DSEAR RISK ASSESSMENT

CSC Fleet Services Ltd
AO Omega Building, Weston Rd, Crewe
CW1 6BW

THE WORKSAFE EXPERTS

This report has been compiled for CSC Fleet Services Ltd and on behalf of EEUK Group by the following competent consultant:

Joseph Isimite CEng MIChemE

Signature: *Joseph Isimite* Date: 14th October 2025

This report has been peer reviewed for CSC Fleet Services Ltd and on behalf of EEUK Group by the following competent consultant:

Signature:  Date: 18th October 2025

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1.0 Executive Summary

Overall Assessment of DSEAR Safety Risk - having considered dangerous substances and explosive atmosphere risks on this site, together with the nature, operation and management of those risks, the EEUK Group assessor is of the opinion that on the date of this assessment, the overall level of risk and the recommended frequency of routine review is as follows:

Overall Risk Level	Frequency of Routine Review	Explanation
Tolerable	**Every 3-5 years or following significant changes in the workshop**	The highest rating of "Tolerable" arises because of the nature of fire and explosion severity resulting in "Severe non-life-threatening injuries requiring medical attention" and the likelihood being considered "unlikely" based on the current control measures in place. Points of significance have been summarised below. Recommendations have been raised to strengthen existing arrangements, implement good practice and in accordance with DSEAR hierarchy of controls.

'Ex' signage should be placed to indicate the possible presence of an explosive atmosphere in the hazardous area classified locations.

For specific assessment detail refer to the hazardous area classification and risk assessment tables in section 5 of this report. Hazardous area classification should be added to any site plans.

Points of significance:

- **Only small quantities of 500ml aerosol and paint cans are currently stored in the metal cabinet inside the workshop. However, it is foreseeable that increased workloads may require larger quantities of flammable aerosols and paints to be stored inside the workshop. It should be ensured that the maximum quantities of flammable aerosols and paints is always less than 50L as recommended in guidance.**
- **During the site visit, it was observed that one of the doors of the flammable aerosol storage cabinet was missing, meaning that the fire integrity of the cabinet was significantly compromised. CSC Fleet Services Ltd should either immediately repair the storage cabinet to restore the fire integrity of the cabinet or replace the cabinet with one of appropriate construction and integrity.**
- **Regular audits of flammable aerosols and paints kept in the workshop should be completed, and flammable substances that are rarely used should be removed to a dedicated store outside the workshops or safely disposed.**
- **It should be ensured that cleaning rags and clothing contaminated with sprayed material is not left in the workshop unless kept in metal lockers or drums with a secure closing lid.**
- **CSC Fleet Services Ltd. should ensure that the interior of the workshop is checked regularly, and accumulations of overspray and dirt should be removed as required to prevent fire initiation and spread.**
- **It is noted that the risk of toppling over of propane/acetylene bottles inside the outdoor storage cage is low because the cylinders are located in an area where vehicular movement is unlikely. However, the use of pallet trucks in this area cannot be precluded. It is recommended that flammable gas bottles stored in the**

outdoor storage cage should be restrained with chains to minimise the risk of toppling following accidental impact.

- **While it is commendable that AO's inspection team identified the compromised acetylene and oxygen welding hoses before a dangerous leak occurred, CSC Fleet Services welding technicians should be trained to a good level of competence so that they can identify damaged hoses, recognise the potential for accidental leakages which can lead to fires and explosions, and take effective remedial action to replace the hoses before they fail.**
- **The following routine checks and practices for compressed gas bottles should be implemented by CSC Fleet Services Ltd: damaged hoses must never be repaired with tape; hoses must never be left unprotected where they may be damaged (e.g. by moving pallet trucks or vehicles; ensure that welding equipment is checked by a competent person before each use; Inspect cylinder gauges and replace any defective gauge or broken glasses.**
- **Where equipment or instrumentation is deemed unserviceable, make sure it is withdrawn and clearly identified as not for use.**
- **Decommission welding equipment properly at the end of each day's work – turn off cylinder valves, vent the lines, and then turn off the valves at the blowpipe; only allow trained, competent people to use welding equipment and carry out welding activities in the workshop.**
- **To minimise the risk of welding flame 'flashback' into hoses or cylinders, welding technicians should be trained in correct lighting-up and working procedures.**
- **Flashback arresters should be fitted onto the welding cylinder regulators, on both the fuel and oxygen supplies. Arresters may be fitted on the blowpipe, but these do not give protection from a fire starting in the hose. For long lengths of hose, arresters should be fitted on both the blowpipe and the regulator.**
- **Ensure battery charging is well managed by trained staff, making sure that batteries are removed from chargers after charging is complete, electric heaters are removed from the vicinity of batteries being charged, and that batteries are not left on charge for long periods.**
- **CSC Fleet Services should provide training, instruction, and information on the use of respiratory protective equipment when handling hazardous substances to drive compliance with health and safety regulations. The company should ensure that Health and Safety advice is obtained from a competent person to ensure compliance with all relevant UK Health and Safety Legislation.**

Detailed information about the actions that need to be taken to reduce DSEAR risks follows each area assessment in section 5 and are logged for ease of reference in section 9, Recommendations.

Combustible dusts

Zone	Location
20	None identified
21	None identified
22	None identified

Flammable liquids and gases

Zone	Location
0	None identified
1	None identified
2	Vehicle repair workshop-Entire enclosure of aerosol metal storage cabinet
2NE	Vehicle repair workshop-Around vehicles being spray painted, LPG and Acetylene Bottles

DSEAR Regulation 5(3) requires this risk assessment to be reviewed by the employer regularly so as to keep it up to date and particularly if –

(a) there is reason to suspect that the risk assessment is no longer valid; or

(b) there has been a significant change in the matters to which the risk assessment relates including when the workplace, work processes, or organisation of the work undergoes significant changes, extensions or conversions; and where, as a result of the review, changes to the risk assessment are required, those changes shall be made.

If in doubt about the significance of a change, please consult with your EEUK Group risk assessor.

A glossary of terms can be found in Appendix 5.

2.0 Introduction

On the 7th of October 2025, a visit was made to CSC Fleet Services Ltd in Crewe to undertake a risk assessment in accordance with the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) [1]. The organisation provides vehicle services, diagnostics, testing and repairs for trucks, trailers and commercial vehicles in their fully equipped workshop in Crewe.

Survey Commissioned by:	Chris Card
Scope of Survey:	This report includes the assessment of the following areas: – **Vehicle repair workshop where the company carries out dent repairs using hand-held spray equipment, oxy-acetylene welding, and battery-charging for powered pallet trucks.**
Limitations / Exclusions:	As per contract arrangements. Assessment findings based on information provided by the Client and on the evidence seen by the EEUK assessor at the time of the survey. The survey is limited to substances with the potential to create explosive atmospheres. Other areas and issues excluded from the survey.
Any special client instructions:	None
No of floors / units:	Not relevant.
Approximate floor area(s):	Not relevant.
Brief details of construction:	Truck and trailer repairs take place in 3x purpose built workshops each measuring approx. 15m x 10m x 9m (L x W x H). A roller shutter door provides access for vehicles to be repaired. Activities inside the workshops include diagnostics, hand-spray painting using 500ml aerosols cans, maintenance activities, and welding. A small oxygen and acetylene cylinder storage cage is located in an outdoor cage. Both manual and battery-powered pallet trucks are used to move heavy items around the workshop. Battery charging takes place inside the office.
Type and nature of occupancy:	Areas assessed solely occupied by the client.
Existing zoning arrangements:	There are no existing zoning arrangements.
Information used to compile this report was sourced from the following:	– Employee feedback during site survey. – Photographs taken at the time of assessment. – Safety Datasheets.

In working with the company, it is incumbent on us to provide relevant advice to minimise the impact from hazardous substances, this is covered in Section 5, focusing on risk control and risk mitigation following the hierarchy of controls referenced in the DSEAR Approved Code of Practice (ACoP) [2]

Recognised standards and guidance are then used in determining the appropriate status and extent of DSEAR hazardous zones for site operations. Section 5 deals with significant findings from the risk assessment which are set out in the risk assessment tables, along with hazardous area classification and recommendations to mitigate fire and explosion hazards or support best practice on-site.

The scope of this assessment covers routine activities. Employers should undertake a risk assessment for non-routine activities which potentially increase the risk, such as process scale-up, maintenance, repair, modification, extension, restructuring, demolition or cleaning:

- **in areas where dangerous substances are present or liable to be present, including where they are used, stored or produced;**
- **on equipment that has contained a dangerous substance.**

Sections 6 and 7 report on emergency arrangements and information, training and instruction, respectively.

Assessor Details

Risk Assessor:	Joseph Isimite
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Contact Details:	Mobile : 07435 698445 Email : hsfenquiries@eeukgroup.co.uk
Accompanied by:	Kieran Miller
Date of Assessment:	7th October 2025

Acknowledgment of Report Content

On receipt of this DSEAR risk assessment, the report should be read in full by an individual who represents the client and who has sufficient knowledge of the premises to ensure that information documented is correct. This individual should sign the risk assessment on behalf of the client and work towards implementing the recommendations in appropriate timescales.

The document should not be considered to be complete and should not be relied upon until it is signed.

This DSEAR risk assessment is made without prejudice to any requirements made by HSE, Local Authority, Building Control, or the local Fire Authority.

Acknowledgement of Report Content

"I confirm that I act on behalf of the Responsible Person, have read this document in its entirety and, to the best of my knowledge, the information within the report is correct."

Signed on behalf of Responsible Person:

Dated:

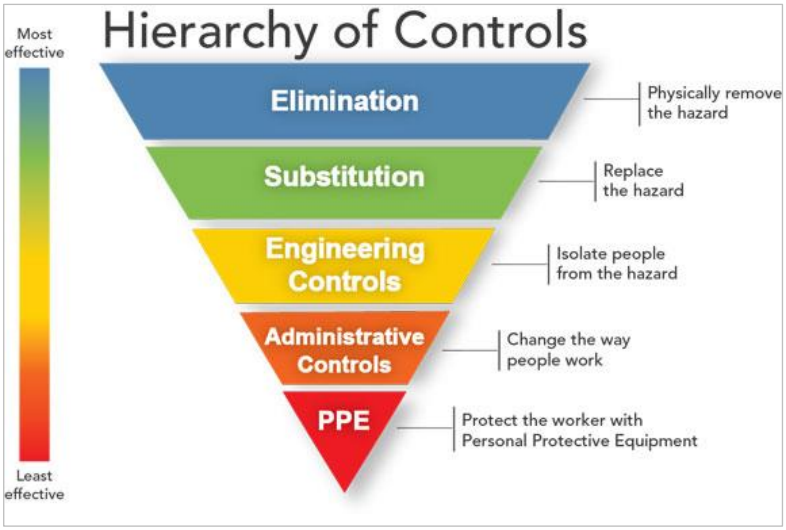
Print name:

Position:

3.0 Dangerous Substances and Explosive Atmospheres Regulations Overview

The Responsible Person must carry out a suitable and sufficient assessment of risk to relevant persons for dangerous substances that are on or may be on site and record the findings where 5 or more people are employed (Reg 5).

DSEAR imposes a duty to eliminate or reduce risks from fire, explosion or other events arising from hazardous properties of any substance used in connection with a work process (Reg 6). This is expressed in the hierarchy of controls diagram below.



Further duties under DSEAR requires employers to:

- **Classify places (zones) where there is potential for an explosive atmosphere (Reg 7);**
- **Ensure equipment & protective systems used in zones meet the "EPS" Regs (Reg 7(2);**
- **Provide equipment and procedures to deal with accidents and emergencies (Reg 8);**
- **Provide employees with suitable and sufficient, information, training and instruction on the precautions for safe use of dangerous substances (Reg 9);**
- **Clearly identify hazardous substances in containers and pipes (Reg 10); and a**
- **Duty of co-ordination (Reg 11)**

DSEAR assessment should supplement the fire risk assessment undertaken in line with requirements of the Regulatory Reform (Fire Safety) Order 2005. This report focuses on dangerous substances and any potential release sources associated with routine site operations while also evaluating whether existing control measures are sufficient to limit the likelihood of a fire and / or explosion incident. The report considers regulatory requirements and established HSE safety guidance.

Zoned areas require that attention is taken when carrying out tasks in these areas to prevent the formation of potentially explosive atmospheres, and that ignition hazards are controlled within the area. 'Ex' warning signs should be displayed at the entrances to places which are used exclusively for an activity involving a flammable substance e.g. flammable paint / solvent stores, spray booths, preparation/grinding areas, and because of their unique hazard, inspection pits or sumps.

Identification of hazardous areas is done in the form of the hazard warning sign shown below.

Explosive atmospheres

The definition in DSEAR sets out the criteria to determine whether an atmosphere is explosive within the scope of the DSEAR Regulations. The definition is particularly important in deciding when certain requirements in DSEAR will apply, particularly regulations 7 (Places where explosive atmospheres may occur) and 11 (Duty of co-ordination).

The following three points are consistent with the guidance on EPS, where 'explosive atmosphere' is similarly defined. This is relevant to Regulation 7 and the selection of equipment for use in explosive atmospheres. For the purposes of DSEAR the following elements must all be present for an explosive atmosphere which is subject to regulations 5(4)(c), (Zoning and equipment), 7 and 11 to form:

Atmospheric Conditions – for the purposes of standardisation, normal atmospheric conditions are defined as -20 °C to 40 °C, and 0.8 to 1.1 bar;

Mixtures of Air and Dangerous Substances – dangerous substances or mixtures of such substances, that are explosive with an oxidant other than air, for example pure oxygen or chlorine, are outside the scope of the definition of explosive atmosphere. The provisions of regulations 5(4)(c) 7 and 11 do not apply although other requirements in DSEAR may do;

Combustion – the definition of explosive atmosphere in Regulation 2 is intended to make clear that where it can be ensured that the gas or dust is present in a concentration below the lower explosive limit, the atmosphere is not explosive, and Regulations 5(4)(c), 7 and 11 do not apply. In this assessment the terms 'flammable limit' and 'explosive limit' (as used for example in 'lower flammable limit'), the words 'flammable' and 'explosive' are intended to have the same meaning and are interchangeable.

Plant Verification before first use

The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996 require that any explosion protection measures included in plant newly brought into use after 30 June 2003 should be verified by a competent person. This might include: checks of the design of vent panels; checks that electrical equipment actually installed is suitable where necessary for use in dusty areas; a review of the zoning diagram; and checks of earthing arrangements, measurements of air flows in extract ducts etc. The objective is to see that the plant is installed correctly and will perform to its intended design. This work may be done by someone working for the installer, user or an independent company.

As part of good risk management it is recommended that periodic plant verification is performed to confirm or challenge the existing suitability of plant and equipment. Robust management of change procedures must be in place in order to maintain a safe plant.

Risk Level Indicator

EEUK Group assesses safety risks by considering first the possible outcome and then the likelihood of it happening, taking account of existing controls that are in place. The following matrix indicates how this assessment is made.

Table 1 - DSEAR Risk tables

Severity								
	Multiple fatalities	5	0	5	10	15	20	25
	<5 fatalities	4	0	4	8	12	16	20
	Severe life-threatening injuries requiring immediate hospitalisation	3	0	3	6	9	12	15
	Severe non-life-threatening injuries requiring medical attention	2	0	2	4	6	8	10
	Minor injuries requiring first aid treatment	1	0	1	2	3	4	5
	No perceivable harm	0	0	0	0	0	0	0
	Frequency		Incredible	Remote	Unlikely	Occasional	Likely	Frequent
			0	1	2	3	4	5

The priority of action is as follows:

TOLERABLE	MEDIUM	HIGH
Minimal or no action required.	Action within one month or sooner.	Stop activity – Action required immediately.

Occasionally an assessor will suggest an improvement to comply with best practice. This is recorded as ADVISORY, to be addressed within 12 months.

4.0 Properties of Hazardous Materials

Properties of Hazardous Materials

The purpose of this section is to provide a summary of the dangerous substances produced / used on the site and considered in the context of this report. This analysis was done on the basis of the inventory of hazardous products used on site and any SDS data provided by the client or obtained from publicly available sources.

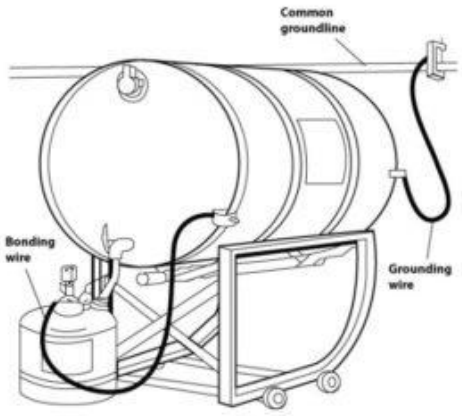
Based on survey observations, site operations routinely store, generate and use the following dangerous substances as defined under DSEAR Regulation 2. No combustible dust substances are in use at the vehicle repair workshop.

Static Electricity

Transferring materials through pipes and ducts is a well-known mechanism (triboelectric charging) for the generation of static charges. There are different types of static discharges which generate varying amounts of electrical charge. Reference to these types of discharges and their relevance can be found in PD CLC/TR 60079-32-1:2018 Explosive atmospheres. Electrostatic hazards, guidance [3].

A key function of equipment earthing is to provide a controlled method to prevent the build-up of static electricity, thus reducing the risk of electrical discharge in potentially hazardous environments. The likelihood of these charges occurring and the possibility of them igniting a flammable vapour or dust cloud of a particular material will depend on equipment construction and the properties of the vapour or dust present. The value of 10^6 Ω, is considered the upper limit for the resistance to earth of a conductor in all situations, and therefore important that all connections are reliable, permanent, and maintained in serviceable condition.

The process of bonding and grounding can be defined as providing an electrically conductive pathway between a dispensing container, a receiving container and an earth ground. This pathway helps eliminate the build-up of static electricity by allowing it to safely dissipate into the ground.



Explosion Pentagon

In order to have an explosion, there must be confinement of the flame propagating in the gas / dust-air mixture. Confinement is the final element making up the dust / gas explosion pentagon. With confinement of the propagating flame front, pressure will rise which may cause rupture of the enclosure.

It is important to note that complete confinement (e.g., four walls, floor, and a roof) is not necessary for dust / gas explosions to reach destructive pressures. Any confinement can lead to pressure rise, acceleration of the flame, or pressure piling, which can all increase the explosion violence.

Table 2 - Summary of Significant Flammable Liquids Characteristics

Name	CLP Classification	Location & Quantity Handled	Flash-point (°C)	AIT (°C)	Gas Group	Temp Class	Flammable Limits (%v/v in air)	Relative Vapour Density (air = 1)	Comment
Tetra Schutz Aerosol	Extremely flammable aerosol 	COSHH Cabinet Vehicle repair area inside workshop	No data	No data	IIA	T2	1.4 – 10.9 (LPG)	1.12	Contains hydrocarbons C9 – C12 and liquified petroleum gases (LPG) as propellant.
SAS Gloss Black Paint	Extremely flammable aerosol 	COSHH Cabinet Vehicle repair area inside workshop	<-40	365	IIA	T2	1.4 – 10.9 (LPG)	1.56	Contains acetone, xylene and liquified petroleum gases (LPG) as propellant.
Premier Ultra Engine Oil	Not Classified	Drums inside vehicle repair workshop	206	No data	No data	No data	No data	No data	Does not present an explosion hazard. A fire hazard is credible.

Table 3 - Summary of Combustible Gases Characteristics

Name	CLP Classification	Location & Quantity Handled	Flash-point (°C)	AIT (°C)	Gas Group	Temp Class	Flammable Limits (%v/v in air)	Relative Vapour Density (air = 1)	Comment
Acetylene (Ethyne)	H220 Extremely flammable gas 	Oxyacetylene welding trolley (acetylene & oxygen) inside vehicle repair workshop	Not Required	305	IIC	T2	2.3 - 100	0.9	Neutrally buoyant gas with wide flammability range. Store gas cylinders in a well-ventilated location
Liquified Propane Gas (LPG)	H220 Extremely flammable gas 	Outdoor wire mesh cage	Not Required	445	IIA	T2	1.7 – 10.9	1.5	Store gas cylinders in a well-ventilated location

Table 2 & 3 Definitions:

Flashpoint – The lowest temperature at which vapours above a volatile combustible substance ignite in air when exposed to flame.

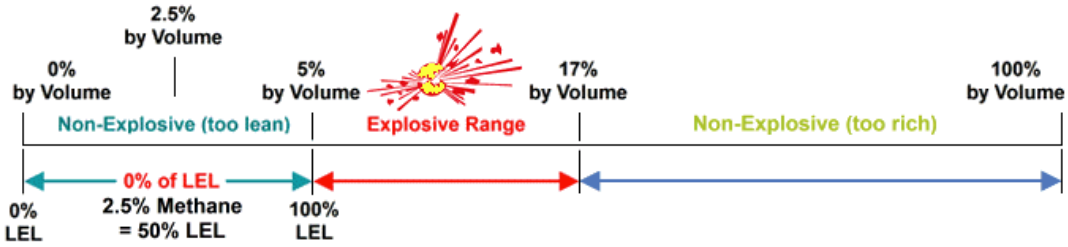
AIT – Auto Ignition Temperature; the lowest temperature at which it spontaneously ignites in normal atmosphere without an external source of ignition.

Gas Group – is the maximum spark energy of the equipment and relates to the minimum ignition energy of the hazardous material in the area where the equipment is installed.

Lower explosive limit (LEL) - The concentration of flammable gas, vapours, or mist in air, below which an explosive gas atmosphere will not be formed.

Upper explosive limit (UEL) - The concentration of flammable gas, vapours, or mist in air, above which an explosive gas atmosphere will not be formed.

As an example: Methane – LEL: 5% by volume in Air / UEL: 17% by volume in Air



Pictorial example to show where on the flammability range % of LEL is measured.

5.0 Risk Assessment & Hazardous Area Classification

Process	**5.1 Vehicle Repair Workshops**
Location	**Crewe**
Dangerous substances in use / released	**500ml Aerosol spray cans, Acetylene, LPG**

5.1.1 Process description

Three purpose-built workshops of metallic construction each measuring approx. 15m x 10m x 9m (L x W x H) are used for truck and trailer repairs. The workshops are located to the South of a large A0 distribution warehouse, with ample space for vehicle manoeuvres and repairs. Approximately 5 workers were seen during the site survey. Two shipping containers are located between two of the workshops – one on top of the other: the lower container is used as an office space while the upper container is used for storage of vehicle parts and other consumables. A typical workshop is shown in Figure 1.

Figure 1 - External and Interior views of CSC Fleet Services Crewe Workshop

Aerosols, Lubricants and Paints

500ml aerosol cans are stored inside a metal cabinet (COSHH cabinet) located in one of the workshops. Only 4 aerosol cans were seen inside the metal cabinet and one of the cabinets doors was missing (Figure 2). Used aerosol cans, greases, lubricants and paints used for vehicle maintenance were seen on top of a shelf inside the workshop. Both used and new engine oil for vehicle maintenance were stored in metal drums which were placed on top of a plastic bund. A hand-pump is used to dispense mineral oil into open buckets during maintenance activities.

HSE publication INDG 473 [4] defines SMART[1] spraying as the spray application of a surface coating to parts of motor vehicles as part of a repair job. The parts coated normally do not extend to a complete panel or panels. This is typical of the spraying activities that take place at the vehicle repair workshop.

Spraying by hand from pre-packaged aerosol spray can is comparable to spraying from a mini-spray gun or airbrush, normally having an inlet pressure up to 2 bar, delivering a volume of air much less than 150 l/min and a fluid flow well below 100 g/min. It is noted that the quantity of paint sprayed is unlikely to exceed 25 ml per coat and the time spent spraying paint is unlikely to exceed 1 minute per coat, although the spray job may take a few minutes [4].

LPG

A metal cage containing 3 LPG cylinders is located in an outdoor area between two of the workshop buildings (Figure 2). The metal cage was securely locked with a padlock. No chains were used to restrain the cylinders inside the cage to prevent toppling. It was stated that no vehicle movement is allowed in the vicinity of the LPG cage, although no barriers are installed to enforce this. Hand Pallet Trucks (manual and battery powered ones) are used to move materials around the workshops.

Welding Gas Bottles

Welding trolleys containing twin acetylene and oxygen cylinders are used inside the workshops for vehicle repairs (Figure 2). The cylinders were firmly secured to the trolleys using chains. Welding hoses are connected to the trolleys via one-way valves. The hoses appeared to be in poor condition, and it was stated that an AO inspection had recommended that the hoses be replaced immediately. Two new replacement hoses were visible awaiting connection after disconnection of the damaged hoses.

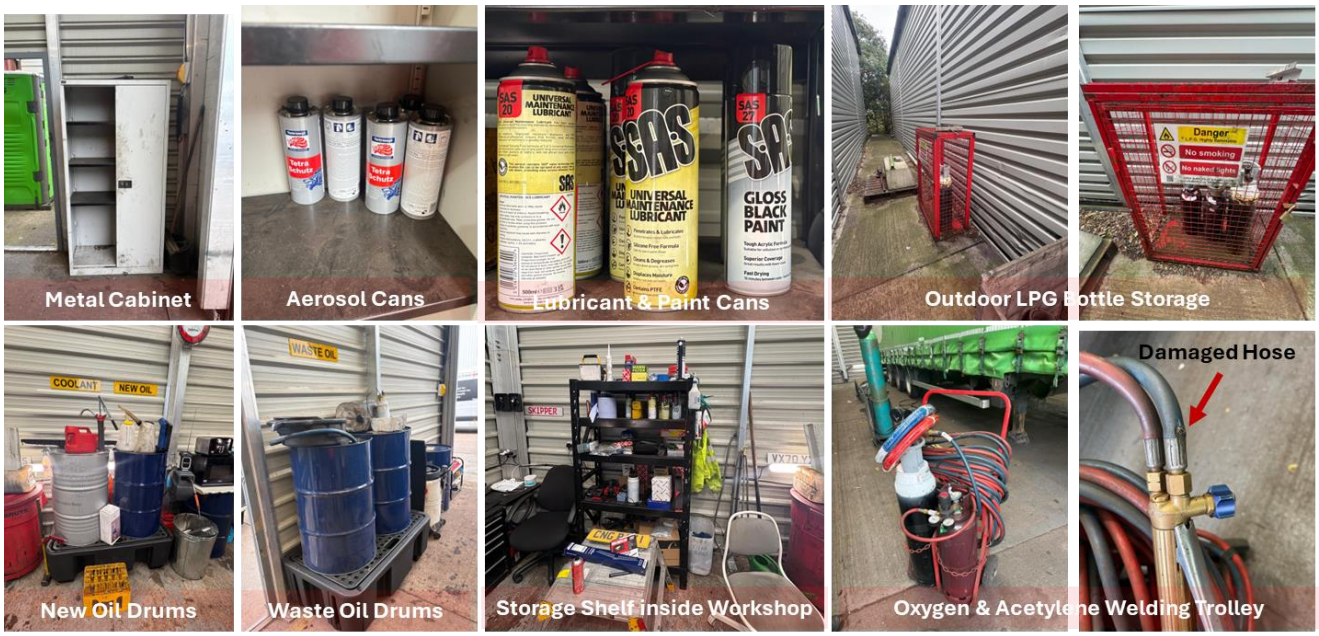


Figure 2 – Range of flammable substances in use at the vehicle repair workshop

Workshop Parts Cleaning Tank

A 50L Sealey Workshop Parts Cleaning Station is used in the workshops (Figure 3). The tank is of steel construction, and is fitted with a fully sealed, magnetic drive pump unit. Cleaning fluid is recirculated through a replaceable filter element and directed onto the workpiece to be cleaned through a flexible metal delivery nozzle. The tank lid is fitted with a fusible link hinge which automatically snaps the lid shut in the event of a fire.

There were clear safety instructions on the tank that only water-based solvents and NOT flammable solvents should be used for cleaning. It was observed during the site survey that the tank was partially filled with a water-based cleaning fluid (degreaser) - Jizer Rinseable Parts Degreasers. The Safety Datasheet for the degreaser showed that it is not flammable.

Forklift Batteries and Battery Charging

Triton EPT15H lithium battery powered pallet trucks are used for moving heavy items around the workshop (Figure 4). The pallet trucks are used to move loads weighing up to 2tons around the workshops at traveling speeds of 4.5km/h (unladen) and 4km/h (laden). The pallet trucks are fitted with maintenance-free lithium-ion batteries which do not need to be topped up with water (non-vented batteries).

The OEM technical specification for the pallet trucks describes the batteries as safe and reliable, with no potential for fires or explosions. The pallet trucks are designed to comply with IEC and UL global standard certification requirements, ensuring maximum safety during use and handling. The lithium-ion batteries have a long service life. They use soft package battery technology, with a built-in protection board and other multiple protections to eliminate overcharge and overdischarge. Battery charging takes place inside the office by plugging them into standard electrical sockets (Figure 3).

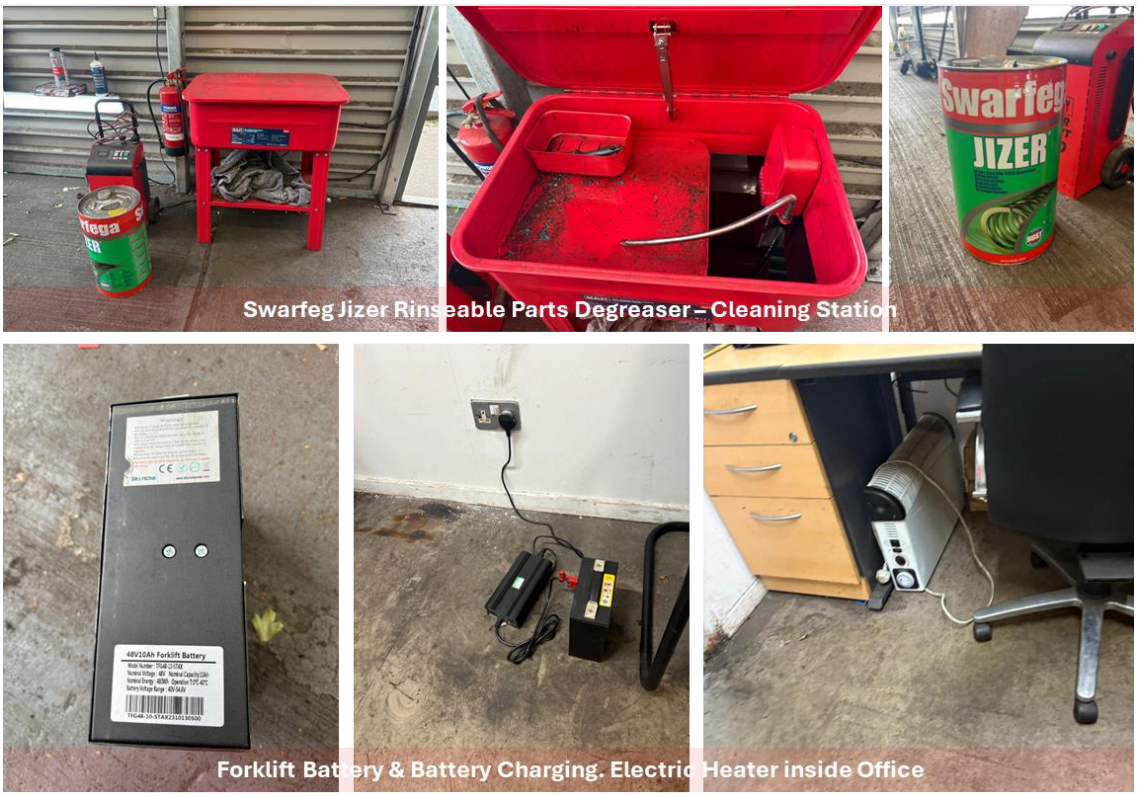


Figure 3 - Cleaning Station and Forklift Battery Charging

Figure 4 - Battery-powered pallet truck

5.1.2 Flammable atmosphere

Comments on sources of release:

Metal Storage Cabinet

Inside the metal storage cabinet in the vehicle repair workshop, there will be no escape of flammable substances in sealed aerosol containers under normal circumstances. Only infrequent releases due to seepages or accidental breakages of container seals may occur. This is classed as a Secondary Grade Release. In line with guidance in HSG 51 [5], the whole of the inside of the cabinet is classified as a Zone 2 area.

Aerosol and Paint Spraying

Hand spraying is used in the vehicle repair workshop to apply paints and coatings from 500ml aerosol cans. The Safety Data Sheet for the aerosols and paints shows that they contain flammable liquids which, when sprayed, may create a flammable atmosphere leading to the risk of fire or explosion.

During spraying, liquid is converted into a mist of droplets which is directed onto a surface to produce an evenly distributed film of the required thickness and texture. Not all the liquid sprayed is deposited on the workpiece. Over 50% may be lost as overspray or bounce-back. These vapours may hit other surfaces - walls, floors and clothing - leaving flammable deposits. Even when these deposits are dry, they may still be flammable. Furthermore, flammable vapours are also released during the drying process. However, the small quantities of aerosols sprayed per application means that releases of flammable solvents during drying will be negligible.

BS EN 16985:2018 [6] states that the entire enclosure of a typical spray booth (fitted with mechanical extract ventilation) is classified as Zone 2 if the following conditions are met:

- The average concentration of flammable solvents (in air) in the spray booth as a percentage of LEL is < 25 % in the internal volume of the spray booth.
- The average concentration of flammable solvents (in air) in the spray booth as a percentage of LEL is < 10 % in the internal volume of exhaust air cleaning system.

The vehicle repair workshop is not classified as a spray both or a spray room as defined in HSG 276 [7]. Only SMART spraying takes place inside the workshop. Ref xx provides a methodology that can be used to determine whether or not the ventilation rate within the workshop enclosure is sufficient to prevent the presence and persistence of a flammable atmosphere during spray application. The method is outlined in Annex C of BS EN 16985 and has been used to calculate the maximum concentration of flammable mist and vapour during spray coat application with natural ventilation available inside the workshop. The results are summarised in Table 5.

Table 4 - Estimation of the conc. of flammable solvent in the Workshop during spray painting

Parameter Description [unit]	Value	Comment
Length of Workshop, l [m]	15	Measured value
Width of Workshop, w [m]	10	Measured value
Average airflow velocity [m/s]	0.022	Average lowest monthly wind speed in Crewe is reported as 12.1km/h = 3.36m/s (https://www.weather-atlas.com/en/united-kingdom/crewe-climate). Wind speed inside workshop is calculated as average wind speed / area of workshop (L x W).
Max mass input of flammable liquid coating material sprayed per hour	6000	HSE INDG 473 states that pre-packaged aerosol spray can are similar to mini-spray guns normally having an inlet pressure up to 2 bar, delivering a volume of air much less than 150 l/min and a fluid flow well below 100 g/min. 100g/min is taken as conservative maximum.
Lower Explosive Limit of Solvent Mixture	40	40 g/m3 used as per BS EN 16985:2018
Mass percentage of flammable solvents content in the liquid coating material at spraying conditions	0.9	Assume 90% of paint is flammable solvent
Estimated percentage of flammable solvents evaporated inside the spray booth	0.8	As per BE EN 16985:2018
Inhomogeneity factor - range of 1 - 5 advised	3	As per BE EN 16985:2019

Minimum fresh air volume flow required	11880	Calculated value using Equation C.3 in BS EN 16985:2018
Average conc. of flammable solvent in the spray booth	1.09	Calculated value using Equation C.2 in BS EN 16985:2019
Average conc. of flammable solvent in the spray booth as a percentage of LEL	2.73%	Calculated value using Equation C.1 in BS EN 16985:2020

The calculated maximum concentration of flammable vapour (using an overly pessimistic approach) in the workshop during spray painting is calculated to be significantly below the 25% LEL value which is the upper limit for a Zone 2 hazardous area classification or a spray booth.

The ventilation characteristics of the Workshops can be summarised as follows:

Type: Natural
Dilution: Medium
Availability: Fair
Location: Indoors

Section C.3.2 of BS EN IEC 60079-10-1:2021 [8] discusses the effectiveness of ventilation for the purpose of hazardous area classification: this refers to the quantity of air relative to the type, release location and release rate of the flammable substance. The higher the amount of ventilation in respect of the possible release rates, the smaller will be the extent of the zones (hazardous areas) and shorter the persistence time of explosive gas atmosphere. With a sufficiently high effectiveness of ventilation for a given release rate, the extent of the hazardous area may be so reduced to be of negligible extent (NE) and be considered a non-hazardous area.

Therefore, given the relatively short duration of spray painting per coating application, and the reasonable level of dilution and natural ventilation present inside the Workshop, the entire workshop is classified as non-hazardous for DSEAR purposes, with a Zone 2NE classification assigned to the area around a vehicle which is being spray painted.

Ref [8] defines Zone 2NE as an area in which an explosive atmosphere consisting of a mixture of air with gas, vapour or mist is not likely to occur in normal operation, but if it does occur, will exist for a short period only before detection and repair and would be of negligible extent. The resultant ignition if it did occur would be such that it would be unlikely to injure persons or damage buildings. Further explanation about Zone 2NE classification is provided in Appendix **Error! Reference source not found.** of this report.

LPG and Acetylene Bottles

BS EN 1127-1:2019 [9] states that gas cylinders properly stored and handled and provided with a closed valve, a cap on the connection hole and valve protection can be regarded as having enhanced tightness. Equipment with enhanced tightness are those from which a flammable substance is not expected to be released into the atmosphere or, if it is released, will not cause any hazardous area. The fittings on the LPG cylinders stored in the outdoor cage were observed to be of varying age and design, and it is credible that leaks may occur at some stage as part of "expected abnormal operation". This would be considered a Secondary Grade of Release.

Such secondary grade releases could result in a potentially flammable atmosphere being present in the area. Ref [10] notes that outdoor gas stores which are appropriately designed, constructed, and managed, for example, they are not enclosed on more than one side and do not have a roof, generally do not require a hazardous area zone designation for the following reasons:

- natural ventilation will disperse any gas release
- the 'open' nature prevents an accumulation of gas
- any leak will only create a small flammable zone around the individual cylinder which is of negligible extent
- the probability of more than one cylinder leaking simultaneously is negligible
- the extent of the released volume is limited to the volume of gas in the leaking cylinder.

The outdoor LPG bottle storage location observed at the Workshop satisfied the above requirements at the time of the site visit. Furthermore, there are no connections on the gas bottles that could introduce leak paths and further increase the likelihood of leaks. Therefore, the outdoor area around the LPG bottle storage cage is classified as Non Hazardous. A Zone 2NE area is assigned to the area around the bottle caps.

Battery charging area

Par 6 of INDG 139 [11] notes that alkaline rechargeable batteries such as nickel-cadmium, nickel-metal hydride and lithium ion, are widely used in small items such as laptop computers, with large-capacity versions of these cells now used in transport (such as the ones used in the pallet trucks at CSC Fleet Services ltd). It is noted that there are two different types of lead/acid and alkaline rechargeable batteries: valve-regulated ('maintenance-free') and vented batteries. In valve-regulated batteries, any hydrogen and oxygen produced during charging does not escape but is converted back into water. It is not possible to add water to these batteries, as they do not need topping up. The pallet truck batteries in use at CSC Fleet Services Crewe Workshop are the valve-regulated ones which do not give off hydrogen during charging.

The likelihood of flammable hydrogen release whilst charging the Triton EPT15H lithium batteries inside the office space is judged to be negligible. Therefore, no hazardous area is present around the battery charging area no further investigation made. Process is non-hazardous hence no zones assigned for this process.

Workshop Parts Cleaning Tank

No flammable substance is used in the cleaning tank. Therefore, the area around the cleaning tank is classified as Non Hazardous hence no zones assigned for this process.

5.1.3 Ignition Sources

EN 1127-1 clause 5 gives 13 potential ignition sources to be considered in potentially explosive atmospheres. Of the 13 ignition sources to be considered, the potential ignition sources present most frequently in industry and applicable to the activities on site are naked flames, hot surfaces, unsuitable or malfunctioning electrical equipment, electrostatic discharges, and mechanical sparking.

Naked Flames

Smoking on site should be limited to designated areas, which should not be located within close proximity to operations containing hazardous areas. Smoking areas do not coincide with the areas under assessment and therefore no formal recommendation is made. Naked flames should be controlled as an ignition source by the appropriate implementation of hot work permits and safe systems of work and are not considered further.

The presence of only Zone 2NE areas in the vehicle repair workshop at CSC Fleet Services Ltd Crewe means that the explosion risk is judged to be negligible. INDG 473 [4] notes that whilst there is a credible fire risk at the vehicle repair workshop, the small quantities of aerosol products used in vehicle spraying means that any fire risk is only likely to be within 15 cm of the spray can's nozzle. An initial small fire in the workshop could easily escalate to other combustible materials such as engine oil stored around the workshop in appreciable quantities. Therefore, it is necessary to control ignition sources inside and around the workshops.

The below table considers each type of potential ignition sources that could be present in locations where there are flammable atmospheres.

Potential Ignition Source from EN1127-1	Examples of potential ignition sources
Hot surfaces	Electric Heaters, Vehicle Engines
Mechanically generated impact, friction and abrasion	Grinders
Malfunctioning electrical equipment and components	Electric Heaters, Light bulbs, Portable Electrical items
Static electricity	Ungrounded personnel

While there is no requirement to use ATEX-rated electrical equipment in the workshop, faulty electrical apparatus can generate a spark or arc with sufficient energy to ignite the flammable vapours / mists produced during spraying operations. For this reason, electrical equipment such as heaters should be kept away from areas where spray application is taking place.

In all cases, the light fittings inside the garage are installed behind a clear transparent barrier. Lighting inside or above any area where flammable hazards may be present should be sealed so that it meets at least, IP54 specification. BS EN 13355 [12] states that lighting devices fitted behind impact resistant panels which are sealed to the workshop structure in a manner that achieves IP54, or greater (i.e., flammable vapours cannot ingress into the

light fitment) can be considered outside of the Hazardous Area. Any other electrical items not necessary for the spray paint operations, including mobile phones and other handheld devices, may become a source of ignition in certain circumstances. For this reason, such items should be prohibited from being used where spray application is taking place. Electrical equipment such as junction boxes in the vehicle repair workshop do not need to be ATEX-certified as the entire workshop is classified as Non-Hazardous.

Frictional sparks could be generated from sanding operations which take place in a dedicated area inside one of the 3 workshops on site. During the site visit, it was stated that a minor fire was once started at the workshop because a technician did not follow housekeeping rules to ensure that sanding offcuts are adequately cleared from the sanding area. It is not possible to reliably discount mechanical sparks as a potential source of ignition for combustible materials inside the workshop. Careful attention should be paid to the use of hand torches and handlamps to ensure that they are of appropriate construction and are not used near areas where spray application is taking place.

Frictional sparks become pronounced during the sanding or hogging of metal off cuts containing metals. Any combustible materials in the vicinity of the sanding operation (such as cardboard) can smoulder and subsequently be fanned into fires. Fire extinguishers are available on site to fight small fires that arise during sanding operations.

The floor covering inside the workshop was found to be metallic (steel construction) and should therefore be static dissipative. Whilst the risk of a persistent flammable atmosphere developing during spray coating application is low, it is good practice for technicians to wear static dissipative footwear and gloves when working in areas where a flammable atmosphere could be present.

Portable electrical equipment such as handlamps/headlamps, electric drills, portable grinders and similar equipment used in the workshop could become effective ignition sources if not properly handled and maintained. The safety of portable electrical equipment depends on the continued integrity of the earthing, and correct connections of the fixed electrical installation (this includes the wiring, fuse box/consumer unit, and switches up to and including the socket supplying the equipment). Trailing cables on the ground can be damaged by vehicles and other equipment, and they could then become prone to sparking which could ignite flammable vapours.

The maintenance of portable electrical equipment involves straightforward inexpensive practices such as user checks, formal visual inspection and testing which must be carried out by a competent person. HSE publication PM38 [13] notes that electrical equipment may prove dangerous if permitted to deteriorate, and that handlamps and other portable electrical equipment used in the workshop should be subjected to regular routine inspection and maintenance.

The hard use which portable equipment receives in a vehicle repair environment, coupled with the fact that this equipment, being handheld, is more likely to inflict serious or fatal injury if it becomes faulty (in addition to the risk of igniting a flammable atmosphere through sparking), demands that such inspection and maintenance should be carried out frequently and stringently. While there is no legal requirement to keep maintenance records of each inspection and test on file, a suitable record is useful as a management tool for monitoring and reviewing the effectiveness of the maintenance.

As several potential ignition sources may exist within workshop in conjunction with a potential flammable atmosphere (albeit of negligible extent), a Basis of Safety must be specified, this is identified after the discussion below, on Risk Control Measures.

5.1.4 Risk Control Measures

Comments on risk controls:

Comments on risk controls:

The small quantities of flammable aerosols used in the vehicle repair workshop means that the risk of an explosion is low. There is however a significant fire risk because of the potential for a smouldering fire to escalate and engulf combustible substances (such as engine oil) inside the workshop. It was observed during the site visit that up to 5 technicians could be working in the workshop at any one time. Therefore, a fire could result in one or more serious injuries if it is not quickly brought under control.

DSEAR sets out how to eliminate or reduce risk to people's safety from the presence of dangerous substances by removing or controlling risks, and by providing measures to limit or mitigate the consequences for people, should an incident occur. The primary safeguard against fire and explosion is the prevention of a flammable atmosphere inside

the workshop. This is inherently achieved by the small quantity of flammable aerosols used in spray painting (500ml spray cans) and supported by adequate ventilation to ensure that the concentration of released flammable substances during spray painting is significantly less than 5% LEL.

Fire resistance of flammable liquids storage cabinets

500ml aerosol cans are stored in a metal cabinet inside the workshop. Where work activities require the convenient availability of flammable liquids and/or flammable liquid-based products, a limited quantity in sealed containers may be stored in suitable cabinets or bins of fire-resisting construction that are designed to retain spills (Ref HSG 51). The capacity of the cabinet should be 110% of the volume of the largest container normally stored in it. Storage cabinets should be kept in designated well-ventilated areas that are away from any processing activities and must not jeopardise the means of escape from buildings [5].

HSG 51 [5] stipulates the recommended maximum quantities that may be stored in cabinets and bins as follows:

- no more than 50 litres for extremely, highly flammable and those flammable liquids with a flashpoint below the maximum ambient temperature of the workroom/working area, and
- no more than 250 litres for other flammable liquids with a higher flashpoint of up to 60 °C.

The quantities of flammable aerosols and paints stored in the workshop metal cabinet was significantly below the above thresholds. It is foreseeable that increased workloads may require larger quantities of flammable aerosols and paints to be stored inside the workshop. It should be ensured that the maximum quantities of flammable aerosols and paints is always less than 50L as recommended in guidance.

Ref [5] further states that the construction of the storage cabinet should be sufficiently robust that its integrity/fire resistance should not be compromised by foreseeable impacts. The materials that cabinets are constructed from, including surface treatments, should be suitably resilient to ensure where contact with the flammable aerosols may occur, its effectiveness to provide safe storage is not compromised. During the site visit, it was observed that one of the doors of the flammable aerosol storage cabinet was missing, meaning that the fire integrity of the cabinet was significantly compromised.

The fire resistance requirement for storage cabinets is defined in Paragraph 272 of the DSEAR ACOP [2]: "Every side, top, floor, door and lid of cabinets that are required to be of fire-resisting construction should provide a minimum of 30-minutes' fire resistance in respect of integrity". This means limiting the passage of fire and hot gas from the cabinet for at least 30-minutes to allow sufficient time for safe evacuation and for the implementation of immediate emergency procedures. CSC Fleet Services Ltd should either immediately repair the storage cabinet to restore the fire integrity of the cabinet or replace the cabinet with one of appropriate construction and integrity.

It is good practice to keep accurate records of the contents in the storage cabinet, as this will provide a ready means to check that the maximum storage quantities are not exceeded. This would also allow the company to keep a log of material usages and assist in stock management. It is recommended that regular audits of flammable aerosols and paints kept in the workshop should be completed, and flammable substances that are rarely used should be removed to a dedicated store outside the workshops or safely disposed.

In addition to the metal cabinet used to store flammable aerosols, other solvents, paints, varnishes, engine oil and other flammable or combustible liquids used in the workshop must be stored and handled safely. It is good practice to have a designated storage space or room that is separate from the workshop where workers are always present. During the site visit, it was stated that a locked shipping container is used for storage. Appropriate segregation must be implemented inside the storage container to ensure that flammable and combustible materials are not stored with non-compatible materials. Flammable substances should only be stored in an enclosure with adequate ventilation.

Fire prevention inside the workshop

During the site visit, it was noticed that clean rags are stored in a plastic container near the storage work shelf inside the workshop. No container for the safe storage and disposal of contaminated rags was seen.

Figure 5 - Clean rags stored in a plastic container

The safe disposal of cleaning materials and clothing contaminated with flammable solvents is important to prevent fires. Approved waste containers should be provided in the workshop for the disposal of rags or waste impregnated with sprayed material. Any contaminated materials should be deposited in the approved bins immediately after use. It should be ensured that cleaning rags and clothing contaminated with sprayed material is not left in the workshop unless kept in metal lockers or drums with a secure closing lid. This is because many fires have originated from the spontaneous ignition of fabric and waste impregnated with coating materials.

Effective cleaning is another precaution against the initiation and spread of fires in spray application areas. The interior of the workshop, especially around areas where spray application takes place, should be cleaned regularly to avoid the accumulation of residues or overspray. A good level of housekeeping was seen during the site was visit. CSC Fleet Services Ltd. should ensure that the interior of the workshops is checked regularly, and accumulations of overspray and dirt should be removed as required to prevent fire initiation and spread.

Safeguards for flammable gas cylinders

Par 306 of HSG 261 [14] notes that gas cylinders present a number of hazards, including fire and explosion hazards such as blast of a gas cylinder explosion or rapid release of compressed gas, contact with released gas or fluid, and fire resulting from the escape of flammable gases or fluids (such as LPG).

During the site visit, it was observed that full and empty LPG cylinders are stored in a safe, well-ventilated outdoor location, away from bulk oil storage drums or anything similar. Furthermore, the welding trolley is used inside the workshop where there may be limited levels of natural ventilation.

It is good practice not to leave charged hoses connected to welding gas bottles for extended periods. This could lead to gradual weakening of the hose's integrity which would make it more prone to accidental leaks that eventually accumulate in a poorly ventilated environment and create a flammable atmosphere. Furthermore, it is good practice to protect cylinders from damage, for example by chaining unstable cylinders in racks, and providing suitable trolleys with restraining chains for moving oxyacetylene sets. The cylinders seen in the oxyacetylene welding trolley whilst on site were adequately restrained to prevent them from toppling over. However, the propane cylinders seen in the outdoor cage were not restrained.

Whilst the risk of toppling over is minimal as the propane cylinders are located in an area where vehicular movement is unlikely, the use of pallet trucks in this area cannot be precluded. It is recommended that the propane gas bottles in the outdoor storage cage should be restrained with chains to minimise the risk of toppling following accidental impact. HSG 261 further recommends changing cylinders for the welding trolley away from sources of ignition in a well-ventilated place. This should ideally be near the workshop entrance or entirely outdoors.

It is necessary to minimise the potential for gas leaks by using the correct hoses, clamps, couplers and regulators for the acetylene and oxygen gas bottles used for welding. During the site visit, significant wear and tear was observed on the hoses connected to a welding cylinder pair (oxygen and acetylene). The loss of integrity had been identified by AO's inspection team, and replacement hoses had been procured ready for installation. While it is commendable that AO's inspection team identified the compromised hoses before a dangerous leak occurred, CSC Fleet Services welding technicians should be trained to a good level of competence so that they can identify damaged hoses, recognise the potential for accidental leakages which can lead to fires and explosions, and take effective remedial action to replace the hoses before they fail.

The following routine checks and practices for compressed gas bottles should be implemented by CSC Fleet Services Ltd: damaged hoses must never be repaired with tape; hoses must never be left unprotected where they may be damaged (e.g. by moving pallet trucks or vehicles; ensure the welding equipment is checked by a competent person before each use; Inspect gauges and replace any defective gauge or broken glasses. Where equipment or instrumentation is deemed unserviceable, make sure it is withdrawn and clearly identified as not for use; never apply grease, oil or other lubricants to oxygen fittings; decommission properly at the end of each day's work – turn off cylinder valves, vent the lines, and then turn off the valves at the blowpipe; only allow trained, competent people to use welding equipment and carry out welding activities in the workshop.

To minimise the risk of welding flame 'flashback' into hoses or cylinders, welding technicians should be trained in correct lighting-up and working procedures. Additionally, flashback arresters should be fitted onto the regulators, on both the fuel and oxygen supply. Arresters may be fitted on the blowpipe, but these do not give protection from a fire starting in the hose. For long lengths of hose, arresters should be fitted on both the blowpipe and the regulator.

Portable electrical equipment safety

HSE Guidance Note PM38 [13] notes that paint spraying areas and places where spilt LPG or Compressed Natural Gas (CNG) could accumulate (e.g. pits, drains or sumps) are areas where potentially explosive atmospheres could be present. At the time of the site visit, the workshop was preparing to start repairing CNG vehicles. No petrol vehicles are repaired or maintained at the workshop. Special precautions must be taken if flammable fuels are handled in the workshop, such as tank draining or refilling. Portable electrical equipment such as ordinary headlamps could pose an ignition risk under such circumstances. Handlamps suitable for use in environments where flammable fuels are handled are available and are specifically constructed for this purpose. The use of low voltage, e.g. 12 volts, does not give protection against the risk of fires and explosions in potentially explosive atmospheres, unless the handlamp has been constructed in accordance with a suitable method of explosion protection.

For the conditions seen at the time of this assessment (spraying activities from 500ml aerosol or paint cans giving rise to a Zone 2NE environment and no handling of flammable fuels), battery-operated LED or halogen hand/head lamps which provide low-voltage alternatives to traditional corded lamps are suitable for use in the workshops. Such lamps provide the additional benefit of having no trailing cables, making them easier to use and manage.

It is recommended in guidance [14] that where mains-supplied lamps are required they should either be: 'all insulated'/'double insulated', the bulb protected by a robust cage of insulating material or a transparent insulating enclosure; or supplied by reduced voltages such as 110 volts (centre tapped to earth) and separated extra-low voltage (SELV), which does not exceed 50 volts ac supplied from a double wound transformer giving electrical separation mains input power or 120 volts dc (ripple-free). SELV bulb filaments are heavier and more robust than normal types and are more suited to rough usage.

Battery charging – fire risk

The British Safety Council [15] notes that lithium-ion batteries are increasingly linked to serious fires in workplaces. While lithium-ion battery failures are relatively rare, in the event of a malfunction, they can represent a serious fire risk. They are safe products and meet stringent EN standards. However, when charged, Li-ion cells store a large amount of energy and are especially sensitive to high temperatures and damage, such as penetration and crushing. During the site visit, it was observed that an electric heater was plugged in and located next to a battery being charged. If the heater is placed too close to the battery, overheating may occur.

If a battery degrades, gets hot, or suffers a short circuit, heat and pressure build up inside. Warning signs that a battery is likely to fail include bulging or swelling, sometimes accompanied by other signs such as discharging too fast and/or the battery being hot to the touch. At a certain level, the chemical reaction creates a thermal runaway, causing rapid overheating. the battery will spontaneously ignite, burning at extremely high temperatures of between 700°C and 1000 °C, and releasing dangerous off gases that can become a flammable vapour cloud explosion (VCE) inside the container office space on site.

The Regulatory Reform (Fire Safety) Order 2005 [16] requires that a fire risk assessment (FRA) is produced for the vehicle repair workshop. CSC Fleet Services should ensure that their FRA considers the fire risk presented by rechargeable batteries and other combustible substances stored and used/or in the workshop.

The following precautions should be adhered to when handling rechargeable batteries in the workshop.

- Only use equipment and chargers supplied by reputable manufacturers
- Make frequent inspections of batteries for signs of damage
- Never use damaged or defective batteries

- Ensure battery handling and storage areas are dry, cool, well-ventilated, and free from high levels of humidity
- Ensure battery handling and storage areas are free from flammable or combustible materials and sharp objects, and that batteries are not left in contact with conductive materials
- Ensure battery charging is well managed by trained staff, making sure that batteries are removed from chargers after charging is complete, electric heaters are removed from the vicinity of batteries being charged, and that batteries are not left on charge for long periods.
- Keep batteries not in use in appropriate containers, such as a proprietary metal battery storage cabinet or fireproof safety bags

Other Health and Safety Precautions

Whilst the following are not the focus of this assessment, protecting the health and safety of employees and visitors to the workshop is a legal requirement.

Injuries to personnel can happen due to impact from falling cylinders or from manual handling activities. Furthermore, the use of respiratory protective equipment (RPE) by personnel during spray application and whilst working with other hazardous substances provides an effective safeguard against health hazards, if used correctly. During the site visit, it was observed that appropriate masks are provided for use when handling hazardous substances. However, it was stated that the use of masks was optional and was down to individual preferences.

CSC Fleet Services should provide training, instruction, and information on the use of respiratory protective equipment when handling hazardous substances to drive compliance with health and safety regulations. The company should ensure that Health and Safety advice is obtained from a competent person to ensure compliance with UK Health and Safety Legislation.

5.1.5 Basis of Safety

The following basis of safety has been identified / required for this unit operation:

Process area /Equipment	Primary Basis of Safety	Secondary Basis of Safety
Metal Storage Cabinet (500ml aerosol and paint cans)	Avoidance of a flammable atmosphere inside cabinet enclosure (sealed aerosol containers)	Control of ignition sources
Aerosol and Paint Spraying	Avoidance of a flammable atmosphere due to limited quantities of sprayed materials and available natural ventilation	Control of ignition sources
LPG and Acetylene Bottles	Avoidance of a flammable atmosphere through abundant natural ventilation	Control of ignition sources

5.1.6 Hazardous Area Classification

No.	Extent of zoning	Images (Locations and conditions identified)	Justification	Zone	Min EPL
1	Entire cabinet enclosure	Metal Storage Cabinet (500ml aerosol and paint cans)	To account for accidental spillages from damaged aerosol can seals	2	Gc
2	Around vehicles being spray painted	Aerosol and Paint Spraying area	Smaller quantity is sprayed which mostly disperse in atmosphere.	2 NE	--
3	LPG and Acetylene Bottles	Outdoor LPG and acetylene bottle storage	Any seepages from capped bottles will be quickly dispersed by abundant natural ventilation	2 NE	--

5.1.7 Risk Assessment

Who may be harmed	Operatives or persons in the immediate vicinity		
How might they be harmed	Ignition of flammable aerosols or solvents leading to flash fire which may spread to other combustible substances in the workshop		
DSEAR Risk rating			
Severity:	Severe non-life-threatening injuries requiring medical attention	**Likelihood:**	Unlikely
Risk rating:	Tolerable		

5.1.8 Recommendations

R1	The quantities of flammable aerosols and paints stored in the workshop metal cabinet was significantly below the recommended thresholds. It is foreseeable that increased workloads may require larger quantities of flammable aerosols and paints to be stored inside the workshop. It should be ensured that the maximum quantities of flammable aerosols and paints is always less than 50L as recommended in guidance.
R2	During the site visit, it was observed that one of the doors of the flammable aerosol storage cabinet was missing, meaning that the fire integrity of the cabinet was significantly compromised. CSC Fleet Services Ltd should either immediately repair the storage cabinet to restore the fire integrity of the cabinet or replace the cabinet with one of appropriate construction and integrity.
R3	It is recommended that regular audits of flammable aerosols and paints kept in the workshop should be completed, and flammable substances that are rarely used should be removed to a dedicated store outside the workshops or safely disposed.
R4	During the site visit, it was stated that a locked shipping container is used for storage. Appropriate segregation must be implemented inside the storage container to ensure that flammable and combustible materials are not stored with non-compatible materials. Flammable substances should only be stored in an enclosure with adequate ventilation.
R5	During the site visit, it was noticed that clean rags are stored in a plastic container near the storage work shelf inside the workshop. No container for the safe disposal of contaminated rags was seen. It should be ensured that cleaning rags and clothing contaminated with sprayed material is not left in the workshop unless kept in metal lockers or drums with a secure closing lid. This is because many fires have originated from the spontaneous ignition of fabric and waste impregnated with coating materials.

R6	Effective cleaning is an important precaution against the initiation and spread of fires in spray application areas. CSC Fleet Services Ltd. should ensure that the interior of the workshops is checked regularly, and accumulations of overspray and dirt should be removed as required to prevent fire initiation and spread.
R7	Whilst the risk of toppling over is minimal inside the outdoor bottle storage cage because the cage located in an area where vehicular movement is unlikely, the use of pallet trucks in this area cannot be precluded. It is recommended that the propane gas bottles in the outdoor storage cage should be restrained with chains to minimise the risk of toppling following accidental impact.
R8	HSG 251 further recommends changing cylinders for the welding trolley away from sources of ignition in a well-ventilated place. This should ideally be near the workshop entrance or entirely outdoors.
R9	While it is commendable that AO's inspection team identified the compromised welding hoses before a dangerous leak occurred, CSC Fleet Services welding technicians should be trained to a good level of competence so that they can identify damaged hoses, recognise the potential for accidental leakages which can lead to fires and explosions, and take effective remedial action to replace the hoses before they fail.
R10	The following routine checks and practices for compressed gas bottles should be implemented by CSC Fleet Services Ltd: damaged hoses must never be repaired with tape and hoses must never be left unprotected where they may be damaged (e.g. by moving pallet trucks or vehicles.
R11	CSC Fleet Services Ltd should ensure the welding equipment is checked by a competent person before each use and that grease, oil or other lubricants are not applied to oxygen fittings.
R12	A competent welding technician should Inspect gauges and replace any defective gauge or broken glasses. Where equipment or instrumentation is deemed unserviceable, make sure it is withdrawn and clearly identified as not for use.
R13	It should be ensured that welding technicians appropriately decommission all welding equipment at the end of each day's work by turn off cylinder valves, venting the lines, and then turning off the valves at the blowpipe.
R14	To minimise the risk of welding flame 'flashback' into hoses or cylinders, welding technicians should be trained in correct lighting-up and working procedures. Additionally, flashback arresters should be fitted onto the regulators, on both the fuel and oxygen supply. Arresters may be fitted on the blowpipe, but these do not give protection from a fire starting in the hose. For long lengths of hose, arresters should be fitted on both the blowpipe and the regulator.
R15	The Regulatory Reform (Fire Safety) Order 2005 requires that a fire risk assessment (FRA) is produced for the vehicle repair workshop. CSC Fleet Services should ensure that their FRA considers the fire risk presented by rechargeable batteries and other combustible substances stored and used/or in the workshop.
R16	The following precautions should be adhered to when handling rechargeable batteries in the workshop. • Only use equipment and chargers supplied by reputable manufacturers • Make frequent inspections of batteries for signs of damage • Never use damaged or defective batteries • Ensure battery handling and storage areas are dry, cool, well-ventilated, and free from high levels of humidity

	• Ensure battery handling and storage areas are free from flammable or combustible materials and sharp objects, and that batteries are not left in contact with conductive materials • Ensure battery charging is well managed by trained staff, making sure that batteries are removed from chargers after charging is complete, electric heaters are removed from the vicinity of batteries being charged, and that batteries are not left on charge for long periods. Keep batteries not in use in appropriate containers, such as a proprietary metal battery storage cabinet or fireproof safety bags
R17	CSC Fleet Services should provide training, instruction, and information on the use of respiratory protective equipment when handling hazardous substances to drive compliance with health and safety regulations. The company should ensure that Health and Safety advice is obtained from a competent person to ensure compliance with UK Health and Safety Legislation.

6.0 Arrangements to Deal with Accident, Incidents and Emergencies

This regulation requires employers to protect the safety of employees by forward planning to have in place arrangements to deal with accidents, incidents and emergencies, including the evacuation, escape or rescue of people. The arrangements include first aid, safety drills and testing, information on hazards, warning and response systems and means of escape. These are required unless such measures would be disproportionate to the risk.

In respect of the dangers arising from an accident, incident or emergency involving the dangerous substance, compliance with regulation 8 of DSEAR fulfils most of the requirements of regulation 8 of the Management Regulations. However, the Management Regulations contain additional requirements to nominate competent persons to initiate procedures, for example.

The employer should consider the conclusions of this risk assessment about the likelihood and scale or magnitude of the predicted effects on people of any foreseeable unplanned event involving dangerous substances on their premises. The resulting emergency arrangements put in place should aim to minimise the impact.

The organisation has site specific procedures for emergency events and site evacuation. The site has a fire alarm system installed, trained first aiders and fire marshals and undertakes investigation following any accidents or near misses.

7.0 Information, Training & Instruction

Appropriate information, training and instruction should be given to contractors and employees on the dangerous substances present together with information on the DSEAR related hazards, risks, precautions and actions necessary for them to remain safe.

The Responsible Person should satisfy themselves that the organisations safety management system arrangements covering Competence are robust and operating as intended.

A site plan showing hazardous classified areas should be produced and relevant persons including contractors when appropriate made aware.

8.0 Conclusions

A DSEAR risk assessment has been conducted for areas where potentially flammable atmospheres could exist.

The overall risk rating is considered as tolerable as justified in section 1.0 executive summary.

Recommendations have been raised to implement good practice and in accordance with the DSEAR hierarchy of controls as discussed in section 3.0. The actions raised in this report will further strengthen the existing arrangements.

The assessor would like to thank Kieran Miller and Chris Card for their support and hospitality provided whilst on site in making this assessment possible and I trust that this report meets your expectations.

9.0 Recommendations

Ref	Recommendations	Location / Process
R1	The quantities of flammable aerosols and paints stored in the workshop metal cabinet was significantly below the recommended thresholds. It is foreseeable that increased workloads may require larger quantities of flammable aerosols and paints to be stored inside the workshop. It should be ensured that the maximum quantities of flammable aerosols and paints is always less than 50L as recommended in guidance.	**Metal storage cabinet inside workshop**
R2	During the site visit, it was observed that one of the doors of the flammable aerosol storage cabinet was missing, meaning that the fire integrity of the cabinet was significantly compromised. CSC Fleet Services Ltd should either immediately repair the storage cabinet to restore the fire integrity of the cabinet or replace the cabinet with one of appropriate construction and integrity.	**Metal storage cabinet inside workshop**
R3	It is recommended that regular audits of flammable aerosols and paints kept in the workshop should be completed, and flammable substances that are rarely used should be removed to a dedicated store outside the workshops or safely disposed.	**Metal storage cabinet inside workshop**
R4	During the site visit, it was stated that a locked shipping container is used for storage. Appropriate segregation must be implemented inside the storage container to ensure that flammable and combustible materials are not stored with non-compatible materials. Flammable substances should only be stored in an enclosure with adequate ventilation.	**Storage container**
R5	During the site visit, it was noticed that clean rags are stored in a plastic container near the storage work shelf inside the workshop. No container for the safe disposal of contaminated rags was seen. It should be ensured that cleaning rags and clothing contaminated with sprayed material is not left in the workshop unless kept in metal lockers or drums with a secure closing lid. This is because many fires have originated from the spontaneous ignition of fabric and waste impregnated with coating materials.	**Workshop**
R6	Effective cleaning is an important precaution against the initiation and spread of fires in spray application areas. CSC Fleet Services Ltd. should ensure that the interior of the workshops is checked regularly, and accumulations of overspray and dirt should be removed as required to prevent fire initiation and spread.	**Workshop**
R7	Whilst the risk of toppling over is minimal inside the outdoor bottle storage cage because the cage located in an area where vehicular movement is unlikely, the use of pallet trucks in this area cannot be precluded. It is recommended that the propane gas bottles in the	

	outdoor storage cage should be restrained with chains to minimise the risk of toppling following accidental impact.	
R8	HSG 251 further recommends changing cylinders for the welding trolley away from sources of ignition in a well-ventilated place. This should ideally be near the workshop entrance or entirely outdoors.	
R9	While it is commendable that AO's inspection team identified the compromised welding hoses before a dangerous leak occurred, CSC Fleet Services welding technicians should be trained to a good level of competence so that they can identify damaged hoses, recognise the potential for accidental leakages which can lead to fires and explosions, and take effective remedial action to replace the hoses before they fail.	
R10	The following routine checks and practices for compressed gas bottles should be implemented by CSC Fleet Services Ltd: damaged hoses must never be repaired with tape and hoses must never be left unprotected where they may be damaged (e.g. by moving pallet trucks or vehicles.	
R11	CSC Fleet Services Ltd should ensure the welding equipment is checked by a competent person before each use and that grease, oil or other lubricants are not applied to oxygen fittings.	
R12	A competent welding technician should Inspect gauges and replace any defective gauge or broken glasses. Where equipment or instrumentation is deemed unserviceable, make sure it is withdrawn and clearly identified as not for use.	
R13	It should be ensured that welding technicians appropriately decommission all welding equipment at the end of each day's work by turn off cylinder valves, venting the lines, and then turning off the valves at the blowpipe.	
R14	To minimise the risk of welding flame 'flashback' into hoses or cylinders, welding technicians should be trained in correct lighting-up and working procedures. Additionally, flashback arresters should be fitted onto the regulators, on both the fuel and oxygen supply. Arresters may be fitted on the blowpipe, but these do not give protection from a fire starting in the hose. For long lengths of hose, arresters should be fitted on both the blowpipe and the regulator.	
R15	The Regulatory Reform (Fire Safety) Order 2005 requires that a fire risk assessment (FRA) is produced for the vehicle repair workshop. CSC Fleet Services should ensure that their FRA considers the fire risk presented by rechargeable batteries and other combustible substances stored and used/or in the workshop.	

R16	The following precautions should be adhered to when handling rechargeable batteries in the workshop. • Only use equipment and chargers supplied by reputable manufacturers • Make frequent inspections of batteries for signs of damage • Never use damaged or defective batteries • Ensure battery handling and storage areas are dry, cool, well-ventilated, and free from high levels of humidity • Ensure battery handling and storage areas are free from flammable or combustible materials and sharp objects, and that batteries are not left in contact with conductive materials • Ensure battery charging is well managed by trained staff, making sure that batteries are removed from chargers after charging is complete, electric heaters are removed from the vicinity of batteries being charged, and that batteries are not left on charge for long periods. • Keep batteries not in use in appropriate containers, such as a proprietary metal battery storage cabinet or fireproof safety bags	
R17	CSC Fleet Services should provide training, instruction, and information on the use of respiratory protective equipment when handling hazardous substances to drive compliance with health and safety regulations. The company should ensure that Health and Safety advice is obtained from a competent person to ensure compliance with UK Health and Safety Legislation.	

Appendix 1 - Methodology

The following elements were considered during the DSEAR risk assessment and hazardous area classification:

- **Hazardous properties of the substances used on site;**
- **Identification of release of flammable materials;**
- **Determination of grade of release;**
- **Establishing zone classification;**
- **Determination of the hazard radii;**
- **Determination of the hazardous area.**

Identification of Release Sources

The first step in area classification is the identification of the possible release sources from the associated equipment. This can include valves, flanges, vents, sampling points etc.

Establish Level of Ventilation

The amount and availability of ventilation is considered when establishing the persistence of a flammable atmosphere.

Hazard Radii

Hazard radii estimation is taken from published sources.

Determining Hazard Area

This is based on the radii as defined above. Where sources overlap then a blanket area classification may be applied.

Assumptions:

Access to hazardous substance inventory controlled & no significant airborne dust / vapour clouds, limited hazardous release expected in normal operation.

Equipment is used in the way it is designed minimising the risk of incident and potential for harm, also assumes effective plant maintenance in line with supplier safe working procedure.

Management supervision and hazardous zones compliance - i.e. good housekeeping, hot-work controls, permit to work, ATEX rated equipment, etc.

Any change to current site arrangements may significantly affect Hazardous Area Classification assigned at the premises - and may add to overall risk of fire and explosion incident.

Hazardous zones based on observations at time of site visit.

Personnel are trained and competent to undertake process plant-based work activities.

Determining the Grade of Release and Zone Classification

The relationship between the grade of release (continuous, primary and secondary) and the corresponding zone is determined. Each source needs considering to determine its grade of release to establish the applicable zone at the point of release.

Zones for Grade of Release and Effectiveness of Ventilation.

Grade of release	Effectiveness of Ventilation						
	High Dilution			Medium Dilution			Low Dilution
	Availability of ventilation						
	Good	Fair	Poor	Good	Fair	Poor	Good, fair or poor
Continuous	Non-hazardous (Zone 0 NE)(a)	Zone 2 (Zone 0 NE)(a)	Zone 1 (Zone 0 NE)(a)	Zone 0	Zone 0 + Zone 2	Zone 0 + Zone 1	Zone 0
Primary	Non-hazardous (Zone 1 NE)(a)	Zone 2 (Zone 1 NE) (a)	Zone 2 (Zone 1 NE)(a)	Zone 1	Zone 1 + Zone 2	Zone 1 + Zone 2	Zone 1 or Zone 0 (c)
Secondary	Non-hazardous (Zone 2 NE)(a)	Zone 2 (Zone 2 NE)(a)	Zone 2	Zone 2	Zone 2	Zone 2	Zone 1 and even Zone 0 (c)

a) Zone 0 NE, 1 NE or 2 NE indicates a theoretical Zone which would be of negligible extent under normal conditions.
b) The Zone 2 area created by a secondary grade of release may exceed that attributable to a primary or continuous grade of release; in this case, the greater distance should be taken.
c) Will be Zone 0 if the ventilation is so weak and the release is such that in practice an explosive gas atmosphere exists virtually continuously (i.e. approaching a 'no ventilation'condition).

'+' signifies 'surrounded by'
Availability of ventilation in naturally enclosed spaces shall never be regarded as good.

Appendix 2 - Factors Affecting Hazardous Area Classification

Release Phase - the phase of a release (liquid, vapour or two-phase) affects the size and shape of the flammable zone.

Release Rate - the rate of release for the substance affects the overall size of the flammable zone.

Temperature and substance buoyancy - the temperature of a released substance may affect its buoyancy and the potential for condensation.

Ventilation - flow and availability of ventilation have a key effect on the size and duration of a flammable mixture and may be critical where a release occurs inside an enclosure reliant on forced ventilation – though where both flow and availability are good, then it may be classed as similar to 'natural' ventilation. For outside locations or open plant structures ventilation is classed as 'natural and with 100% availability.

Grade of Release - three basic grades of release are used in zone classification; continuous, primary or secondary;

Continuous grade of release - A release, which is continuous or expected to occur frequently or for long periods.

Primary grade of release - A release which can be expected to occur periodically or occasionally during normal operation.

Secondary grade of release - A release which is not expected to occur in normal operation and if it does occur, is likely to do so only infrequently and for short periods.

Flammability limits - the flammable range for a given substance is relevant to the potential size of a hazardous zone. Limits may vary widely depending on the material but also vary (increase) with temperature and pressure.

Minimum ignition energy (MIE) - is a measure of how easy a particular flammable mixture may ignite. A lower MIE substance is easier to ignite and is reflected by 'Gas Group' for relevant materials, while the MIE is also used often to specify precautions needed to avoid electrostatic ignition of dusts.

Auto Ignition Temperature - is a measure of how easy it is to ignite a mixture without a flame present e.g. from a hot surface such as a motor. This is utilised for 'Temperature Classification" of equipment.

Layer Ignition Temperature - is a measure of the ease of ignition for a layer of dust or powder on a flat, hot surface and is the temperature at which smouldering, or combustion occurs. Generally, it decreases as the layer thickness increases. Standard tests are carried out in the EU with a 5mm thick layer. For dusts and non-conductive liquids conductivity is a measure of the potential for the material to become charged and thus cause a static electricity ignition hazard.

Appendix 3 - Management of Hazardous Areas

Safety management for hazardous areas is important. Specific recommendations are highlighted in the DSEAR ACoP L138 to ensure that a sustainable Safety Management System is in place to address hazardous area issues throughout the life of the facility.
Key requirements relate to;

- **Identification and marking of hazardous area**
- **Materials in use**
- **Storage of materials**
- **Processes undertaken**
- **Control of ignition sources**
- **Specification of equipment**
- **Installation of equipment**
- **Inspection and maintenance of equipment**
- **Modifications and repairs.**

Formal safety management arrangements for controlling maintenance in hazardous areas is essential, this could include for example, a 'hot' permit to work issued by a competent person. A robust engineering change control system should be exercised to prevent changes that can affect the basis of safety such as;

- **Unsuitable electrical and mechanical equipment,**
- **Unsuitable chemicals,**
- **Changes in operational and process activity.**

Safety management system audits can confirm or challenge the suitability of the arrangements and should be performed regularly as part of the safety management system audit arrangements. Existing control and mitigation measures may need to be improved, extended or replaced, using a system of experience reviews. Measures selected should be appropriate to the work activity, consistent with the risk assessment and sufficient to reduce the risk so far as reasonably practicable.

Appendix 4 - Equipment for Use in Hazardous Areas

All new equipment for use in hazardous areas must be designed and constructed to the correct standard. It must also have the correct labelling containing information such as the relevant temperature classification, gas group, etc. Additionally, all ATEX compliant equipment must be accompanied by a relevant certificate and the certificate must be kept for the service life of the equipment. There is a wide range of label and certificate formats in use driven by the global supply chain, but the information presented here is critical in selecting the correct category of equipment for many hazardous areas.

Equipment used in hazardous areas has to be of the correct Temperature Classification and Gas Group to maintain the basis of safety. Temperature Classification (or maximum surface temperature) reflects the lowest 'autoignition' temperature (AIT) of material present, while the Gas Group depends on the minimum ignition energy of materials.
Incorrect specification of equipment can result in an ignition if the surface temperature is too high, or because the energy level may lead to spark. The maximum surface temperature of equipment should ideally, be no more than 80% of the theoretical AIT to allow a margin of safety for zones 0 and 1 and for zone 2 should not exceed the AIT.

For hot surfaces subject to dust, the temperature should have a safety margin of 75°C below the layer ignition temperature or 2/3rds the dust cloud minimum ignition temperature, whichever is the lowest.

Temperature Classification – is the maximum surface temperature of the equipment under fault conditions. This is designed to ensure that equipment does not get hot enough to cause ignition of the hazardous material by the surface temperature.
The tables below illustrate the relationship between surface temperature and T Class, along with a range of Gas Group and ignition energy factors.

Maximum Surface Temp (°C)	Temperature Class (T Class)
450	T1
300	T2
200	T3
135	T4
100	T5
85	T6

Typical Gas Hazard	Gas Group	Minimum Ignition Energy (mJ)
Acetylene	IIC	0.02
Hydrogen	IIC	0.02
Ethylene	IIB	0.06
Propane	IIA	0.18

Gas Group – is the maximum spark energy of the equipment and relates to the minimum ignition energy of the hazardous material in the area where the equipment is installed.

Equipment Category

The equipment category defines the level of protection against ignition sources. Equipment is categorised as 1,2 or 3, with category 1 providing the highest level of protection. Equipment is also categorised for Gases or Dusts and will have a one or both letters on the ATEX label depending on the suitability i.e. "G" for Gases, "D" for dusts or "GD" for equipment suitable for gases and dusts.

Group I – Equipment intended for use in mines susceptible to firedamp (flammable mixture of gases naturally occurring in a mine).
Group II – Equipment intended for use in places with an explosive gas atmosphere other than mines susceptible to firedamp. Group II equipment is subdivided into three subgroups.
Group IIA – Atmospheres containing propane, or gases and vapours of equivalent hazard.
Group IIB – Atmospheres containing ethylene, or gases and vapours of equivalent hazard.
Group IIC – Atmospheres containing acetylene or hydrogen, or gases and vapours of equivalent hazard.
Group III – Equipment intended for use in places with an explosive dust atmosphere.
Group III – Equipment is subdivided into three subgroups.
Group IIIA – Atmospheres containing combustible fibres / flying's.

Group IIIB – Atmospheres containing non-conductive dust.
Group IIIC – Atmospheres containing conductive dust.

Equipment Category	Zone Suitability		
	Zone 0	Zone 1	Zone 2
1	✔	✔	✔
2	X	✔	✔
3	X	X	✔

Equipment Protection Concepts

Equipment categorisation – Equipment Protection Levels (EPL)

Zone	ATEX Category	Means of Protection	EPL
0	1G	Ex ia – Ex ma	Ga
1	1G 2G	"Ex d" – "Ex e" – "Ex i" – "Ex m" – "Ex p" – "Ex o" – "Ex q"	Gb
2	1G 2G 3G	"Ex d" – "Ex e" – "Ex i" – "Ex m" – "Ex p" – "Ex o" – "Ex q" – "Ex n"	Gc
20	1D	pD – mD – tD – iaD - ibD	Da
21	1D 2D	pD – mD – tD – iaD - ibD	Db
22	1D 2D 3D	pD – mD – tD – iaD - ibD	Dc

The letters "G" and "D" of ATEX category determine whether the equipment can be used in areas containing hazardous gases or dusts. In the classification of EPL, 1, 2 and 3 categories have been replaced by the letters a, b, c. Intrinsic safety equipment is denoted with "ia" and "ib".

Code	Protection method	Zone	Principle
EEx d	Flameproof	1,2	Contain explosion, quench flame
EEx q	Powder filling	1,2	Contain explosion, quench flame
EEx p	Pressurisation	1,2	Keep flammable gas out
EEx m	Encapsulation	1,2	Keep flammable gas out
EEx o	Oil emersion	1,2	Keep flammable gas out
EEx e	Increased safety	2	No arcs, sparks, or hot surfaces
EEx ia	Intrinsic safety	0,1,2	Limit spark energy and surface temp
EEx ib	Intrinsic safety	1,2	Limit spark energy and surface temp

Protection against dusts

Zone 20	IP 6X	The X should be replaced by a number rating equivalent to the required liquid ingress protection for the area.
Zone 21	IP 6X	

Zone 22	Non-conductive dusts IP5X Conductive dusts IP6 X	

Gases EPL

EPL Ga: Equipment for explosive atmospheres due to the presence of gas, with a level of protection 'very high', which is not a source of ignition in normal operation, or in case of expected failure or when subjected to a rare failure.

EPL Gb: Equipment for use in explosive atmospheres due to the presence of gas, with a 'high' level of protection that is not the source of ignition in normal operation or when subject to expected malfunctions, although not on a regular basis.

EPL Gc: Equipment for use in explosive atmospheres due to the presence of gas, with a level of protection "increased" that is not a source of ignition in normal operation. It has some additional security measures in order to ensure that it remains a source of ignition not active in case of expected events on a regular basis (for example, the failure of a lamp).

Dusts EPL

EPL Da: Equipment for explosive atmospheres due to the presence of combustible dust, which has a level of protection 'very high' and does not constitute a source of ignition in normal operation or when subject to rare failures.

EPL Db: Equipment for explosive atmospheres due to the presence of combustible dust, which has a level of protection 'high'. It does not constitute a source of ignition in normal operation or when subject to expected failures, although not on a regular basis.

EPL Dc: Equipment for explosive atmospheres due to the presence of dust, with a level of protection 'increased', which is not a source of ignition in normal operation. It may have additional protections in order. In the case of equipment that is suitable for both explosive gas atmospheres and explosive dust atmospheres, the equipment should display two separate markings. For example, this would appear within the marking plate (see Figure 1) information as:

(a) II 1 G – Ex ia IIB T4; and

(b) II 1 D – Ex ia IIIC T120 °C.

Figure 1 Typical ATEX equipment marking plate.

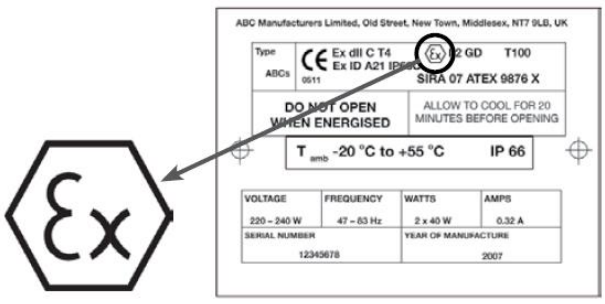


Figure 2 is an example of a marking plate including ATEX requirements, those of European and International standards and the EPL:

Figure 2

1) ATEX Category: suitable for Zone 1 (product group II, product category 2)

2) Means of protection "Ex e" according to IEC/EN 60079-7 standard

3) Protection level Gb: suitable for Zone 1

Equipment Maintenance

Inspection, maintenance and repair of electrical equipment for use in Hazardous Areas must be done by qualified and competent personnel. A 'standard' 18th Edition qualified electrician or similar is not competent to carry out the inspection or repair of hazardous area equipment because the training does not cover the special protection methods used in hazardous area equipment.

Maintenance of ATEX equipment by non-qualified personnel may result in a breach of the basis of safety for the equipment. Electrical technicians trained and competent to inspect, maintain & repair hazardous area equipment are CompEx qualified. This is a special training course which specifically covers the ignition protection properties of Hazardous Area equipment. Non-CompEx trained electricians should not be allowed to carry out work on ATEX (Ex rated) electrical equipment.

It is important that all protective equipment installed to support safety within classified hazardous zones are also maintained by competent persons in line with supplier recommendations. Specifically explosion suppression, pressure relief or other protective devices should also undergo any recommended function tests to confirm satisfactory operation.

Note: where it is necessary to isolate systems (or parts) to avoid inadvertent operation during such testing, any impairment should be subject to local change management, safe isolation, shutdown and permit systems.

Appendix 5 – Standards, Regulations & Glossary of Terms

Explosion Protection Standards and Regulations

BS/EN 60079 –10 shall be used as the basis, for defining the principles of Hazardous Area Classification.

British Regulations and European Directives (ATEX)

The Dangerous Substances and Explosive Atmospheres Regulations; 2002 (DSEAR) (Statutory Instrument 2002, No.2776); ATEX Directive 2014/34/EU

EN / BS Standards and IEC Standards

BS EN 60079 - 0 Explosive atmospheres, General requirements; (2018 edition)

BS/EN 60079 10-1 Explosive gas atmospheres - Classification of Hazardous Areas; (2015 edition);

BS/EN 60079 10-2 Classification of Hazardous Areas – Explosive Dust Atmospheres; (2015 edition);

Definition of Terms

The following definitions have been taken from BS EN60079-10-1, Section 2 "Definition of Terms".

Explosive gas atmosphere

A mixture with air, under normal atmospheric condition, of flammable substances in the form of gas, vapour, mist or dust in which, after ignition, combustible spreads throughout the unconsumed mixture.

Hazardous area

An area in which an explosive gas atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of apparatus.

Non-hazardous area

An area in which an explosive gas atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation and use of electrical apparatus.

Zones

Hazardous area classification is carried out as an integral part of the risk assessment process. Its purpose is to define the extent, frequency and duration of the occurrence of any explosive atmosphere (the zone). The zone in turn defines the requirements for the selection and installation of equipment and protective system so as to prevent sources of ignition. BS EN 60079-10-1 defines the hazardous area classification zoning as detailed in the table below (the hours in brackets have been added and is not from the British Std, but discussed in the DSEAR ACoP):

Hazardous Area Zone Definitions

Liquids, Mists, Gases & Dusts	
Zone 0	An area in which an explosive gas atmosphere is present continuously or for long periods. (Explosive atmosphere for more than 1000h/yr).
Zone 1	An area in which an explosive gas atmosphere is likely to occur in normal operation. (Explosive atmosphere for more than 10h/yr, but less than 1000h/yr).
Zone 2	An area in which an explosive gas atmosphere is not likely to occur in normal operation and, if it does occur, is likely to do so only infrequently and will exist for a short period only. (Explosive atmosphere for less than 10h/yr, but still sufficiently likely as to require controls over ignition sources).
Zone 20	A place in which an explosive dust atmosphere, in the form of a cloud of dust in air, is present continuously, or for long periods or frequently. (Explosive atmosphere for more than 1000h/yr).
Zone 21	A place in which an explosive dust atmosphere, in the form of a cloud of dust in air, is likely to occur in normal operation occasionally. (Explosive atmosphere for more than 10hr/yr but less than 1000h/yr).
Zone 22	A place in which an explosive dust atmosphere, in the form of a cloud of dust in air, is not likely to occur in normal operation but, if it does occur, will persist for a short period only. (Explosive atmosphere for less than 10h/yr, but still sufficiently likely as to require controls over ignition sources).

Explanation of Zone 2 NE

Hazardous areas are classified into zones based on the frequency of the occurrence and the duration of an explosive gas atmosphere. In the case of a secondary release, the relevant zone is zone 2, i.e. a place where an explosive atmosphere is not likely to occur in normal operation but, if it does occur, will persist for a short period only. In areas where the ventilation is 'high' relative to the leak size, BS EN 60079:10 recommends that the area classification is zone 2 but of negligible extent (NE), i.e. that no action is thus required to control sources of ignition within.

A hazardous zone from a secondary release may be classified as being of 'negligible extent' (NE) if the volume of the foreseeable gas cloud with an average concentration of 50% LEL can be shown to be less than $0.1m^3$. No action is required to control sources of ignition within an NE zone although it should be noted that limiting parameters may apply to this decision. A zone of negligible extent is not the same as a safe area even though neither requires further action with regard to potential ignition sources. In particular, it may be that a zone of negligible extent becomes more onerous if ventilation is reduced during modifications to buildings and housings.

Source of Release

A point or location from which a gas, vapour, mists or liquid may be released into the atmosphere so that an explosive gas atmosphere could be formed. There are three basic grades of release as listed below in order of decreasing frequency and likelihood of the explosive gas atmosphere being present. A source of release may give rise to any of these grades of release, or to a combination of more than one.

Continuous grade of release
A release, which is continuous or expected to occur frequently or for long periods.

Primary grade of release
A release which can be expected to occur periodically or occasionally during normal operation.

Secondary grade of release
A release which is not expected to occur in normal operation and if it does occur, is likely to do so only infrequently and for short periods.

Ventilation Terminology (see EN Standard 60079-10)

Natural Ventilation
Movement of air and its replacement with fresh air due to the effects of wind and / or temperature gradients.

General Artificial Ventilation
Movement of air and its replacement with fresh air by artificial means (e.g. fans) and applied to a general area.

Local Artificial Ventilation
Movement of air and its replacement with fresh air by artificial means (usually extraction) applied to a particular source of release or local area.

Adequate Ventilation
Ventilation is considered adequate if it is sufficient to prevent accumulation of significant flammable concentrations above 25% of the lower flammable limit. (see IP 15, Sect. 6.4.1. This criterion may be used to assess the need for hazardous area classification for fuel oil equipment, when heated above the flash point.

Dilution Ventilation
The term "Dilution Ventilation" will be used if artificial ventilation is used to avoid the accumulation of significant quantities of explosive gas mixture in conjunction with risk assessment to determine if adequate ventilation is provided.

No Ventilation
No ventilation exists where no arrangements have been made to circulate fresh air.

Flammable / Explosive Terminology

Extremely flammable
Liquids which have a flashpoint lower than 23°C and a boiling point (or, in the case of a boiling range, the initial boiling point) lower than or equal to 35°C

Highly flammable
Liquids which have a flashpoint below 23°C but which are not extremely flammable.

Flammable
Liquids which have a flashpoint equal to or greater than 23°C and less than or equal to 60°C and which support combustion when tested in the prescribed manner at 60°C or any relevant liquids with a flashpoint above 60°C which are stored at temperatures above their flash point.

Lower explosive limit (LEL)
The concentration of flammable gas, vapours, or mist in air, below which an explosive gas atmosphere will not be formed.

Upper explosive limit (UEL)
The concentration of flammable gas, vapours, or mist in air, above which an explosive gas atmosphere will not be formed.

Flashpoint
The lowest liquid temperature at which, under certain standardized conditions, a liquid gives off vapours in quantity such as to be capable of forming an ignitable vapour/air mixture.

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Document Revision

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V1	Report issued to client.	LZP	RJ/LZP