



# Hazardous Locations - an Overview



Simplifying Complexity. Delivering Safety.



**HYDROGEN  
SAFETY  
FORUM**

**Lunch & Learn 1**  
Monday 7<sup>th</sup> Dec 2020  
12:30 – 13:30 GMT

# Objectives

---



As a result of this presentation, you will be able to:

- Understand the definition of hazardous areas
- Identify the main characteristics for safety compliance
- Appreciate the methods of protection available
- Feel confident about developing product & systems for such applications

# DSEAR



- Created after 94/92/EC – ATEX “Workplace” Directive
- Dangerous Substances and Explosive Atmospheres Regulations 2002
- Requires duty holder (employer & self-employed persons) to protect people (workers & public) from risks to their safety as a result of workplace activity.
- You must:
  - Identify dangerous substances & their risks
  - Remove substances or take other actions to mitigate risk
  - Prepare plans & procedures to deal with accidents & emergencies
  - Inform & train employees about the risk
  - Identify & classify plant areas (Zoning) and implement measures to prevent ignition
- DSEAR ACOP – available as a PDF

# Approved Codes of Practice



- DSEAR ACOP is issued by Health & Safety Executive (HSE)\*
- When properly followed, usually sufficient to demonstrate compliance with the law
- When not followed, demonstration of compliance with DSEAR is much more difficult.
- HSE Inspectors seek to demonstrate compliance or non-compliance with the law and use ACOP as their yard-stick.

\* <https://www.hse.gov.uk/pubns/books/I138.htm>

Simplifying Complexity. Delivering Safety.



# Hazardous Area Classification (HAC)



- **Hazardous area:** where an explosive atmosphere may occur in quantities that require special precautions to protect the health and safety of workers.
- **Non-hazardous area:** where an explosive atmosphere is not likely to occur in quantities that require special precautions to protect the health and safety of workers.
- Assessment considers the **likelihood** of releases of explosive atmospheres and the **potential quantity** of such releases when considering area classification.
- “**Special precautions**” means precautions to control potential ignition sources within a hazardous area, particularly in relation to the construction, installation and use of equipment.



# Definitions of Zones

## Zone 0 (gas) / Zone 20 (dust)

- An area/volume where a potentially explosive atmosphere is present continuously or for a very significant portion of time
- Industry Estimate: >1000 hr/year

## Zone 1 (gas) / Zone 21 (dust)

- An area/volume where a potentially explosive atmosphere is likely during normal operation
- Industry Estimate: 10 – 1000 hr/yr

## Zone 2 (gas) / Zone 22 (dust)

- An area/volume where a potentially explosive atmosphere is not likely during normal operation, and if present due to fault, will only persist for a short time.
  - Industry Estimate < 10 hr/yr

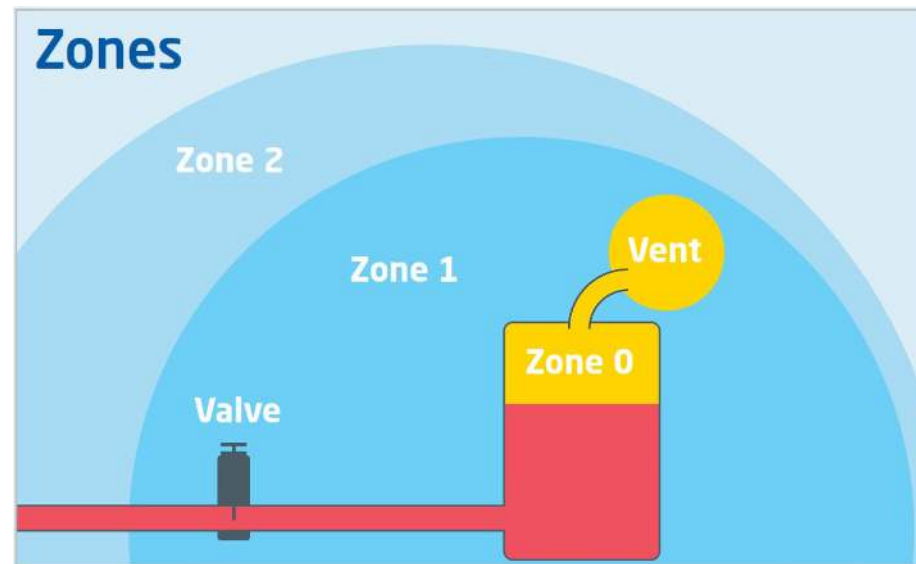
Note: timings shown are not officially adopted but are commonly used – see HSE website Technical Measures document on HAC and Control of Ignition Sources

---

# Hazardous areas - IEC



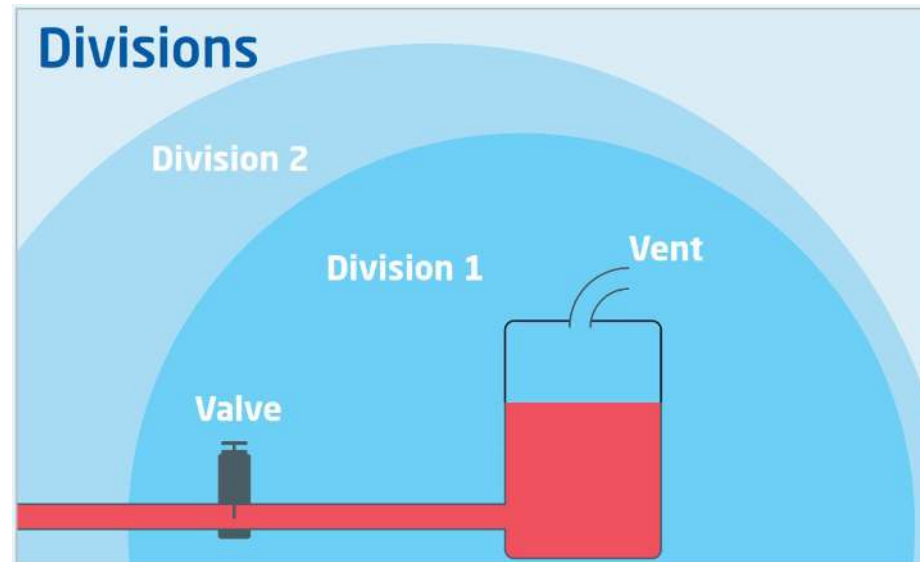
IEC 60079-10-1  
"Area Classification – Gas"



Simplifying Complexity. Delivering Safety.



# Hazardous areas - NEC

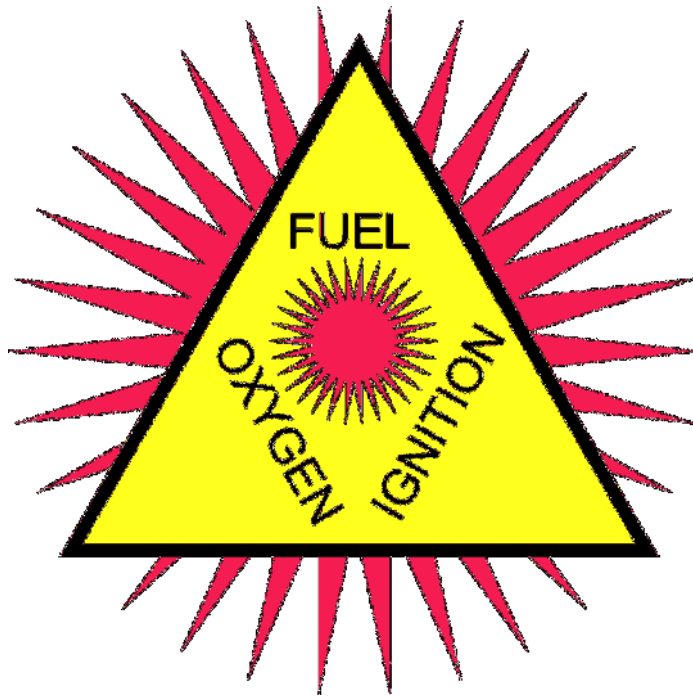


Simplifying Complexity. Delivering Safety.





# Explosion Triangle



Explosion requires:

- Fuel
- Oxidiser
- Ignition source

Explosion protection

- Elimination or control of one or more of these elements

# Potential ignition sources



- Flames
  - Direct fired space and process heating
  - Use of cigarettes/matches etc
  - Cutting and welding flames
- Hot surfaces;
  - Heated process vessels
  - Space heating equipment
- Mechanical machinery
  - Friction heating or sparks
  - Impact sparks
- Spontaneous heating
- Electrical equipment and lights
- Sparks from electrical equipment;
  - Stray currents from electrical equipment
  - Electrostatic discharge sparks
- Lightning strikes.
- Electromagnetic radiation of different wavelengths
- Vehicles, unless specially designed
- Optical fibres

# ATEX “Product” Directive

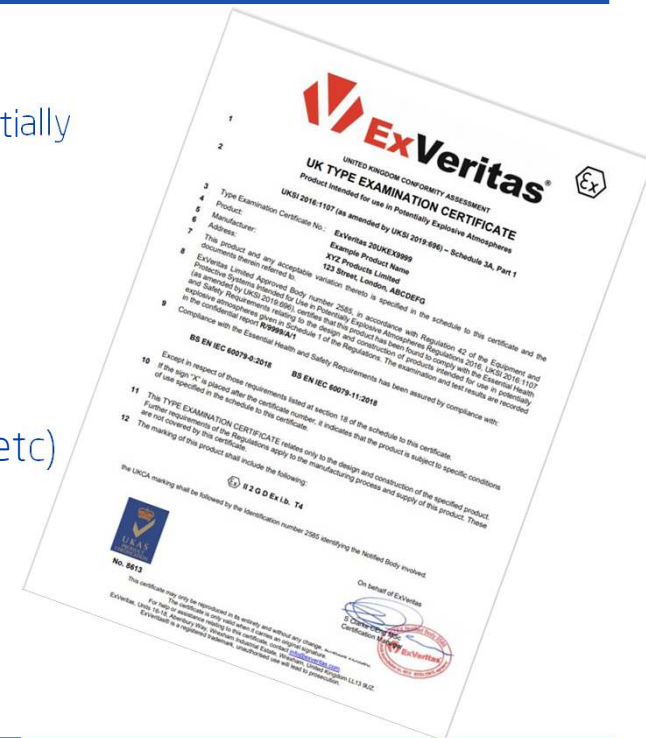


- ATEX 2014/34/EU (was 94/9/EC)
  - To enable equipment manufacturers & users to more easily demonstrate the measures taken in their design, manufacture & use of equipment
  - Not proscriptive, but requires use of standards
- ATEX approval is by Notified Bodies (state registered but independent organisations accredited as being experts in the field)
- Marking of ATEX approvals allows free trade across national borders within EU
- Post-BREXIT, most manufacturers will still need ATEX compliance for sales into the EU, and EPS compliance will be required for UK sales (will be based on identical standards until technical divergence).

# Post BREXIT internal UK market



- ATEX Directive replaced by EPS
  - Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2019
- UKCA mark
  - CE still allowed to end 2021, thereafter UKCA mark required
- Notified Body (EU) replaced by UK Approved Body
- Declaration to UK recognised standards (BS EN 60079-0 etc)
- UK Type Examination Certificate
- UK QAN Quality System



Simplifying Complexity. Delivering Safety.



# Protection by design



- Give consideration to alternative design that eliminates risk
- Where risk is unavoidable, consider
  - Likelihood of release
    - Ventilation to atmosphere (below flammable limit)
    - Potential collection points
    - Complete Zone diagram of plant or location
  - Device power requirements
    - Select appropriate protection concept
    - Match concept to Zone & practicality of use
- Complete Technical File
  - Demonstrates that designers have taken account of foreseeable risk

# Methods of Protection - electrical

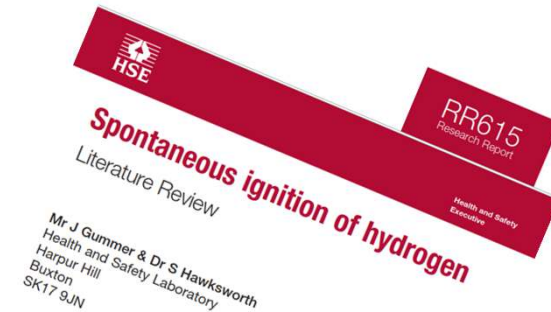


- Eliminate / Control Ignition
  - Flameproof IEC 60079-1 strong box, tight seals
  - Intrinsic safety IEC 60079-11 very low power
  - Increased safety IEC 60079-7 no hot spots
  - Sand filling IEC 60079-5 quenching arcs
- Eliminate / Control Fuel
  - Purge & pressurization IEC 60079-2 well below LEL
  - Liquid filling IEC 60079-6 sealed, allows moving parts
  - Encapsulation IEC 60079-18 sealed around static parts
- Eliminate / Control Oxidiser
  - Purge with inert gas IEC 60079-2 eliminate oxygen

# Properties of Hydrogen Gas



- Very low molecular weight/specific gravity
  - 0.071 g/l at 0°C and 1 atm.
  - 0.0695 specific gravity (relative density to air)
- Very easy to ignite by spark
  - 19 µJ
- Not so easy to ignite by hot surface
  - Auto-ignition temp 560°C acc. IEC 60079-20:2000
- Ignition by corona discharge
  - Identified where hydrogen was vented to atmosphere under certain atmospheric conditions
  - High pressure releases almost always ignite



# Hydrogen Compressor



HV Motor driving a compressor

- Compressor demands high power prime mover
- High voltage supply makes high power motor efficient
- HV motor is in hazardous area



Simplifying Complexity. Delivering Safety.





# Objectives restated

---



- Understand the definition of hazardous areas
- Identify the main characteristics for safety compliance
- Appreciate the methods of protection available
- Feel confident about developing product & systems for such applications



Thank you for your attention.

Simplifying Complexity. Delivering Safety.

