UNIVERSITY OF SUSSEX BRIGHTON

Guidance on Completing DSEAR Risk Assessments

1. Introduction

This document provides guidance to Faculties and Divisions to support them in keeping staff, students and others safe, by eliminating or reducing the risk of a fire or explosion. This is managed by fulfilling duties under the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR). This guidance should be read in conjunction with the Dangerous Substances and Explosive Atmospheres Safety Code of Practice and the DSEAR risk assessment templates available from the Health, Safety and Wellbeing Team's A-Z webpage.

A dangerous substance, as defined by DSEAR, is any substance or mixture of substances that could create risks to people's safety from fires, explosions, or similar energetic events, such as 'thermal runaway' from chemical reactions or are corrosive to metal. Such substances will display the pictograms displayed in Figure 1. It should be noted that although the corrosive pictogram is consistent with any corrosive substance, in relation to DSEAR, you only need to be concerned where the corrosive logo is present and the substance hazard statements detail that the substance is corrosive to metal. You will be managing corrosion risks to health through your COSHH risk assessment.

Figure 1: Dangerous substance pictograms (Flammable, Compressed gas, Oxidiser, Explosive, Corrosive to metal)

The DSEAR Regulations, University policy on the Safe Management of Chemicals, Other Hazardous Substances, and their Waste, DSEAR Safety Code of Practice and this supporting guidance will apply to you if:

- A dangerous substance is present (or liable to be present) at your work location and in connection with your work.
- The dangerous substance/s could be a risk to the safety of people as a result of fires, explosions or similar energetic events or through corrosion to metal.

Dangerous substances are found in nearly all workplaces and include such things as solvents, paints, varnishes, flammable gases, dusts (such as wood and metal), pressurised

gases and foodstuffs such as suitable quantities of flour dust and sugar dust that could become airborne and create an explosive atmosphere. You should apply this guidance in any area of the University where a dangerous substance is, or is liable to be, used or present in connection with work. It covers dangerous substances that are purchased and those that are produced as part of a work process, such as those produced during a chemical reaction in a laboratory.

Following this guidance will ensure a consistent approach to looking after everyone's health and safety, by ensuring that those who work with dangerous substances carry out a risk assessment, put measures in place to control and mitigate the risk from dangerous substances, and carry out hazardous area classification where required. The guidance explains how to share these arrangements with those involved in the work, or who may be affected by it, and what training in DSEAR is available. It also supports you in ensuring there are emergency procedures in place for responding to a DSEAR related incident.

2. Scope

This guidance document can be applied to any area under the University's control, whether on or off campus where dangerous substances are, or are liable to be, used or present in connection with work, research or education. This includes dangerous substances that are purchased and those that are produced as part of a work process.

Work, research and education activities include, where applicable, the ordering, receiving, transportation, storage, processing, production and disposal of these substances.

3. Definitions

ATEX – the name commonly given to the two European Directives for controlling explosive atmospheres i.e. ATEX 137 on minimum requirements for improving health and safety protection of workers potentially at risk from explosive atmospheres, and ATEX 114 equipment and protective systems intended for use in potentially explosive atmospheres.

Dangerous Substance – any substance or preparation used or present at the University that could, if not properly controlled, cause harm to people as a result of fire or explosion, or corrosion to metal. They include such things as solvents, paints, varnishes, flammable gases, dusts from machining and sanding, dusts from foodstuffs, chemical dusts, pressurised gases and substances corrosive to metal.

Energetic Event – includes things such as runaway exothermic reactions involving chemicals e.g. the decomposition of unstable substances such as peroxides.

EX – the abbreviation used on signage to notify others of the presence of an explosive atmosphere where special measures will need to be followed. The signage includes a black EX in a yellow triangle with black border.

Explosive Atmosphere – a mixture of dangerous substances with air, under atmospheric conditions, in the form of gases, vapours, mist or dust in which, after ignition has occurred, combustion spreads to the entire unburned mixture. Atmospheric conditions are commonly referred to as ambient temperatures and pressures, usually temperatures of -20°C to 40°C and pressures of 0.8 to 1.1 bar.

Hazardous Area Classification – the process of identifying where an explosive atmosphere may form and its extent.

4. Carrying out a DSEAR Risk Assessment

4.1 Identifying dangerous substances

The first stage of managing the risks posed by dangerous substances is to identify where they are in your Faculty or Division and the maximum quantities you will use and store. DSEAR requires you to consider all dangerous substances that are used and/or produced in relation to work. This includes any that you purchase and also those that are produced as a result of a process, such as an experiment in a lab.

A dangerous substance can be identified by checking if the packaging, or its Safety Data Sheet (SDS), shows any of the pictograms in Figure 1. Alternatively, if it is a substance that has been produced by an in-house process, the person who has produced it should be able to confirm whether the substance would be classified as a dangerous substance based on: the substances used to produce it, similar and/or related substances, or where necessary by seeking specialist advice. Finally, you should also ensure you identify any pipework that transports dangerous substances, whether these are flammable gases such as acetylene, hydrogen or natural gas, certain refrigerants, flammable liquids and any other substance classed as dangerous under DSEAR 2002. You will also need to identify any pressure systems as defined in the Pressure Systems Safety Regulations 2000 (PSSR). These systems may not necessarily carry a dangerous substance but may cause an energetic event should they fail.

Faculties and Divisions need to assess the presence of dangerous substances in the areas and activities under their control. For example, a workplace inspection could be carried out with the aim of identifying the presence of dangerous substances, or a communication could be sent out to colleagues with responsibility for work areas to collate the information. A form to help keep track of dangerous substances that are present is available under DSEAR on the Health & Safety A-Z webpage.

4.2 DSEAR Standard for laboratories and workshops

Specifcally for laboratories and workshops, where flammable substances are handled routinely, you should ensure you're in compliance with the requirements of the defined DSEAR Standard. If you're not able to do this you will need to carry out a full DSEAR risk assessment. You should discuss this with the FoSEM Health and Safety Team or University Health, Safety and Wellbeing Team first.

If you undertake processes that present a DSEAR risk outside of what is covered by the standard, such as work with compressed gas cylinders and manifolds, substances corrosive to metal, processes that create airborne dust etc. a full DSEAR risk assessment may be required following discussion with either the FoSEM Health and Safety Team or University Health, Safety and Wellbeing Team.

For activities covered by the DSEAR Standard, it is expected that the controls for these are likely to be covered by relevant COSHH risk assessments. However, these control measures must be clearly identified as DSEAR control and mitigation measures within the relevant COSHH risk assessment.

4.3 DSEAR Risk Assessment

If your work area is not a laboratory or workshop, or you do not meet the requirements of the DSEAR Standard, you can use the information from your review of dangerous substances to carry out your DSEAR risk assessment. The purpose of the risk assessment is to methodically consider the dangerous substances you have and their properties. This allows you to assess how effective existing control measures are and to consider what additional ones may be required to eliminate, or further reduce, the risk. To assist you in your risk assessment, and to ensure you cover all the points you need to, you should use the DSEAR risk assessment templates available from the Health, Safety and Wellbeing Team's webpages. If you are risk assessing work areas and processes that use and/or produce a number of dangerous substances, you should use the 'Large Inventory' template, for anything else, such as risk assessing hydrogen release from faulty Uninterruptible Power Supplies (UPS), you should use the 'Single Substance' template.

4.4 Pre DSEAR Risk Assessment Questionnaire

Page 1 of the DSEAR risk assessment form must be completed to determine whether a full in-depth risk assessment is required.

You should answer the questions in this section based on all the substances that are being used and/or produced during the process you are reviewing, or that are used/produced within the work area, such as a lab or workshop.

To support you in answering the questions, you should refer to the substance's safety data sheet. This will help you determine which of the substances you are using or producing are classified as explosive, oxidising, flammable, a compressed gas or corrosive to metal.

If none of the substances you will be using or producing are classified as explosive, oxidising, flammable, a compressed gas or corrosive to metal, the rest of the questionnaire can be answered as 'no' and you do not need to go any further with the risk assessment. You should keep a copy of the pre-questionnaire with the associated COSHH risk assessment.

If you do plan to use and/or produce substances classified as dangerous, where applicable, consideration should also be given to the flashpoint of these substances. As a reference, you should determine whether the substances have a flashpoint lower than 32°C. This is

considered to be an average summers day in the UK and has been benchmarked against other universities. If a substance does have a flashpoint lower than 32°C, it presents a risk of ignition at ambient temperatures on an average summers day.

Finally, you should consider whether the substances you will be using or producing will be able to release sufficient vapour, gas or dust to form an explosive atmosphere. It is important that 25% of the Lower Explosive Limit (LEL) of a substance is not exceeded as this is a specific legal requirement under DSEAR. The regulations require that 25% of the LEL is not exceeded in well-ventilated areas and that 10% of the LEL is not exceeded in confined spaces. To support you in making this decision you can use a calculation (Appendix 2) specifically for calculating how much of a flammable liquid could evaporate before reaching 25% of the substance's LEL. The calculation is based on the specific substance and the dimensions of the room you will be using or producing that substance in.

If any of the dangerous substances you will be using or producing have a flashpoint of 32°C or lower, they will release sufficient vapour, gas or dust to produce an explosive atmosphere, or you will be using compressed gas, explosive substances, or substances corrosive to metal, you will need to carry out a full DSEAR risk assessment by following the rest of the template.

4.5 Description of the project/activity and the type of ventilation

Section 1.1 of the assessment template is where you should describe the process or workspace you will be risk assessing. There should be enough detail in this section to allow the reader to understand what it is that is being risk assessed. For example, if you are risk assessing a process, describe what is being done, why it is being done, where it is being carried out, when it will be carried out, how it will be carried out and who will be involved. If there is a COSHH risk assessment that covers the process, this should be referenced in this section as well.

If you are risk assessing a workspace, describe what it is e.g. lab, workshop etc., its dimensions, the number of people that will be using the space and what type of work will be carried out that has prompted the DSEAR risk assessment.

You should also describe the type of ventilation that will be in use during the process or in the general area. For example, will the process be carried out in a fume cupboard and does the room have natural ventilation or mechanical ventilation. If mechanical ventilation is in use, you should enquire with the Estates Team to find out what number of air changes per hour are expected in the room. This can be done via the Estates Helpdesk (estateshelpdesk@sussex.ac.uk) .

Once confirmed, details about the ventilation present should be included in this section of the risk assessment. If this information cannot be confirmed, you should note this in this section and assume poor ventilation (less than 5-10 air changes per hour) when considering control measures and mitigation measures through the rest of the risk assessment. Whatever type of ventilation serves the workspace, there should be a minimum of 5 air changes per hour and you should consider the location of vents. For example, when working

with substances with a vapour density greater than air, vents should be located towards floor level as vapours will sink. Vapours less dense than air will require ventilation at high level, while a mixture of both will require vents at high and low level.

4.6 Potential ignition sources present

Section 1.2 of the assessment template requires you to consider all the ignition sources that are, or may, be present in the workspace or during the process you are assessing. Consider each of the seven categories and use the drop-down lists to select whether they are applicable to this assessment or not. Where they are applicable, you should list the relevant equipment and add any additional comments (Table 1).

Table 1: Example ignition sources (non-exhaustive)	
Ignition Source	**Examples**
Hot surfaces	Heat mantles, radiators, hot plates.
Electrical	Lighting, switches, mobile phones, heat mantles, hot plates, grinders, fans, power drills
Mechanical	Grinders, fans, other moving parts of machinery.
Hot works/maintenance arrangements	Welding, tools that generate a spark such as power drills.
Static	People, clothing, footwear, friction of substances over other materials.
Naked flames	Bunsen burners, candles, lighters, smoking.
Lightning	Building confirmed as earthed by Estates.
Other	Self-heating and self-igniting substances, concentrated sunlight through glazing.

4.7 Chemical Analysis

Section 2 of the assessment template is the foundation of the DSEAR risk assessment process and allows you to consider the risks associated with the dangerous substances you will use and/or produce by reviewing their properties. You should consider the chemical properties of all the dangerous substances you have identified as this will help you decide what control measures and mitigations to put in place. Suggested properties such as boiling point, flammability category, vapour density relative to air, auto ignition temperature, flashpoint, explosive limits, minimum ignition energy, gas group and temperature class are included on the template, however, if there are others that you think need to be considered, you should include these too.

4.7.1 Details of dangerous substances being handled, stored or produced

In section 2.1 of the assessment template you should list all of the substances that will be used or produced. You should list the name of the substance, the quantity that will be present and select whether it is a solid, liquid or gas from the drop-down list. You must also use the substance's safety data sheet to identify the type of dangerous substance it has

been classified as (explosive, oxidising, flammable, flammable compressed gas, oxidising compressed gas, corrosive to metal).

Finally you need to decide what severity rating to assign to the dangerous substance. This should be considered based on the flammability category of the substance, the amount that will be used or stored and by considering the consequences if it were to be involved in a fire or explosion, such as the types of injuries sustained and the number of people who may be affected. To help you make your decision, you can use the University's risk rating matrix in Appendix 1 of the risk assessment template. Use the drop-down list next to each substance to select the level of severity. You may have a range of severity levels selected once complete, you should keep the highest severity level in mind when considering control and mitigation measures.

4.7.2 Flammable gases, liquids and solids

In sections 2.2, 2.3 and 2.4 of the assessment template you need to consider each substance's state i.e. solid, liquid or gas. You also need to consider the substance properties listed in Table 2. If any of these properties are not applicable to a particular substance, mark them as 'N/A'. If there are any properties that will impact the DSEAR assessment that are not included on the template, you should make note of these too.

These sections also require you to consider the hazard statements associated with the dangerous substances you use and/or produce; these can be found on the safety data sheets. For the DSEAR risk assessment you only need to note the hazard statements specifically related to fire, explosion or corrosion to metal. This is because hazard statements related to health are considered through your COSHH risk assessment/s. Select the relevant H-statements from the dropdown lists.

4.7.3 Frequency of use and who may be at risk?

In section 2.5 of the assessment template you need to state the frequency with which you will be using/producing the substances. For example, if a process is to be carried out once a week, you should select 'weekly'. If your assessment is covering a whole work area, you should select 'daily'.

In section 2.6 of the assessment template you should also identify who may be at risk of being injured in the event of a fire, explosion or an incident relating to the corrosion of metal. You should do this by selecting from the categories of people, for example, students, visitors etc., and indicate how many people from each category could be at risk. In this section you should consider whether you can reduce the number of people who could be at risk, by minimising the number of people in the work area or involved in the operation, as far as practicable. To aid mitigation if there were to be a fire or explosion, you should be aiming for as few people as possible being in the work area or being part of the process.

Table 2: Chemical property definitions	
Property	**Definition**
Boiling point	The temperature at which a liquid is rapidly turned into vapour. This may need to be considered if the substances you are working with have a boiling point at or below ambient temperature or the temperature control you have put in place for the work activity.
Flashpoint	The lowest temperature at which a substance produces a flammable vapour/air mixture that can be ignited by a spark or another source of ignition.
Flammability class	This replaces the previous classifications of extremely flammable, highly flammable and flammable. Flammability classes include Flammable Gases, Flammable Liquids and Flammable Solids. Please see Appendix 3 for a more detailed breakdown.
Vapour density relative to air	This helps you identify how heavy a gas, vapour or mist is. Air is given a vapour density of one. Therefore if the vapour density of a substance is less than one, this means it is lighter than air. If the vapour density is greater than one, this indicates the substance is heavier than air. This will allow you to identify where an explosive atmosphere may be present and to consider whether high or low level ventilation is required.
Auto ignition temperature	The minimum temperature required to ignite a substance/air mixture in a normal atmosphere without any external source of ignition such as a flame or spark.
Explosive limits	Defined by the lower explosive limit (LEL) and upper explosive limit (UEL). This is the range in which a mixture of flammable vapour/mist/gas and air is actually flammable. DSEAR places a legal duty on the University to ensure that 25% of the LEL of a substance is never exceeded.
Gas group	Flammable gases, vapours and mists are assigned a gas group based on the explosive pressure they generate and their minimum ignition energy (MIE). The groups are classified as IIA, IIB and IIC. IIA substances are the least explosive, whilst IIC substances are the most.
Minimum ignition energy (MIE)	A measure of how sensitive a flammable/explosive vapour or dust is to electrical spark ignition. Where a hazardous area has been classified, typically, if a substance has a gas group of IIB or IIC, and a MIE of less than 0.2 mj, earth dissipating clothing and footwear should be worn. If the substances have a gas group of IIA and a MIE greater than 0.2 mj, antistatic footwear should be worn (DSC Limited).
Temperature class	This is applied to electrical equipment and identifies the temperature at which the equipment will shut down to prevent a hot surface on the equipment from igniting a flammable atmosphere. The class is shown as a 'T' value i.e. T1-T6, where the temperature reached before shutdown decreases as the 'T' value increases. This helps you identify suitable equipment in flammable atmospheres when considering a substance's auto ignition temperature.

4.8 Current control measures and mitigations

The next step, in section 3 of the assessment template, is to consider the control measures and mitigations that are already in place. This gives you an opportunity to assess whether these are suitable and sufficient, or if you will require additional controls and mitigations to make sure the risk is reduced to as low as reasonably practicable.

Under DSEAR, a control measure is something that either eliminates, or reduces the chance, of a fire or explosion taking place. A mitigation is put in place to reduce the consequences of a fire or explosion that has occurred, despite control measures being in place.
Sections 3.1 to 3.6 of the DSEAR risk assessment 'Large Inventory' template takes you through a question set to help you consider what is already in place and what additional measures may be needed. For each question you have the option to say if the question has been met, unmet or if it is not applicable to the work area or process you are assessing.

Where you identify that a question has been met, you should enter on to the template what is in place to meet the question. Where a question is unmet, you should state why on the template and add an action to remediate this.

Where you identify further actions are required, it is important to assign each action to an individual, giving them a timeframe in which to complete it. For more detailed guidance on filling in this section of the DSEAR risk assessment, please see Appendix 4.

When considering control measures you must consider the DSEAR hierarchy of control. You must consider control measures in the order detailed below:

1) Reduce the quantity of dangerous substances to a minimum – Consider the substances you plan to use and decide if these can be eliminated or substituted for substances which are not dangerous, or are less dangerous. Consider how much you need for your activity and reduce this as far as practicable, for example, by only keeping enough of a dangerous substance in your work area to support you for a day's work.
2) Avoid or minimise releases of dangerous substances – look at the entire work process and where possible, design the process so that issues that may result in the release of dangerous substances are removed or reduced. For example, you can ensure the process is carried out in a fume hood or in a work area that has at least 5 air changes per hour.
3) Control releases of dangerous substances at source – For example, by ensuring lids are always put back on bottles of dangerous substances after each use. During heating processes, that don't require vapour to release, you could cover the vessel the substance is held in, to reduce the release of vapour at source.
4) Prevent the formation of a dangerous atmosphere – here you need to consider ventilation. If in a science lab, you should use suitable ventilation methods such as a fume hood or extract canopy. In other work areas it may be sufficient to ensure good natural ventilation by opening windows. There should be good general ventilation in the work area, wherever you will be working, this should be at least 5-10 air changes per hour.

5) Collect, contain and remove any releases to a safe place (for example, through ventilation) – similarly to point 4 above, good local exhaust ventilation in a lab will ensure that any releases are removed from the fume hood and released from stacks on the roof of the building.
6) Avoid ignition sources – where dangerous substances will be used you will need to consider ignition sources. Wherever possible these should be removed, or reduced by adapting them e.g. ATEX rated electrical equipment. The latter would only be required within an established EX Zone (see section 4.10).
7) Avoid adverse conditions (for example, exceeding the limits of temperature or control settings) that could lead to danger – if a dangerous substance has a flashpoint of 26°C, consider how the temperature of the work area can be maintained below this to prevent the production of flammable vapours.
8) Keep incompatible substances apart – consider storage arrangements and making sure that incompatible substances, such as acids and bases, are kept apart. You can use the chart and key in Appendix 5 to support you with this, or you can contact the FoSEM Health and Safety Team based in JMS Building.

When considering mitigation measures you should:

1) Reduce the number of people exposed to the risk – the fewer people involved in an activity or permitted in the area during the activity will mean fewer people affected should something go wrong.
2) Provide plant that is explosion resistant – If using equipment where there is a risk of explosion within it, it should be purchased from a reputable retailer and the specification checked to ensure it is suitable for what you intend to use it for e.g. it is of suitable ATEX rating.
3) Provide plant that is corrosion resistant – if you are using substances that are corrosive to metal, you should ensure that the materials of the equipment you use are suitable for those substances. For example, a metal cupboard used to store corrosive substances must be made of suitable materials to prevent it from degrading.
4) Provide explosion suppression or explosion relief equipment – If the risk assessment identifies that an explosion is a risk, there should be measures in place to suppress the explosion and explosion relief equipment fitted in the work area or on equipment to ensure the energy can be released safely.
5) Take measures to control or minimise the spread of fires or explosions – here you should consider the provision of fire fighting equipment, whether a fire risk assessment is in place for the work area and if any actions from this have been completed. You may need to consult the Fire Safety Team by contacting healthsafety@sussex.ac.uk to confirm these points for your assessment.
6) Provide suitable personal protective equipment – this may be required where there is a significant risk of fire, such as flame proof overalls, or antistatic footwear to reduce the chance of electrostatic ignition if a hazardous area (EX Zone) has been established.

4.9 Further control measures

Section 4 of the assessment template prompts you to think about any further control measures that may be required to minimise risk when thinking about storage and disposal of dangerous substances. In section 4.1 you should detail the storage arrangements for your dangerous substances and in section 4.2 you should detail the waste disposal process for any dangerous substances. This may be transport of the dangerous substance to the designated waste store, or may mean contacting the FoSEM Health and Safety Team at JMS Building.

The remaining parts of section 4 require you to think about emergency procedures that need to be in place to address any emergency situations involving your dangerous substances. You will need to find out who your emergency contacts are for your Faculty or Division, for example, it may be a Principal Investigator (PI), someone in Technical Services or someone else (Section 4.3). You should enquire with your line manager or Health & Safety Coordinator if you are unsure. You should also consider foreseeable emergency situations (Section 4.4) such as fire, and plan for a response to these. Where you have a planned response to a foreseeable emergency, this procedure needs to be communicated to all those who will be required to follow it and the procedure should be tested periodically to ensure everyone remains aware of what to do. For example, a quarterly test of the emergency procedures. For more guidance on procedures for foreseeable emergencies, please see section 4.16 of this guidance document. Lastly, you should detail on the assessment what training will be required by people in the area/undertaking the operation.

4.10 Hazardous Area Classification

Section 5 of the assessment template is where you should detail if there is a possibility that an explosive atmosphere could be present in the work area or during a process. If you have identified that there is a possibility, an EX zone must be established. This requires you to identify the type of zone that is present and its extent, allowing you to make decisions around the measures required to control ignition sources within the zone. There is specific guidance around hazardous area classification in laboratories, which is detailed in Section 4.11.

Depending on the substances present, you should decide what type of release is possible (Section 5.1) i.e. continuous, primary or secondary, and zone areas using the classifications in Table 3.

Once you have classified a zone, you must also estimate its extent (Section 5.2). This can be done by using data regarding the substances concerned and applying it in a formula available from British Standard BS EN 60079, a copy of which can be obtained from the Health, Safety and Wellbeing Team.

Once you know the estimated extent of the zone, you can identify ignition sources that need to be controlled within it. For example, if a plug socket is positioned within your hazardous area, this would need to be upgraded to an ATEX rated plug socket and the installation of it certified by a CompEx certified contractor.

A schematic illustration of the EX zone must be created (Section 5.3). The illustration must provide a plan view of the zone, and a side and front elevation. The zone category and the distances it extends must be clearly labelled on the schematics. This information can then be shared with others who need to be made aware that an EX zone is in place, for example, contractors that need to carry out work within or nearby the zone.

Table 3: Hazardous area classification categories	
Gases, vapours and mists	
Zone 0	A place in which an explosive atmosphere consisting of a mixture of air and a dangerous substance in the form of a gas, vapour or mist is present continuously or for long periods or frequently e.g. the atmosphere being present for more than 4hrs/day.
Zone 1	A place in which an explosive atmosphere consisting of a mixture of air and a dangerous substance in the form of a gas, vapour or mist is likely to form occasionally under normal operation e.g. the atmosphere being present for 3mins-4hrs/day.
Zone 2	A place in which an explosive atmosphere consisting of a mixture of air and a dangerous substance in the form of a gas, vapour or mist is not likely to form in normal operation, but if it does occur, will persist for a short period only e.g. the atmosphere being present for less than 3mins/day.
Dusts	
Zone 20	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously or for long periods and infrequently e.g. over 4hrs/day.
Zone 21	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur occasionally in normal operation e.g. 3mins-4hrs/day.
Zone 22	A place in which an explosive 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 e.g. less than 3mins/day.

Finally, a List of Equipment for Hazardous Area Classification (LEAC) must be collated. You can use the template available on the Health, Safety and Wellbeing website. This document must list what equipment has been adapted or upgraded in order for it to comply with the zone it can be found within.

Where a zone has been identified, 'EX' signage, like that on page 2 of this guidance document, must be displayed at the entrance/s to the work area.

Identified EX zones need to be recorded on the University's MiCAD system to ensure this information is available and shared with those who may need to work in these areas e.g. contractors. If you need to establish an EX zone as part of your risk assessment, contact healthsafety@sussex.ac.uk to discuss how to record this on the MiCAD system.

4.11 Hazardous Area Classification in laboratories

If you work in laboratories, the Health & Safety Executive (HSE) provides specific guidance around how to apply the process of hazardous area classification.

In short, many of the dangerous substances used in laboratories will also be classified as hazardous to health. In some cases they will have a workplace exposure limit (WEL) detailed in the HSE document, EH40, that must not be exceeded. The control measures you have implemented through the COSHH risk assessment process may control any explosive atmosphere that may be created. This is because in some cases the WEL will be lower than the legal requirement of 25% of the LEL of a dangerous substance. However, there are some exceptions to this, so you must always check this information for each substance and not base your assessment on assumption. It is essential that you check the detail of a substance's WEL in relation to 25% of its LEL.

HSE guidance splits laboratory activities into three categories of scale: very small scale operations, medium scale operations and larger/pilot scale operations. As a guide, small scale operations will include use of flammable substances in quantities up to 50ml, whilst medium scale operations would include volumes of up to 2.5 litres (a standard Winchester bottle). The majority of lab activities are expected to sit within these two categories at the University. Therefore, hazardous area classification is unlikely to be required, but only if other control measures to manage the release of dangerous substances into the lab are in place and working. If this is not the case or cannot be confirmed, hazardous area classification should be implemented as detailed in section 4.10. If hazardous area classification is not required, your risk assessment must still consider how ignition sources will be removed or reduced as far as reasonably practicable. For more detail around the application of hazardous area classification in laboratories, check out the HSE guidance.

4.12 Labelling of pipes and containers

Through your exercise to identify dangerous substances that are present or likely to be present in your work area, you should also identify any pipework that contains or is likely to contain dangerous substances. For example, a gas manifold that transports acetylene or natural gas into a lab. If there is pipework in your work area and it is not immediately obvious what this contains, a job should be raised with the Estates Helpdesk to investigate and confirm the contents. If the pipe contains a dangerous substance, the pipe must be clearly labelled with its contents. For example, a label stating 'acetylene' can be affixed to the pipe at various points along it. Confirmation of what the pipe contains, or if it has been confirmed as decommissioned, should be kept as part of your DSEAR risk assessment.

4.13 Assessing the risk using the risk matrix

Once you have completed the assessment and noted control and mitigation measures already in place, you need to assess the level of risk presented with those existing controls in place (Section 6 of the assessment template). To do this, use the risk matrix provided in Appendix 1 of the risk assessment template. Consider the control measures that are in place already to manage the risk from the dangerous substances you will be using/producing.

With this in mind decide what the severity of an incident would be, for example, if there were to be a fire or explosion. As part of this process you should also consider whether the release of the dangerous substance is intentional (part of the process) or unintentional (such as a spill). You should assign a value of 1 to 5 as detailed in the risk matrix. Then, consider how likely it is that an incident such as a fire or explosion will occur, assuming the existing control measures are in place and working. Again, assign a value of 1 to 5, where 5 means a fire or explosion is expected to occur weekly. Multiply these two values together to calculate the risk rating for the work area or activity with only the existing controls in place.

Next, consider the additional control measures you have entered into the action lists in your risk assessment. Again, assuming that these additional control measures will be in place and working effectively once the work activity starts or the work area is in use, select a value of 1 to 5 for the level of severity and the likelihood and multiply them to get your overall risk rating, that takes into account all the additional control measures and mitigations. The risk rating should be lower with your additional controls and mitigations in place. If this is not the case, you should consider if further controls and mitigations are required to improve safety in the work area or of the activity.

4.14 Sign off process

Once your risk assessment is complete, it is important to ensure this is signed off (Section 7) by a responsible person to ensure resource for controls and mitigation is available, that it is suitable and sufficient, that fire safety has been considered and that technical elements have been reviewed and confirmed. Some elements of the sign off process (verification, Section 8) will depend on whether hazardous area classification has been required.

A responsible person could be a Principal Investigator, line manager, or a colleague of equal or higher seniority, provided they have suitable knowledge and understanding of the activity. The person assessing the activity must not sign off their own risk assessment.

4.14.1 Approval

The person who has carried out the DSEAR risk assessment must sign and date section 7.1. If more than one person has carried it out, the assessment must be signed by all parties. You can add more rows as necessary.

The risk assessment must also be approved by an appropriate responsible person in section 7.2. This could be a Principal Investigator, line manager, or a colleague of equal or higher seniority, provided they have suitable knowledge and understanding of the activity. The person assessing the activity must not approve their own risk assessment.

4.14.2 Verification

Verification (Section 8) is only required if a hazardous area (EX Zone) needs to be established. The verification process is undertaken by the University Health, Safety and Wellbeing Team, Fire Safety Team and the Senior Technical Manager for the area the DSEAR risk assessment will apply. This process does not need to be followed routinely for all risk assessments. The person carrying out the assessment must keep these parties informed of

their assessment by contacting:

- Senior Technical Manager for the work area.
- FoSEM Health and Safety Team (safetyscienceschools@sussex.ac.uk).
- University Health, Safety and Wellbeing Team (healthsafety@sussex.ac.uk).
- Fire Safety Team (healthsafety@sussex.ac.uk).

If the assessment falls outside the verifier's competence, they will make a decision on whether external verification is required. The cost of this is the responsibility of the Faculty or Division to which the DSEAR assessment belongs. Therefore, research proposals and other projects will need to factor this cost into grant applications and other budgetary arrangements.

Where verifiers make recommendations to the person carrying out the risk assessment to make control and mitigations more robust, these must be adopted before the risk assessment is verified.

Once verified, the person carrying out the assessment should share the document with the relevant Faculty Health and Safety Committee or Campus Operational Safety Group so that these groups and the Executive Dean of Faculty/Director of Professional Services Division can be kept informed of the locations of EX Zones in the areas they are responsible for.

For information on how to carry out the verification process, Verifier's should refer to the separate document 'DSEAR Risk Assessment Verification SOP'.

4.14.3 Review

The DSEAR risk assessment must be reviewed (Section 9) at regular intervals. It is recommended a review takes place at least annually, but outside of this, following an incident, following a change in the dangerous substances being used/produced, changes in the work area, changes to those involved in the process and any changes in law, guidance or industry best practice.

Once reviewed, the person/s reviewing the assessment must sign and date Section 9. If a hazardous area classification is included, the verification process detailed in 4.14.2 must be followed as part of the review.

4.14.4 Assessment Acknowledgement

Anybody involved in the work activity, or who works in the area the DSEAR risk assessment covers, must sign and date the completed assessment to confirm that they have read, understood and agree to follow the risk assessment (Section 10).

4.15 Third Parties

Third parties are those that may be invited onto campus to provide a service, carry out building works or they may be based on campus as part of a letting arrangement. It is important that information regarding DSEAR is shared with these third parties in the same way you would share other health and safety information that is relevant to them.

The sharing of hazardous area classification is of particular importance. For example, if you have arranged for a contractor to carry out work next to an uninterruptible power supply (UPS), where a hazardous area has been established around the UPS. The information needs to be shared with the contractor so that suitable measures can be put in place to eliminate ignition sources within that zone. For example, depending on the relevant risk assessment, it may be agreed with users that the UPS must be turned off as this would then mean the hazardous area could be temporarily suspended, or if not, it may be that the contractor cannot use equipment that will create a spark, must wear antistatic footwear and prevent use of flammable substances within the established zone.

Third party organisations that hire space from the University, must manage their own DSEAR risks, but they should ensure they meet the requirements of the DSEAR Safety Code of Practice, they may follow this guidance to do so. It is the responsibility of the team who agrees the hire to ensure the third party organisation is not introducing DSEAR risks to the campus. If it is, these need to be assessed and agreed before the hire goes ahead.

4.16 Emergency planning

As part of the DSEAR risk assessment process, you must consider foreseeable emergencies such as spillages (both large and small), fires, events as a result of mixing incompatible substances etc. These foreseeable events must be documented in your risk assessment. However, if your Faculty or Division has an emergency operating procedure or standard operating procedure covering these foreseeable events, you can refer to these documents in the risk assessment, for example by noting the procedure title and document control number.

The response to these foreseeable events must be documented. How this is done is up to the Faculty or Division to determine. The key things that must be completed to ensure foreseeable emergencies are properly planned for are:

- Identify the foreseeable event.
- Document the response procedure e.g. who will lead the response from the Faculty or Division, building closure arrangements, how this process links in with the University's incident response process etc.
- Communicate the procedure to those who need to be aware.
- Provide any equipment required to respond to the event.
- Test the procedure periodically e.g. quarterly.
- Address any issues that are identified through these tests such as reviewing the procedure or providing additional training.

4.17 Accidents, incidents and near misses

All accidents, incidents and near misses related to DSEAR need to be reported using Sussex Direct. For example, if a fire starts, there is a build up of dust on surfaces in a workshop, or a Winchester bottle of solvent is left open overnight, allowing flammable vapour to be released and potentially build up in a work area. Once reported, and depending on the nature of the report, it may be assigned to a local Health and Safety Manager from the

Faculty or Division, or to a Health and Safety Coordinator for follow-up. The University Health, Safety and Wellbeing Team may investigate further in order to identify opportunities to further build on control and mitigation measures to make them more robust. The aim of an incident follow-up is to identify areas of learning, not to place blame on individuals or teams.

4.18 Monitoring and review

Monitoring and review should be carried out by Faculties and Divisions on a regular basis. For example, control and mitigation measures in place for DSEAR could be reviewed through Faculty and Division workplace inspections.

The University Health, Safety and Wellbeing Team will also carry out periodic review of DSEAR arrangements. For example, DSEAR themed audits may be carried out whereby the team would review Faculty and Division DSEAR arrangements against the University's Safety Code of Practice.

Whether carried out locally by Faculties and Divisions, or carried out by the University Health, Safety and Wellbeing Team, the findings and actions from monitoring and review activities should be documented and tracked so that actions can be completed.

5. Other Considerations

5.1 Contact Information

Faculty of Science, Engineering and Medicine (FoSEM) Health and Safety Team

E: safetysciencesschools@sussex.ac.uk

JMS Building
University of Sussex
Falmer

University Health, Safety and Wellbeing Team

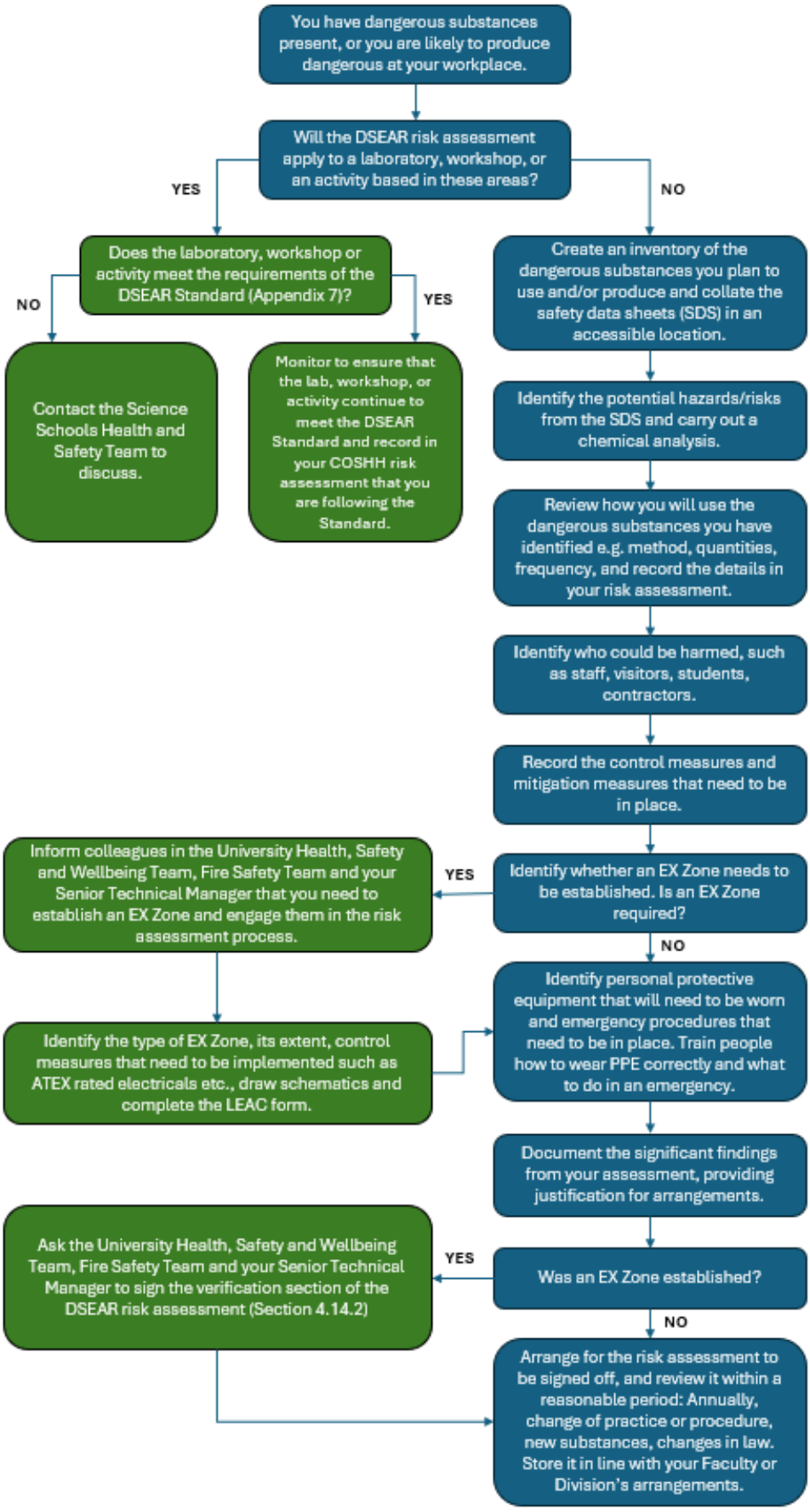
E: healthsafety@sussex.ac.uk

Sussex House
University of Sussex
Falmer

See also:

- Health and Safety A-Z: Dangerous Substances and Explosive Atmospheres Regulations (DSEAR)
- Pressure Systems : A to Z of health and safety : Health and Safety : Schools and services : University of Sussex
- HS C804 Management of DSEAR Safety Code of Practice
- HS I803 Instructions for Verifiers of DSEAR Risk Assessments
- HS I802 DSEAR Laboratory and Workshop Standard
- HS F052 Dangerous Substances Identification Sheet
- HS F053 List of Equipment for Area Classification (LEAC)

Appendix 1: Quick Reference Guide



Appendix 2: Determining whether a flammable liquid is capable of releasing sufficient vapour to produce an explosive atmosphere.

First you need to convert the lower explosive limit of the substance to grams per cubic metre (g/m^3). This can be done by multiplying the LEL% by the substance's molecular weight, then dividing this by the constant, 2.4.

$$g/m^3 = \frac{\text{LEL\% x Mol weight}}{2.4}$$

Worked example – Acetone

$$g/m^3 = \frac{2.5 \times 58.08}{2.4}$$

$$g/m^3 = \frac{145.2}{2.4}$$

$$g/m^3 = 60.5 g/m^3$$

Next you should work out how much of the substance could be spilt, and fully evaporate, before the LEL% is reached. This can be done by multiplying the LEL% grams per cubic metre conversion by the volume of the room you will be working in, then dividing this by density (g/m^3) of that substance at 20°C (ambient temperature, though bear in mind you may not always be operating at 20°C). This will provide a value in grams, which can then be converted to litres by dividing by 1000.

$$\frac{g/m^3 \text{ x room volume}}{\text{specific density @ 20°C}} \quad /1000$$

Worked example – Acetone in a room 5 x 7 x 3 metres in size (105 m^3 volume)

$$\frac{60.5 \times 105}{0.79} \quad /1000$$

$$\frac{6352.5}{0.79} \quad /1000$$

$$8041.14 \quad /1000$$

$$= 8.04 \text{ litres}$$

In this worked example, 8.04 litres of acetone would need to evaporate in the room for the LEL% to be reached. However, DSEAR requires that 25% of the LEL% is not exceeded. Therefore the number of litres should be further divided by 4 in order to find out the number of litres that would need to evaporate before 25% of the LEL% is reached.

$$\frac{8.04 \text{ litres}}{4}$$

= 2.01 litres

Therefore, in this worked example for Acetone, in a room of 105 m^3 volume, 2.01 litres of acetone would need to evaporate before 25% of the LEL% is reached (the legal limit), and 8.04 litres would need to evaporate before an explosive atmosphere could be produced in the room. Therefore, if allowed to evaporate, the maximum size of a container of acetone in this room should not exceed that of a standard Winchester bottle i.e. 2.5 litres.

This calculation provides you with an indication of the limits of this space, however bear in mind it does not take into account other substances that may also be producing vapour in the same room and therefore contributing to production of an explosive atmosphere. It is also unlikely that full evaporation will be able to take place, therefore localized zoning may be required above the open container or spillage depending on the location your calculations are covering. The calculations also do not take into account ventilation in the area, which would support keeping the LEL% as low as possible.

Data used in this worked example was taken from the GESTIS data base.

Appendix 3: Flammability Classes for liquids, gases and solids

Flammable Liquids			
Flammability Category	**Previously known as**	**Flashpoint (FP) & Initial Boiling Point (IBP)**	**Examples**
1	Extremely flammable liquid and vapour.	<23°C FP ≤ 35°C IBP	Diethyl Ether
2	Highly flammable liquid and vapour.	<23°C FP >35°C IBP	Isopropanol, Methanol, Ethanol
3	Flammable liquid and vapour.	≥ 23°C and ≤ 60°C FP	Acetic Acid
4	Other combustible liquids.	> 60°C and ≤ 93°C FP	Diesel fuel

Flammable Gases		
Flammability Category	**Definition**	**Examples**
1	Gases, which at 20°C and a standard pressure of 101.3kPa: a) Are ignitable when in a mixture of 13% or less by volume in air; or b) Have a flammable range with air of at least 12 percentage points regardless of the lower flammable limit.	Hydrogen Acetylene
2	Gases, other than those of Category 1, which at 20°C and a standard pressure of 101.3kPa, have a flammable range while mixed with air.	Ammonia

Flammable Solids		
Flammability Category	**Definition**	**Examples**
1	Burning rate test: Substances or mixtures other than metal powders: a) Wetted zone does not stop fire; and b) Burning time < 45s or burning rate > 2.2mm/s Metal powders: burning time ≤ 5mins.	Sodium
2	Burning rate test: Substances or mixtures other than metal powders: a) Wetted zone stops the fire for at least 4mins; and b) Burning time < 45s or burning rate > 2.2mm/s Metal powders: burning time > 5mins and ≤ 10mins.	Barium

Appendix 4: Guidance for completing Section 3 of the 'Large Inventory' DSEAR Assessment

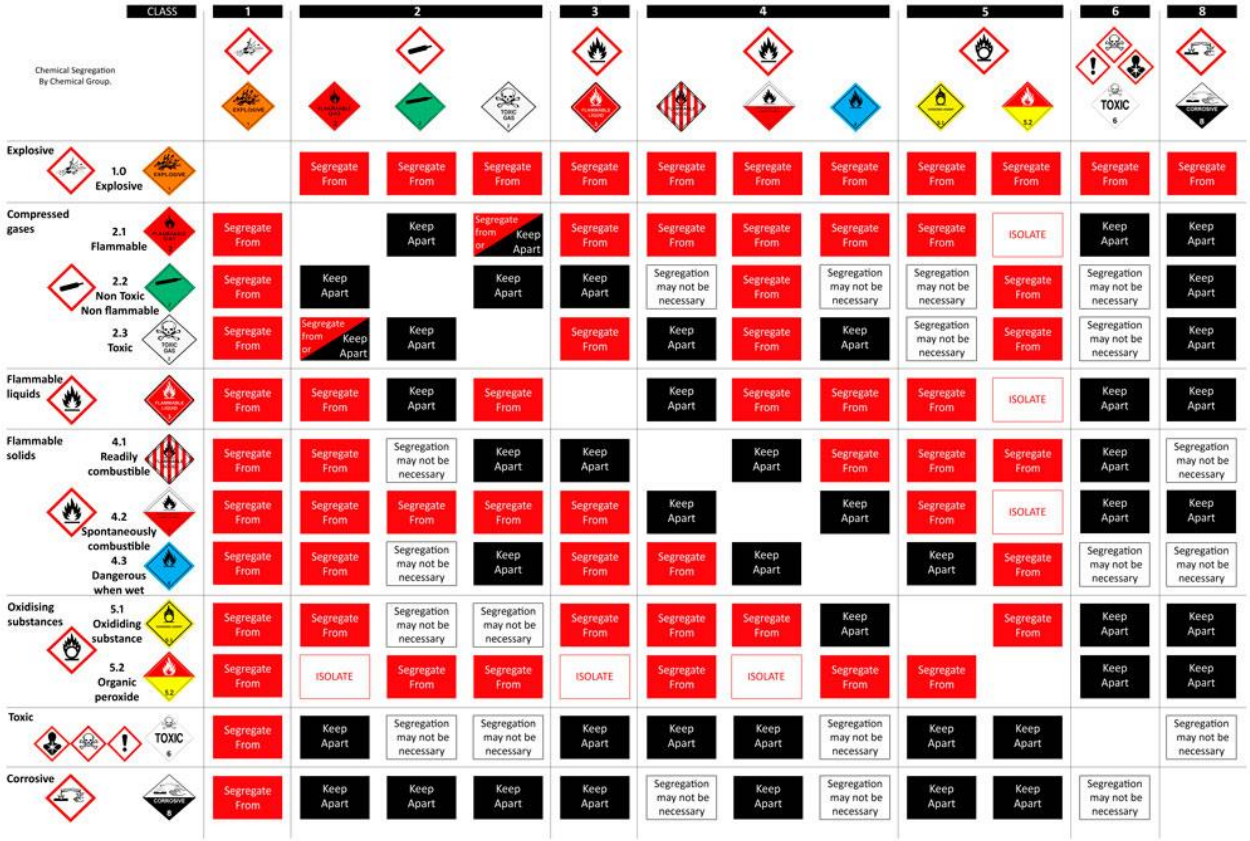
3.1 Process/Activity **Where appropriate to the nature of the process or activity:**	**Yes**	**No**	**N/A**
Has the quantity of the dangerous substance held/used been reduced to a minimum?			
State what has been done to reduce the quantity of the dangerous substance to the minimum required and provide justification for this quantity. As a guide, you should only have enough of a dangerous substance present to allow you to work for a day.			
Have steps been taken to avoid or minimise releases (whether the release is intentional or unintentional?			
This may be things such as securing bottles of dangerous substances with their cap when you finish using them, containing processes within fume hoods or covering processes to reduce any vapour that may be created.			
Have steps been taken to control release at source?			
For example, has a container holding a dangerous substance been covered during a process. In terms of storage, are Winchester bottles capped in passive storage to prevent releases.			
Have steps been taken to prevent the formation of an explosive atmosphere?			
Is your process or activity being carried out within a fume cupboard. Are measures in place to minimise the risk of spills, such as the use of Winchester carry baskets			
Have steps been taken to collect, contain and remove any releases to a safe place (e.g. by ventilation)			
Where will the process or activity be carried out. For example, will it take place in a fume cupboard. Has general ventilation in the work area been confirmed as providing at least 5 air changes per hour.			
Have steps been taken to avoid adverse conditions (e.g. the limits of temperature or other control settings)?			
If you have measures in place to manage the risk from dangerous substances, for example, operating a work area at a certain temperature to prevent flammable substances being used from reaching their flashpoint, what other measures are in place to ensure these controls are maintained.			
Are incompatible substances kept apart in storage and so far as is practicable, in use (e.g. oxidisers and combustibles)?			
Explain here what is done to ensure this is the case. For example, do you have separate chemical cupboards for keeping incompatible substances apart and are those involved in the process aware of what substances should be kept apart.			
Have the number of employees exposed to the dangerous substances or explosive atmosphere been reduced to the minimum?			
Give consideration here to how many people will be exposed during the process. You should consider everyone who may be exposed, not just those directly involved. For example, if you are carrying out the process in a shared lab, have those sharing the lab been considered. You should aim to have the least number of people at risk and provide justification for this.			
Has plant been supplied that is explosion resistant?			
Where there is a risk of explosion within equipment that you plan to use, this must be supplied by a reputable retailer (as with all equipment) and able to contain the pressure from an explosion. For example, a temporary flammable store with vented panels that seal in a fire and are able to contain low pressure changes as a result of ignition of substances held within the unit.			
Is explosion suppression or relief provided on equipment?			
Where there is a risk of explosion consider whether suppression is required or pressure relief panels. For example, if you are working with a pressure system, does it have pressure relief valves fitted and if so, are these kept free from obstruction.			
Have adequate measures been taken to control or minimise the spread of fire, or explosion?			
State what measures are in place such as a fire risk assessment that covers the area the activity or process is to take place in. If you are unsure, you should contact healthsafety@sussex.ac.uk to confirm.			
Has suitable Personal Protective Equipment (PPE) been provided and have operatives been trained how to wear it correctly? E.g. Antistatic boots.			
Is personal protective equipment required to protect operatives, for example, heat resistant gloves, or antistatic footwear if an EX zone needs to be established as a result of your risk assessment.			
3.2 Workplace/process and management systems **Where appropriate to the nature of the process or activity:**	**Yes**	**No**	**N/A**
Is the workplace designed, constructed and maintained so as to provide adequate fire resistance and/or explosion relief?			

Detail what is in your workplace to achieve this. You may need to consult a fire risk assessment covering your building or work area. You may also need to consult the fire safety team.			
Is any assembly, construction, installation, rig, plant, equipment, protection system etc. designed in such a manner as to minimise risk of fire and/or explosion?			
If any of the equipment you will be using is designed to minimise the risk of fire or explosion, detail that here. Any specifications you may have can also be attached to the risk assessment as an appendix.			
Have appropriate safe systems of work, or other required procedural systems of organising work, been developed and communicated to the workforce, either by way of this form or another document?			
Detail here what has been communicated to those involved in the activity or those who may be affected and need to be aware. If this is yet to be done, you can state that here and include an action in the plan below.			
Is a permit to work scheme required for working with the substance(s), or in the work area, and are these strictly enforced?			
Detail here if a permit is required for accessing the work area or for using the substance. For example, any hot works such as welding will require a permit before the activity is undertaken.			
Have all such areas been classified into zones in accordance with Schedule 2 of the Regulations?			
If there is likely to be an explosive atmosphere present, then you need to state that here and explain what zone is to be established i.e. 0, 1 or 2 for flammable gases, mists and vapours or 20, 21 or 22 for dusts. There is no need to go into the extent of the zone at this point as this can be detailed in the calculation section later in the assessment. If you work in a laboratory with flammable substances, you may not need to classify hazardous areas if you have robust control measures in place for preventing the formation of an explosive atmosphere or you are carrying out small or medium scale research. You should refer to HSE guidance on this for support.			
Where necessary have such classified zones been marked at their entry points with the specified 'EX' hazard warning sign?			
Detail here if the work area where an EX zone has been established already has EX signage on its entry points. If it doesn't, this can be included as an action.			
3.3 Storage	**Yes**	**No**	**N/A**
Are all flammable substances kept in suitable fire-resistant storage and are all quantities in excess of 50ltrs kept in an appropriately protected external flammable store?			
Where dangerous substances cannot be kept in external stores, the preferred method of internal storage is use of double skinned 90 minute flammable cabinets. Wherever possible, storage should be limited, for example, having a shared supply of the dangerous substance rather than individuals and teams having their own supply.			
Are all petroleum spirits, or derivatives thereof, in excess of 50ltrs kept in dedicated and appropriately protected petroleum spirit stores?			
Consideration needs to be given to volume of petroleum spirits and derivatives stored. This is because large supplies may be covered by separate regulations.			
Are incompatible substances stored apart (e.g., flammables, oxidisers, combustibles, flammable gases, LPG)?			
Some substances cannot be stored together as they may violently react with one another, or promote a fire. You can use the storage chart in appendix 4 to support you with this, or you can contact the DSEAR Technical Team.			
Where appropriate have storage areas been designed to provide explosion relief/resistance?			
This should be considered with any storage. For example, if external storage is used, are there openings in the roof to allow explosion pressure to be released and not across a footpath. If indoor storage is unavoidable, Asecos double skinned cabinets will withstand an internal explosion containing it within the cupboard.			
3.4 Emergency Procedures	**Yes**	**No**	**N/A**
Have suitable emergency procedures been developed and communicated to the workforce to deal with adverse process conditions (e.g., exceeding limits of temperature, or other control settings)?			
Consider all scenarios where something could go wrong, such as a temperature controlled process going out of control. For each, there should be a clear procedure in place that everyone who may be affected is aware of and can follow. This procedure should be tested periodically, such as quarterly, to ensure those involved remain aware of action to take and that any safety equipment required is stocked and working effectively. If there is the likelihood of an incident affecting the wider university community, it			

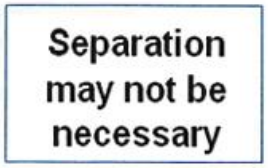
should link to the university's incident management process.			
Have suitable emergency procedures been developed and communicated to the workforce to deal with fire and evacuation?			
Similarly to above, consider what emergency procedures are in place to deal with a fire or evacuation. The university's standard fire evacuation process may not be suitable for the activity you are assessing, and there may be other steps you need to include.			
Have suitable emergency procedures been developed and communicated to the workforce to deal with the spillage of dangerous substances?			
Again, consider the procedures and equipment that are needed in place to ensure spillages, both large and small, can be dealt with effectively. Those involved should be aware of what they need to do and equipment should be readily available. The procedures should be tested periodically to ensure they remain effective.			
3.5 Waste Disposal	**Yes**	**No**	**N/A**
Have suitable procedures been developed, communicated to the workforce and implemented to deal with the safe transport and disposal of dangerous substances?			
Consider waste arrangements. In most cases you will be able to follow the university's waste process for dangerous substances. Get in contact with the DSEAR Technical Team to discuss this further and detail the outcome in this section.			
3.6 Information, Instruction & Training	**Yes**	**No**	**N/A**
Has appropriate information, instruction and training, commensurate with the hazard potential of the dangerous substances, or process, been provided to the workforce as regards; product detail, hazard, risk reduction methods to be employed, management systems to be followed, emergency systems, etc.?			
Consider what information needs to be shared and training provided for those involved in the activity, wider work area or others who need to be aware that could be affected. Describe here what will need to be provided and to whom.			
Are only trained and competent persons involved in work with dangerous substances?			
Consider who will be involved in the process or in the work area. Are they competent to work with the substances or in the area. Any gaps in competence should be addressed and you can summarise these here. For example, all staff should attend COSHH and DSEAR Risk Assessor training, and attend refresher training periodically.			

Appendix 5: Chemical Compatibility Chart and Key

This chemical compatibility chart is used in industry and should be used as a guide. In a number of locations on campus, such as laboratories, storage risk is mitigated through the provision and use of 90-minute fire rated cabinets. Contact safetysciencesschools@sussex.ac.uk or healthsafety@sussex.ac.uk for further support (Reference DSC Limited). Some Faculties, such as FoSEM, have a Standard Operating Procedure in place for the storage of substances. You should check your Faculty or Division's arrangements.



These combinations should not be kept in the same building compartment or outdoor storage compound. Compartment walls should be imperforate, of at least 30-minute fire resistance and sufficiently durable to withstand normal wear and tear. Brick or concrete construction is recommended. An alternative is to provide separate outdoor storage compounds with an adequate space between them.



Separation may not be necessary, but consult suppliers about requirements for individual substances. In particular, note that some types of chemicals within the same class, particularly Class 8 corrosives, may react violently, generate a lot of heat if mixed, or evolve toxic fumes.

This is used for organic peroxides, for which dedicated buildings are recommended. Alternatively, some peroxides may be stored outside in fire resisting secure cabinets. In either case, adequate separation from other buildings and boundaries is required.

Separate packages by at least 3 metres in the storeroom or storage area outdoors. Materials in non-combustible packaging that are not dangerous substances and present a low fire hazard may be stored in the separation area. This standard of separation should be regarded as a minimum between substances known to react together readily, if that reaction would increase the danger of an escalating incident.

The lower standard refers to the outside storage of gas cylinders. Where non-liquefied flammable gases are concerned, the 3-metre segregation distance may be reduced to 1 metre.

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