Dangerous Substances & Explosive Atmospheres Regulation 2002
” The Basics”

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DSEAR Regulations 2002

- Sets minimum requirements for the protection of workers from fire & explosion risks arising from dangerous substances and potentially explosive atmospheres.

- These regulations consider hazardous areas due to the likely presence of explosive atmospheres (Under atmospheric conditions).

- These are created by dangerous substances consisting of a mixture with air of flammable substance in the form of a gas vapour or mist/dust.

- This then can be classified as a Hazardous Area.
Objectives of the Regulation

- Identify the circumstances of work, the amount of dangerous substance used and the process of application
- Review activities and risk assess
- Review the effectiveness of the existing control measures

- Identify the probability of a flammable atmosphere being created & its duration
- Identify the likelihood of an ignition source
- Identify the scale of the fire or explosion
- Consider other places of work that the fire / explosion may effect
Risk Assessment must be available from the 1st July 2003

Workplaces already in use are given up to July 2006 to comply

If the workplace was in use before July 2003 but modified before July 2006 must comply at the time of the modification

Where the workplace is brought into use after July 2003 must comply.
DSEAR – In a nutshell!

- Employers and the self employed must;
  - Carry out a risk assessment of any work activity involving dangerous substances
  - Provide technical & organisational measures to eliminate or reduce “sfarp” the identified risks
  - Provide equipment & procedures to deal with accidents and emergencies
  - Provide information & training to employees
  - Classify places where explosive atmospheres may occur into zones & mark zones
The Triangle of Fire

• Remove anyone of these & the fire will not occur!
Basic Terminology

**Flash point**
The lowest temperature at which the surface of a liquid gives off sufficient vapour to form a flammable mixture.

**Auto Ignition Temperature**
The ignition temperature of a gas or vapour is the lowest surface temperature to which the most easily ignited fuel - air ratio of a flammable atmosphere has to be exposed to cause ignition.

**Flammable range**
- A mixture of fuel & air/oxygen is only capable of being ignited if it is between the upper & lower explosive limits.

- Above UEL - Flammable mixture is too rich to ignite
- Below LEL - Flammable mixture is too weak to ignite

**Oxygen enrichment?**
Basic Terminology

Ventilation & Vapour density

- Good - rapid dilution of any gas or vapour that will reduce the atmosphere below the LEL.
- Vapour Density – Heavier than / lighter than air
- Grade of Release – Normal / Abnormal.
- Type of release
  - Continuous
  - Primary
  - Secondary
Flash Point

STAGES OF A FIRE

- What is flash point?
- What impact will ambient temperature have on the chemical?
Prevention of a dust explosion

1) Dust settles on flat surfaces
2) Some “event” disturbs the settled dust into a cloud
3) Dust cloud is ignited

Figure 2
UEL (Upper Explosive Limit)

LEL (Lower Explosive Limit)

Explosive Range

Mixture of air and flammable gas is explosive if ignited

Lets start your car
Basics of the “BIG three” Regs

- Reg 5 - Risk Assessment. (supporting the requirements MHSR 1999)
- Reg 6 – Defines scope and priority of risk control measures (prescriptive)
- Reg 7 – Hazardous area classification and diagrams
Reg 5 (2) Hazard Identification

- Reg 5 (2) "risk assessment SHALL include"

- Hazardous Properties

- Hazards – consider the following

<table>
<thead>
<tr>
<th>Substance</th>
<th>Flash Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone,</td>
<td>-20</td>
</tr>
<tr>
<td>Styrene based resin (Crystic),</td>
<td>31 to 40</td>
</tr>
<tr>
<td>Propane (LPG)</td>
<td>-104</td>
</tr>
<tr>
<td>Kerosene</td>
<td>37-65</td>
</tr>
</tbody>
</table>

(HFL) (FL) (EF)
Signage / GHS

Explosive  Stray electric currents  Radiation  Hot surfaces

What's in your local Flam Cabinet! Are these chemicals stored correctly!
“Basis of Safety” - Methods of Control

- **Eliminate**
  - Do we need to do the job
  - Can it be done in a different way

- **Substitute**
  - Do we need to do it with that substance
  - Can we change the process/ remove ignition sources or surface temperatures

- **Segregate**
  - Change location
  - Enclose the process

- **Engineering Control**
  - LEV
  - Correct ex protection for equipment
  - Bonding and Earthing

- **Managerial Controls**
  - Permits to work
  - Removing staff from the area etc

Article 3
99/92/EC
- Prevention
- Avoidance
- Mitigation
<table>
<thead>
<tr>
<th>Mitigation Control Measures</th>
<th>Reduce Quantities 6(4)a</th>
<th>Prevention of an ex atmosphere 6(4)d</th>
<th>Avoid adverse conditions 6(4)f ii</th>
<th>Minimise no of employees 6(5)a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid / minimise the release 6 (4b)</td>
<td>Avoiding Ignition sources 6(4)f</td>
<td>Segregation of incompatible substances 6(4) g</td>
<td>Avoid propagation of fires / explosions 6(5)b</td>
<td></td>
</tr>
<tr>
<td>Control release at source 6(4)c</td>
<td>Design of Storage 6 (8)</td>
<td>Provision of pressure relief 6(5)c</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explosion suppression 6(5)d&amp;e</td>
<td>Provision of suitable PPE 6(5)f</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Ignition sources

Ignition Sources of Dust Explosions

- Electrical Equipment: 3.5%
- Mechanical: 30%
- Other: 2.5%
- Unknown: 11.5%
- Friction: 9%
- Welding: 5%
- Self-ignition: 6%
- Hot Surfaces: 6.5%
- Fire: 8%
- Smoker Spot: 9%
- Static Electricity: 9%
Temperature Classification

Auto-ignition classes and temperatures for gas

- Hydrogen 560° (T1)
- Methane 537° (T1)
- Ethylene 425° (T2)
- Acetylene 305° (T2)
- Kerosene 210° (T3)
- Ethyl ether 160° (T4)
- Carbon disulphide 95° (T6)

Classes and temperatures for suspended dust particle combustion

- Soot 810° (T1)
- PVC 700° (T1)
- Aluminum 590° (T1)
- Corn dust 510° (T1)
- Sugar 490° (T1)
- Flour 490° (T1)
- Methyl cellulose 420° (T2)
- Polyethylene 420° (T2)
- Carbon dust 380° (T2)
Lets link our discussion together!
Reg 7 Hazardous Area Classification

- Developed over 50 years by the oil and chemical industries
- Takes no account of the consequences of an ignition
- Should be applied more systematically than in the past (requirements in Schedules to Regs)
- New specific link between the zone and equipment allowed in it
It is necessary to classify places where explosive atmospheres may occur into zones and mark these zones where necessary.

**Zone - t**

Zone **0** - An atmosphere where a mixture of air and flammable substances in the form of gas, vapor or mist is present frequently, continuously or for long periods.

Zone **1** - An atmosphere where a mixture of air and flammable substances in the form of gas, vapor or mist is likely to occur in normal operation occasionally.

Zone **2** - An atmosphere where a mixture of air and flammable substances in the form of gas, vapor or mist is not likely to occur in normal operation, but if it does occur will persist for only a short period.

Zone **20** - An atmosphere where a cloud of combustible dust in the air is present frequently, continuously or for long periods.

Zone **21** - An atmosphere where a cloud of combustible dust in the air is likely to occur in normal operation occasionally.

Zone **22** - An atmosphere where a cloud of combustible dust in the air is not likely to occur in normal operation, but if it does occur will persist for only a short period.

**Figure 1:** European Classification of hazardous areas generally follows the International Electrotechnical Commission (IEC)/ATEX.

<table>
<thead>
<tr>
<th>Area classification does</th>
<th>Area classification does not</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifies the point of release</td>
<td>Take account of the consequences of the ignition</td>
</tr>
<tr>
<td>Estimates the extent &amp; the duration of the flammable atmosphere</td>
<td>Specify the correct equipment to use</td>
</tr>
<tr>
<td>Allocates grades &amp; sizes to the hazardous areas</td>
<td></td>
</tr>
</tbody>
</table>
Reg 7(2) Equipment for use in hazardous zones

Schedule 3 gives details of Category.
Cat 1 in Zone 0/20, Cat 2 in Zone 1/21, Cat 3 in Zone 2/22
Zoning & Extent of the zone

- Zone boundaries are either calculated or identified via codes:
  - EN 60079-10-1/2
  - Petro chemical
  - Gas storage
  - Ammonia systems

- Zone boundaries will change in shape to allow for overlapping zones.
## Selection of apparatus & zoning

<table>
<thead>
<tr>
<th>Protection Technique</th>
<th>Zone 0</th>
<th>Zone 1</th>
<th>Zone 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Flameproof “d”</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(B) Purged and pressurized</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(C) Intrinsic safety</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(D) Type of protection “n”</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(E) Oil immersion</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(F) Increased safety “e”</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(G) Encapsulation “m”</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(H) Powder filling “q”</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(I) Combustible gas detection system</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
No fuel

No oxygen

No oxygen

No fuel via restricted breathing
ATEX Marking

**Typical ATEX and IECEx Marking [ATEX only]**

- **CE** 0359
- **Ex** II 2 G Ex d IIC T4 Gb

- **Complies with European Directive**
- **Specific Marking for Explosion Protection**
- **Notified Body Number**
- **Equipment Category**
- **Environment**
- **Explosion Protection**
- **Type of Protection**
- **Gas group**
- **Temperature Class (T1-T6)**
- **Equipment Protection Level**
Intrinsic Safety Products for use in “Hazardous Area”:

The released energy must be under the safety threshold also in case of fault.

The risks are:

- High temperature
- Sparks
Reg 7(3) Mark areas with signs at point of entry

- The “EX” triangle sign is shown in Schedule 4.
- Use based on risk assessment and added safety value
Questions ?