officiel de la République française</i> n° 180 du 6.8.2003, p. 13554 (NOR: SOCTo311077A). Arrêté du 8 juillet 2003 complétant l'arrêté du 4 novembre 1993 relatif à la signalisation de sécurité et de santé au travail <i>Journal officiel de la République française</i> du 26.7.2003, p. 12667 (NOR: SOCTo310970A).
Ireland	Safety, Health and Welfare at Work (Explosive Atmospheres) Regulations 2003 SI No 258 of 26.6.2003.

Italy	Decreto legislativo 12 giugno 2003, n. 233 – Attuazione della direttiva 1999/92/CE relativa alle prescrizioni minime per il miglioramento della Tutela della sicurezza e della salute dei lavoratori esposti al rischio di atmosfere esplosive; GURI (Gazzetta ufficiale della Repubblica italiana), Serie generale n. 197, del 26.8.2003, pag. 13.
Cyprus	Οι περί ασφάλειας και υγείας στην εργασία (ελάχιστες απαιτήσεις για την προστασία των προσώπων στην εργασία από κινδύνους από εκρήξιμες ατμόσφαιρες) κανονισμοί του 2002 [Επίσημη Εφημερίδα της 21ης Ιουνίου 2002, αριθ. 3612, σ. 2847, I(I)–2860, I(I)]
Latvia	Ministru kabineta noteikumi nr. 300 "Darba aizsardzības prasības darbā sprādzienbīstamā vidē" (Latvijas Vēstnesis 13/06/2003, Nr. 89)
Lithuania	Lietuvos Respublikos socialinės apsaugos ir darbo ministro įsakymas Nr.110 „Dėl darbuotojų, dirbančių potencialiai sprogioje aplinkoje, saugos nuostatų patvirtinimo“ (Valstybės žinios, 2001 01 05, Nr. 1)
Luxembourg	Règlement grand-ducal du 21 mars 2005 concernant les prescriptions minimales visant à améliorer la protection en matière de sécurité et de santé des travailleurs susceptibles d’être exposés au risque d’atmosphères explosives (Mémorial A du 5.4.2005, n° 39, p. 683-688)
Hungary	1993. évi XCIII. tv. a munkavédelemről (Magyar Közlöny, 1993/11/03, 160. sz., 9942–9953. o.) 3/2003. (III. 11.) FMM-ESzCsM együttes rendelet a potenciálisan robbanásveszélyes környezetben levő munkahelyek minimális munkavédelmi követelményeiről (Magyar Közlöny, 2003/03/11, 24. sz., 1885–1890. o.) A gazdasági miniszter 17/2000. (VI. 9.) GM rendelete a sújtólég- vagy robbanásbiztos védelmű villamos gyártmányok vizsgálatáról és tanúsításáról szóló 25/1996. (IV. 17.) IKM rendelet módosításáról (Magyar Közlöny, 2000/06/09, 56. sz., 3256–3230. o.)
Malta	Regolamenti ta' l-2004 dwar Il-Post Tax-Xoghol (Bzonnijiet Ta' Sahha U Sigurtà Minimi Fuq Ix-Xoghol) (Spazji Ristretti Jew Spazji b'Atmosferi Esplossivi) Taht L- Att Dwar L-Awtorità Ghas-Sahha U S-Sigurtà Fuq Il-Post Tax-Xoghol (Kap. 424) (The Malta government gazette of: 30/01/2004, no 17534, p. B 327- B 374)
Netherlands	Wijziging Arbeidsomstandighedenregeling. (ref.: Staatscourant nr. 128 van 8.7.2003, blz. 10. Besluit van 19.6.2003 tot wijziging van het Arbeidsomstandighedenbesluit houdende regels betreffende explosieve atmosferen. Ref.: Staatsblad nr. 268 van 19.6.2003 blz. 1.
Austria	Gesetz vom 02/07/2003 über den Schutz der Bediensteten in den Dienststellen des Landes Tirol, der Gemeinden und der Gemeindeverbände (Tiroler Bedienstetenschutzgesetz 2003 – TBSG 2003), LGBL Tirol Nr. 75 vom 02/09/2003, Seite 275.

NÖ Landarbeitsordnung 1973, LGBl. 9020-19.

Land- und forstwirtschaftliche Sicherheits- und Gesundheitsschutz-Verordnung, LGBl. Nr. 96 vom 13/11/2001, Seite 461.

NÖ Bediensteten-Schutzverordnung 2003 (NÖ BSVO 2003) LGBl. für NÖ Nr. 2015/1-o vom 21/11/2003.

Verordnung der Kärntner Landesregierung vom 15. Februar 2005 über den Schutz der Bediensteten des Landes, der Gemeinden und der Gemeindeverbände vor Gefährdungen durch explosionsfähige Atmosphären, LGBl. Nr. 21/2005 vom 07/03/2005.

Verordnung der Oö. Landesregierung, mit der die Oö. Arbeitsmittelverordnung (Oö. AmV), die Oö. Landes-Bauarbeiterschutz-Verordnung (Oö. LBauV) und die Oö. Gesundheitsüberwachungsverordnung (Oö. GÜV) geändert werden (Oö. Landesbedienstetenschutz-Anpassungsverordnung 2004), LGBl. Nr. 18/2005 vom 31/03/2005.

309. Verordnung des Bundesministers für Wirtschaft und Arbeit über den Schutz der Arbeitnehmer/innen vor explosionsfähigen Atmosphären und mit der die Bauarbeiterschutz-Verordnung und die Arbeitsmittel-Verordnung geändert werden (Verordnung explosionsfähige Atmosphären – VEXAT), Bundesgesetzblatt für die Republik Österreich BGBl. II Nr. 309/2004 vom 26/07/2004.

Verordnung der Vorarlberger Landesregierung über den Schutz der Landes- und Gemeindebediensteten vor Gefährdungen durch explosionsfähige Atmosphären, LGBl. Nr. 47/2004, 22. Stück vom 05/10/2004.

Verordnung der Salzburger Landesregierung – Schutz von Dienstnehmerinnen und Dienstnehmern vor Gefährdungen durch explosionsfähige Atmosphären, LGBl. 11. Stück vom 15/07/2004 Nr. 46.

Änderung des Landeslehrer-Dienstrechtsgesetzes und des Landesvertragslehrergesetzes 1966, Bundesgesetzblatt für die Republik Österreich BGBl. I Nr. 69/2004 vom 06/07/2004.

Verordnung der Kärntner Landesregierung vom 21. Dezember 2004, Zl. 14-SV-3004/16/04, über den Schutz der Dienstnehmer in der Land- und Forstwirtschaft vor explosionsfähigen Atmosphären, LGBl. Nr. 2/2005 vom 18/01/2005.

Landesverfassungsgesetz und Gesetz vom 18. November 2004, mit dem die Kärntner Landesverfassung geändert wird und ein Gesetz über die Sicherheit und den Gesundheitsschutz der in den Dienststellen des Landes, der Gemeinden und Gemeindeverbände beschäftigten Bediensteten (Kärntner Bedienstetenschutzgesetz 2005 – K-BSG) erlassen wird, LGBl. Nr. 7/2005 vom 03/02/2005.

Verordnung der Steiermärkischen Landesregierung vom 18. April 2005, mit der die Verordnung über die Durchführung des Bedienstetenschutzes im Bereich der Dienststellen des Landes geändert wird, LGBl. Nr. 34/2005 vom 29/04/2005.

Verordnung der Wiener Landesregierung über den Schutz der in Dienststellen der Gemeinde Wien beschäftigten Bediensteten vor Gefahren durch explosionsfähige Atmosphären, LGBl. Nr. 3/2005 vom 09/02/2005.

Tirol: Verordnung der Landesregierung vom 23. November 2004, mit der die Arbeitsstoffe-Verordnung, die Arbeitsmittel-Verordnung und die Bauarbeiterschutz-Verordnung geändert werden, LGBl. Nr. 93/2004 vom 23/11/2004.

Tirol: Verordnung der Landesregierung vom 23. November 2004, mit der die Gesundheitsüberwachungs-Verordnung geändert wird, LGBl. Nr. 94/2004 vom 23/11/2004.

Verordnung der Oö. Landesregierung über den Schutz der Bediensteten vor explosionsfähigen Atmosphären (Oö. Verordnung über explosionsfähige Atmosphären – Oö. VEXAT), LGBL. Nr. 86/2004 vom 30/11/2004.

Poland

Rozporządzenie Ministra Gospodarki, Pracy i Polityki Społecznej z dnia 29 maja 2003 r. w sprawie minimalnych wymagań dotyczących bezpieczeństwa i higieny pracy pracowników zatrudnionych na stanowiskach pracy, na których może wystąpić atmosfera wybuchowa (Dziennik Ustaw z dnia 24/06/2003).

Portugal

Decreto-Lei n.º 236 de 30.9.2003. Diário da República, I Série A, n.º 226 de 30.9.2003, p. 6419.

Slovenia

Odredba o protieksplzijski zaščiti (Uradni list RS z dne 10.11.2000, št. 102/2000, str. 10810 – 10840).

Slovakia

Zákon Národnej rady Slovenskej republiky č. 330/1996 Z. z. o bezpečnosti a ochrane zdravia pri práci (Zbierka zákonov SR z 23.11.1996 č. 117 s.2142 – 2146).

Zákon č. 367/2001 Z. z. – Úplné znenie zákona Národnej rady Slovenskej republiky č. 330/1996 Z. z. o bezpečnosti a ochrane zdravia pri práci, ako vyplýva zo zmien a doplnení vykonaných zákonom č. 95/2000 Z. z. a zákonom č. 158/2001 Z. z. (Zbierka zákonov SR z 15.9.2001 č. 147, s. 3642 – 3652).

Zákon č. 95/2000 Z. z. o inšpekcii práce a o zmene a doplnení niektorých zákonov (Zbierka zákonov SR z 23.3.2000, č. 43, s. 1406 – 1413).

Zákon č. 231/2002 Z. z., ktorým sa mení a dopĺňa zákon č. 95/2000 Z. z. o inšpekcii práce a o zmene a doplnení niektorých zákonov a ktorým sa mení zákon Národnej rady Slovenskej republiky č. 320/1993 Z. z. o úprave náhrady za stratu na zárobku po skončení pracovnej neschopnosti vzniknutej pracovným úrazom alebo chorobou z povolania (Zbierka zákonov SR z 3.5.2002, č. 99, s. 2282 – 2283).

Nariadenie vlády Slovenskej republiky č. 117/2001 Z. z., ktorým sa ustanovujú podrobnosti o technických požiadavkách a postupoch posudzovania zhody zariadení a ochranných systémov určených na použitie v prostredí s nebezpečenstvom výbuchu (Zbierka zákonov SR z 31.3.2001, č. 48, s. 1322 – 1341).

Zákon č. 109/1998 Z. z. – Úplné znenie zákona č. 50/1976 Zb. o územnom plánovaní a stavebnom poriadku (stavebný zákon), ako vyplýva zo zmien a doplnení vykonaných zákonom č. 103/1990 Zb., zákonom č. 262/1992 Zb., zákonom NR SR č. 136/1995 Z. z., zákonom NR SR č. 199/1995 Z. z., nálezom Ústavného súdu SR č. 286/1996 Z. z. a zákonom č. 229/1997 Z. z. (Zbierka zákonov SR z 18.4.1998, č. 39, s. 762 – 789).

Zákon č. 237/2000 Z. z., ktorým sa mení a dopĺňa zákon č. 50/1976 Zb. o územnom plánovaní a stavebnom poriadku (stavebný zákon) v znení neskorších predpisov a o zmene a doplnení niektorých zákonov (Zbierka zákonov SR z 28.7.2000, č. 102, s. 2907 – 293).

Zákon č. 50/1976 Zb. o územnom plánovaní a stavebnom poriadku (stavebný zákon) (Zbierka zákonov SR z 7.5.1976, č. 9, s. 145 – 174).

Nariadenie vlády Slovenskej republiky č. 493/2002 Z. z. o minimálnych požiadavkách na zaistenie bezpečnosti a ochrany zdravia pri práci vo výbušnom prostredí (Zbierka zákonov SR z 24.8.2002, č. 190, s. 4994 – 5003).

Finland Valtioneuvoston asetus räjähdyskelpoisten ilmaseosten työntekijöille aiheuttaman varaan torjunnasta. SSK n° 576/2003 tehty 18.6.2003.

Sweden Arbetsmiljöverkets föreskrifter om arbete i explosionsfarlig miljö. AFS nr 3 av den 30 juni 2003, s. 1.

United Kingdom Dangerous Substances and Explosive Atmospheres (Northern Ireland) Regulations 2003, S.I. No 152 of 7.3.2003.

The Dangerous Substances and Explosive Atmospheres Regulations 2002, S.I. No 2776 of 15.11.2002.

Factories (Explosive Atmospheres) Regulations 2004, Second Supplement to the Gibraltar Gazette No 3386 of 8.1.2004.

A.2.3. Selected European standards

A current list can be found on the website of the European Committee for Standardisation (CEN) at: http://www.cenorm.be/standardization/tech_bodies/cen_bp/workpro/tc305.htm.

EN 50 281-3	Classification of areas where combustible dusts are or may be present.
EN 1127-1	Explosive atmosphere— explosion prevention and protection — Part 1: Basic concepts and methodology; version EN 1127-1:1997
EN 13463-1	Non-electrical equipment for potentially explosive atmospheres — Part 1: Basic method and requirements; version EN 13463-1:2001
EN 12874	Flame arresters — Performance requirements, test methods and limits for use; version EN 12874: 2001
EN 60079-10	Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas; version EN 60079-10:1996
prEN 1839	Determination of explosion limits of gases, vapours and their mixtures
prEN 13237-1	Potentially explosive atmospheres — explosion prevention and protection — Part 1: Terms and definitions for equipment and protective systems intended for use in potentially explosive atmospheres; version prEN 13237-1:1998
prEN 13463-2	Non-electrical equipment intended for use in potentially explosive atmospheres — Part 2: Protection by flow restricting enclosure 'fr'; version prEN 13463-2:2000
prEN 13463-5	Non-electrical equipment intended for use in potentially explosive atmospheres — Part 5: Protection by constructional safety; version prEN 13463-5:2000
prEN 13463-8	Non-electrical equipment for potentially explosive atmospheres — Part 8: Protection by liquid immersion 'k'; version prEN 13463-8:2001
prEN 13673-1	Determination of the maximum explosion pressure and maximum rate of pressure rise of gases and vapours — Part 1: Determination of the maximum explosion pressure; version prEN 13673-1:1999
prEN 13673-2	Determination of maximum explosion pressure and maximum explosion pressure rise of gases and vapours — Part 2: Determination of the maximum explosion pressure rise
prEN 13821	Determination of minimum ignition energy of dust/air mixtures; version prEN 13821:2000
prEN 13980	Potentially explosive atmospheres — Application of quality systems; version prEN 13980:2000
prEN 14034-1	Determination of explosion characteristics of dust clouds — Part 1: Determination of the maximum explosion pressure; version prEN 14034-1:2002
prEN 14034-4	Determination of explosion characteristics of dust clouds — Part 4: Determination of limiting oxygen concentration of dust clouds; version prEN 14034-4:2001
prEN 14373	Explosion suppression systems
prEN 14460	Explosion resistant equipment
prEN 14491	Dust explosion venting protective systems
prEN 14522	Determination of the minimum ignition temperature of gases and vapours

A.3. Specimen forms and checklists

The specimen forms and checklists are an aid to practical application of the guide, but make no claim to exhaustiveness.

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Checklist: Explosion protection assessment I		Processed by	
Focus: Inside apparatus		Date	
Purpose To evaluate explosion protection inside plant and apparatus, in order to assess the existing explosion protection strategy on the basis of targeted questions and to take any further action necessary. Points of doubt can be resolved by referring to the Guide sections indicated, consulting local health and safety organisations or studying the current literature.			
Apparatus/plant			
Item	Yes	No	Measures taken/comments
Is the presence of flammable substances avoided as far as possible [see 2.2.1]?	☐	☐	
Is the formation of explosive mixtures from the flammable substances present prevented as far as possible [see 2.2.2/2.2.3]?	☐	☐	
Is the occurrence of hazardous quantities of explosive atmospheres precluded as far as possible [see 2.2.4]?	☐	☐	
Can the formation of explosive mixtures inside the apparatus be prevented or limited [see 3.1]?	☐	☐	
Can process conditions ensure compliance with safe concentrations [see 3.1.2]?	☐	☐	
Is the concentration reliably and lastingly kept below the lower explosion limit or above the upper explosion limit [see 3.1.2]?	☐	☐	
Is the explosion range avoided during startup and shutdown of the plant [see 3.1.2]?	☐	☐	
Can mixtures emerging from the apparatus during operation above the upper explosion limit form explosive atmospheres outside it and is this prevented [see 3.1.4]?	☐	☐	
When vacuum plant is operated above the upper explosion limit, is air ingress and hence the formation of explosive mixtures prevented?	☐	☐	
Is the explosion hazard or violence reduced by lowered pressure (operation under vacuum)?	☐	☐	
Is the formation of explosive mixtures reliably prevented in all operating conditions by injection of inert substances (e.g. nitrogen, carbon dioxide, noble gases, water vapour or inert powders) [see 3.1.3]?	☐	☐	
- When inerting is carried out with water vapour, is the effect of condensation taken into account?	☐	☐	
- Has allowance been made for the possibility that an inerted mixture may again become explosive on addition of sufficient oxygen or air (e.g. on discharge to the open air)?	☐	☐	

Continued

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Checklist: Explosion protection assessment I Focus: Inside apparatus			Processed by
			Date
Item	Yes	No	Measures taken/comments
Has a safety margin been specified between the experimentally determined limiting oxygen concentration and the maximum permissible oxygen concentration, taking account of spatial and temporal variations resulting from operational factors and malfunctions and of the delay between triggering of protective measures and their becoming effective?	☐	☐	
Are undesirable dust deposits or accumulations avoided [see 3.1.4.1]?	☐	☐	
Is the prevention or limitation of explosive mixtures inside apparatus monitored?	☐	☐	
Can hazardous explosive atmospheres occur inside the plant or apparatus despite the above measures [see 2.2.5]?	☐	☐	
Are all necessary measures taken to prevent the ignition of a hazardous explosive atmosphere [see 3.2/3.2.2]? - Are zones known and classified [see 3.2.1]? - Are effective ignition sources of the 13 known types to be expected according to the zoning [see 3.2.3]?	☐	☐	
Can a hazardous explosive atmosphere be ignited inside the plant or apparatus despite all the above measures [see 2.2.6]?	☐	☐	
Are the effects of an explosion limited to an acceptable extent by suitable mitigation measures designed in accordance with the state of the art, without endangering the surrounding area (e.g. by venting) [see 3.3]? - Explosion-resistant design [see 3.3.1]? - Explosion relief [see 3.3.2]? - Explosion suppression [see 3.3.3]? - Prevention of flame and explosion propagation to upstream and downstream items of plant [see 3.3.4]? - Flame arresters for gases, vapours and mists? - Decoupling devices for dusts? - Explosion decoupling for hybrid mixtures?	☐	☐	

A.3.2. Checklist: Explosion protection around apparatus

Checklist: Explosion protection assessment II Focus: Around apparatus		Processed by
		Date
<i>Purpose</i> To evaluate explosion protection around plant and apparatus, in order to assess the existing explosion protection strategy on the basis of targeted questions and to take any further action necessary. Points of doubt can be resolved by referring to the Guide sections indicated, consulting local health and safety organisations or studying the current literature.		
<i>Apparatus/plant</i>		
Item	Yes	No
Is the formation of explosive atmospheres around apparatus prevented [see 3.1.4]?	☐	☐
Are explosive atmospheres prevented by operational measures, design or spatial configuration?	☐	☐
Is the apparatus/plant leakproof?	☐	☐
Is ventilation or extraction used?	☐	☐
Are arrangements in place to monitor the concentration around apparatus [see 3.1.5]?	☐	☐
By means of gas instruments which trigger an alarm?	☐	☐
By means of gas instruments which trigger protective measures?	☐	☐
By means of gas instruments which trigger emergency functions?	☐	☐
Can a hazardous explosive atmosphere occur around the plant or apparatus despite the above measures [see 2.2.5]?	☐	☐

Continued

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Checklist: Explosion protection assessment II Focus: Around apparatus			Processed by
			Date
Item	Yes	No	Measures taken/comments
Are all necessary measures taken to prevent the ignition of a hazardous explosive atmosphere [see 3.2/3.2.2]?	☐	☐	
- Are zones known and classified [see 3.2.1]? - Are effective ignition sources of the 13 known types to be expected according to the zoning [see 3.2.3]?	☐	☐	
What civil engineering measures are taken to limit the effects of an explosion to an acceptable extent, e.g.	☐	☐	
Bricking of high-pressure autoclaves?	☐	☐	
Are organisational measures taken to ensure the effectiveness of the technical measures [see Section 4]?	☐	☐	
- Are operating instructions in place? - Are competent personnel used? - Are workers given training? - Is a permit-to-work system in place? - Are hazardous places marked?	☐	☐	
Are protective measures in place for maintenance work [see 4.5]?	☐	☐	

A.3.3. Specimen: Permit-to-work form for work involving ignition sources in places with hazardous atmospheres

Permit-to-work form		
for work involving ignition sources in places with hazardous atmospheres		
1	Working place	
2	Task (e.g. weld pipe)	
3	Nature of work	☐ Welding ☐ Cutting ☐ Abrasive cutting ☐ Soldering ☐ Thawing ☐
4	Precautions taken before starting work	☐ Remove all movable combustible objects and substances, including dust deposits, within a radius of m and – where necessary – also in adjacent rooms ☐ Cover the immovable combustible objects, e.g. wooden beams and floors, plastic parts, with protective materials ☐ Seal openings, joints and cracks in the building and other apertures such as gratings with non-flammable substances ☐ Remove cladding and insulation ☐ Eliminate explosion hazard in containers and pipework, possibly by inerting ☐ Close openings in pipework, containers and accessories, etc. ☐ Post a fire sentry with filled water buckets, fire extinguishers or connected fire hose (spray only for dusts)
5	Fire sentry	☐ While work is in progress ☐ Name: ☐ After work is completed ☐ Name: Duration: hrs
6	Alarm	Location of the nearest Fire alarm Telephone Fire service telephone number:
7	Firefighting equipment/extinguishing agent	☐ Fire extinguisher with ☐ water ☐ CO ₂ ☐ powder ☐ Filled water buckets ☐ Connected fire hose
8	Authorisation	The safety measures listed must be taken. The statutory provisions for accident prevention and the insurers' safety regulations must be observed. Date Signature of the manager or the person appointed by him Signature of the person carrying out the work

A.3.4. Checklist: Coordination for on-site explosion protection

Checklist: Coordination measures Focus: On-site explosion protection		Processed by			
		Date			
Purpose This checklist may serve as an aid to checking whether the protective measures are being carried out as agreed to allow principal and contractor to work together safely, whether the persons concerned have received adequate instruction and whether they are complying with the agreed protective measures.					
Task					
Item	Yes	No			
Is a check made on compliance with statutory and company regulations implementing Directive 1999/92/EC?	☐	☐			
• Has a person (the coordinator) been appointed to coordinate work carried out jointly [see 5.1]?	☐	☐			
• Does the appointed person meet the necessary requirements [see 5.1]?	☐	☐			
• Is the coordinator known on site?	☐	☐			
• Are subcontractors notified to the employer?	☐	☐			
Is the work procedure checked for hazardous interaction [see 5.2]?	☐	☐			
• Is it impossible for hazardous explosive atmospheres to form in places where there may be ignition sources?	☐	☐			
• Is the use or creation of ignition sources prevented in places with hazardous explosive atmospheres?	☐	☐			
• Are malfunctions avoided in nearby operations involving hazardous places?	☐	☐			
Is the work procedure laid down [see checklist in Annex A.3.5]?	☐	☐			
Are the agreed protective measures adapted to take account of the progress of work or of any shortcomings detected?	☐	☐			
• Is training provided throughout?	☐	☐			
• Is there consultation throughout?	☐	☐			
• Are instructions issued throughout?	☐	☐			
• Are checks made throughout?	☐	☐			

Checklist: Coordination tasks		Processed by
Focus: On-site explosion protection		Date
<i>Purpose</i> To specify the tasks of the person responsible for coordination (preferably a coordinator appointed by the employer) in order to ensure that the work of the groups/contractors concerned is so orchestrated that any possible hazardous interaction is detected and prevented in good time and action can be taken quickly in the event of incidents.		
<i>Task</i>		
Item	Yes	No
Is a site inspection carried out?	☐	☐
Is a work schedule drawn up?	☐	☐
• Have the place and time of the individual tasks been indicated? • Have the persons concerned been named, including the persons in charge? • Has the timeline been specified? • Have the special requirements for carrying out the work been specified? • Have specific explosion protection measures been laid down? • Have the danger zones, and in particular the places where an explosive atmosphere may occur, been determined and marked? • Have measures been put in place in case of incident?	☐ ☐	☐ ☐
Are consultations arranged between the persons concerned?	☐	☐
Are checks made on compliance with the work schedule?	☐	☐
Are the operations replanned in the event of an incident?	☐	☐

A.3.6. Checklist: Completeness of the explosion protection document

Checklist: Explosion protection document Check on completeness		Processed by	
		Date	
<i>Purpose</i> To check the completeness of an explosion protection document, indicating information sources. Points of doubt can be resolved by referring to the Guide sections indicated, consulting local health and safety organisations or studying the current literature.			
<i>Explosion protection document (title, location)</i>			
Item	Information source		
	Explosion protection document	Other documents	Still to be produced
Description of the workplace and working areas available [see 6.3.1]? • Textual description • Site plan • Layout plan • Plan of escape and rescue routes			☐ ☐ ☐ ☐ ☐
Description of process steps / activities [see 6.3.2]? • Textual description • Process flowchart (where necessary) • P & I flowchart (where necessary) • Details of ventilation (where necessary)			☐ ☐ ☐ ☐ ☐
Description of the substances used [see 6.3.3]? • Textual description • Safety datasheets • Safety parameters			☐ ☐ ☐ ☐

Checklist: Explosion protection document Check on completeness		Processed by	
		Date	
Item	Information source		
	Explosion protec- tion document	Other documents	Still to be pro- duced
Results of the risk analysis described [see 6.3.4]? • Statement of hazard identification procedure • Hazardous places inside items of plant (textual) • Hazardous places around plant (textual) • Zoning (textual) • Zone plan (graphic) • Hazards in normal operation • Hazards during startup and shutdown • Hazards in the event of malfunction • Hazards during cleaning • Hazards in the event of process/product changes			☐
Technical explosion protection measures described [see 6.3.5]? • Prevention • Mitigation • PCE measures • Requirements for and selection of work equip- ment			☐

Continued

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Checklist: Explosion protection document Check on completeness		Processed by	
		Date	
Item	Information source		
	Explosion protec- tion document	Other documents	Still to be pro- duced
Organisational explosion protection measures described [see 6.3.6]?			☐
• Written operating instructions			☐
• Instructions for use of work equipment			☐
• Description of personal protective equipment			☐
• Evidence of competence			☐
• Documentation of training			☐
• Description of the permit-to-work system			☐
• Description of maintenance, inspection and surveillance intervals			☐
• Documentation of the marking of hazardous places			☐
• Checks on effectiveness			☐
Documentation of persons responsible and competent persons [see 6.3.7]?			☐
Documentation of coordination measures and arrangements [see 6.3.8]?			☐
Content of the annex [see 6.3.9]:			☐
•			☐
•			☐
•			☐

A.4. Directives 1999/92/EC, 89/391/EEC and 1994/9/EC

Directive 1999/92/EC	81
Directive 89/391/EEC	89
Directive 1994/9/EC	97

**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 (15th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 137 thereof,

Having regard to the proposal from the Commission ⁽¹⁾, submitted after consultation with the Advisory Committee on Safety, Hygiene and Health Protection at Work and the Safety and Health Commission for the Mining and Other Extractive Industries,

Having regard to the opinion of the Economic and Social Committee ⁽²⁾,

After consulting the Committee of the Regions,

Acting in accordance with the procedure referred to in Article 251 of the Treaty, in the light of the joint text approved by the Conciliation Committee on 21 October 1999 ⁽³⁾,

Whereas:

- (1) Article 137 of the Treaty provides that the Council may adopt, by means of Directives, minimum requirements for encouraging improvements, especially in the working environment, to guarantee a better level of protection of the health and safety of workers;
- (2) Under the terms of that Article, those Directives are to avoid imposing administrative, financial and legal constraints in a way which would hold back the creation and development of small and medium-sized undertakings;
- (3) The improvement of occupational safety, hygiene and health is an objective which should not be subordinated to purely economic considerations;
- (4) Compliance with the minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres is essential if workers' safety and health protection is to be ensured;
- (5) This Directive is an individual Directive within the meaning of Article 16(1) of Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health

of workers at work ⁽⁴⁾; therefore, the provisions of the said Directive, in particular those relating to worker information, to the consultation and participation of workers and to the training of workers, are also fully applicable to cases in which workers are potentially at risk from explosive atmospheres, without prejudice to more restrictive or specific provisions contained in this Directive;

- (6) This Directive constitutes a practical step towards the achievement of the social dimension of the internal market;
- (7) Directive 94/9/EC of the European Parliament and of the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres ⁽⁵⁾ states that it is intended to prepare an additional Directive based on Article 137 of the Treaty covering, in particular, explosion hazards which derive from a given use and/or types and methods of installation of equipment;
- (8) Explosion protection is of particular importance to safety; whereas explosions endanger the lives and health of workers as a result of the uncontrolled effects of flame and pressure, the presence of noxious reaction products and consumption of the oxygen in the ambient air which workers need to breathe;
- (9) The establishment of a coherent strategy for the prevention of explosions requires that organisational measures complement the technical measures taken at the workplace; Directive 89/391/EEC requires the employer to be in possession of an assessment of the risks to workers' health and safety at work; this requirement is to be regarded as being specified by this Directive in that it provides that the employer is to draw up an explosion protection document, or set of documents, which satisfies the minimum requirements laid down in this Directive and is to keep it up to date; the explosion protection document includes the identification of the hazards, the evaluation of risks and the definition of the specific measures to be taken to safeguard the health and safety of workers at risk from explosive atmospheres, in accordance with Article 9 of Directive 89/391/EEC; the explosion protection document may be part of the assessment of the risks to health and safety at work required by Article 9 of Directive 89/391/EEC;

⁽¹⁾ OJ C 332, 9.12.1995, p. 10 and OJ C 184, 17.6.1997, p. 1.

⁽²⁾ OJ C 153, 28.5.1996, p. 35.

⁽³⁾ Opinion of the European Parliament of 20 June 1996 (OJ C 198, 8.7.1996, p. 160) confirmed on 4 May 1999 (OJ C 279, 1.10.1999, p. 55), Council Common Position of 22 December 1998 (OJ C 55, 25.2.1999, p. 45), Decision of the European Parliament of 6 May 1999 (OJ C 279, 1.10.1999, p. 386). Decision of the European Parliament of 2 December 1999 and Council Decision of 6 December 1999.

⁽⁴⁾ OJ L 183, 29.6.1989, p. 1.

⁽⁵⁾ OJ L 100, 19.4.1994, p. 1.

- (10) An assessment of explosion risks may be required under other Community acts; whereas, in order to avoid unnecessary duplication of work, the employer should be allowed, in accordance with national practice, to combine documents, parts of documents or other equivalent reports produced under other Community acts to form a single 'safety report';
- (11) The prevention of the formation of explosive atmospheres also includes the application of the substitution principle;
- (12) Coordination should take place when workers from several undertakings are present at the same workplace;
- (13) Preventive measures must be supplemented if necessary by additional measures which become effective when ignition has taken place; maximum safety can be achieved by combining preventive measures with other additional measures limiting the detrimental effects of explosions on workers;
- (14) Council Directive 92/58/EEC of 24 June 1992 on the minimum requirements for the provision of safety and/or health signs at work (ninth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC⁽¹⁾) is fully applicable, in particular to places immediately contiguous to hazardous areas, where smoking, crosscutting, welding and other activities introducing flames or sparks may interact with the hazardous area;
- (15) Directive 94/9/EC divides the equipment and protective systems which it covers into equipment groups and categories; this Directive provides for a classification by the employer of the places where explosive atmospheres may occur in terms of zones and determines which equipment and protective systems groups and categories should be used in each zone,

HAVE ADOPTED THIS DIRECTIVE:

SECTION I

GENERAL PROVISIONS

Article 1

Object and scope

1. This Directive, which is the 15th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC, lays down minimum requirements for the safety and health

protection of workers potentially at risk from explosive atmospheres as defined in Article 2.

2. This Directive shall not apply to:

- (a) areas used directly for and during the medical treatment of patients;
- (b) the use of appliances burning gaseous fuels in accordance with Directive 90/396/EEC⁽²⁾;
- (c) the manufacture, handling, use, storage and transport of explosives or chemically unstable substances;
- (d) mineral-extracting industries covered by Directive 92/91/EEC⁽³⁾ or Directive 92/104/EEC⁽⁴⁾;
- (e) the use of means of transport by land, water and air, to which the pertinent provisions of the international agreements (e.g. ADN, ADR, ICAO, IMO, RID), and the Community Directives giving effect to those agreements, apply. Means of transport intended for use in a potentially explosive atmosphere shall not be excluded.

3. The provisions of Directive 89/391/EEC and the relevant individual Directives are fully applicable to the domain referred to in paragraph 1, without prejudice to more restrictive and/or specific provisions contained in this Directive.

Article 2

Definition

For the purposes of this Directive, 'explosive atmosphere' means a mixture with air, under atmospheric conditions, of flammable substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture.

SECTION II

OBLIGATIONS OF THE EMPLOYER

Article 3

Prevention of and protection against explosions

With a view to preventing, within the meaning of Article 6(2) of Directive 89/391/EEC, and providing protection against explosions, the employer shall take technical and/or organisational measures appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow that,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

These measures shall where necessary be combined and/or supplemented with measures against the propagation of explosions and shall be reviewed regularly and, in any event, whenever significant changes occur.

⁽²⁾ OJ L 196, 26.7.1990, p. 15. Directive as amended by Directive 93/68/EEC (OJ L 220, 30.8.1993, p. 1).

⁽³⁾ OJ L 348, 28.11.1992, p. 9.

⁽⁴⁾ OJ L 404, 31.12.1992, p. 10.

⁽¹⁾ OJ L 245, 26.8.1992, p. 23.

*Article 4***Assessment of explosion risks**

1. In carrying out the obligations laid down in Articles 6(3) and 9(1) of Directive 89/391/EEC the employer shall assess the specific risks arising from explosive atmospheres, taking account at least of:

- the likelihood that explosive atmospheres will occur and their persistence,
- the likelihood that ignition sources, including electrostatic discharges, will be present and become active and effective,
- the installations, substances used, processes, and their possible interactions,
- the scale of the anticipated effects.

Explosion risks shall be assessed overall.

2. Places which are or can be connected via openings to places in which explosive atmospheres may occur shall be taken into account in assessing explosion risks.

*Article 5***General obligations**

To ensure the safety and health of workers, and in accordance with the basic principles of risk assessment and those laid down in Article 3, the employer shall take the necessary measures so that:

- where explosive atmospheres may arise in such quantities as to endanger the health and safety of workers or others, the working environment is such that work can be performed safely,
- in working environments where explosive atmospheres may arise in such quantities as to endanger the safety and health of workers, appropriate supervision during the presence of workers is ensured in accordance with the risk assessment by the use of appropriate technical means.

*Article 6***Duty of coordination**

Where workers from several undertakings are present at the same workplace, each employer shall be responsible for all matters coming under his control.

Without prejudice to the individual responsibility of each employer as provided for in Directive 89/391/EEC, the employer responsible for the workplace in accordance with national law and/or practice shall coordinate the implementation of all the measures concerning workers' health and safety and shall state, in the explosion protection document referred

to in Article 8, the aim of that coordination and the measures and procedures for implementing it.

*Article 7***Places where explosive atmospheres may occur**

1. The employer shall classify places where explosive atmospheres may occur into zones in accordance with Annex I.

2. The employer shall ensure that the minimum requirements laid down in Annex II are applied to places covered by paragraph 1.

3. Where necessary, places where explosive atmospheres may occur in such quantities as to endanger the health and safety of workers shall be marked with signs at their points of entry in accordance with Annex III.

*Article 8***Explosion protection document**

In carrying out the obligations laid down in Article 4, the employer shall ensure that a document, hereinafter referred to as the 'explosion protection document', is drawn up and kept up to date.

The explosion protection document shall demonstrate in particular:

- that the explosion risks have been determined and assessed,
- that adequate measures will be taken to attain the aims of this Directive,
- those places which have been classified into zones in accordance with Annex I,
- those places where the minimum requirements set out in Annex II will apply,
- that the workplace and work equipment, including warning devices, are designed, operated and maintained with due regard for safety,
- that in accordance with Council Directive 89/655/EEC ⁽¹⁾, arrangements have been made for the safe use of work equipment.

The explosion protection document shall be drawn up prior to the commencement of work and be revised when the workplace, work equipment or organisation of the work undergoes significant changes, extensions or conversions.

The employer may combine existing explosion risk assessments, documents or other equivalent reports produced under other Community acts.

*Article 9***Special requirements for work equipment and workplaces**

1. Work equipment for use in places where explosive atmospheres may occur which is already in use or is made available in the undertaking or establishment for the first time before 30 June 2003 shall comply from that date with the minimum requirements laid down in Annex II, Part A, if no other Community Directive is applicable or is so only partially.

⁽¹⁾ OJ L 393, 30.12.1989, p. 13. Directive as amended by Directive 95/63/EC (OJ L 335, 30.12.1995, p. 28).

2. Work equipment for use in places where explosive atmospheres may occur which is made available in the undertaking or establishment for the first time after 30 June 2003 shall comply with the minimum requirements laid down in Annex II, Parts A and B.

3. Workplaces which contain places where explosive atmospheres may occur and which are used for the first time after 30 June 2003 shall comply with minimum requirements set out in this Directive.

4. Where workplaces which contain places where explosive atmospheres may occur are already in use before 30 June 2003, they shall comply with the minimum requirements set out in this Directive no later than three years after that date.

5. If, after 30 June 2003, any modification, extension or restructuring is undertaken in workplaces containing places where explosive atmospheres may occur, the employer shall take the necessary steps to ensure that these comply with the minimum requirements set out in this Directive.

SECTION III

MISCELLANEOUS PROVISIONS

Article 10

Adjustments to the annexes

Purely technical adjustments to the annexes made necessary by:

- the adoption of Directives on technical harmonisation and standardisation in the field of explosion protection, and/or
- technical progress, changes in international regulations or specifications, and new findings on the prevention of and protection against explosions,

shall be adopted in accordance with the procedure laid down in Article 17 of Directive 89/391/EEC.

Article 11

Guide of good practice

The Commission shall draw up practical guidelines in a guide of good practice of a non-binding nature. This guide shall address the topics referred to in Articles 3, 4, 5, 6, 7 and 8, Annex I and Annex II, Part A.

The Commission shall first consult the Advisory Committee on Safety, Hygiene and Health Protection at Work in accordance with Council Decision 74/325/EEC⁽¹⁾.

In the context of the application of this Directive, Member States shall take the greatest possible account of the above-

mentioned guide in drawing up their national policies for the protection of the health and safety of workers

Article 12

Information to undertakings

Member States shall, on request, endeavour to make relevant information available to employers in accordance with Article 11, with particular reference to the guide of good practice

Article 13

Final provisions

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive not later than 30 June 2003. They shall forthwith inform the Commission thereof.

When Member States adopt these measures, they shall contain a reference to this Directive or shall be accompanied by such reference on the occasion of their official publication. The methods of making such reference shall be laid down by the Member States.

2. Member States shall communicate to the Commission the text of the provisions of domestic law which they have already adopted or adopt in the field governed by this Directive.

3. Member States shall report to the Commission every five years on the practical implementation of the provisions of this Directive, indicating the points of view of employers and workers. The Commission shall inform thereof the European Parliament, the Council, the Economic and Social Committee and the Advisory Committee on Safety, Hygiene and Health Protection at Work.

Article 14

This Directive shall enter into force on the day of its publication in the *Official Journal of the European Communities*.

Article 15

This Directive is addressed to the Member States.

Done at Brussels, 16 December 1999.

For the European Parliament

The President

N. FONTAINE

For the Council

The President

K. KEMILÄ

⁽¹⁾ OJ L 185, 9.7.1974, p. 15. Decision as last amended by the 1994 Act of Accession.

ANNEX I

CLASSIFICATION OF PLACES WHERE EXPLOSIVE ATMOSPHERES MAY OCCUR**Preliminary note**

The following system of classification must be applied to places where precautions in accordance with Articles 3, 4, 7 and 8 are taken.

1. Places where explosive atmospheres may occur

A place in which an explosive atmosphere may occur in such quantities as to require special precautions to protect the health and safety of the workers concerned is deemed to be hazardous within the meaning of this Directive.

A place in which an explosive atmosphere is not expected to occur in such quantities as to require special precautions is deemed to be non-hazardous within the meaning of this Directive.

Flammable and/or combustible substances are considered as materials which may form an explosive atmosphere unless an investigation of their properties has shown that in mixtures with air they are incapable of independently propagating an explosion.

2. Classification of hazardous places

Hazardous places are classified in terms of zones on the basis of the frequency and duration of the occurrence of an explosive atmosphere.

The extent of the measures to be taken in accordance with Annex II, Part A, is determined by this classification.

Zone 0

A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently.

Zone 1

A place in which an explosive atmosphere consisting of a mixture with air or flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.

Zone 2

A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

Zone 20

A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently.

Zone 21

A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally.

Zone 22

A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

Notes:

1. Layers, deposits and heaps of combustible dust must be considered as any other source which can form an explosive atmosphere.
2. 'Normal operation' means the situation when installations are used within their design parameters.

ANNEX II

A. MINIMUM REQUIREMENTS FOR IMPROVING THE SAFETY AND HEALTH PROTECTION OF WORKERS POTENTIALLY AT RISK FROM EXPLOSIVE ATMOSPHERES

Preliminary note

The obligations laid down in this Annex apply to:

- places classified as hazardous in accordance with Annex I whenever required by the features of workplaces, workstations, the equipment or substances used or the danger caused by the activity related to the risks from explosive atmospheres,
- equipment in non-hazardous places which is required for, or helps to ensure, the safe operation of equipment located in hazardous places.

1. Organisational measures**1.1. Training of workers**

The employer must provide those working in places where explosive atmospheres may occur with sufficient and appropriate training with regard to explosion protection.

1.2. Written instructions and permits to work

Where required by the explosion protection document:

- work in hazardous places must be carried out in accordance with written instructions issued by the employer,
- a system of permits to work must be applied for carrying out both hazardous activities and activities which may interact with other work to cause hazards.

Permits to work must be issued by a person with responsibility for this function prior to the commencement of work.

2. Explosion protection measures

- 2.1. Any escape and/or release, whether or not intentional, of flammable gases, vapours, mists or combustible dusts which may give rise to explosion hazards must be suitably diverted or removed to a safe place or, if that is not practicable, safely contained or rendered safe by some other suitable method.
- 2.2. If an explosive atmosphere contains several types of flammable and/or combustible gases, vapours, mists or dusts, protective measures shall be appropriate to the greatest potential risk.
- 2.3. Prevention of ignition hazards in accordance with Article 3 must also take account of electrostatic discharges, where workers or the working environment act as charge carrier or charge producer. Workers must be provided with appropriate working clothes consisting of materials which do not give rise to electrostatic discharges that can ignite explosive atmospheres.
- 2.4. Plant, equipment, protective systems and any associated connecting devices must only be brought into service if the explosion protection document indicates that they can be safely used in an explosive atmosphere. This applies also to work equipment and associated connecting devices which are not regarded as equipment or protective systems within the meaning of Directive 94/9/EC if their incorporation into an installation can in itself give rise to an ignition hazard. Necessary measures must be taken to prevent confusion between connecting devices.
- 2.5. All necessary measures must be taken to ensure that the workplace, work equipment and any associated connecting device made available to workers have been designed, constructed, assembled and installed, and are maintained and operated, in such a way as to minimise the risks of an explosion and, if an explosion does occur, to control or minimise its propagation within that workplace and/or work equipment. For such workplaces appropriate measures must be taken to minimise the risks to workers from the physical effects of an explosion.
- 2.6. Where necessary, workers must be given optical and/or acoustic warnings and withdrawn before the explosion conditions are reached.
- 2.7. Where required by the explosion protection document, escape facilities must be provided and maintained to ensure that, in the event of danger, workers can leave endangered places promptly and safely.
- 2.8. Before a workplace containing places where explosive atmospheres may occur is used for the first time, its overall explosion safety must be verified. Any conditions necessary for ensuring explosion protection must be maintained.

Such verification must be carried out by persons competent in the field of explosion protection as a result of their experience and/or professional training.

2.9. Where the risk assessment shows it is necessary:

- it must be possible, where power failure can give rise to the spread of additional risks, to maintain equipment and protective systems in a safe state of operation independently of the rest of the installation in the event of power failure,
- manual override must be possible in order to shut down the equipment and protective systems incorporated within automatic processes which deviate from the intended operating conditions, provided that this does not compromise safety. Only workers competent to do so may take such action,
- on operation of the emergency shutdown, accumulated energy must be dissipated as quickly and as safely as possible or isolated so that it no longer constitutes a hazard.

B. CRITERIA FOR THE SELECTION OF EQUIPMENT AND PROTECTIVE SYSTEMS

If the explosion protection document based on a risk assessment does not state otherwise, equipment and protective systems for all places in which explosive atmospheres may occur must be selected on the basis of the categories set out in Directive 94/9/EC.

In particular, the following categories of equipment must be used in the zones indicated, provided they are suitable for gases, vapours or mists and/or dusts as appropriate:

- in zone 0 or zone 20, category 1 equipment,
 - in zone 1 or zone 21, category 1 or 2 equipment,
 - in zone 2 or zone 22, category 1, 2 or 3 equipment.
-

ANNEX III

Warning sign for places where explosive atmospheres may occur, pursuant to Article 7(3):



Place where explosive atmospheres may occur

Distinctive features:

- triangular shape,
- black letters on a yellow background with black edging (the yellow part to take up at least 50 % of the area of the sign).

Member States may add other explanatory data if they wish.

II

(Acts whose publication is not obligatory)

COUNCIL

COUNCIL DIRECTIVE

of 12 June 1989

on the introduction of measures to encourage improvements in the safety and health of workers at work

(89/391/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 118a thereof,

Having regard to the proposal from the Commission ⁽¹⁾, drawn up after consultation with the Advisory Committee on Safety, Hygiene and Health Protection at Work,

In cooperation with the European Parliament ⁽²⁾,

Having regard to the opinion of the Economic and Social Committee ⁽³⁾,

Whereas Article 118a of the Treaty provides that the Council shall adopt, by means of Directives, minimum requirements for encouraging improvements, especially in the working environment, to guarantee a better level of protection of the safety and health of workers;

Whereas this Directive does not justify any reduction in levels of protection already achieved in individual Member States, the Member State being committed, under the Treaty, to encouraging improvements in conditions in this area and to harmonizing conditions while maintaining the improvements made;

Whereas it is known that workers can be exposed to the effects of dangerous environmental factors at the work place during the course of their working life;

Whereas, pursuant to Article 118a of the Treaty, such Directives must avoid imposing administrative, financial and legal constraints which would hold back the creation and development of small and medium-sized undertakings;

Whereas the communication from the Commission on its programme concerning safety, hygiene and health at work ⁽⁴⁾ provides for the adoption of Directives designed to guarantee the safety and health of workers;

Whereas the Council, in its resolution of 21 December 1987 on safety, hygiene and health at work ⁽⁵⁾, took note of the Commission's intention to submit to the Council in the near future a Directive on the organization of the safety and health of workers at the work place;

Whereas in February 1988 the European Parliament adopted four resolutions following the debate on the internal market and worker protection; whereas these resolutions specifically invited the Commission to draw up a framework Directive to serve as a basis for more specific Directives covering all the risks connected with safety and health at the work place;

Whereas Member States have a responsibility to encourage improvements in the safety and health of workers on their territory; whereas taking measures to protect the health and safety of workers at work also helps, in certain cases, to preserve the health and possibly the safety of persons residing with them;

⁽¹⁾ OJ No C 141, 30. 5. 1988, p. 1.

⁽²⁾ OJ No C 326, 19. 12. 1988, p. 102, and OJ No C 158, 26. 6. 1989.

⁽³⁾ OJ No C 175, 4. 7. 1988, p. 22.

⁽⁴⁾ OJ No C 28, 3. 2. 1988, p. 3.

⁽⁵⁾ OJ No C 28, 3. 2. 1988, p. 1.

Whereas Member States' legislative systems covering safety and health at the work place differ widely and need to be improved; whereas national provisions on the subject, which often include technical specifications and/or self-regulatory standards, may result in different levels of safety and health protection and allow competition at the expense of safety and health;

Whereas the incidence of accidents at work and occupational diseases is still too high; whereas preventive measures must be introduced or improved without delay in order to safeguard the safety and health of workers and ensure a higher degree of protection;

Whereas, in order to ensure an improved degree of protection, workers and/or their representatives must be informed of the risks to their safety and health and of the measures required to reduce or eliminate these risks; whereas they must also be in a position to contribute, by means of balanced participation in accordance with national laws and/or practices, to seeing that the necessary protective measures are taken;

Whereas information, dialogue and balanced participation on safety and health at work must be developed between employers and workers and/or their representatives by means of appropriate procedures and instruments, in accordance with national laws and/or practices;

Whereas the improvement of workers' safety, hygiene and health at work is an objective which should not be subordinated to purely economic considerations;

Whereas employers shall be obliged to keep themselves informed of the latest advances in technology and scientific findings concerning work-place design, account being taken of the inherent dangers in their undertaking, and to inform accordingly the workers' representatives exercising participation rights under this Directive, so as to be able to guarantee a better level of protection of workers' health and safety;

Whereas the provisions of this Directive apply, without prejudice to more stringent present or future Community provisions, to all risks, and in particular to those arising from the use at work of chemical, physical and biological agents covered by Directive 80/1107/EEC ⁽¹⁾, as last amended by Directive 88/642/EEC ⁽²⁾;

Whereas, pursuant to Decision 74/325/EEC ⁽³⁾, the Advisory Committee on Safety, Hygiene and Health

Protection at Work is consulted by the Commission on the drafting of proposals in this field;

Whereas a Committee composed of members nominated by the Member States needs to be set up to assist the Commission in making the technical adaptations to the individual Directives provided for in this Directive.

HAS ADOPTED THIS DIRECTIVE:

SECTION I

GENERAL PROVISIONS

Article 1

Object

1. The object of this Directive is to introduce measures to encourage improvements in the safety and health of workers at work.
2. To that end it contains general principles concerning the prevention of occupational risks, the protection of safety and health, the elimination of risk and accident factors, the informing, consultation, balanced participation in accordance with national laws and/or practices and training of workers and their representatives, as well as general guidelines for the implementation of the said principles.
3. This Directive shall be without prejudice to existing or future national and Community provisions which are more favourable to protection of the safety and health of workers at work.

Article 2

Scope

1. This Directive shall apply to all sectors of activity, both public and private (industrial, agricultural, commercial, administrative, service, educational, cultural, leisure, etc.).
2. This Directive shall not be applicable where characteristics peculiar to certain specific public service activities, such as the armed forces or the police, or to certain specific activities in the civil protection services inevitably conflict with it.

In that event, the safety and health of workers must be ensured as far as possible in the light of the objectives of this Directive.

⁽¹⁾ OJ No L 327, 3. 12. 1980, p. 8.

⁽²⁾ OJ No L 356, 24. 12. 1988, p. 74.

⁽³⁾ OJ No L 185, 9. 7. 1974, p. 15.

*Article 3***Definitions**

For the purposes of this Directive, the following terms shall have the following meanings:

- (a) worker: any person employed by an employer, including trainees and apprentices but excluding domestic servants;
- (b) employer: any natural or legal person who has an employment relationship with the worker and has responsibility for the undertaking and/or establishment;
- (c) workers' representative with specific responsibility for the safety and health of workers: any person elected, chosen or designated in accordance with national laws and/or practices to represent workers where problems arise relating to the safety and health protection of workers at work;
- (d) prevention: all the steps or measures taken or planned at all stages of work in the undertaking to prevent or reduce occupational risks.

Article 4

1. Member States shall take the necessary steps to ensure that employers, workers and workers' representatives are subject to the legal provisions necessary for the implementation of this Directive.

2. In particular, Member States shall ensure adequate controls and supervision.

SECTION II**EMPLOYERS' OBLIGATIONS***Article 5***General provision**

- 1. The employer shall have a duty to ensure the safety and health of workers in every aspect related to the work.
- 2. Where, pursuant to Article 7 (3), an employer enlists competent external services or persons, this shall not discharge him from his responsibilities in this area.
- 3. The workers' obligations in the field of safety and health at work shall not affect the principle of the responsibility of the employer.
- 4. This Directive shall not restrict the option of Member States to provide for the exclusion or the limitation of employers' responsibility where occurrences are due to unusual and unforeseeable circumstances, beyond the

employers' control, or to exceptional events, the consequences of which could not have been avoided despite the exercise of all due care.

Member States need not exercise the option referred to in the first subparagraph.

*Article 6***General obligations on employers**

1. Within the context of his responsibilities, the employer shall take the measures necessary for the safety and health protection of workers, including prevention of occupational risks and provision of information and training, as well as provision of the necessary organization and means.

The employer shall be alert to the need to adjust these measures to take account of changing circumstances and aim to improve existing situations.

2. The employer shall implement the measures referred to in the first subparagraph of paragraph 1 on the basis of the following general principles of prevention:

- (a) avoiding risks;
- (b) evaluating the risks which cannot be avoided;
- (c) combating the risks at source;
- (d) adapting the work to the individual, especially as regards the design of work places, the choice of work equipment and the choice of working and production methods, with a view, in particular, to alleviating monotonous work and work at a predetermined work-rate and to reducing their effect on health.
- (e) adapting to technical progress;
- (f) replacing the dangerous by the non-dangerous or the less dangerous;
- (g) developing a coherent overall prevention policy which covers technology, organization of work, working conditions, social relationships and the influence of factors related to the working environment;
- (h) giving collective protective measures priority over individual protective measures;
- (i) giving appropriate instructions to the workers.

3. Without prejudice to the other provisions of this Directive, the employer shall, taking into account the nature of the activities of the enterprise and/or establishment:

- (a) evaluate the risks to the safety and health of workers, *inter alia* in the choice of work equipment, the chemical substances or preparations used, and the fitting-out of work places.

Subsequent to this evaluation and as necessary, the preventive measures and the working and production methods implemented by the employer must:

- assure an improvement in the level of protection afforded to workers with regard to safety and health,
 - be integrated into all the activities of the undertaking and/or establishment and at all hierarchical levels;
- (b) where he entrusts tasks to a worker, take into consideration the worker's capabilities as regards health and safety;
- (c) ensure that the planning and introduction of new technologies are the subject of consultation with the workers and/or their representatives, as regards the consequences of the choice of equipment, the working conditions and the working environment for the safety and health of workers;
- (d) take appropriate steps to ensure that only workers who have received adequate instructions may have access to areas where there is serious and specific danger.

4. Without prejudice to the other provisions of this Directive, where several undertakings share a work place, the employers shall cooperate in implementing the safety, health and occupational hygiene provisions and, taking into account the nature of the activities, shall coordinate their actions in matters of the protection and prevention of occupational risks, and shall inform one another and their respective workers and/or workers' representatives of these risks.

5. Measures related to safety, hygiene and health at work may in no circumstances involve the workers in financial cost.

Article 7

Protective and preventive services

1. Without prejudice to the obligations referred to in Articles 5 and 6, the employer shall designate one or more workers to carry out activities related to the protection and prevention of occupational risks for the undertaking and/or establishment.

2. Designated workers may not be placed at any disadvantage because of their activities related to the protection and prevention of occupational risks.

Designated workers shall be allowed adequate time to enable them to fulfil their obligations arising from this Directive.

3. If such protective and preventive measures cannot be organized for lack of competent personnel in the undertaking

and/or establishment, the employer shall enlist competent external services or persons.

4. Where the employer enlists such services or persons, he shall inform them of the factors known to affect, or suspected of affecting, the safety and health of the workers and they must have access to the information referred to in Article 10 (2).

5. In all cases:

- the workers designated must have the necessary capabilities and the necessary means,
- the external services or persons consulted must have the necessary aptitudes and the necessary personal and professional means, and
- the workers designated and the external services or persons consulted must be sufficient in number

to deal with the organization of protective and preventive measures, taking into account the size of the undertaking and/or establishment and/or the hazards to which the workers are exposed and their distribution throughout the entire undertaking and/or establishment.

6. The protection from, and prevention of, the health and safety risks which form the subject of this Article shall be the responsibility of one or more workers, of one service or of separate services whether from inside or outside the undertaking and/or establishment.

The worker(s) and/or agency(ies) must work together whenever necessary.

7. Member States may define, in the light of the nature of the activities and size of the undertakings, the categories of undertakings in which the employer, provided he is competent, may himself take responsibility for the measures referred to in paragraph 1.

8. Member States shall define the necessary capabilities and aptitudes referred to in paragraph 5.

They may determine the sufficient number referred to in paragraph 5.

Article 8

First aid, fire-fighting and evacuation of workers, serious and imminent danger

1. The employer shall:

- take the necessary measures for first aid, fire-fighting and evacuation of workers, adapted to the nature of the

activities and the size of the undertaking and/or establishment and taking into account other persons present,

- arrange any necessary contacts with external services, particularly as regards first aid, emergency medical care, rescue work and fire-fighting.

2. Pursuant to paragraph 1, the employer shall, *inter alia*, for first aid, fire-fighting and the evacuation of workers, designate the workers required to implement such measures.

The number of such workers, their training and the equipment available to them shall be adequate, taking account of the size and/or specific hazards of the undertaking and/or establishment.

3. The employer shall:

- (a) as soon as possible, inform all workers who are, or may be, exposed to serious and imminent danger of the risk involved and of the steps taken or to be taken as regards protection;
- (b) take action and give instructions to enable workers in the event of serious, imminent and unavoidable danger to stop work and/or immediately to leave the work place and proceed to a place of safety;
- (c) save in exceptional cases for reasons duly substantiated, refrain from asking workers to resume work in a working situation where there is still a serious and imminent danger.

4. Workers who, in the event of serious, imminent and unavoidable danger, leave their workstation and/or a dangerous area may not be placed at any disadvantage because of their action and must be protected against any harmful and unjustified consequences, in accordance with national laws and/or practices.

5. The employer shall ensure that all workers are able, in the event of serious and imminent danger to their own safety and/or that of other persons, and where the immediate superior responsible cannot be contacted, to take the appropriate steps in the light of their knowledge and the technical means at their disposal, to avoid the consequences of such danger.

Their actions shall not place them at any disadvantage, unless they acted carelessly or there was negligence on their part.

Article 9

Various obligations on employers

1. The employer shall:

- (a) be in possession of an assessment of the risks to safety and health at work, including those facing groups of workers exposed to particular risks;

- (b) decide on the protective measures to be taken and, if necessary, the protective equipment to be used;

- (c) keep a list of occupational accidents resulting in a worker being unfit for work for more than three working days;

- (d) draw up, for the responsible authorities and in accordance with national laws and/or practices, reports on occupational accidents suffered by his workers.

2. Member States shall define, in the light of the nature of the activities and size of the undertakings, the obligations to be met by the different categories of undertakings in respect of the drawing-up of the documents provided for in paragraph 1 (a) and (b) and when preparing the documents provided for in paragraph 1 (c) and (d).

Article 10

Worker information

1. The employer shall take appropriate measures so that workers and/or their representatives in the undertaking and/or establishment receive, in accordance with national laws and/or practices which may take account, *inter alia*, of the size of the undertaking and/or establishment, all the necessary information concerning:

- (a) the safety and health risks and protective and preventive measures and activities in respect of both the undertaking and/or establishment in general and each type of workstation and/or job;

- (b) the measures taken pursuant to Article 8 (2).

2. The employer shall take appropriate measures so that employers of workers from any outside undertakings and/or establishments engaged in work in his undertaking and/or establishment receive, in accordance with national laws and/or practices, adequate information concerning the points referred to in paragraph 1 (a) and (b) which is to be provided to the workers in question.

3. The employer shall take appropriate measures so that workers with specific functions in protecting the safety and health of workers, or workers' representatives with specific responsibility for the safety and health of workers shall have access, to carry out their functions and in accordance with national laws and/or practices, to:

- (a) the risk assessment and protective measures referred to in Article 9 (1) (a) and (b);

- (b) the list and reports referred to in Article 9 (1) (c) and (d);
- (c) the information yielded by protective and preventive measures, inspection agencies and bodies responsible for safety and health.

Article 11

Consultation and participation of workers

1. Employers shall consult workers and/or their representatives and allow them to take part in discussions on all questions relating to safety and health at work.

This presupposes:

- the consultation of workers,
- the right of workers and/or their representatives to make proposals,
- balanced participation in accordance with national laws and/or practices.

2. Workers or workers' representatives with specific responsibility for the safety and health of workers shall take part in a balanced way, in accordance with national laws and/or practices, or shall be consulted in advance and in good time by the employer with regard to:

- (a) any measure which may substantially affect safety and health;
- (b) the designation of workers referred to in Articles 7 (1) and 8 (2) and the activities referred to in Article 7 (1);
- (c) the information referred to in Articles 9 (1) and 10;
- (d) the enlistment, where appropriate, of the competent services or persons outside the undertaking and/or establishment, as referred to in Article 7 (3);
- (e) the planning and organization of the training referred to in Article 12.

3. Workers' representatives with specific responsibility for the safety and health of workers shall have the right to ask the employer to take appropriate measures and to submit proposals to him to that end to mitigate hazards for workers and/or to remove sources of danger.

4. The workers referred to in paragraph 2 and the workers' representatives referred to in paragraphs 2 and 3 may not be placed at a disadvantage because of their respective activities referred to in paragraphs 2 and 3.

5. Employers must allow workers' representatives with specific responsibility for the safety and health of workers

adequate time off work, without loss of pay, and provide them with the necessary means to enable such representatives to exercise their rights and functions deriving from this Directive.

6. Workers and/or their representatives are entitled to appeal, in accordance with national law and/or practice, to the authority responsible for safety and health protection at work if they consider that the measures taken and the means employed by the employer are inadequate for the purposes of ensuring safety and health at work.

Workers' representatives must be given the opportunity to submit their observations during inspection visits by the competent authority.

Article 12

Training of workers

1. The employer shall ensure that each worker receives adequate safety and health training, in particular in the form of information and instructions specific to his workstation or job:

- on recruitment,
- in the event of a transfer or a change of job,
- in the event of the introduction of new work equipment or a change in equipment,
- in the event of the introduction of any new technology.

The training shall be:

- adapted to take account of new or changed risks, and
- repeated periodically if necessary.

2. The employer shall ensure that workers from outside undertakings and/or establishments engaged in work in his undertaking and/or establishment have in fact received appropriate instructions regarding health and safety risks during their activities in his undertaking and/or establishment.

3. Workers' representatives with a specific role in protecting the safety and health of workers shall be entitled to appropriate training.

4. The training referred to in paragraphs 1 and 3 may not be at the workers' expense or at that of the workers' representatives.

The training referred to in paragraph 1 must take place during working hours.

The training referred to in paragraph 3 must take place during working hours or in accordance with national practice either within or outside the undertaking and/or the establishment.

SECTION III

WORKERS' OBLIGATIONS

Article 13

1. It shall be the responsibility of each worker to take care as far as possible of his own safety and health and that of other persons affected by his acts or Commissions at work in accordance with his training and the instructions given by his employer.

2. To this end, workers must in particular, in accordance with their training and the instructions given by their employer:

- (a) make correct use of machinery, apparatus, tools, dangerous substances, transport equipment and other means of production;
- (b) make correct use of the personal protective equipment supplied to them and, after use, return it to its proper place;
- (c) refrain from disconnecting, changing or removing arbitrarily safety devices fitted, e.g. to machinery, apparatus, tools, plant and buildings, and use such safety devices correctly;
- (d) immediately inform the employer and/or the workers with specific responsibility for the safety and health of workers of any work situation they have reasonable grounds for considering represents a serious and immediate danger to safety and health and of any shortcomings in the protection arrangements;
- (e) cooperate, in accordance with national practice, with the employer and/or workers with specific responsibility for the safety and health of workers, for as long as may be necessary to enable any tasks or requirements imposed by the competent authority to protect the safety and health of workers at work to be carried out;
- (f) cooperate, in accordance with national practice, with the employer and/or workers with specific responsibility for the safety and health of workers, for as long as may be necessary to enable the employer to ensure that the working environment and working conditions are safe and pose no risk to safety and health within their field of activity.

SECTION IV

MISCELLANEOUS PROVISIONS

Article 14

Health surveillance

1. To ensure that workers receive health surveillance appropriate to the health and safety risks they incur at work, measures shall be introduced in accordance with national law and/or practices.

2. The measures referred to in paragraph 1 shall be such that each worker, if he so wishes, may receive health surveillance at regular intervals.

3. Health surveillance may be provided as part of a national health system.

Article 15

Risk groups

Particularly sensitive risk groups must be protected against the dangers which specifically affect them.

Article 16

Individual Directives — Amendments —

General scope of this Directive

1. The Council, acting on a proposal from the Commission based on Article 118a of the Treaty, shall adopt individual Directives, *inter alia*, in the areas listed in the Annex.

2. This Directive and, without prejudice to the procedure referred to in Article 17 concerning technical adjustments, the individual Directives may be amended in accordance with the procedure provided for in Article 118a of the Treaty.

3. The provisions of this Directive shall apply in full to all the areas covered by the individual Directives, without prejudice to more stringent and/or specific provisions contained in these individual Directives.

Article 17

Committee

1. For the purely technical adjustments to the individual Directives provided for in Article 16 (1) to take account of:

- the adoption of Directives in the field of technical harmonization and standardization, and/or
- technical progress, changes in international regulations or specifications, and new findings,

the Commission shall be assisted by a committee composed of the representatives of the Member States and chaired by the representative of the Commission.

2. The representative of the Commission shall submit to the committee a draft of the measures to be taken.

The committee shall deliver its opinion on the draft within a time limit which the chairman may lay down according to the urgency of the matter.

The opinion shall be delivered by the majority laid down in Article 148 (2) of the Treaty in the case of decisions which the Council is required to adopt on a proposal from the Commission.

The votes of the representatives of the Member States within the committee shall be weighted in the manner set out in that Article. The chairman shall not vote.

3. The Commission shall adopt the measures envisaged if they are in accordance with the opinion of the committee.

If the measures envisaged are not in accordance with the opinion of the committee, or if no opinion is delivered, the Commission shall, without delay, submit to the Council a proposal relating to the measures to be taken. The Council shall act by a qualified majority.

If, on the expiry of three months from the date of the referral to the Council, the Council has not acted, the proposed measures shall be adopted by the Commission.

Article 18

Final provisions

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by 31 December 1992.

They shall forthwith inform the Commission thereof.

2. Member States shall communicate to the Commission the texts of the provisions of national law which they have already adopted or adopt in the field covered by this Directive.

3. Member States shall report to the Commission every five years on the practical implementation of the provisions of this Directive, indicating the points of view of employers and workers.

The Commission shall inform the European Parliament, the Council, the Economic and Social Committee and the Advisory Committee on Safety, Hygiene and Health Protection at Work.

4. The Commission shall submit periodically to the European Parliament, the Council and the Economic and Social Committee a report on the implementation of this Directive, taking into account paragraphs 1 to 3.

Article 19

This Directive is addressed to the Member States.

Done at Luxembourg, 12 June 1989.

For the Council

The President

M. CHAVES GONZALES

ANNEX

List of areas referred to in Article 16 (1)

- Work places
- Work equipment
- Personal protective equipment
- Work with visual display units
- Handling of heavy loads involving risk of back injury
- Temporary or mobile work sites
- Fisheries and agriculture

I

(Acts whose publication is obligatory)

DIRECTIVE 94/9/EC OF THE EUROPEAN PARLIAMENT AND THE COUNCIL

of 23 March 1994

on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 100a thereof,

Having regard to the proposal from the Commission ⁽¹⁾,

Having regard to the opinion of the Economic and Social Committee ⁽²⁾,

Acting in accordance with the procedure referred to in Article 189b of the Treaty establishing the European Community,

Whereas it is the duty of Member States to protect, on their territory, the safety and health of persons and, where appropriate, domestic animals and property and, in particular, that of workers, especially against the hazards resulting from the use of equipment and systems providing protection against potentially explosive atmospheres;

Whereas mandatory provisions within the Member States determine the level of safety to be achieved by protective equipment and systems intended for use in potentially explosive atmospheres; whereas these are generally electrical and non-electrical specifications having an effect on the design and structure of equipment which can be used in potentially explosive atmospheres;

Whereas the requirements to be met by such equipment differ from one Member State to another in respect of their extent and differing inspection procedures; whereas these differences are, therefore, likely to raise barriers to trade within the Community;

Whereas harmonization of national legislation is the only way in which to remove these barriers to free trade; whereas this objective cannot be satisfactorily achieved by the individual Member States; whereas this Directive

merely lays down the requirements vital to freedom of movement for the equipment to which it applies;

Whereas the regulations intended to remove technical barriers to trade are required to follow the new approach provided for in the Council resolution of 7 May 1985 ⁽³⁾, which requires a definition of the essential requirements regarding safety and other requirements of society without reducing existing, justified levels of protection within the Member States; whereas that resolution provides that a very large number of products be covered by a single Directive in order to avoid frequent amendments and the proliferation of Directives;

Whereas the existing Directives on the approximation of the laws of the Member States to electrical equipment for use in potentially explosive atmospheres have made positive steps towards protection against explosions via measures linked with the structure of the equipment at issue and which have helped to remove barriers to trade in this area; whereas, in parallel, a revision and expansion of the existing Directives is necessary since, more particularly, in an overall context, action must be taken to guard against the potential hazards arising from such equipment. This implies in particular that measures intended to guarantee effective protection of users and third parties must already be contemplated at the design and manufacturing stages;

Whereas the form taken by the hazard, the protective measures and the test methods are often very similar, if not identical, for both mining and surface equipment; whereas it is, therefore, absolutely necessary to cover by a single Directive protective equipment and systems falling within both groups;

Whereas the two groups of equipment referred to above are used in a large number of commercial and industrial sectors and possess considerable economic significance;

Whereas compliance with the basic safety and health requirements is essential in order to ensure the safety of

⁽¹⁾ OJ No C 46, 20. 2. 1992, p. 19.

⁽²⁾ OJ No C 106, 27. 4. 1992, p. 9.

⁽³⁾ OJ No C 136, 4. 6. 1985, p. 1.

protective equipment and systems; whereas those requirements have been subdivided into general and additional requirements which must be met by protective equipment and systems; whereas, in particular, the additional requirements are intended to take account of existing or potential hazards; whereas protective equipment and systems will, therefore, embody at least one of those requirements where this is necessary for their proper functioning or is to apply to their intended use; whereas the notion of intended use is of prime importance for the explosion-proofing of protective equipment and systems; whereas it is essential that manufacturers supply full information; whereas specific, clear marking of said equipment, stating its use in a potentially explosive atmosphere, is also necessary;

Whereas the intention is to prepare a Directive on operations in potentially explosive atmospheres which is based on Article 118a; whereas that additional Directive will, in particular, aim at explosion hazards which derive from a given use and/or types and methods of installation;

Whereas compliance with essential health and safety requirements is imperative if the safety of equipment is to be ensured; whereas judgment will have to be exercised in the implementation of those requirements in order to take account of both the technology obtaining at the time of manufacture and overriding technical and economic requirements;

Whereas, therefore, this Directive sets out essential requirements only; whereas, in order to facilitate the task of proving compliance with the essential requirements, harmonized European standards are necessary, more especially with regard to the non-electrical aspects of protection against explosions — standards relating to the design, manufacture and testing of equipment, compliance with which enables a product to be presumed to meet such essential requirements; whereas harmonized European standards are drawn up by private bodies and must retain their non-mandatory status; whereas, for this purpose, the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (Cenelec) are recognized as the bodies competent to adopt harmonized standards which follow the general guidelines for cooperation between the Commission and those two bodies, signed on 13 November 1984; whereas, for the purposes of this Directive, a harmonized standard is a technical specification (European Standard or harmonization document) adopted by one or other of those bodies, or by both, at the prompting of the Commission pursuant to Council Directive 83/189/EEC of the 28 March 1983 providing for a procedure governing the provision of information on technical standards and regulations⁽¹⁾ and pursuant to the general guidelines referred to above;

Whereas the legislative framework should be improved in order to ensure that employers and workers make an effective and appropriate contribution towards the standardization process; whereas this should be completed by the time this Directive is implemented;

Whereas, in view of the nature of the risks involved in the use of equipment in potentially explosive atmospheres it is necessary to establish procedures applying to the assessment of compliance with the basic requirements of the Directives; whereas these procedures must be devised in the light of the level of risk which may be inherent in equipment and/or against which systems must protect the immediate environment; whereas, therefore, each category of equipment conformity must be supplemented by an adequate procedure or a choice between several equivalent procedures; whereas the procedures adopted comply fully with Council Decision 93/465/EEC of 22 July 1993 concerning the modules for the various phases of the conformity assessment procedures which are intended to be used in the technical harmonization Directives⁽²⁾;

Whereas the Council has provided for the affixing of the CE marking by either the manufacturer or his authorized representative within the Community; whereas that marking means that the product complies with all the basic requirements and assessment procedures provided for by the Community law applying to that product;

Whereas it is appropriate that the Member States, as provided for by Article 100a of the Treaty, may take temporary measures to limit or prohibit the placing on the market and the use of equipment and protective systems in cases where they present a particular risk to the safety of persons and, where appropriate, domestic animals or property, provided that the measures are subject to a Community control procedure;

Whereas the recipients of any decision taken as part of this Directive must be aware of the reasons behind that decision and the means of appeal open to them;

Whereas, on 18 December 1985, the Council adopted a framework Directive on electrical equipment for use in potentially explosive atmospheres (76/117/EEC)⁽³⁾ and, on 15 February 1982, a Directive concerning electrical equipment for use in potentially explosive atmospheres in mines susceptible to fire damp (82/130/EEC)⁽⁴⁾; whereas, from the outset of harmonization work, the conversion into total harmonization of the optional and partial harmonization on which these Directives are based had been contemplated; whereas this Directive fully covers the

⁽¹⁾ OJ No L 109, 26. 4. 1983, p. 8. Directive as last amended by Directive 88/182/EEC (OJ No L 81, 26. 3. 1988, p. 75).

⁽²⁾ OJ No L 220, 30. 8. 1993, p. 23.

⁽³⁾ OJ No L 24, 31. 1. 1976, p. 45. Directive as last amended by Directive 90/487/EEC (OJ No L 270, 2. 10. 1990, p. 23).

⁽⁴⁾ OJ No L 59, 2. 3. 1982, p. 10.

scope of the abovementioned Directives and whereas, therefore, these Directives must be repealed;

Whereas the internal market incorporates an area without internal frontiers within which the free movement of goods, persons, services and capital is assured;

Whereas it is necessary to provide for a transitional arrangement enabling equipment manufactured in compliance with the national regulations in force at the date of adoption of this Directive to be marketed and placed in service,

HAVE ADOPTED THIS DIRECTIVE:

CHAPTER I

Scope, placing on the market and freedom of movement

Article 1

1. This Directive applies to equipment and protective systems intended for use in potentially explosive atmospheres.
2. Safety devices, controlling devices and regulating devices intended for use outside potentially explosive atmospheres but required for or contributing to the safe functioning of equipment and protective systems with respect to the risks of explosion are also covered by the scope of this Directive.
3. For the purposes of this Directive, the following definitions shall apply:

Equipment and protective systems intended for use in potentially explosive atmospheres

- (a) 'Equipment' means machines, apparatus, fixed or mobile devices, control components and instrumentation thereof and detection or prevention systems which, separately or jointly, are 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.
- (b) 'Protective systems' means design units which are intended to halt incipient 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.
- (c) 'Components' means any item essential to the safe functioning of equipment and protective systems but with no autonomous function.

Explosive atmospheres

Mixture with air, under atmospheric conditions, of flammable substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture.

Potentially explosive atmosphere

An atmosphere which could become explosive due to local and operational conditions.

Equipment groups and categories

Equipment group I applies to equipment intended for use in underground parts of mines, and to those parts of surface installations of such mines, liable to be endangered by firedamp and/or combustible dust.

Equipment group II applies to equipment intended for use in other places liable to be endangered by explosive atmospheres.

The categories of equipment defining the required levels of protection are described in Annex I.

Equipment and protective systems may be designed for a particular explosive atmosphere. In this case, they must be marked accordingly.

Intended use

The use of equipment, protective systems, and devices referred to in Article 1 (2) in accordance with the equipment group and category and with all the information supplied by the manufacturer which is required for the safe functioning of equipment, protective systems and devices.

4. The following are excluded from the scope of this Directive:

- medical devices intended for use in a medical environment,
- equipment and protective systems where the explosion hazard results exclusively from the presence of explosive substances or unstable chemical substances,
- equipment intended for use in domestic and non-commercial environments where potentially explosive atmospheres may only rarely be created, solely as a result of the accidental leakage of fuel gas,
- personal protective equipment covered by Directive 89/686/EEC ⁽¹⁾,
- seagoing vessels and mobile offshore units together with equipment on board such vessels or units,

⁽¹⁾ OJ No L 399, 30. 12. 1989, p. 18.

- means of transport, i.e. vehicles and their trailers intended solely for transporting passengers by air or by road, rail or water networks, as well as means of transport in so far as such means are designed for transporting goods by air, by public road or rail networks or by water. Vehicles intended for use in a potentially explosive atmosphere shall not be excluded,
- the equipment covered by Article 223 (1) (b) of the Treaty.

Article 2

1. Member States shall take all appropriate measures to ensure that the equipment, protective systems and devices referred to in Article 1 (2) to which this Directive applies may be placed on the market and put into service only if, when properly installed and maintained and used for their intended purpose, they do not endanger the health and safety of persons and, where appropriate, domestic animals or property.

2. The provisions of this Directive shall not affect Member States' entitlement to lay down, in due observance of the provisions of the Treaty, such requirements as they may deem necessary to ensure that persons and, in particular, workers are protected when using the equipment, protective systems, and devices referred to in Article 1 (2) in question provided that this does not mean that such equipment, protective systems, or devices are modified in a way not specified in the Directive.

3. At trade fairs, exhibitions, demonstrations, etc., Member States shall not prevent the showing of equipment, protective systems, or the devices referred to in Article 1 (2) which do not conform to the provisions of this Directive, provided that a visible sign clearly indicates that such equipment, protective systems, and devices referred to in Article 1 (2) do not conform and that they are not for sale until they have been brought into conformity by the manufacturer or his authorized representative established in the Community. During demonstrations, adequate safety measures shall be taken to ensure the protection of persons.

Article 3

Equipment, protective systems, and the devices referred to in Article 1 (2) to which this Directive applies must meet the essential health and safety requirements set out in Annex II which apply to them, account being taken of their intended use.

Article 4

1. Member States shall not prohibit, restrict or impede the placing on the market and putting into service in their

territory of equipment, protective systems, or devices referred to in Article 1 (2) which comply with this Directive.

2. Member States shall not prohibit, restrict or impede the placing on the market of components which, accompanied by a certificate of conformity as referred to in Article 8 (3), are intended to be incorporated into equipment or protective systems within the meaning of this Directive.

Article 5

1. Member States shall regard as conforming to all the provisions of this Directive, including the relevant conformity assessment procedures laid down in chapter II:

- equipment, protective systems, and devices referred to in Article 1 (2) accompanied by the EC declaration of conformity referred to in Annex X and bearing the CE marking provided for in Article 10,
- the components referred to in Article 4 (2), accompanied by the certificate of conformity referred to in Article 8 (3).

In the absence of harmonized standards, Member States shall take any steps which they deem necessary to bring to the attention of the parties concerned the existing national technical standards and specifications regarded as important or relevant to the proper implementation of the essential health and safety requirements in Annex II.

2. Where a national standard transposing a harmonized standard, the reference for which has been published in the *Official Journal of the European Communities*, covers one or more of the essential health and safety requirements, the equipment, protective system, device referred to in Article 1 (2), or the component referred to in Article 4 (2), constructed in accordance with that standard shall be presumed to comply with the relevant essential health and safety requirements.

Member States shall publish the references of national standards transposing harmonized standards.

3. Member States shall ensure that appropriate measures are taken to enable the social partners to influence the process of preparing and monitoring the harmonized standards at national level.

Article 6

1. Where a Member State or the Commission considers that the harmonized standards referred to in

Article 5 (2) do not entirely satisfy the relevant essential health and safety requirements referred to in Article 3, the Commission or the Member State concerned shall bring the matter before the Committee set up under Directive 83/189/EEC, hereinafter referred to as 'the Committee', giving reasons therefor. The Committee shall deliver an opinion without delay.

Upon receipt of the Committee's opinion, the Commission shall inform the Member States whether or not it is necessary to withdraw those standards from the published information referred to in Article 5 (2).

2. The Commission may adopt any appropriate measure with a view to ensuring the practical application in a uniform manner of this Directive in accordance with the procedure laid down in paragraph 3.

3. The Commission shall be assisted by a Standing Committee, consisting of representatives appointed by the Member States and chaired by a representative of the Commission.

The Standing Committee shall draw up its own rules of procedure.

The representative of the Commission shall submit to the Committee a draft of the measures to be taken. The Committee shall deliver its opinion on the draft, within a time limit which the chairman may lay down according to the urgency of the matter, if necessary by taking a vote.

The opinion shall be recorded in the minutes; in addition, each Member State shall have the right to ask to have its position recorded in the minutes.

The Commission shall take the utmost account of the opinion delivered by the committee. It shall inform the committee of the manner in which its opinion has been taken into account.

4. The Standing Committee may furthermore examine any question relating to the application of this Directive and raised by its chairman either on the latter's initiative, or at the request of a Member State.

Article 7

1. When a Member State ascertains that equipment, protective systems or devices referred to in Article 1 (2) bearing the CE conformity marking and used in accordance with their intended use are liable to endanger the safety of persons and, where appropriate, domestic animals or property, it shall take all appropriate measures to withdraw such equipment or protective systems from the market, to prohibit the placing on the market, putting into service or use thereof, or to restrict free movement thereof.

The Member State shall immediately inform the Commission of any such measure, indicating the reasons for its decision and, in particular, whether non-conformity is due to:

- (a) failure to satisfy the essential requirements referred to in Article 3;
- (b) incorrect application of the standards referred to in Article 5 (2);
- (c) shortcomings in the standards referred to in Article 5 (2).

2. The Commission shall enter into consultation with the parties concerned without delay. Where the Commission considers, after this consultation, that the measure is justified, it shall immediately so inform the Member State which took the initiative and the other Member States. Where the Commission considers, after this consultation, that the action is unjustified, it shall immediately so inform the Member State which took the initiative and the manufacturer or his authorized representative established within the Community. Where the decision referred to in paragraph 1 is based on a shortcoming in the standards and where the Member State at the origin of the decision maintains its position, the Commission shall immediately inform the Committee in order to initiate the procedures referred to in Article 6 (1).

3. Where equipment or a protective system which does not comply bears the CE conformity marking, the competent Member State shall take appropriate action against the person(s) having affixed the marking and shall so inform the Commission and the other Member States.

4. The Commission shall ensure that the Member States are kept informed of the progress and outcome of this procedure.

CHAPTER II

Conformity assessment procedures

Article 8

1. The procedures for assessing the conformity of equipment, including where necessary the devices referred to in Article 1 (2), shall be as follows:

- (a) *equipment-group I and II, equipment-category M 1 and 1*

The manufacturer or his authorized representative established in the Community must, in order to affix the CE marking, follow the CE type-examination procedure (referred to in Annex III), in conjunction with:

- the procedure relating to production quality assurance (referred to in Annex IV),
 - or
 - the procedure relating to product verification (referred to in Annex V);
- (b) *Equipment-group I and II, equipment-category M 2 and 2*
- (i) In the case of internal combustion engines and electrical equipment in these groups and categories, the manufacturer or his authorized representative established in the Community shall, in order to affix the CE mark, follow the EC-type examination procedure (referred to in Annex III), in conjunction with:
 - the procedure relating to conformity to type referred to in Annex VI, or
 - the procedure relating to product quality assurance referred to in Annex VII;
 - (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.
- (c) *equipment-group II, equipment-category 3*
- The manufacturer or his authorized representative established in the Community must, in order to affix the CE marking, follow the procedure relating to internal control of production referred to in Annex VIII;
- (d) *equipment-groups I and II*
- In addition to the procedures referred to in paragraph 1(a), (b) and (c), the manufacturer or his authorized representative established in the Community may also, in order to affix the CE marking, follow the procedure relating to CE unit verification (referred to in Annex IX).

2. The provisions of 1(a) or 1(d) above shall be used for conformity assessment of autonomous protective systems.

3. The procedures referred to in paragraph 1 shall be applied in respect of components as referred to in Article 4 (2), with the exception of the affixing of the CE marking. A certificate shall be issued by the manufacturer or his authorized representative established in the Community, declaring the conformity of the components with the provisions of this Directive which apply to them and stating their characteristics and how they must be incorporated into equipment or protective systems to

assist compliance with the essential requirements applicable to finished equipment or protective systems.

4. In addition, the manufacturer or his authorized representative established in the Community may, in order to affix the CE marking, follow the procedure relating to internal control of production (referred to in Annex VIII) with regard to the safety aspects referred to in point 1.2.7 of Annex II.

5. Notwithstanding the previous paragraphs, the competent authorities may, on a duly justified request, authorize the placing on the market and putting into service on the territory of the Member State concerned of the equipment, protective systems and individual devices referred to in Article 1 (2) in respect of which the procedures referred to in the previous paragraphs have not been applied and the use of which is in the interests of protection.

6. Documents and correspondence relating to the procedures referred to in the abovementioned paragraphs shall be drawn up in one of the official languages of the Member States in which those procedures are being applied or in a language accepted by the notified body.

7. (a) Where the equipment and protective systems are subject to other Community Directives covering other aspects which also provide for the affixing of the CE marking referred to in Article 10, that marking shall indicate that the equipment and protective systems are also presumed to conform with the provisions of those other Directives.

(b) However, where one or more of those Directives allow the manufacturer, during a transitional period, to choose which arrangements to apply, the CE marking shall indicate conformity only with the Directives applied by the manufacturer. In this case, particulars of the said Directives, as published in the *Official Journal of the European Communities*, must be given in the documents, notices or instructions required by the Directives and accompanying the equipment and protective systems.

Article 9

1. Member States shall notify the Commission and the other Member States of the bodies which they have appointed to carry out the procedures referred to in Article 8, together with the specific tasks which these bodies have been appointed to carry out and the identification numbers assigned to them beforehand by the Commission.

The Commission shall publish in the *Official Journal of the European Communities* a list of the notified bodies, with their identification numbers and the tasks for which they have been notified. The Commission shall ensure that this list is kept up to date.

2. Member States shall apply the criteria laid down in Annex XI in assessing the bodies to be indicated in such notification. Bodies meeting the assessment criteria laid down in the relative harmonized standards shall be presumed to fulfil those criteria.

3. A Member State which has approved a body must withdraw its notification if it finds that the body no longer meets the criteria referred to in Annex XI. It shall immediately inform the Commission and the other Member States accordingly.

CHAPTER III

CE conformity marking

Article 10

1. The CE conformity marking shall consist of the initials 'CE'. The form of the marking to be used is shown in Annex X. The CE marking shall be followed by the identification number of the notified body where such body is involved in the production control stage.

2. The CE marking shall be affixed distinctly, visibly, legibly and indelibly to equipment and protective systems, supplementary to the provisions of point 1.0.5. of Annex II.

3. The affixing of markings on the equipment or protective systems which are likely to deceive third parties as to the meaning and form of the CE marking shall be prohibited. Any other marking may be affixed to the equipment or protective systems, provided that the visibility and legibility of the CE marking is not thereby reduced.

Article 11

Without prejudice to Article 7:

- (a) where a Member State establishes that the CE marking has been incorrectly affixed, the manufacturer or his authorized representative established within the Community shall be obliged to make the product conform as regards the provisions concerning the CE marking and to end the infringement under the conditions imposed by the Member State;
- (b) in the event of continuing non-conformity, the Member State must take all appropriate measures to restrict or prohibit the placing on the market of the product in question or to ensure that it is withdrawn from the market in accordance with the procedures laid down in Article 7.

CHAPTER IV

Final provisions

Article 12

Any decision taken pursuant to this Directive which restricts or prohibits the placing on the market and/or the putting into service or requires the withdrawal from the market of equipment, a protective system, or a device referred to in Article 1 (2) shall state the exact grounds on which it is based. Such a decision shall be notified forthwith to the party concerned, who shall at the same time be informed of the legal remedies available to him under the laws in force in the Member State concerned and of the time limits to which such remedies are subject.

Article 13

Member States shall ensure that all the parties involved in the application of the Directive are bound to observe confidentiality in respect of all information obtained in the performance of carrying out their tasks. This does not affect the obligations of the Member States and of the notified bodies regarding reciprocal information and the dissemination of warnings.

Article 14

1. Directive 76/117/EEC, Directive 79/196/EEC ⁽¹⁾ and Directive 82/130/EEC shall be repealed as from 1 July 2003.

2. EC certificates of conformity to the harmonized standards obtained in accordance with the procedures laid down in the Directives referred to in paragraph 1 shall continue to be valid until 30 June 2003 unless they expire before that date. Their validity shall continue to be limited to the harmonized standards indicated in the aforementioned Directives.

3. Member States shall take the necessary action to ensure that the notified bodies which are responsible pursuant to Article 8 (1) to (4) for the assessment of the conformity of electrical equipment placed on the market before 1 July 2003 take account of the results of tests and verifications already carried out under the Directives referred to in paragraph 1.

Article 15

1. Member States shall adopt and publish the laws, regulations and administrative provisions necessary to

⁽¹⁾ OJ No L 43, 20. 2. 1979, p. 20. Directive as last amended by Directive 90/487/EEC (OJ No L 270, 2. 10. 1990, p. 23).

comply with this Directive before 1 September 1995. They shall forthwith inform the Commission thereof.

The Member States shall apply these measures with effect from 1 March 1996.

When Member States adopt the measures referred to in the first subparagraph, they shall contain a reference to this Directive or shall be accompanied by such reference at the time of their official publication. The methods of making such reference shall be laid down by Member States.

2. However, Member States shall allow the placing on the market and the putting into service of equipment and protective systems conforming with the national

regulations in force in their territory at the date of adoption of this Directive for the period until 30 June 2003.

Article 16

This Directive is addressed to the Member States.

Done at Brussels, 23 March 1994.

*For the
European Parliament
The President
E. KLEPSCH*

*For the Council
The President
TH. PANGALOS*

ANNEX I

CRITERIA DETERMINING THE CLASSIFICATION OF EQUIPMENT-GROUPS INTO CATEGORIES

1. Equipment-group I

- (a) Category M 1 comprises equipment designed and, where necessary, equipped with additional special means of protection to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a very high level of protection.

Equipment in this category is intended for use in underground parts of mines as well as those parts of surface installations of such mines endangered by firedamp and/or combustible dust.

Equipment in this category 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 protection such that:

- either, in the event of failure of one means of protection, at least an independent second means provides the requisite level of protection,
- or the requisite level of protection is assured in the event of two faults occurring independently of each other.

Equipment in this category must comply with the supplementary requirements referred to in Annex II, 2.0.1.

- (b) Category M 2 comprises equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a high level of protection.

Equipment in this category is 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.

This equipment is intended to be de-energized in the event of an explosive atmosphere.

The means of protection relating to equipment in this category assure the requisite level of protection during normal operation and also in the case of more severe operating conditions, in particular those arising from rough handling and changing environmental conditions.

Equipment in this category must comply with the supplementary requirements referred to in Annex II, 2.0.2.

2. Equipment-group II

- (a) Category 1 comprises equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a very high level of protection.

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 frequently.

Equipment in this category must ensure the requisite level of protection, even in the event of rare incidents relating to equipment, and is characterized by means of protection such that:

- either, in the event of failure of one means of protection, at least an independent second means provides the requisite level of protection,
- or the requisite level of protection is assured in the event of two faults occurring independently of each other.

Equipment in this category must comply with the supplementary requirements referred to in Annex II, 2.1.

- (b) Category 2 comprises equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and of ensuring a high level of protection.

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.

The means of protection relating to equipment in this category ensure the requisite level of protection, even in the event of frequently occurring disturbances or equipment faults which normally have to be taken into account.

Equipment in this category must comply with the supplementary requirements referred to in Annex II, 2.2.

- (c) Category 3 comprises equipment designed to be capable of functioning in conformity with the operating parameters established by the manufacturer and ensuring a normal level of protection.

Equipment in this category is intended for use in areas in which explosive atmospheres caused by gases, vapours, mists, or air/dust mixtures are unlikely to occur or, if they do occur, are likely to do so only infrequently and for a short period only.

Equipment in this category ensures the requisite level of protection during normal operation.

Equipment in this category must comply with the supplementary requirements referred to in Annex II, 2.3.

ANNEX II

ESSENTIAL HEALTH AND SAFETY REQUIREMENTS RELATING TO THE DESIGN AND CONSTRUCTION OF EQUIPMENT AND PROTECTIVE SYSTEMS INTENDED FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES

Preliminary observations

- A. Technological knowledge, which can change rapidly, must be taken into account as far as possible and be utilized immediately.
- B. For the devices referred to in Article 1 (2), the essential requirements shall apply only in so far as they are necessary for the safe and reliable functioning and operation of those devices with respect to the risks of explosion.

1. COMMON REQUIREMENTS FOR EQUIPMENT AND PROTECTIVE SYSTEMS

1.0. General requirements

1.0.1. *Principles of integrated explosion safety*

Equipment and protective systems intended for use in potentially explosive atmospheres must be designed from the point of view of integrated explosion safety.

In this connection, the manufacturer must take measures:

- above all, if possible, to prevent the formation of explosive atmospheres which may be produced or released by equipment and by protective systems themselves,
- to prevent the ignition of explosive atmospheres, taking into account the nature of every electrical and non-electrical source of ignition,
- should an explosion nevertheless occur which could directly or indirectly endanger persons and, as the case may be, domestic animals or property, to halt it immediately and/or to limit the range of explosion flames and explosion pressures to a sufficient level of safety.

- 1.0.2. Equipment and protective systems must be designed and manufactured after due analysis of possible operating faults in order as far as possible to preclude dangerous situations.

Any misuse which can reasonably be anticipated must be taken into account.

1.0.3. *Special checking and maintenance conditions*

Equipment and protective systems subject to special checking and maintenance conditions must be designed and constructed with such conditions in mind.

1.0.4. *Surrounding area conditions*

Equipment and protective systems must be so designed and constructed as to be capable of coping with actual or foreseeable surrounding area conditions.

1.0.5. *Marking*

All equipment and protective systems must be marked legibly and indelibly with the following minimum particulars;

- name and address of the manufacturer,
 - CE marking (see Annex X, point A),
 - designation of series or type,
 - serial number, if any,
 - year of construction,
 - the specific marking of explosion protection  followed by the symbol of the equipment group and category,
 - for equipment-group II, the letter 'G' (concerning explosive atmospheres caused by gases, vapours or mists),
- and/or
- the letter 'D' (concerning explosive atmospheres caused by dust).

Furthermore, where necessary, they must also be marked with all information essential to their safe use.

1.0.6. Instructions

- (a) All equipment and protective systems must be accompanied by instructions, including at least the following particulars:

- a recapitulation of the information with which the equipment or protective system is marked, except for the serial number (see 1.0.5.), together with any appropriate additional information to facilitate maintenance (e.g. address of the importer, repairer, etc.);
- instructions for safe:
 - putting into service,
 - use,
 - assembling and dismantling,
 - maintenance (servicing and emergency repair),
 - installation,
 - adjustment;
- where necessary, an indication of the danger areas in front of pressure-relief devices;
- where necessary, training instructions;
- details which allow a decision to be taken beyond any doubt as to whether an item of equipment in a specific category or a protective system can be used safely in the intended area under the expected operating conditions;
- electrical and pressure parameters, maximum surface temperatures and other limit values;
- where necessary, special conditions of use, including particulars of possible misuse which experience has shown might occur;
- where necessary, the essential characteristics of tools which may be fitted to the equipment or protective system.

- (b) The instructions must be drawn up in one of the Community languages by the manufacturer or his authorized representative established in the Community.

On being put into service, all equipment and protective systems must be accompanied by a translation of the instructions in the language or languages of the country in which the equipment or protective system is to be used and by the instructions in the original language.

This translation must be made by either the manufacturer or his authorized representative established in the Community or the person introducing the equipment or protective system into the language area in question.

By way of derogation from this requirement, the maintenance instructions for use by the specialist personnel employed by the manufacturer or his authorized representative established in the Community may be drawn up in a single Community language understood by that personnel.

- (c) The instructions must contain the drawings and diagrams necessary for the putting into service, maintenance, inspection, checking of correct operation and, where appropriate, repair of the equipment or protective system, together with all useful instructions, in particular with regard to safety.
- (d) Literature describing the equipment or protective system must not contradict the instructions with regard to safety aspects.

1.1. Selection of materials

- 1.1.1. The materials used for the construction of equipment and protective systems must not trigger off an explosion, taking into account foreseeable operational stresses.
- 1.1.2. Within the limits of the operating conditions laid down by the manufacturer, it must not be possible for a reaction to take place between the materials used and the constituents of the potentially explosive atmosphere which could impair explosion protection.
- 1.1.3. Materials must be so selected that predictable changes in their characteristics and their compatibility in combination with other materials will not lead to a reduction in the protection afforded; in particular, due account must be taken of the material's corrosion and wear resistance, electrical conductivity, impact strength, ageing resistance and the effects of temperature variations.

1.2. Design and Construction

1.2.1. Equipment and protective systems must be designed and constructed with due regard to technological knowledge of explosion protection so that they can be safely operated throughout their foreseeable lifetime.

1.2.2. Components to be incorporated into or used as replacements in equipment and protective systems must be so designed and constructed that they function safely for their intended purpose of explosion protection when they are installed in accordance with the manufacturer's instructions.

1.2.3. *Enclosed structures and prevention of leaks*

Equipment which may release flammable gases or dusts must wherever possible employ enclosed structures only.

If equipment contains openings or non-tight joints, these must as far as possible be designed in such a way that developing gases or dusts cannot give rise to explosive atmospheres outside the equipment.

Points where materials are introduced or drawn off must, as far as possible, be designed and equipped so as to limit escapes of flammable materials during filling or draining.

1.2.4. *Dust deposits*

Equipment and protective systems which are intended to be used in areas exposed to dust must be so designed that deposit dust on their surfaces is not ignited.

In general, dust deposits must be limited where possible. Equipment and protective systems must be easily cleanable.

The surface temperatures of equipment parts must be kept well below the glow temperature of the deposit dust.

The thickness of deposit dust must be taken into consideration and, if appropriate, means must be taken to limit the temperature in order to prevent a heat build up.

1.2.5. *Additional means of protection*

Equipment and protective systems which may be exposed to certain types of external stresses must be equipped, where necessary, with additional means of protection.

Equipment must withstand relevant stresses, without adverse effect on explosion protection.

1.2.6. *Safe opening*

If equipment and protective systems are in a housing or a locked container forming part of the explosion protection itself, it must be possible to open such housing or container only with a special tool or by means of appropriate protection measures.

1.2.7. *Protection against other hazards*

Equipment and protective systems must be so designed and manufactured as to:

- (a) avoid physical injury or other harm which might be caused by direct or indirect contact;
- (b) assure that surface temperatures of accessible parts or radiation which would cause a danger, are not produced;
- (c) eliminate non-electrical dangers which are revealed by experience;
- (d) assure that foreseeable conditions of overload shall not give rise to dangerous situations.

Where, for equipment and protective systems, the risks referred to in this paragraph are wholly or partly covered by other Community Directives, this Directive shall not apply or shall cease to apply in the case of such equipment and protective systems and of such risks upon application of those specific Directives.

1.2.8. *Overloading of equipment*

Dangerous overloading of equipment must be prevented at the design stage by means of integrated measurement, regulation and control devices, such as over-current cut-off switches, temperature limiters, differential pressure switches, flowmeters, time-lag relays, overspeed monitors and/or similar types of monitoring devices.

1.2.9. *Flameproof enclosure systems*

If parts which can ignite an explosive atmosphere are placed in an enclosure, measures must be taken to ensure that the enclosure withstands the pressure developed during an internal explosion of an explosive mixture and prevents the transmission of the explosion to the explosive atmosphere surrounding the enclosure.

1.3. **Potential ignition sources**

1.3.1. *Hazards arising from different ignition sources*

Potential ignition sources such as sparks, flames, electric arcs, high surface temperatures, acoustic energy, optical radiation, electromagnetic waves and other ignition sources must not occur.

1.3.2. *Hazards arising from static electricity*

Electrostatic charges capable of resulting in dangerous discharges must be prevented by means of appropriate measures.

1.3.3. *Hazards arising from stray electric and leakage currents*

Stray electric and leakage currents in conductive equipment parts which could result in, for example, the occurrence of dangerous corrosion, overheating of surfaces or sparks capable of provoking an ignition must be prevented.

1.3.4. *Hazards arising from overheating*

Overheating caused by friction or impacts occurring, for example, between materials and parts in contact with each other while rotating or through the intrusion of foreign bodies must, as far as possible, be prevented at the design stage.

1.3.5. *Hazards arising from pressure compensation operations*

Equipment and protective systems must be so designed or fitted with integrated measuring, control and regulation devices that pressure compensations arising from them do not generate shock waves or compressions which may cause ignition.

1.4. **Hazards arising from external effects**

1.4.1. Equipment and protective systems must be so designed and constructed as to be capable of performing their intended function in full safety, even in changing environmental conditions and in the presence of extraneous voltages, humidity, vibrations, contamination and other external effects, taking into account the limits of the operating conditions established by the manufacturer.

1.4.2. Equipment parts used must be appropriate to the intended mechanical and thermal stresses and capable of withstanding attack by existing or foreseeable aggressive substances.

1.5. **Requirements in respect of safety-related devices**

1.5.1. Safety devices must function independently of any measurement or control devices required for operation.

As far as possible, failure of a safety device must be detected sufficiently rapidly by appropriate technical means to ensure that there is only very little likelihood that dangerous situations will occur.

For electrical circuits the fail-safe principle is to be applied in general.

Safety-related switching must in general directly actuate the relevant control devices without intermediate software command.

1.5.2. In the event of a safety device failure, equipment and/or protective systems shall, wherever possible, be secured.

1.5.3. Emergency stop controls of safety devices must, as far as possible, be fitted with restart lockouts. A new start command may take effect on normal operation only after the restart lockouts have been intentionally reset.

1.5.4. *Control and display units*

Where control and display units are used, they must be designed in accordance with ergonomic principles in order to achieve the highest possible level of operating safety with regard to the risk of explosion.

1.5.5. *Requirements in respect of devices with a measuring function for explosion protection.*

In so far as they relate to equipment used in explosive atmospheres, devices with a measuring function must be designed and constructed so that they can cope with foreseeable operating requirements and special conditions of use.

1.5.6. Where necessary, it must be possible to check the reading accuracy and serviceability of devices with a measuring function.

1.5.7. The design of devices with a measuring function must incorporate a safety factor which ensures that the alarm threshold lies far enough outside the explosion and/or ignition limits of the atmospheres to be registered, taking into account, in particular, the operating conditions of the installation and possible aberrations in the measuring system.

1.5.8. *Risks arising from software*

In the design of software-controlled equipment, protective systems and safety devices, special account must be taken of the risks arising from faults in the programme.

1.6. **Integration of safety requirements relating to the system**

1.6.1. Manual override must be possible in order to shut down the equipment and protective systems incorporated within automatic processes which deviate from the intended operating conditions, provided that this does not compromise safety.

1.6.2. When the emergency shutdown system is actuated, accumulated energy must be dispersed as quickly and as safely as possible or isolated so that it no longer constitutes a hazard.

This does not apply to electrochemically-stored energy.

1.6.3. *Hazards arising from power failure*

Where equipment and protective systems can give rise to a spread of additional risks in the event of a power failure, it must be possible to maintain them in a safe state of operation independently of the rest of the installation.

1.6.4. *Hazards arising from connections*

Equipment and protective systems must be fitted with suitable cable and conduit entries.

When equipment and protective systems are intended for use in combination with other equipment and protective systems, the interface must be safe.

1.6.5. *Placing of warning devices as parts of equipment*

Where equipment or protective systems are fitted with detection or alarm devices for monitoring the occurrence of explosive atmospheres, the necessary instructions must be provided to enable them to be provided at the appropriate places.

2. **SUPPLEMENTARY REQUIREMENTS IN RESPECT OF EQUIPMENT**

2.0. **Requirements applicable to equipment in category M of equipment-group I**

2.0.1. *Requirements applicable to equipment in category M 1 of equipment-group I*

2.0.1.1. Equipment must be so designed and constructed that sources of ignition do not become active, even in the event of rare incidents relating to equipment.

Equipment must be equipped with means of protection such that:

- either, in the event of failure of one means of protection, at least an independent second means provides the requisite level of protection,
- or, the requisite level of protection is ensured in the event of two faults occurring independently of each other.

Where necessary, this equipment must be equipped with additional special means of protection.

It must remain functional with an explosive atmosphere present.

2.0.1.2. Where necessary, equipment must be so constructed that no dust can penetrate it.

2.0.1.3. The surface temperatures of equipment parts must be kept clearly below the ignition temperature of the foreseeable air/dust mixtures in order to prevent the ignition of suspended dust.

- 2.0.1.4. Equipment must be so designed that the opening of equipment parts which may be sources of ignition is possible only under non-active or intrinsically safe conditions. Where it is not possible to render equipment non-active, the manufacturer must affix a warning label to the opening part of the equipment.
- If necessary, equipment must be fitted with appropriate additional interlocking systems.
- 2.0.2. *Requirements applicable to equipment in category M 2 of equipment-group I*
- 2.0.2.1. Equipment must be equipped with means of protection ensuring that sources of ignition do not become active during normal operation, even under more severe operating conditions, in particular those arising from rough handling and changing environmental conditions.
- The equipment is intended to be de-energized in the event of an explosive atmosphere.
- 2.0.2.2. Equipment must be so designed that the opening of equipment parts which may be sources of ignition is possible only under non-active conditions or via appropriate interlocking systems. Where it is not possible to render equipment non-active, the manufacturer must affix a warning label to the opening part of the equipment.
- 2.0.2.3. The requirements regarding explosion hazards arising from dust applicable to category M 1 must be applied.
- 2.1. **Requirements applicable to equipment in category 1 of equipment-group II**
- 2.1.1. *Explosive atmospheres caused by gases, vapours or hazes*
- 2.1.1.1. Equipment must be so designed and constructed that sources of ignition do not become active, even in event of rare incidents relating to equipment.
- It must be equipped with means of protection such that:
- either, in the event of failure of one means of protection, at least an independent second means provides the requisite level of protection,
 - or, the requisite level of protection is ensured in the event of two faults occurring independently of each other.
- 2.1.1.2. For equipment with surfaces which may heat up, measures must be taken to ensure that the stated maximum surface temperatures are not exceeded even in the most unfavourable circumstances.
- Temperature rises caused by heat build-ups and chemical reactions must also be taken into account.
- 2.1.1.3. Equipment must be so designed that the opening of equipment parts which might be sources of ignition is possible only under non-active or intrinsically safe conditions. Where it is not possible to render equipment non-active, the manufacturer must affix a warning label to the opening part of the equipment.
- If necessary, equipment must be fitted with appropriate additional interlocking systems.
- 2.1.2. *Explosive atmospheres caused by air/dust mixtures*
- 2.1.2.1. Equipment must be so designed and constructed that ignition of air/dust mixtures does not occur even in the event of rare incidents relating to equipment.
- It must be equipped with means of protection such that
- either, in the event of failure of one means of protection, at least an independent second means provides the requisite level of protection,
 - or, the requisite level of protection is ensured in the event of two faults occurring independently of each other.
- 2.1.2.2. Where necessary, equipment must be so designed that dust can enter or escape from the equipment only at specifically designated points.
- This requirement must also be met by cable entries and connecting pieces.
- 2.1.2.3. The surface temperatures of equipment parts must be kept well below the ignition temperature of the foreseeable air/dust mixtures in order to prevent the ignition of suspended dust.
- 2.1.2.4. With regard to the safe opening of equipment parts, requirement 2.1.1.3 applies.
- 2.2. **Requirements for category 2 of equipment-group II**
- 2.2.1. *Explosive atmospheres caused by gases, vapours or mists*
- 2.2.1.1. Equipment must be so designed and constructed as to prevent ignition sources arising, even in the event of frequently occurring disturbances or equipment operating faults, which normally have to be taken into account.

- 2.2.1.2. Equipment parts must be so designed and constructed that their stated surface temperatures are not exceeded, even in the case of risks arising from abnormal situations anticipated by the manufacturer.
- 2.2.1.3. Equipment must be so designed that the opening of equipment parts which might be sources of ignition is possible only under non-active conditions or via appropriate interlocking systems. Where it is not possible to render equipment non-active, the manufacturer must affix a warning label to the opening part of the equipment.
- 2.2.2. *Explosive atmospheres caused by air/dust mixtures*
 - 2.2.2.1. Equipment must be designed and constructed so that ignition of air/dust mixtures is prevented, even in the event of frequently occurring disturbances or equipment operating faults which normally have to be taken into account.
 - 2.2.2.2. With regard to surface temperatures, requirement 2.1.2.3 applies.
 - 2.2.2.3. With regard to protection against dust, requirement 2.1.2.2 applies.
 - 2.2.2.4. With regard to the safe opening of equipment parts, requirement 2.2.1.3 applies.
- 2.3. **Requirements applicable to equipment in category 3 of equipment-group II**
 - 2.3.1. *Explosive atmospheres caused by gases, vapours or mists*
 - 2.3.1.1. Equipment must be so designed and constructed as to prevent foreseeable ignition sources which can occur during normal operation.
 - 2.3.1.2. Surface temperatures must not exceed the stated maximum surface temperatures under intended operating conditions. Higher temperatures in exceptional circumstances may be allowed only if the manufacturer adopts special additional protective measures.
 - 2.3.2. *Explosive atmospheres caused by air/dust mixtures*
 - 2.3.2.1. Equipment must be so designed and constructed that air/dust mixtures cannot be ignited by foreseeable ignition sources likely to exist during normal operation.
 - 2.3.2.2. With regard to surface temperatures, requirement 2.1.2.3 applies.
 - 2.3.2.3. Equipment, including cable entries and connecting pieces, must be so constructed that, taking into account the size of its particles, dust can neither develop explosive mixtures with air nor form dangerous accumulations inside the equipment.
- 3. **SUPPLEMENTARY REQUIREMENTS IN RESPECT OF PROTECTIVE SYSTEMS**
 - 3.0. **General requirements**
 - 3.0.1. Protective systems must be dimensioned in such a way as to reduce the effects of an explosion to a sufficient level of safety.
 - 3.0.2. Protective systems must be designed and capable of being positional in such a way that explosions are prevented from spreading through dangerous chain reactions or flashover and incipient explosions do not become detonations.
 - 3.0.3. In the event of a power failure, protective systems must retain their capacity to function for a period sufficient to avoid a dangerous situation.
 - 3.0.4. Protective systems must not fail due to outside interference.
 - 3.1. **Planning and design**
 - 3.1.1. *Characteristics of materials*

With regard to the characteristics of materials, the maximum pressure and temperature to be taken into consideration at the planning stage are the expected pressure during an explosion occurring under extreme operating conditions and the anticipated heating effect of the flame.
 - 3.1.2. Protective systems designed to resist or contain explosions must be capable of withstanding the shock wave produced without losing system integrity.
 - 3.1.3. Accessories connected to protective systems must be capable of withstanding the expected maximum explosion pressure without losing their capacity to function.

- 3.1.4. The reactions caused by pressure in peripheral equipment and connected pipe-work must be taken into consideration in the planning and design of protective systems.
- 3.1.5. *Pressure-relief systems*
- If it is likely that stresses on protective systems will exceed their structural strength, provision must be made in the design for suitable pressure-relief devices which do not endanger persons in the vicinity.
- 3.1.6. *Explosion suppression systems*
- Explosion suppression systems must be so planned and designed that they react to an incipient explosion at the earliest possible stage in the event of an incident and counteract it to best effect, which due regard to the maximum rate of pressure increase and the maximum explosion pressure.
- 3.1.7. *Explosion decoupling systems*
- Decoupling systems intended to disconnect specific equipment as swiftly as possible in the event of incipient explosions by means of appropriate devices must be planned and designed so as to remain proof against the transmission of internal ignition and to retain their mechanical strength under operating conditions.
- 3.1.8. Protective systems must be capable of being integrated into a circuit with a suitable alarm threshold so that, if necessary, there is cessation of product feed and output and shutdown of equipment parts which can no longer function safely.
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ANNEX III

MODULE EC-TYPE EXAMINATION

1. This module describes that part of the procedure by which a notified body ascertains and attests that a specimen representative of the production envisaged meets the relevant applicable provisions of the Directive.
2. The application for the EC-type examination shall be lodged by the manufacturer or his authorized representative established within the Community with a notified body of his choice.

The application shall include:

- the name and address of the manufacturer and, if the application is lodged by the authorized representative, his name and address in addition;
- a written declaration that the same application has not been lodged with any other notified body;
- the technical documentation, as described in point 3.

The applicant shall place at the disposal of the notified body a specimen representative of the production envisaged and hereinafter called 'type'. The notified body may request further specimens if needed for carrying out the test programme.

3. The technical documentation shall enable the conformity of the product with the 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 and shall to that extent contain:
 - a general type-description;
 - design and manufacturing drawings and layouts of components, sub-assemblies, circuits, etc.;
 - descriptions and explanations necessary for the understanding of said drawings and layouts and the operation of the product;
 - a list of the standards referred to in Article 5, applied in full or in part, and descriptions of the solutions adopted to meet the essential requirements of the Directive where the standards referred to in Article 5 have not been applied;
 - results of design calculations made, examinations carried out, etc.;
 - test reports.
4. The notified body shall:
 - 4.1. examine the technical documentation, verify that the type has been manufactured in conformity with the technical documentation and identify the elements which have been designed in accordance with the relevant provisions of the standards referred to in Article 5, as well as the components which have been designed without applying the relevant provisions of those standards;
 - 4.2. perform or have performed the appropriate examinations and necessary tests to check whether the solutions adopted by the manufacturer meet the essential requirements of the Directive where the standards referred to in Article 5 have not been applied;
 - 4.3. perform or have performed the appropriate examinations and necessary tests to check whether these have actually been applied, where the manufacturer has chosen to apply the relevant standards;
 - 4.4. agree with the applicant the location where the examinations and necessary tests shall be carried out.
5. Where the type meets the provisions of the Directive, the notified body shall issue an EC-type-examination certificate to the applicant. The certificate shall contain the name and address of the manufacturer, conclusions of the examination and the necessary data for identification of the approved type.

A list of the relevant parts of the technical documentation shall be annexed to the certificate and a copy kept by the notified body.

If the manufacturer or his authorized representative established in the Community is denied a type certification, the notified body shall provide detailed reasons for such denial.

Provision shall be made for an appeals procedure.

6. The applicant shall inform the notified body which holds the technical documentation concerning the EC-type-examination certificate of all modifications to the approved equipment or protective system which must receive further approval where such changes may effect conformity with the essential requirements or with the prescribed conditions for use of the product. This further approval is given in the form of an addition to the original EC-type-examination certificate.
7. Each notified body shall communicate to the other notified bodies the relevant information concerning the EC-type-examination certificates and additions issued and withdrawn.
8. The other notified bodies may receive copies of the EC-type-examination certificates and/or their additions. The annexes to the certificates shall be kept at the disposal of the other notified bodies.
9. The manufacturer or his authorized representative established in the Community shall keep with the technical documentation copies of EC-type-examination certificates and their additions for a period ending at least 10 years after the last equipment or protective system was manufactured.

Where neither the manufacturer nor his authorized representative is established within the Community, the obligation to keep the technical documentation available shall be the responsibility of the person who places the product on the Community market.

ANNEX IV

MODULE: PRODUCTION QUALITY ASSURANCE

1. This module describes the procedure whereby the manufacturer who satisfies the obligations of point 2 ensures and declares that the products concerned are in conformity with the type as described in the EC-type-examination certificate and satisfy the requirements of the Directive which apply to them. The manufacturer, or his authorized representative established in the Community, shall affix the CE marking to each piece of equipment and draw up a written declaration of conformity. The CE marking shall be accompanied by the identification number of the notified body responsible for EC monitoring, as specified in Section 4.
2. The manufacturer shall operate an approved quality system for production, final equipment inspection and testing as specified in Section 3 and shall be subject to monitoring as specified in Section 4.
3. **Quality system**

- 3.1. The manufacturer shall lodge an application for assessment of his quality system with a notified body of his choice, for the equipment concerned.

The application shall include:

- all relevant information for the product category envisaged;
- the documentation concerning the quality system;
- technical documentation on the approved type and a copy of the EC-type-examination certificate.

- 3.2. The quality system shall ensure compliance of the equipment with the type as described in the EC-type-examination certificate and with the requirements of the Directive which apply to them.

All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic and orderly manner in the form of written policies, procedures and instructions. The quality system documentation must permit a consistent interpretation of quality programmes, plans, manuals and records.

It shall contain, in particular, an adequate description of

- the quality objectives and the organizational structure, responsibilities and powers of the management with regard to equipment quality;
- the manufacturing, quality control and quality assurance techniques, processes and systematic actions which will be used;
- the examinations and tests which will be carried out before, during and after manufacture and the frequency with which they will be carried out;
- the quality records, such as inspection reports and test data, calibration data, reports on the qualifications of the personnel concerned, etc.;
- the means to monitor the achievement of the required equipment quality and the effective operation of the quality system.

- 3.3. The notified body shall assess the quality system to determine whether it satisfies the requirements referred to in Section 3.2. It shall presume conformity with these requirements in respect of quality systems which implement the relevant harmonized standard. The auditing team shall have at least one member with experience of evaluation in the equipment technology concerned. The evaluation procedure shall include an inspection visit to the manufacturer's premises. The decision shall be notified to the manufacturer. The notification shall contain the conclusions of the examination and the reasoned assessment decision.

- 3.4. The manufacturer shall undertake to fulfil the obligations arising out of the quality system as approved and to uphold the system so that it remains adequate and efficient.

The manufacturer or his authorized representative shall inform the notified body which has approved the quality system of any intended updating of the quality system.

The notified body shall evaluate the modifications proposed and decide whether the amended quality system will still satisfy the requirements referred to in Section 3.2 or whether a re-assessment is required.

It shall notify its decision to the manufacturer. The notification shall contain the conclusions of the examination and the reasoned assessment decision.

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4. **Surveillance under the responsibility of the notified body**
 - 4.1. The purpose of surveillance is to make sure that the manufacturer duly fulfils the obligations arising out of the approved quality system.
 - 4.2. The manufacturer shall, for inspection purposes, allow the notified body access to the manufacture, inspection, testing and storage premises and shall provide it with all necessary information, in particular
 - the quality system documentation
 - the quality records, such as inspection reports and test data, calibration data, reports on the qualifications of the personnel concerned, etc.
 - 4.3. The notified body shall periodically carry out audits to ensure that the manufacturer maintains and applies the quality system and shall provide an audit report to the manufacturer.
 - 4.4. Furthermore, the notified body may pay unexpected visits to the manufacturer. During such visits, the notified body may carry out tests, or arrange for tests to be carried out, to check that the quality system is functioning correctly, if necessary. The notified body shall provide the manufacturer with a visit report and, if a test has taken place, with a test report.
 5. The manufacturer shall, for a period ending at least 10 years after the last piece of equipment was manufactured, keep at the disposal of the national authorities:
 - the documentation referred to in the second indent of Section 3.1;
 - the updating referred to in the second paragraph of Section 3.4;
 - the decisions and reports from the notified body which are referred to in Section 3.4, last paragraph, Section 4.3 and Section 4.4.
 6. Each notified body shall apprise the other notified bodies of the relevant information concerning the quality system approvals issued and withdrawn.
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ANNEX V

MODULE: PRODUCT VERIFICATION

1. This module describes the procedure whereby a manufacturer or his authorized representative established within the Community checks and attests that the equipment subject to the provisions of point 3 are in conformity with the type as described in the EC-type-examination certificate and satisfy the relevant requirements of the Directive.
2. The manufacturer shall take all measures necessary to ensure that the manufacturing process guarantees conformity of the equipment with the type as described in the EC-type-examination certificate and with the requirements of the Directive which apply to them. The manufacturer or his authorized representative established in the Community shall affix the CE marking to each piece of equipment and shall draw up a declaration of conformity.
3. The notified body shall carry out the appropriate examinations and tests in order to check the conformity of the equipment, protective system or device referred to in Article 1 (2), with the relevant requirements of the Directive, by examining and testing every product as specified in Section 4.

The manufacturer or his authorized representative shall keep a copy of the declaration of conformity for a period ending at least 10 years after the last piece of equipment was manufactured.
4. Verification by examination and testing of each piece of equipment.
 - 4.1. All equipment shall be individually examined and appropriate tests as set out in the relevant standard(s) referred to in Article 5 or equipment tests shall be carried out in order to verify their conformity with the type as described in the EC-type-examination certificate and the relevant requirements of the Directive.
 - 4.2. The notified body shall affix or have affixed its identification number to each approved item of equipment and shall draw up a written certificate of conformity relating to the tests carried out.
 - 4.3. The manufacturer or his authorized representative shall ensure that he is able to supply the notified body's certificates of conformity on request.

ANNEX VI

MODULE: CONFORMITY TO TYPE

1. This module describes that part of the procedure whereby the manufacturer or his authorized representative established within the Community ensures and declares that the equipment in question is in conformity with the type as described in the EC-type-examination certificate and satisfy the requirements of the Directive applicable to them. The manufacturer or his authorized representative established within the Community shall affix the CE marking to each piece of equipment and draw up a written declaration of conformity.
2. The manufacturer shall take all measures necessary to ensure that the manufacturing process assures compliance of the manufactured equipment or protective systems with the type as described in the EC-type-examination certificate and with the relevant requirements of the Directive.
3. The manufacturer or his authorized representative shall keep a copy of the declaration of conformity for a period ending at least 10 years after the last piece of equipment was manufactured. Where neither the manufacturer nor his authorized representative is established within the Community, the obligation to keep the technical documentation available shall be the responsibility of the person who places the equipment or protective system on the Community market.

For each piece of equipment manufactured, tests relating to the anti-explosive protection aspects of the product shall be carried out by the manufacturer or on his behalf. The tests shall be carried out under the responsibility of a notified body, chosen by the manufacturer.

On the responsibility of the notified body, the manufacturer shall affix the former's identification number during the manufacturing process.

ANNEX VII

MODULE: PRODUCT QUALITY ASSURANCE

1. This module describes the procedure whereby the manufacturer who satisfies the obligations of Section 2 ensures and declares that the equipment is in conformity with the type as described in the EC-type-examination certificate. The manufacturer or his authorized representative established within the Community shall affix the CE marking to each product and draw up a written declaration of conformity. The CE marking shall be accompanied by the identification number of the notified body responsible for surveillance as specified in Section 4.
2. The manufacturer shall operate an approved quality system for the final inspection and testing of equipment as specified in Section 3 below and shall be subject to surveillance as specified in Section 4 below.
3. **Quality system**
 - 3.1. The manufacturer shall lodge an application for assessment of his quality system for the equipment and protective systems, with a notified body of his choice.

The application shall include:

 - all relevant information for the product category envisaged;
 - documentation on the quality system;
 - technical documentation on the approved type and a copy of the EC-type-examination certificate.
 - 3.2. Under the quality system, each piece of equipment shall be examined and appropriate tests as set out in the relevant standard(s) referred to in Article 5 or equivalent tests shall be carried out in order to ensure its conformity with the relevant requirements of the Directive. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic and orderly manner in the form of written policies, procedures and instruments. This quality system documentation must permit a consistent interpretation of the quality programmes, plans, manuals and records.

It shall contain, in particular, an adequate description of:

 - the quality objectives and the organizational structure, responsibilities and powers of the management with regard to product quality;
 - the examinations and tests which will be carried out after manufacture;
 - the means to monitor the effective operation of the quality system;
 - quality records, such as inspection reports and test data, calibration data, reports on the qualifications of the personnel concerned, etc.
 - 3.3. The notified body shall assess the quality system to determine whether it satisfies the requirements referred to in Section 3.2. It shall presume conformity with these requirements in respect of quality systems which implement the relevant harmonized standard.

The auditing team shall have at least one member experienced as an assessor in the product technology concerned. The assessment procedure shall include an assessment visit to the manufacturer's premises.

The decision shall be notified to the manufacturer. The notification shall contain the conclusions of the examination and the reasoned assessment decision.
 - 3.4. The manufacturer shall undertake to discharge the obligations arising from the quality system as approved and to maintain it in an appropriate and efficient manner.

The manufacturer or his authorized representative shall inform the notified body which has approved the quality system of any intended updating of the quality system.

The notified body shall evaluate the modifications proposed and decide whether the modified quality system will still satisfy the requirements referred to in Section 3.2 or whether a re-assessment is required.

It shall notify its decision to the manufacturer. The notification shall contain the conclusions of the examination and the reasoned assessment decision.

4. Surveillance under the responsibility of the notified body

- 4.1. The purpose of surveillance is to ensure that the manufacturer duly fulfils the obligations arising out of the approved quality system.
 - 4.2. The manufacturer shall for inspection purposes allow the notified body access to the inspection, testing and storage premises and shall provide it with all necessary information, in particular:
 - quality system documentation;
 - technical documentation;
 - quality records, such as inspection reports and test data, calibration data, reports on the qualifications of the personnel concerned, etc.
 - 4.3. The notified body shall periodically carry out audits to ensure that the manufacturer maintains and applies the quality system and shall provide an audit report to the manufacturer.
 - 4.4. Furthermore, the notified body may pay unexpected visits to the manufacturer. At the time of such visits, the notified body may carry out tests or arrange for tests to be carried out in order to check the proper functioning of the quality system, where necessary; it shall provide the manufacturer with a visit report and, if a test has been carried out, with a test report.
 5. The manufacturer shall, for a period ending at least 10 years after the last piece of equipment was manufactured, keep at the disposal of the national authorities:
 - the documentation referred to in the third indent of Section 3.1;
 - the updating referred to in the second paragraph of Section 3.4;
 - the decisions and reports from the notified body which are referred to in Section 3.4, last paragraph, Section 4.3 and Section 4.4.
 6. Each notified body shall forward to the other notified bodies the relevant information concerning the quality system approvals issued and withdrawn.
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ANNEX VIII

MODUL: INTERNAL CONTROL OF PRODUCTION

1. This module describes the procedure whereby the manufacturer or his authorized representative established within the Community, who carries out the obligations laid down in Section 2, ensures and declares that the equipment satisfy the requirements of the Directive applicable to it. The manufacturer or his authorized representative established within the Community shall affix the CE marking to each piece of equipment and draw up a written declaration of conformity.
2. The manufacturer shall establish the technical documentation described in Section 3 and he or his authorized representative established within the Community shall keep it at the disposal of the relevant national authorities for inspection purposes for a period ending at least 10 years after the last piece of equipment was manufactured.

Where neither the manufacturer nor his authorized representative is established within the Community, the obligation to keep the technical documentation available shall be the responsibility of the person who places the equipment on the Community market.

3. 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:
 - a general description of the equipment,
 - conceptual design and manufacturing drawings and schemes of components, sub-assemblies, circuits, etc.,
 - descriptions and explanations necessary for the understanding of said drawings and schemes and the operation of the equipment,
 - 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,
 - results of design calculations made, examinations carried out, etc.,
 - test reports.
4. The manufacturer or his authorized representative shall keep a copy of the declaration of conformity with the technical documentation.
5. The manufacturer shall take all measures necessary to ensure that the manufacturing process guarantees compliance of the manufactured equipment with the technical documentation referred to in Section 2 and with the requirements of the Directive applicable to such equipment.

ANNEX IX

MODULE: UNIT VERIFICATION

1. This module describes the procedure whereby the manufacturer ensures and declares that the equipment or protective system which has been issued with the certificate referred to in Section 2 conforms to the requirements of the Directive which are applicable to it. The manufacturer or his authorized representative in the Community shall affix the CE marking to the equipment or protective system and draw up a declaration of conformity.
2. The notified body shall examine the individual equipment or protective system and carry out the appropriate tests as set out in the relevant standard(s) referred to in Article 5, or equivalent tests, to ensure its conformity with the relevant requirements of the Directive.

The notified body shall affix, or cause to be affixed, its identification number on the approved equipment or protective system and shall draw up a certificate of conformity concerning the tests carried out.

3. The aim of the technical documentation is to enable conformity with the requirements of the Directive to be assessed and the design, manufacture and operation of the equipment or protective system to be understood.

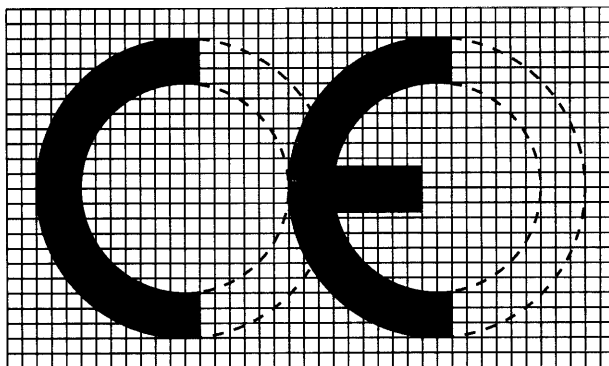
The documentation shall contain:

- a general description of the product;
 - conceptual design and manufacturing drawings and layouts of components, sub-assemblies, circuits, etc.;
 - descriptions and explanations necessary for the understanding of said drawings and layouts and the operation of the equipment or protective system;
 - a list of the standards referred to in Article 5, applied in full or in part, and descriptions of the solutions adopted to meet the essential requirements of the Directive where the standards referred to in Article 5 have not been applied;
 - results of design calculations made, examinations carried out, etc.;
 - test reports.
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ANNEX X

A. CE Marking

The CE conformity marking shall consist of the initials 'CE' taking the following form:



If the marking is reduced or enlarged, the proportions given in the above graduated drawing must be respected.

The various components of the CE marking must have substantially the same vertical dimension, which may not be less than 5 mm.

This minimum dimension may be waived for small-scale equipment, protective systems or devices referred to in Article 1 (2).

B. Content of the EC declaration of conformity

The EC declaration of conformity must contain the following elements:

- the name or identification mark and the address of the manufacturer or his authorized representative established within the Community;
- a description of the equipment, protective system, or device referred to in Article 1 (2);
- all relevant provisions fulfilled by the equipment, protective system, or device referred to in Article 1 (2);
- where appropriate, the name, identification number and address of the notified body and the number of the EC-type-examination certificate;
- where appropriate, reference to the harmonized standards;
- where appropriate, the standards and technical specifications which have been used;
- where appropriate, references to other Community Directives which have been applied;
- identification of the signatory who has been empowered to enter into commitments on behalf of the manufacturer or his authorized representative established within the Community.

ANNEX XI

MINIMUM CRITERIA TO BE TAKEN INTO ACCOUNT BY MEMBER STATES FOR THE NOTIFICATION OF BODIES

1. The body, its director and the staff responsible for carrying out the verification tests shall not be the designer, manufacturer, supplier or installer of equipment, protective systems, or devices referred to in Article 1 (2) which they inspect, nor the authorized representative of any of these parties. They shall become involved neither directly nor as authorized representatives in the design, construction, marketing or maintenance of the equipment, protective systems or devices referred to in Article 1 (2) in question. This does not preclude the possibility of exchanges of technical information between the manufacturer and the body.
 2. The body and its inspection staff shall carry out the verification tests with the highest degree of professional integrity and technical competence and shall be free from all pressures and inducements, particularly financial, which may influence their judgement or the results of the inspection, especially from persons or groups of persons with an interest in the result of verifications.
 3. The body shall have at its disposal the necessary staff and possess the necessary facilities to enable it to perform properly the administrative and technical tasks connected with verification; it shall also have access to the equipment required for special verification.
 4. The staff responsible for inspection shall have:
 - sound technical and professional training;
 - satisfactory knowledge of the requirements of the tests which they carry out and adequate experience of such tests;
 - the ability to draw up the certificates, records and reports required to authenticate the performance of the tests.
 5. The impartiality of inspection staff shall be guaranteed. Their remuneration shall not depend on the number of tests carried out or on the results of such tests.
 6. The body shall take out liability insurance unless its liability is assumed by the State in accordance with national law or the Member State itself is directly responsible for the tests.
 7. The staff of the body shall be bound to observe professional secrecy with regard to all information gained in carrying out its tasks (except *vis-à-vis* the competent administrative authorities of the State in which its activities are carried out) under this Directive or any provision of national law giving effect to it.
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European Commission

**Non-binding guide to good practice for implementing Directive 1999/92/EC
"ATEX" (explosive atmospheres)**

Luxembourg: Office for Official Publications of the European Communities

2005 — 125 pp. — 21 x 29.7 cm

ISBN 92-894-8721-6

