Guide for Risk Assessment
in Small and Medium Enterprises

7 Hazards arising from Explosions

Identification and Evaluation of Hazards; Specification of Measures

issa | INTERNATIONAL SOCIAL SECURITY ASSOCIATION

Section for Electricity
Section for Iron and Metal
Section for Machine and System Safety

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Imprint

Authors: Stephanos Achillides,
Department of Labour Inspection, Cyprus

Dipl.-Ing. Daniela Gecelovská,
Národný inšpektorát práce Košice, Slovakia

Jürgen Gehre, ISSA,
Section Metal, Germany

In cooperation with
Dr. Martin Gschwind, Ake Harmanny, Ing. Klaus Kopia,
Explosion Protection Group of the ISSA Section Machinery and System Safety

Production: Verlag Technik & Information e.K.,
Wohlfahrtstrasse 153, 44799 Bochum, Germany
Tel. +49(0)234-94349-0, Fax +49(0)234-94349-21

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Introductory Note

This brochure is intended to assist small and medium enterprises (SMEs) to identify gas and dust explosion hazards at the workplace, evaluate the associated risks and recommend possible preventive and protective measures.

This brochure does not cover other types of explosions such as runaway reactions, detonations of high explosives, or bursting pressure vessels.

The brochure is structured as follows:

1. **Basic Information – Principles**
2. **Checklists for Risk Assessment (Hazard Identification)**
3. **Risk Assessment**
4. **Risk Reduction – Taking Measures**
5. **Explosion Protection Document**

Other topics treated in this series of brochures organised along the same lines and already published or being prepared are:

- **Hazards arising from machinery and other work equipment**
- **Hazards arising from electricity**
- **Slipping and falling from a height**
- **Hazards arising from whole-body/hand-arm vibrations**
- **Chemical hazards**
- **Physical strain (e.g. heavy and one-side work)**
- **Noise**
- **Mental workload**

1. Basic Information – Principles

1.1 | What is an explosion?

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

A gas or dust explosion therefore can be described as the consequence of a fast combustion of gas/dust mixed with air.

Some of the effects of an explosion are loud noise and pressure waves, which can collapse walls and shatter windows.

Also, searing heat, clouds of smoke and balls of flame are other deadly effects produced by the sudden violent expansion of gases.

1.2 | How it is generated?

To create an explosion there has to be fuel (i.e. gas, such as hydrogen or dust, such as flour), an oxidizer (the oxygen in air) and an ignition source (i.e. a hot surface or an electrical spark). Once the mechanism of mixing the fuel with the air is established and the concentration of the fuel is within the explosion limits, the resulting mixture can be ignited if the ignition source has sufficient strength.

1.3 | Elements of an explosion

Explosive atmosphere can be created when a flammable gas escapes, or a flammable liquid or vapour leaks, or a flammable dust disperses in the working environment.

When the flammable material is mixed with air, an explosive atmosphere can be formed. If the concentration of material in the mixture is within the explosion limits (Lower and Upper), then the presence of an active ignition source could ignite the mixture and create an explosion.

Lower explosion limit (LEL) – is the minimum concentration of flammable gas, flammable liquid vapour or dust with air, where an explosion can occur.

Upper explosion limit (UEL) – is the maximum concentration of flammable gas, flammable liquid vapour or dust with air where an explosion can occur.

When the concentration is lower than the lower explosion limit, the explosion cannot occur. When the concentration is higher than the upper explosion limit, the mixture is «too rich» and thus there is insufficient oxygen for an explosion.

Temperature and pressure also influence flammability limits. Higher temperature results in lower LEL and higher UEL, while greater pressure increases both values.

The following Table shows some examples of explosion limits:

Flammable substance	Lower explosion limit	Upper explosion limit
Natural gas	5 %	13 %
Propane	1,5 %	9,5 %
Acetylene	2,5 %	81 %
Sugar	30g/m^3	–
Flour	30g/m^3	–

Information about the explosion limits for gas or vapour is usually given in the Material Safety Data Sheets supplied by the producer or importer of the flammable substance/product or other sources of information.

In practice, the UEL for dusts are hardly known since they are not useful for dusts because of the difficulty to control explosive mixtures by limiting the concentration. The UEL of most dusts typically ranges from 2000 – 6000g/m^3. Information on the LEL of many dusts can be found e.g. on the GESTIS website. Please bear in mind that dust deposits can create a dust cloud. For example, due to a sudden movement of air from an open door or a minor explosion, or dust deposits falling from a cable tray.

It is important to know that less than 1 mm of dust can already create an explosive atmosphere.

Although an explosion happens at the blink of an eye, there are several phases which happen at that instant: the original shock wave blast of the explosion; the flying fragments of the exploding container; and, depending on the pressure of the blast, parts of walls, roof, floors, doors, windows and ceilings could collapse. Also, the generated heat may cause secondary fires, burns and secondary structural collapse/damage. Moreover, shock waves may severly damage gas, water, electric and sewer pipes. The effects of an explosion are severe and the consequences in human lives and destruction of property dramatic.

Very dangerous are also the noxious reaction products, which are developed during an explosion and the consumption of oxygen in the ambient air which can cause suffocation of workers.

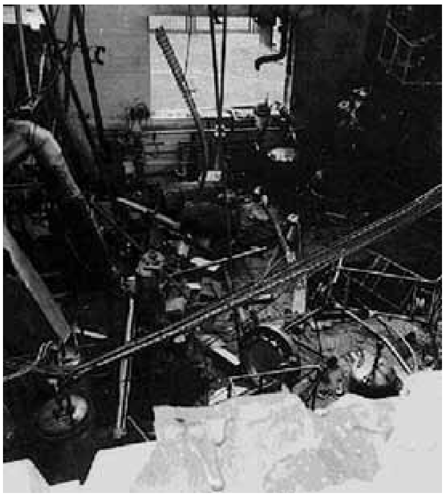

Figure 1: Outcome of an explosion

1.4 | What could trigger an explosion?

There are a number of different ignition sources which can be found in SMEs with the potential to ignite the flammable material/air mixture. Typical ignition sources are: hot surfaces, flames and hot gases, mechanically generated sparks (while grinding or cutting), electrical sparks, static electricity, etc. Other ignition sources are: lightning, electromagnetic fields, chemical reactions, etc.

Details on the various types of ignition sources can be found in the European standard EN 1127-1.

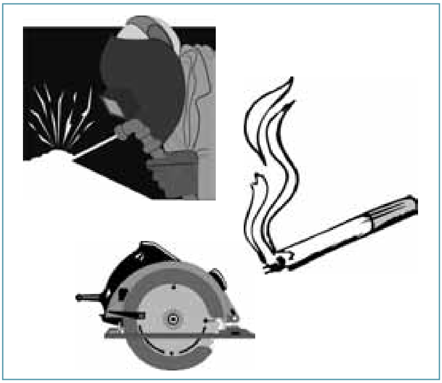

Figure 2: Ignition sources

1.5 | Relevant European legislation

The Council Directive 1999/92/EC, usually referred to as ATEX-137, (hereinafter "User ATEX Directive"), is the legal basis for the necessary measures at the workplace to improve the safety and health protection of workers potentially at risk from explosive atmospheres.

The User ATEX Directive defines the minimum requirements for the protection of safety and health of workers at risk from explosive atmospheres.

With a view to preventing 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 and other persons at risk.

The Council Directive 94/9/EC, usually referred to as ATEX-95, is also relevant since it specifies the essential requirements for equipment and protective systems intended for use in explosive atmospheres.

1.6 | Hazardous area classification?

In the sense of the User ATEX Directive, If an explosive atmosphere may occur at a place in such quantities as to require special protective measures to safeguard the safety and health of the workers concerned, then that place is described as a hazardous place and the corresponding atmosphere in that place as a hazardous explosive atmosphere.

Ex sign

At such workplaces, a special warning sign must be placed. The EX sign warns workers and other persons of an explosion risk at certain areas of the workplace due to the presence of flammable materials. The flammable material could be in the form of liquid vapour, gas or flammable dust.

Explosive atmospheres could be created in several branches of economic activity such as in the chemical industry, in refineries, in power generating companies, gas equipment, etc. In SMEs explosive atmospheres could be created in the wood-working industry, in vehicle paint booths, in agriculture farms, in the food processing industry, at fuel stations, etc.

It is important to know that once the existence of an 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 be assumed that an explosion will cause substantial harm and that a hazardous explosive atmosphere is present.

On the basis of the above mentioned principles, a risk assessment of an explosion risk at the workplace of the SME, should be carried out. The hazardous places must be identified and classified into zones according to the frequency that an explosive atmosphere will occur and its duration.

For example:

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 of 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 flammable 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 flammable 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 flammable dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

A widely used standard to determine area extent and classification for flammable vapour is EN 60079-10. This standard makes a clear link between the amount of flammable vapour that may be released, the ventilation at that location, and the zone number.

Various other sources have tried to place time limits on to these zones, but none have been officially adopted.

Examples of some common values used are:

- **Zone 0:** Explosive atmosphere for more than 10 % of the operation time of the plant, or 1000 h/yr.
- **Zone 1:** Explosive atmosphere for more than 0,1 % of the operation time or 10 h/yr, but less than 10 % of the operation time, or 1000 h/yr.
- **Zone 2:** Explosive atmosphere for less than 0,1 % of the operation time, or 10 h/yr, but still sufficiently likely as to require controls over ignition sources.

The number given in terms of h/yr could be used in cases where the plant is operational throughout the year.

Where people wish to quantify the zone definitions, these values are the most appropriate, but for the majority of situations a purely qualitative approach is adequate.

Zoning can also be used to determine the extent of protective measures with respect to the category of the protective systems to be used in the hazardous place.

2. Checklists for Risk Assessment (Hazard Identification)

Hazard means anything that can cause harm (e.g. chemicals, electricity, working from ladders, an open pit, a circular saw, etc).

Risk is the chance, high or low, that someone could be harmed by these and other hazards together with an indication of how serious the harm could be.

To assess the risk it is necessary to consider the likelihood of an explosive atmosphere and the potential consequences, following its subsequent ignition, from an explosion.

Risk Assessment can be carried out using the following checklist to identify explosion hazards at the workplace and following an assessment of the risk, come up with the proper preventive and protective measures.

Explosion Hazards	Measures	Remarks
General ❑ Are flammable substances (gases, vapours, dust) present? ❑ Is generation of explosive mixtures possible due to sufficient dispersion in air (Estimate sources and quantity of explosive atmosphere)? ❑ Is generation of hazardous explosive atmosphere possible?	**Measures limiting or preventing generation of hazardous explosive atmosphere** ❍ Replace flammable substances by non flammable or less flammable substances ❍ Limit the quantity of materials stored at workplaces to that required for progress of work ❍ Store waste, residues occurring at the end of work/shift intermediately at safe places ❍ Prevention or limitation of explosive atmosphere in the internal volume of systems and part of systems by – limitation of concentration; – Inertisation ❍ Prevention or limitation of explosive atmosphere within the vicinity of systems and parts of systems by – tight system Extraction systems; – for gases: ventilation (natural or forced) – for dust: measures to eliminate deposits ❍ Monitoring of gas concentration	
❑ Is the generation of hazardous explosive atmosphere prevented thoroughly by the measures above?	❍ Measures preventing or limiting ignition of hazardous explosive atmosphere ❍ Assessment of probability and duration of occurrence of hazardous explosive atmosphere (classification into zones) ❍ According to the classification of zones, electrical and non electrical devices and components shall be selected in conformity with the corresponding equipment categories	
❑ Is ignition of hazardous explosive atmosphere prevented safely by the measures above?	❍ Design measures for explosion protection limiting the effects of an explosion to a harmless extent. – explosion resistant design – explosion venting – explosion suppression – explosion isolation in combination with the previous measures	
❑ other ________________________	❍ other ________________________	

Explosion Hazards	Measures	Remarks
Ignition sources ❑ Are ignition sources present? Ignition hazards by: ❑ Flames or hot gases (e.g. smoking, fire, naked flames, welding and cutting ❑ mechanically generated sparks (e.g. during grinding, rubbing and hammering) ❑ electrical systems (e.g. switches, relays) ❑ hot surfaces (e.g. dryer, boiler, hot ducts, due to rubbing and machining) ❑ static electricity, (e.g. resulting from rubbing, pneumatic conveying, flowing of liquids) ❑ other ________________________	**Prevent effective ignition hazards within hazardous zones** – Do not allow any ignition sources within the working area of easily flammable substances – Prevent ignition sources and prohibit fire, naked flames and smoking ❍ Mechanically generated sparks can be limited by, for instance, water cooling at the grinding spot or by selecting the most favourable combinations of materials ❍ Select suitable electrical equipment (e.g. ATEX 95). ❍ Monitor and limit the temperature of hot surfaces ❍ Safe dissipation of charges by use of conductive materials and by earthing measures ❍ other ________________________	
Preventive Maintenance Hot work (e.g. grinding, flame cutting, welding) in areas with potential explosion hazards (general) ❑ other ________________________	❍ Eliminate movable flammable substances and remove dust deposits, if necessary ❍ keep work area clean by regular cleaning by means of proper cleaning equipment and material ❍ maintain electrical and mechanical equipment regularly following the manufacturer's instructions ❍ other ________________________	

3. Risk Assessment

The selection of the preventive and protective measures which should be implemented may be established from the Probability Factor and the Severity Factor using the risk assessment matrix shown below:

		Severity Factor			
Propability Factor		**Minor** (Light injuries)	**Significant** (Medium injuries)	**Major** (Serious injuries or deaths)	**Catastrophic** (Multiple death)
	High (Likely to occur at least every year during the plant lifetime	4	5	6	7
	Medium (Likely to occur more than once during the plant lifetime)	3	4	5	6
	Low (Unlikely to uccur during the plant lifetime)	2	3	4	5
	Very low (Remotely possible to occur, if ever)	1	2	3	4

In the above scenario, the plant lifetime is estimated at 20 years. Based on the values established from the table above, the necessary action and the time frame in which it must be taken is indicated from the table below:

Measured value	Action taken and time frame
1 – 2 (acceptable risk)	No additional control measures are required. Possible improvement measure should consider the cost/benefit relationship. Steadfast monitoring to ensure that control measures are implemented.
3 – 4 (Reduction of risk necessary)	Within a fixed time frame measure must be implemented to reduce risk to an acceptable level.
5 – 7 (Reduction of risk urgently necessary)	Commencement of work is forbidden until risk mitigation. The required improvement measures are important and should be implemented immediately for work tasks which are already in progress. If risk cannot be reduced to an acceptable level, the prohibition of work activities must remain in effect.

4. Risk Reduction – Taking Measures

4.1 Introduction

If the risk assessment has indicated that there is a risk of explosion at the workplace, then measures must be devised and implemented to:

- eliminate the risk,

  or

- reduce the risk to an acceptable level.

The necessary measures could be **preventive** or **protective** or a combination of those. Furthermore, the aforementioned measures could be **technical** and **organisational**.

Important:

If such preventive and protective measures cannot be organized due to lack of competent personnel in the SME, the employer shall enlist competent external services or persons.

4.2 Preventive measures

The purpose of the preventive measures is to eliminate, if possible, the risk of explosion by preventing the creation of an explosive atmosphere, or by preventing ignition sources.

Such preventive measures include:

4.2.1 Prevent or reduce flammable material

Following the prevention principles of the safety and health legislation, this type of measure is high in the hierarchy of prevention. In many cases however, the flammable material cannot be replaced by a non flammable, either because the material itself is the outcome of specific process of the SME, or it is essential to the process itself as an ingredient.

In such a case, the quantity of the flammable material kept at the workplace should be reduced to the absolute minimum needed. Flammable materials should be stored in suitable fireproof storage containers, properly labelled and away from potential ignition sources. It is important not to store them together with incompatible materials that may react with each other and initiate an explosion.

4.2.2 Keeping the concentration of the flammable material in the material/air mixture outside the explosion limits

The formation of explosive atmospheres outside of installations should be prevented as far as possible. This may be achieved by closed installations. These parts of the installation shall be of sufficiently tight construction to prevent leakage. The installations shall be so designed that no leakage can occur under the foreseeable operating conditions. This shall also be ensured by regular maintenance and testing.

If leakage of flammable substances cannot be eliminated, the formation of explosive atmosphere must be prevented by suitable measures so that the concentration of the flammable material in the material/air mixture is kept outside the explosion limits. Such possible measures include ventilation and cleaning.

Specifically for gases or vapours:

- Natural ventilation
  (air exchange without forced technical means)
- Mechanical ventilation
  (room ventilation with directed forced technical means)

For dusts, extraction measures are considered effective to prevent dust leakage from equipment. Preferably, the flammable dust should be extracted directly at the point of generation. Also, proper housekeeping is very important. Flammable dust deposits can be avoided by regular cleaning measures using suitable cleaning equipment. Stirring the flammable dust should be avoided as it could generate a dust cloud. Wetting the flammable dust before removing prevents dispersion.

It should be noted that despite the effectiveness of the ventilation systems and cleaning operations, there could always be a residual risk that need to be reassessed and mitigated by further measures.

Figure 3: Improper and proper methods for removing flammable dust

4.2.3 Control the size of the flammable material granules/fines

This measure can be used for dust/air mixtures. If the particles of the flammable material are sufficiently large, e.g. greater than 0,5mm, the probability of explosive mixtures is reduced.

Warning:
Even with coarse materials fines can always be present, or arise due to friction.

4.2.4 Elimination/control of possible ignition sources from becoming active

Potential ignition sources, such as welding, grinding, smoking, hot surfaces, electrical and electrostatic sparks, mechanical sparks, exothermic chemical reactions, etc, are amongst those commonly found in SMEs.

Operational ignition sources and sources resulting from equipment/process malfunction or misuse could be prevented from becoming active by:

- electrostatic grounding,
- avoiding materials and objects of low electrical conductivity,
- reducing the size of non-conductive surfaces,
- avoiding the use for dust conveying and filling operations of conducting pipes and containers with an electrically insulating inner coating,
- selection of low speed mechanical equipment,
- selection of electrical and mechanical equipment as per the requirements of the ATEX 95 Directive. It should be noted that the equipment must be suitable for the nature of the hazardous workplace environment, e.g. gas certified equipment must only be used in areas with gas explosive atmospheres.

4.2.5 Detection of and explosive atmosphere

Suitable detection systems may be used to provide an early warning when an explosive atmosphere is formed. These systems typically trigger the alarm when the concentration of the flammable material/air mixture is around 10 % of the LEL. Such systems may shut down non explosion proof equipment, start the exhaust fan, etc.

4.3 Organisational measures

The effectiveness of measures may be amplified if these are combined with work organisation measures.

Organisational measures must interact harmoniously with the other measures to create a work environment in which workers can carry out their work without risk to their safety and health, or to persons who might be affected by the work activities.

Common ignition sources, such as smoking, welding, or grinding, could be controlled by suitable organisational measures, such as prohibition of smoking, handing out written operating instructions to the workers, issuing codes of behaviour, issuing Work Permits, providing adequate training and supervision. Possible organisational measures include:

Figure 4: Organisational measures

4.3.1 *Issue of written operating instructions*

Operating instructions should contain written rules of conduct issued by the employer to the workers. Also, a list of all mobile work equipment permitted for use in the hazardous place concerned. They should also indicate what personal protective equipment must be worn by persons entering such a place.

4.3.2 *Provide training*

Employers must provide workers with training on the explosion hazards present at the workplace and on the relevant prevention and protection measures taken. This training must take place before work commencement and when job description changes, when new work equipment is introduced or changed and when new technology is introduced.

The training should explain, for example, how the explosion hazard arises and in what parts of the workplace it is likely to appear, the measures taken and the correct use and maintenance of the work equipment. Also, workers must be instructed on how to work safely in or near hazardous areas. The employer should also brief third persons, such as visitors to the SME as well as subcontractors, on the risk of explosion.

4.3.3 *Adopt a Work Permit System*

Works, which may cause an explosion, in or near a hazardous place must be carried out through a Work Permit System. A Work Permit Form signed by the responsible person should be issued which should include at least the following:

- The work location.
- A description and duration of the work to be undertaken.
- The number and names of workers involved.
- The work equipment to be used.
- Identification of the hazards.
- List of the precautionary measures followed by an acknowledgement by the responsible person that they have been implemented.
- The personal protective equipment needed.
- An acknowledgement that the workers involved have received adequate training.

For example, before maintenance work commences in a hazardous area a Work Permit must be issued. Experience shows that a high accident risk is associated with maintenance and servicing work. Before, during and after completion of the work, it must be ensured that all necessary protective measures are taken.

4.3.4 *Inspection*

Before a workplace that contains areas where an explosive atmosphere may occur, is used for the first time, its overall explosion safety must be assessed by a competent person. Inspection should also be carried out when alterations, with an impact on the safety levels, take place in an area and also after the use of the area in question.

4.3.5 Supervision

Appropriate workers´ supervision must be ensured during the presence of workers in workplaces where an explosive atmosphere may occur.

4.3.6 Marking

The points of entry to hazardous place, must be properly marked using the proper warning signs.

See section 2.6.

4.4 | Protective measures

4.4.1 Explosion protection measures

Where the possibility of explosion cannot be eliminated to an acceptable level, additional measures must be taken. These measures do not prevent explosions, but help to minimize their effects so as to avoid or reduce casualties or damages to the installation or the enterprise itself.

The repercussions of an explosion may be limited by **constructional protection measures**, as follows:

- explosion resistant design,
- explosion venting,
- explosion suppression

  and
- explosion isolation in combination with the aforementioned.

The protective systems to be used must comply with the ATEX 95 Directive.

4.4.2 Explosion resistant design

When this measure is applied all plant items concerned, must be so designed that they can withstand an internal explosion without rupturing.

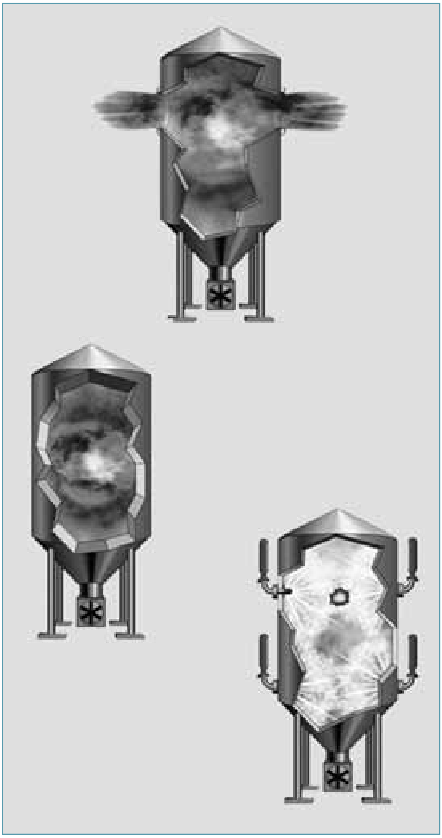

Figure 5: Explosion resistant vessel (left), explosion venting (top) and explosion suppression (bottom right)

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

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

After every explosion, the affected items of plant must be checked and screened for deformation before further operation is allowed.

4.4.3 Explosion venting

Explosion venting comprises of all measures used to vent the initially closed vessel or equipment in a non hazardous direction. The explosion venting devices are intended to ensure that the plant/installation is not subjected to explosion stresses exceeding its design strength. Bursting discs or explosion doors are, for example, such venting devices.

Explosion venting however, may not be used if vented substances are hazardous, e.g. toxic, corrosive, etc.

4.4.4 Explosion suppression

Explosion suppression systems are devices which, as in the case of explosion venting, prevent the buildup of an inadmissibly high pressure during explosions in vessels. They function by sensing the pressure rise, or the flame propagation, during the onset of an explosion and suppressing the explosion by the release of extinguishing agents.

4.4.5 Explosion isolation

An explosion occurring in one part of a plant can propagate to upstream and downstream parts, where it may cause further explosions. Excessive explosion overpressure is caused by displacement, turbulence during the propagation of an explosion. The explosion overpres-

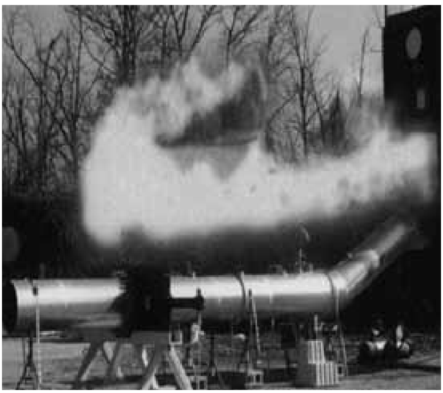

Figure 6: Explosion venting

Figure 7: Explosion isolation equipment

sures developed can be much higher than the maximum explosion pressure under normal conditions and may destroy unprotected sections of an installation, or even items of a plant which are of the explosion pressure resistant, or explosion pressure shock resistant type.

It is therefore important to isolate possible explosions to single parts of the plant. This is achieved by explosion isolation.

Explosion isolation can be performed by means of:

- rapid-action mechanical isolation;

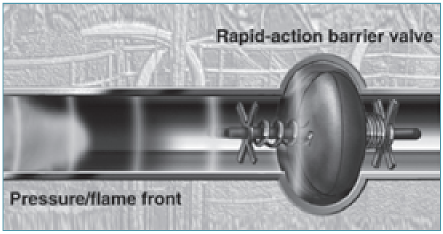

Figure 8: Explosion isolation with rapid reaction valve

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

5. Explosion Protection Document

The User ATEX Directive provides for the employer to prepare an Explosion Protection Document. This document should be prepared for every process or installation initially, and be kept up to date when alterations take place.

Essentially, the Explosion Protection Documents contains much of the information explained in sections 2.7, 3, 4 and 5 of the Brochure.

For example:

- The risk assessment and the safety measures taken to mitigate the risk,
- the zoning of the various work areas,
- the training and maintenance procedures, and
- how coordination of the safety measures is achieved.

Cyprus

The Cyprus national legislation transposing the provisions of the Council Directive 1999/92/EC is the Safety and Health at Work (Minimum Requirements for the Protection of Persons at Work from Risks from Explosive Atmospheres) Regulations of 2002 (P.I. 291/2002) issued on 21.6.2002.

Germany

The German national legislation transposing the provisions of the Council Directive 1999/92/EC is the Betriebssicherheitsverordnung (BetrSichV, Ordinance on Industrial Safety and Health) „Ordinance concerning the protection of safety and health in the provision of work equipment and its use at work, concerning safety when operating installations subject to monitoring and concerning the organisation of industrial safety and health at work (Verordnung über Sicherheit und Gesundheitsschutz bei der Bereitstellung von Arbeitsmitteln und deren Benutzung bei der Arbeit, über Sicherheit beim Betrieb überwachungsbedürftiger Anlagen und über die Organisation des betrieblichen Arbeitsschutzes)“ of September 27, 2002, latest amendment Dezember 18, 2008.

Thematic focuses of the BetrSichV:

- Hazard evaluation
(see § 3 BetrSichV)
- Explosion protection document
(see § 6 BetrSichV)
- Testing of work equipment
(siehe § 10 BetrSichV)
- Special regulations for plants requiring special supervision
(see clause 3 of the BetrSichV)
- Zone classification of explosive areas
(see Annex 3 of the BetrSichV)
- Minimum requirements for the improvement of safety and health of workers possibly endangered by hazardous explosive atmosphere
(see Annex 4, clause A of the BetrSichV)
- Criteria for the choice of devices and protective systems
(see Annex 4, clause B of the BetrSichV)

Slovakia

The Slovak national legislation transposing the provisions of the Council Directive 1999/92/EC is the Slovak Government Decree No. 393/2006 Coll. on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmosphere.

The following ISSA International Sections on Prevention elaborated the brochure. They are also available for further information:

ISSA Section for Iron and Metal

c/o Allgemeine Unfallversicherungsanstalt
Office for International Relations
Adalbert-Stifter-Strasse 65
1200 Vienna · Austria
Fon: +43 (0) 1-33 111-558
Fax: +43 (0) 1-33 111-469
E-Mail: issa-metal@auva.at

ISSA Section for Electricity

c/o Berufsgenossenschaft
Energie Textil Elektro
Medienerzeugnisse
Gustav-Heinemann-Ufer 130
50968 Köln · Germany
Fon: +49 (0) 221 - 3778 - 6007
Fax: +49 (0) 221 - 3778 - 196007
E-Mail: electricity@bgetem.de

ISSA Section for Machine and System Safety

Dynamostrasse 7-11
68165 Mannheim · Germany
Fon: +49 (0) 621-4456-2213
Fax: +49 (0) 621-4456-2190
E-Mail: info@ivss.org

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