Guidance on Risk Assessments for compliance with Dangerous Substances and Explosive Atmospheres Regulations (DSEAR)

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INTRODUCTION

With the increasing use of refrigerants with various levels of flammability, it is important for the industry to understand how to comply with the Dangerous Substances and Explosive Atmospheres Regulation 2002 (DSEAR).

When originally written, DSEAR only applied to those refrigerants defined under hazard classes H220 (Extremely Flammable Gas) or H221 (Flammable Gas). Refrigerant classes A2 and A3 are classified as H220, and with the introduction of class A2L refrigerants, they were also classified as H220. Ammonia (Class B2L) is, however, classified as H221.

As of May 2019, class A2L refrigerants have been re-classified as H221 Flammable Gas.
The regulation was amended in 2015 to include gases under pressure (hazard class H280), which means all classes of refrigerant are within the scope of DSEAR, and hence ALL refrigeration, air conditioning and heat pump (RACHP) installations need to be compliant.

As a result, and in addition to normal Management of Health and Safety at Work assessments, a risk assessment must be undertaken to cover all aspects of work pertaining to the refrigerant in use. This document is intended to be a general guide as to how to approach preparing a risk assessment which will ensure compliance with DSEAR. It should be read in conjunction with the regulation itself. Following publication of this introductory guide, more application specific guidance will be issued in due course.

This guide has been issued by FETA, and we acknowledge the contributions of the Institute of Refrigeration and the Health and Safety Executive in its preparation.

DEFINITIONS

Dangerous Substance
A substance or preparation which meets the criteria in the approved classification and labelling guide for classification as a substance which is explosive, oxidising, flammable, highly flammable, or extremely flammable, whether or not that substance or preparation is classified under the CHIP regulations. However, these regulations were revoked on the 1st July 2015. The definition of a dangerous substance is now defined within the Classification, Labelling and Packaging Regulations. It is defined as:

"A substance or a mixture fulfilling the criteria relating to physical hazards, health hazards or environmental hazards, laid down in Parts 2 to 5 of Annex I is hazardous and shall be classified in relation to the respective hazard classes provided for in that Annex. "

"Where, in Annex I, hazard classes are differentiated on the basis of the route of exposure or the nature of the effects, the substance or mixture shall be classified in accordance with such differentiation. "

Explosive Atmosphere
A mixture under atmospheric conditions of air and a gas, that once ignited spreads to the entire unburned mixture. The following is also worth noting:

(a) Atmospheric conditions are -20°C to 40°C and 0.8 to 1.1 bar;
(b) Combustion - the definition within the regulation states that where it can be ensured that the gas is present in a concentration below the lower explosive limit, the atmosphere is not explosive. (Within the HSE approved code of practice the Lower Flammable Limit (LFL) and Lower Explosion Limit (LEL) are intended to have the same meaning).

Hazard
The physico-chemical property of a dangerous substance which has the potential to give rise to fire, explosion or other events which can result in harmful physical effects of a kind similar to those which can be caused by fire or explosion.

NOTE: Sudden release of pressure due to a failure of pressure containment is classified as an "explosion" even when there is no ignition or combustion.

Risk
The likelihood of a person's safety being affected by harmful physical effects being caused from fire, explosion or other events arising out of the use of the hazardous substance.

Risk Assessment
There are two methods of Risk Assessment commonly used, these are:

- Qualitative Assessments, a simple study using personal judgement and perception on elements of risk;
- Quantitative Assessments, to give an objective probability estimate, an in depth study using known information on elements to calculate the effects of risk exposure on people, environment and economy.

Employer
A person, partnership, corporate body, unincorporated body or organisation that employs one or more persons under a contract of employment. The term employer is used throughout the HSE DSEAR Approved Code of Practice. For the purposes of the regulations and this guidance document, employers include the end user of the refrigeration, air conditioning and heat pump systems as well as contractors, sub-contractors and self-employed persons. In the case of the "end user" employing a contractor, subcontractor or self employed person, both employers have duties under the regulations. Each employer has duties to their own and the other employers employees. The employers should co-operate and collaborate to ensure that all duties imposed by DSEAR are fulfilled.

Competency
The definition of competency is complex. A common description of a competent person would include the following traits:

- Trained;
- Experienced;
- Skilled;
- Appointed;

A competent person undertaking a risk assessment would also need to be given adequate time and resources to enable the assessment to be carried out to the required standard.

Workplace
Any premises or part thereof used for or in conjunction with work and includes; any place within the premises to which an employee has access while at work and any areas used as a means of access or egress from that place of work.

(a) Workplace also includes areas in private dwellings where work is carried out.
(b) Premises can also be used to include vehicles, vessels, land based or off-shore, private roads or paths on industrial estates and business parks.

Control
Is used to describe steps taken to reduce the likelihood of a fire, explosion or uncontrolled release. Control measures should be considered before mitigation.

Mitigation
Is the description of the steps taken to minimise the consequences of the aforementioned events.

Reducing Risk
The Health and Safety Executive attaches particular importance to reducing risks to people as a result of appropriate consideration of health and safety in design. During the design stage, which covers concept selection through to detailed design specification (drawings, calculations, specifications, etc), there is the maximum potential for reducing risks, by application of the principles of inherently safer design.

The aim of the risk reduction process is to achieve as low a level as reasonably practicable (ALARP). Detailed guidance on the principles of ALARP can be found on the HSE website, see below.

REFERENCE

This guidance should be read in conjunction with the regulation itself, and the HSE's own Approved Code of Practice (ACOP).

The regulation can be downloaded at: http://www.legislation.gov.uk/uksi/2002/2776/contents/made

The ACOP can be downloaded at: http://www.hse.gov.uk/pubns/books/l138.htm

The HSE website has further information at: http://www.hse.gov.uk/fireandexplosion/dsear.htm

ALARP can be found at: http://www.hse.gov.uk/risk/theory/alarp.htm

The Dangerous Substances and Explosive Atmospheres Regulations of 2002

These regulations were amended in 2015. One part of that change was to extend the regulation to cover gases under pressure (H280). It therefore places requirements on employers to assess the risk for such substances (refrigerants etc) and put into place suitable control and mitigation measures.

RISK ASSESSMENT

Regulation 5 of DSEAR requires all employers and self-employed people to undertake a risk assessment to identify all potential risks to employees and others whose safety may be affected by the use or presence of a dangerous substance in the workplace.

The Management of Health and Safety at Work Regulations requires that employers with 5 or more employees must record the significant findings of their assessment. If less than 5 persons are employed. It is best practice that the assessment is recorded. It may be used as evidence that the evaluation of risk has been completed to a satisfactory standard.

All Refrigeration, Air Conditioning, Heat Pump and Building Services Contractors should be familiar with this concept, as a large proportion of their work activities require the generation of a suitable and sufficient risk assessment.

It could be the case that a separate DSEAR assessment may not be necessary (provided that the minimum requirements of a DSEAR assessment are included) as the assessment of the relevant risk may be highlighted within the risk assessment required by the Management of Health and Safety Work Regulations.

DSEAR states that the following shall be considered with regard to risk assessment as a minimum:

- The hazardous properties of the substance;
- Persons likely to be affected and the severity of the consequences;
- Information on safety provided by the supplier, including information contained in any relevant safety data sheet;
- The work involved including:
    - The work process;
    - Type and amount of substances used;
    - If the work involves more than one substance, would the risk increase if these interacted;
    - Safe handling, storage and transport of dangerous substances and of waste containing dangerous substances;
- Potentially high-risk activities such as maintenance;
- The effectiveness of control measures that have or will be taken;
- The likelihood of an explosive atmosphere occurring and its persistence;
- The likelihood of ignition;
- The scale of the fire or explosion and its effects;
- Damage to adjacent premises;
- Additional safety information required.

Within the Refrigeration, Air Conditioning and Heat Pump industry it is possible to split the activities into the following areas:

- Installation (High Risk);
- Operation (Low Risk);
- Service (Medium Risk to High Risk);
- Maintenance (Medium to High Risk);
- Repair and Decommissioning (High Risk);

Each operation listed above brings with it differing levels of risk. The levels indicated are merely an indication of the potential risk. The assumptions regarding likely risk rating are based upon the risk without sufficient control measures; the rating once suitable measures have been identified will obviously be reduced. As illustrated above, the area with the potential to have the lowest risk rating would be the operation of the plant or equipment as long as the equipment has been sized and selected in accordance with the relevant standards.

If a refrigeration, air conditioning or heat pump system were to leak either during operation, or when refrigerant was being added or removed there will always be a possibility of a flammable mixture being present, albeit for a very short period of time. The is due to the fact that as the refrigerant leaks, at one point the refrigerant to air mixture will pass through the lower and upper flammability limits.

However, if it can be ensured that the concentration of refrigerant/air mixture within the space does not reach the lower explosion or flammable limit, then this atmosphere is not flammable. Therefore the DSEAR requirements for risk assessment, zoning and co-ordination do not apply. However, If the equipment is installed in an environment that already requires zoning, then the DSEAR requirements for risk assessment, zoning and co-ordination will apply.

BS EN 60079-10-1:2015 states that “in some cases a zone of negligible extent (NE) may arise and may be treated as non-hazardous. Such a zone implies that an explosion, if it takes place, will have negligible consequences”.

If the risk assessment is carried out on a system that contains R717, it is of interest that BS EN 60079-10-1:2015 states that “Experience has shown that a release of ammonia with a LFL of 15% by volume, will often dissipate rapidly in open air, so a flammable gas atmosphere will, in most cases be of negligible extent”. This reflects the low molecular weight of ammonia and so cannot be applied to heavier refrigerants without further analysis.

When the equipment is to be installed or repaired/decommissioned, or in some cases serviced, then the risk increases due to the nature of the work involved. It is not the purpose of this document to cover the basic principles, or indeed to give a step by step guide on a standard risk assessment. Therefore, we will concentrate on the areas specific to DSEAR.

Work processes that will potentially require DSEAR specific assessments to be undertaken will include the following:

- Installation/repair of pipework using Oxy/Fuel systems;
- Pressure tightness and strength testing of pipework using a suitable inert gas;
- Use of solvent based cleaning materials;
- Use of adhesives;
- Flushing of contaminants from within the system;
- Adding/removing refrigerant from the system;
- Decanting oil from a refrigerating system.

The above list is by no means exhaustive and is only intended to illustrate the sort of activities where significant risk could occur.

If the risk assessment is carried out correctly it will enable employers to identify and carefully examine all dangerous substances that are present or likely to be present within the workplace. This information will enable the employer to reduce the risks, so far as reasonably practicable. Recording the findings of the risk assessment will in turn demonstrate that the employer has thoroughly considered the risks to the safety of his employees and others.

Employers should carry out hazardous area classification as part of the risk assessment to identify places within the workplace where controls over potential ignition sources are needed and also those places where no risk is present. Employers would also need to consider how this will affect existing and future fire precautions.

Hazardous substances used in workplace will include:

- Substances handled, stored and used for processing;
- Those produced or given off by a process or activity, or as a result of an incident or accident;
- Any used for or arise from maintenance, cleaning and repair work;
- Substances produced as a by-product of any work or process;
- Any substance naturally occurring in the workplace.

Hazardous properties of substances used must be assessed. These substances could include the following:

- HFC Refrigerants;
- HFO Refrigerants;
- CO_2;
- Hydrocarbons;
- Ammonia;
- Oxygen free nitrogen;
- Trace Gas (Nitrogen/Hydrogen mix);
- Oxygen;
- Acetylene;
- Propane;
- Butane;
- MAPP Gas;
- Solvents;
- Adhesives;
- Paint.

The above list is by no means exhaustive and is only intended to illustrate a range of potentially dangerous substances.

Information on the dangerous substances used with the workplace can be found by consulting material safety data sheets. Safety data sheets should be kept by the employer and the contents within communicated with all relevant members of staff. These will need to be reviewed periodically to ensure that they are current.

When considering the potential for the release of dangerous substances, the following should be included:

- Unavoidable releases, such as purging of air from oxy/fuel brazing equipment;
- Intentional releases, such as propellant from aerosol leak sprays;
- Foreseeable releases, leaks from refrigerant cylinders whilst charging/recovery.

When assessing the potential risk when undertaking any of the work practices, the employer must assess whether an explosive/flammable atmosphere is likely to form and for how long. This part of the assessment is potentially the most problematical. Within the HSE Dangerous Substances and Explosive Atmospheres Regulations approved code of practice (ACOP) it does state that a dangerous substance travelling through a seamless pipe, that is well maintained, is extremely unlikely to leak and therefore should not be considered as hazardous. Therefore, any refrigerant within seamless pipework is unlikely to be considered as a possible leakage point for the purposes of the assessment.

Other parts of the system and those jointed by non-permanent means are required to be assessed for likelihood and potential for leakage.

Risk assessments looking at a range of refrigeration systems and the likelihood of leakage and potential effects have been published and are a useful source of information when determining the risk of a particular installation.

REVIEW OF RISK ASSESSMENT

Employers should review their risk assessment at regular Intervals, dependent upon the nature of the risk. If any major changes are made with regard to the process or substances used, then the risk assessment would need to be reviewed. Employers commonly note the next planned review date each time the risk assessment has been reviewed.

The HSE ACOP states that changes in the workplace which should require a risk assessment to be reviewed may include:

- Changes to the substances used;
- Replacement or modification to the plant and/or equipment used;
- Changes in processes or methods of work which could affect the nature of hazards and risks;
- Changes to the workforce;
- Adverse events such as accidents, dangerous occurrences or near misses should be a trigger for reviewing the original risk assessment.

CONSIDERATION OF IGNITION SOURCES

Part of the risk assessment is to identify potential ignition sources. As with all risk assessments, the likelihood and severity of the result should be considered.

The ACOP requires that we consider the following forms of energy as ignition sources:

- heat;
- electrical;
- mechanical;
- chemical.

The following table shows characteristics of some of the refrigerants that may be required to be assessed (table kindly supplied by Chemours).

Refrigerant	Safety Classification	Saturated Liquid Temp °C	Practical Limit kg/m³	LFL kg/m³	LFL %	UFL kg/m³	UFL %	Density kg/m³	MIE mJ	Molar Mass	Auto Ignition Temperature °C	Hot Surface Ignition Temperature °C	Heat of Combustion
R134a	A1	-26.1	0.25	N/F	N/F	N/F	N/F	5.26	N/F	102.03	N/F	N/F	N/F
R600a	A3	-11.8	0.011	0.043	1.8	0.203	8.4	2.44	0.25	58.12	543	N/A	49.15
R290	A3	-42.1	0.008	0.038	2.1	0.192	10.1	1.83	0.25	44.1	468	N/A	46.3
R1270	A3	-47.6	0.008	0.046	2	0.253	11.1	1.74	0.28	42	455	N/A	45.8
R170	A3	-88.6	0.0086	0.038	3	0.253	12.4	1.24	0.24	30.06	959	N/A	51.9
R152a	A2	-24	0.027	0.130	3.9	0.563	16.9	2.76	0.38	66	454	N/A	18.47
R32	A2L	-51.7	0.061	0.307	14.4	0.680	29.3	2.15	30-100	52	648	➢ 800°C	9.40
R1234yf	A2L	-29.5	0.058	0.289	6.2	0.573	12.3	4.77	5k-10k	114	405	➢ 800°C	10.70
R1234ze	A2L	-19	0.061	0.303	7	0.443	9.5	4.77	61k-64k	114	368	➢ 800°C	10.20
R454A	A2L	-48.3	0.056	0.278	8	0.522	15	3.34	300-1k	80.47	457	➢ 800°C	10.04
R454C	A2L	-45.9	0.059	0.293	7.7	0.569	15	3.78	300-1k	90.78	444	➢ 800°C	10.51

- Safety Classification from ISO 817.
- Saturation temperature (boiling point) measured in °C at standard atmospheric pressure.
- Practical limit - the maximum physical amount allowed in an occupied space in kg/m³.
- LFL (lower flammability limit) also known as LEL (lower explosion limit) - the minimum quantity of the substance, mixed with air, required to create a flammable mixture measured in kg/m³. LFL is also given in percentage terms (at 23°C 50% relative humidity (% volume/volume)).
- UFL (upper flammability limit) also known as UEL (upper explosion limit) - is the maximum quantity of the substance mixed with air, required to create a flammable mixture measured in kg/m³. UFL is also given in percentage terms (at 23°C 50% relative humidity (% volume/volume)).
- Density of the refrigerant at standard atmospheric pressure and 21°C.
- MIE (minimum ignition energy) in mJ.
- Molar mass in g/mol.
- N/F + Non Flammable.
- Hot surface ignition temperature test (ASTM D8211-18) was developed to measure the ignition temperature of A2L refrigerants, therefore A3 values are not available.
- Heat of Combustion, heat released kilojoules (kJ) when 1kg of the substance is completely burnt in air

ELIMINATION OR REDUCTION OF RISK

It is the responsibility of the employer to eliminate the risk if possible. If this is not achievable then the risk should be reduced to as low as reasonably practicable.

With regard to the refrigerant used within the system, it is not always possible to eliminate this, other than using a secondary fluid to control the environment (water, air etc.). If elimination is not possible then substitution shall be considered next.

This could involve the employer replacing a system which has a relatively high-risk rating to one with a lower risk e.g. replacing a system designed to work with an A3 refrigerant with a system designed to work with an A2L refrigerant. Another example of substitution would be the use of propane instead of acetylene as the fuel gas whilst undertaking hots works. When considering substitution, all characteristics of the substance must be taken into consideration.

Other ways of reducing the risk when undertaking the servicing and maintenance of refrigeration, air conditioning and heat pump systems would be to minimise the amount of the dangerous substance. Consideration should be made also to the temporary storage of such materials on site. If this is required, it may affect any existing risk assessment. Any substances should be stored in suitable cabinets or bins, located in designated well ventilated areas. Flammable substances should be stored separately from other substances that may increase the risk of fire.

THE HIERARCHY OF MITIGATION MEASURES

The following list is from the HSE DSEAR ACOP. The list is in order of priority:

- Reduction of the quantity of dangerous substances to a minimum;
- Avoidance, or minimising, of the release of a dangerous substance;
- Control of the release of a dangerous substance at source;
- Prevention of the formation of an explosive atmosphere, including the application of suitable ventilation;
- Ensuring that any release of a dangerous substance which may give rise to risk is suitably collected, contained, removed or otherwise rendered safe;
- Avoidance of:
    - ignition sources including electrostatic discharges;
    - adverse conditions which could cause dangerous substances to give rise to harmful effects;
    - segregation of incompatible dangerous substances.

VENTILATION

If the elimination or minimisation cannot be achieved and the system has the potential for leakage and pooling of the dangerous substances then additional ventilation may be required. If possible, natural ventilation should be utilised. For example, if all of the refrigeration containing parts are located in a machine/plant room, then a suitable number of vents should be in the walls of the room at low and high level. Adequate ventilation is typically taken to be that which limits the average concentration to no more than 25% of the LEL within the building, room or enclosure containing the dangerous substance. Further guidance on what would be considered adequate ventilation and how to calculate its effect can be found in BS EN 378, ISO 60335-2-89 and BS EN 60079-10-1.

HIERARCHY OF VENTILATION CONTROL

- Locate in open air. Where weather protection is required, it should be designed to prevent the accumulation of dangerous substances.
- Adequate natural ventilation for any potential source of release inside any enclosure or building where the flow of air is liable to be restricted. The ventilation should be designed to dilute the concentration of foreseeable releases of dangerous substances to a safe level by maintaining the average concentration during normal operations to below that which could form an explosive atmosphere.
- Enclosure within a cabinet or other suitable enclosure which is constructed of fire resisting materials and directly provided with local exhaust ventilation (LEV) to a safe place.
- Adequate LEV, provided and positioned to prevent or minimise releases of potentially unsafe concentrations, into the work area or room.
- Adequate mechanical general ventilation to the workspace in the event that closely positioned LEV is either not reasonably practicable or is insufficient by itself to dilute concentrations of releases of dangerous substances to a safe level.

For further guidance on Local exhaust ventilation please refer to HSG258 Controlling airborne contaminants at work.

SYSTEMS OF WORK

Employers should ensure that there is a system of work that ensures that the control measures for a particular activity are properly understood and implemented and that an appropriate level of control is in place.

The level of control will depend on the risks associated with the activity and may be based on simple operating procedures, safety method statements or a permit-to-work system.

OPERATING PROCEDURES (LOW-RISK ACTIVITIES)

For low-risk activities adequate control measures should be implemented through supervision or a system of work that may include the use of written operating procedures.

Low-risk activities are those activities that do not increase the level of risk associated with the work normally carried out in that area. They do not, for example, introduce ignition sources into the work area or create a risk of releasing dangerous materials. They may include:

- routine cleaning operations;
- dealing with small leaks and spills of non-hazardous materials during normal manufacturing or handling operation;
- routine machine and equipment adjustments.

SAFETY METHOD STATEMENTS (MEDIUM-RISK ACTIVITIES)

For medium-risk activities the employer should ensure that appropriate control measures are implemented through the use of safety method statements.

Medium-risk activities include maintenance, repair and service activities carried out by employees and contractors within or near to hazardous areas or on plant or equipment containing a dangerous substance.

They may involve work that releases small quantities of dangerous substances but they should not have the potential to release a significant quantity. A 'significant quantity' is considered to be one that could create explosive atmospheres beyond the hazardous areas already designated for the installation or one that could affect the health and safety of others on or off the site. Medium-risk activities are also those which do not introduce ignition sources into hazardous areas.

Such activities may include:

- Routine leak testing pipework and systems;
- Hot work, in areas where there are only small quantities of dangerous substances present that do not give rise to hazardous places (not on or near to a system that contains or has contained a hazardous substance).

A safety method statement is a written procedure to cover a particular non-routine task. As well as specifying the work to be done it will also identify the hazards associated with the work and the measures necessary to control those hazards. For repetitive tasks a generic safety method statement can be used and, where necessary, modified to take into account job-specific requirements or deviations. Safety method statements are inappropriate for high-risk activities which should be subject to a permit-to-work system. However, safety method statements may be incorporated into the permit-to-work system.

The safety method statement, whether it is prepared in-house or by outside contractors, should be clear, concise and contain the following information:

- Description of the task and where it is to be carried out;
- Sequence and method of work;
- Authors name and details of authorising persons;
- Hazards identified during the risk assessment;
- Skills required to deal with the hazards;
- Control precautions;
- Specific safety procedures;
- Details of isolations and related control procedures;
- Details of tools and equipment to be used;
- Method of disposal of waste and debris;
- Details of the state or condition in which the plant or equipment will be left at the end of the activity.

PERMIT-TO-WORK SYSTEMS (HIGH-RISK ACTIVITIES)

Where the proposed work is identified as a high-risk activity, employers should ensure that strict controls are in place and that the work is only carried out against previously agreed safety procedures. This should include implementing a permit-to-work system issued by a responsible person. They should be sufficiently knowledgeable about permit systems and the materials, processes, plant and equipment associated with the proposed work to be able to identify all the potential hazards and precautions.

High-risk activities are those where the foreseeable consequences of an error or an omission could result in immediate and serious injuries, e.g. an explosion or a fire that immediately affects people or traps them. They will normally include:

- Brazing, particularly on parts of the systems that have previously contained refrigerant;
- Carrying out hot work or introducing ignition sources in areas that are normally designated as hazardous;
- Work carried out in confined spaces;
- Breaking into the refrigeration plant.

Guidance on permit-to-work systems may be found on HSE's website at http://www.hse.gov.uk/safemaintenance/permits.htm and in Guidance on permit-to-work systems HSG250.

A permit-to-work is a documented system that allows specified personnel to carry out specific work within a specified time frame. It details the precautions required to complete the work safely and should be based on a suitable and sufficient risk assessment. It will describe what work will be done, how it will be done and by whom.

The permit-to-work requires affirmations from the person authorising the work and from the person carrying out the work. Where necessary it will also require a declaration from those involved in shift handover procedures or extensions to the permit to work. Once the work has been completed it will require a declaration from the originator of the permit that the work is complete and that the plant is ready for normal use.

The permit-to-work should be clearly laid out and easily understood by all parties. It should be designed to allow for use in unusual circumstances and detail procedures for suspension of the work, if required.

As well as detailing the precautions that need to be taken to prevent a fire or explosion, the permit-to-work should cover the precautions that are required to control health hazards and where necessary the hazards arising from entry into confined spaces, electric shock, high-pressure systems and contact with moving equipment.

HOT WORK

Hot work and maintenance processes that involve the application of heat such as brazing should be eliminated wherever reasonably practicable. However, if it is not possible to do so, before work commences employers should carry out the following:

- Carry out a specific risk assessment;
- If the systems have been previously charged with a refrigerant, ensure that all refrigerant is removed from the area where heat will be applied;
- Ensure that the system is suitably purged with a suitable inert gas prior to undertaking any hot works;
- Ensure that the purge gas is discharged in a safe well-ventilated area;
- Use a suitable flammable gas detector at all times;
- All hot works must be undertaken by trained competent persons;
- All hot work must be undertaken under a strict permit to work system.

HAZARDOUS AREA CLASSIFICATION

Regulation 7 of DSEAR requires competent identification of hazardous and non-hazardous zones before the work commences.

Hazardous places are classified in terms of zones. This description is based upon the frequency and duration of the occurrence of an explosive atmosphere.

The principle behind zoning is to analyse and classify the areas where explosive/flammable atmospheres could occur and therefore, select proper equipment to be used safely in that environment. Once this is complete equipment with a higher equipment protection level may be required.

Zone 0
A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is present continuously, or for long periods, or frequently.

Zone 1
A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.

Zone 2
A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

In some cases, a zone of negligible extent (NE) may arise and may be treated as non-hazardous. BS EN 60079-10-1:2015 notes that indications of the frequency of the occurrence and duration may be taken from codes relating to specific industries or applications.

The Air Conditioning, Heating, and Refrigeration Institute of America (AHRI) and The Japan Society of Refrigerating and Air Conditioning Engineers have independently published comprehensive reports documenting risk analysis.

AHRI have computational fluid dynamic modelling for R1234ze and R32 installed in a variety of applications. The Japanese publication follows a similar methodology to assess the risk in using a lower flammability refrigerant within a wider range of applications. These documents are valuable resources when undertaking hazardous area classification and when calculating the likelihood and severity of a leak.

BS EN 60079-10-1:2015 also details a complete methodology for the zoning of hazardous areas and calculating dispersal areas.

Drawings of the workplace illustrating the zoning areas are usually required.

When considering zoning of the workplace the zoning may change temporarily due to maintenance requirements. There is no specific requirement to draw up revised area classification when undertaking short term maintenance or repair of systems; however, an appropriate risk assessment is necessary.

The following flow charts are variants on those within BS EN 60079-10-1:2015. They illustrate the process for assessing the zoning requirements. We have included the initial process chart which ends with a link to either:

- Continuous grade of release;
- Primary grade of release;
- Secondary grade of release.

The next, more detailed flow chart shows the steps requires based upon “Secondary grade of release”. This is likely to be the most common path when dealing with the installation, operation, servicing and maintenance of refrigeration, air conditioning and heat pump systems, however more information on “continuous and primary grades of release” are to be found in Annex F of BS EN 60079-10-1:2015.

Once a hazardous area has been identified, it should be identified in the form of a drawing; examples can be found within Annex E of BS EN 60079-10-1:2015.

The drawing will include information on the following:

- Hazardous areas and zones;
- Extent of the zones in both plan and elevation view;
- Includes information on:
    - the substances involved;
    - the work activities;
    - other assumptions.

The drawing should be kept and maintained as part of the risk assessment process and reviewed periodically and any time substantive changes are made.

This is only a requirement when the assessment has identified the work environment as hazardous with regard to the potential of a flammable/explosion atmosphere occurring, and special precautions are required to protect persons within the workplace. If special precautions are not deemed necessary the workplace is deemed non-hazardous, but other parts of DSEAR are to be considered.

The term “special precautions” means precautions to control potential ignition sources within the hazardous area. The term “not expected to occur in such qualities” means that we need to consider the likelihood of a flammable/explosive atmosphere and quantity of the substance when considering the area classification. If the release of the flammable refrigerant from a system is highly unlikely to occur and if it was to happen the amount released is unlikely to form a flammable mixture then it would be unnecessary to classify the area as hazardous.

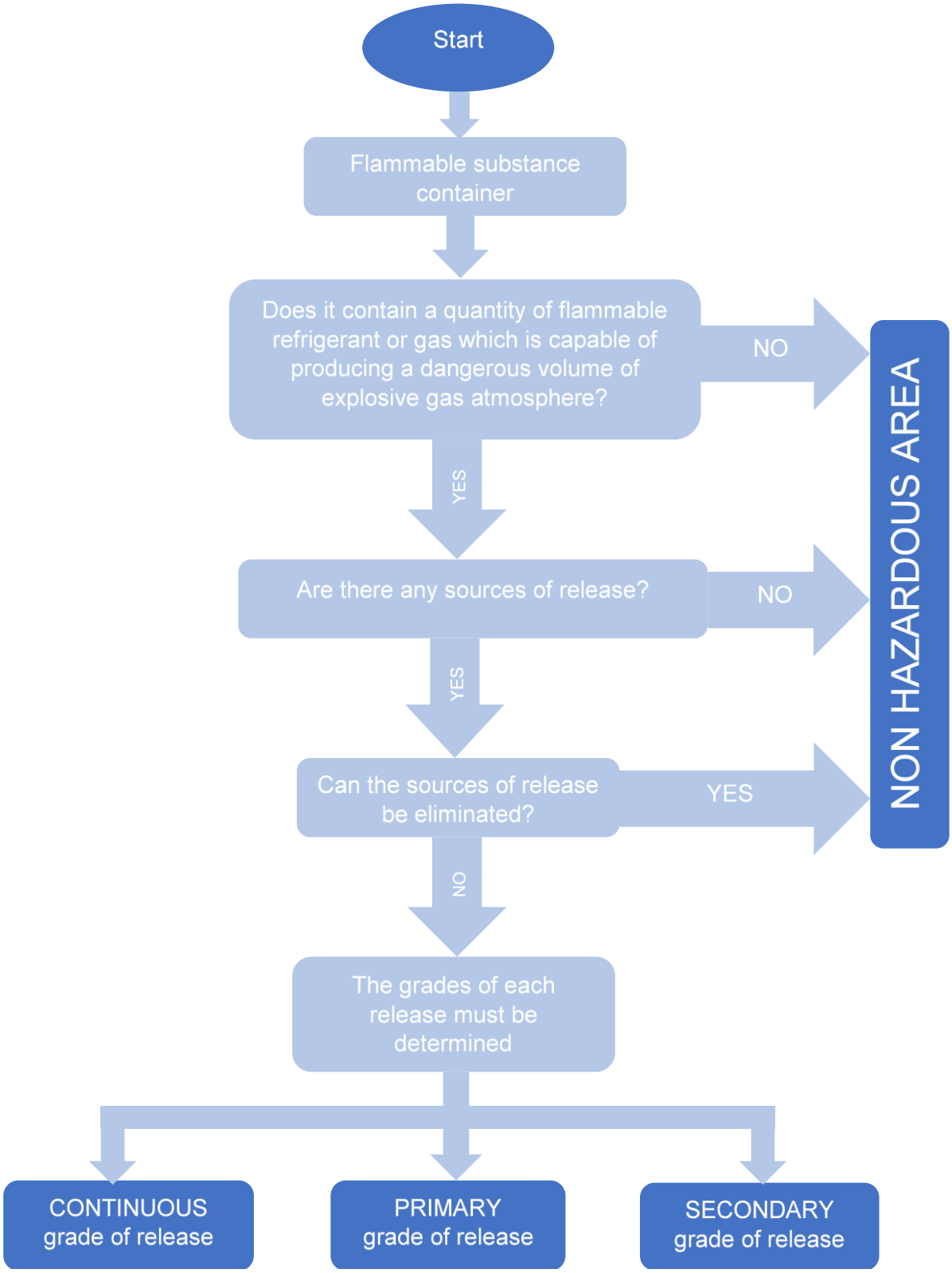
If the assessment concludes that new equipment and protective systems should be provided for use in places classified as hazardous, then the employer should only use equipment that is suitably rated. Further guidance can be found within:

- BS EN 13463-1 Non- electrical equipment for use in potentially explosive atmospheres. Basic methods and requirements
- BS EN 60079-14 Explosive atmospheres. Electrical installations design, selection and erection
- BS EN 60079-0 Explosive atmospheres. Equipment. General requirements
- BS EN 1127-1 Explosive atmospheres. Explosion prevention and protection. Basic concepts and methodology

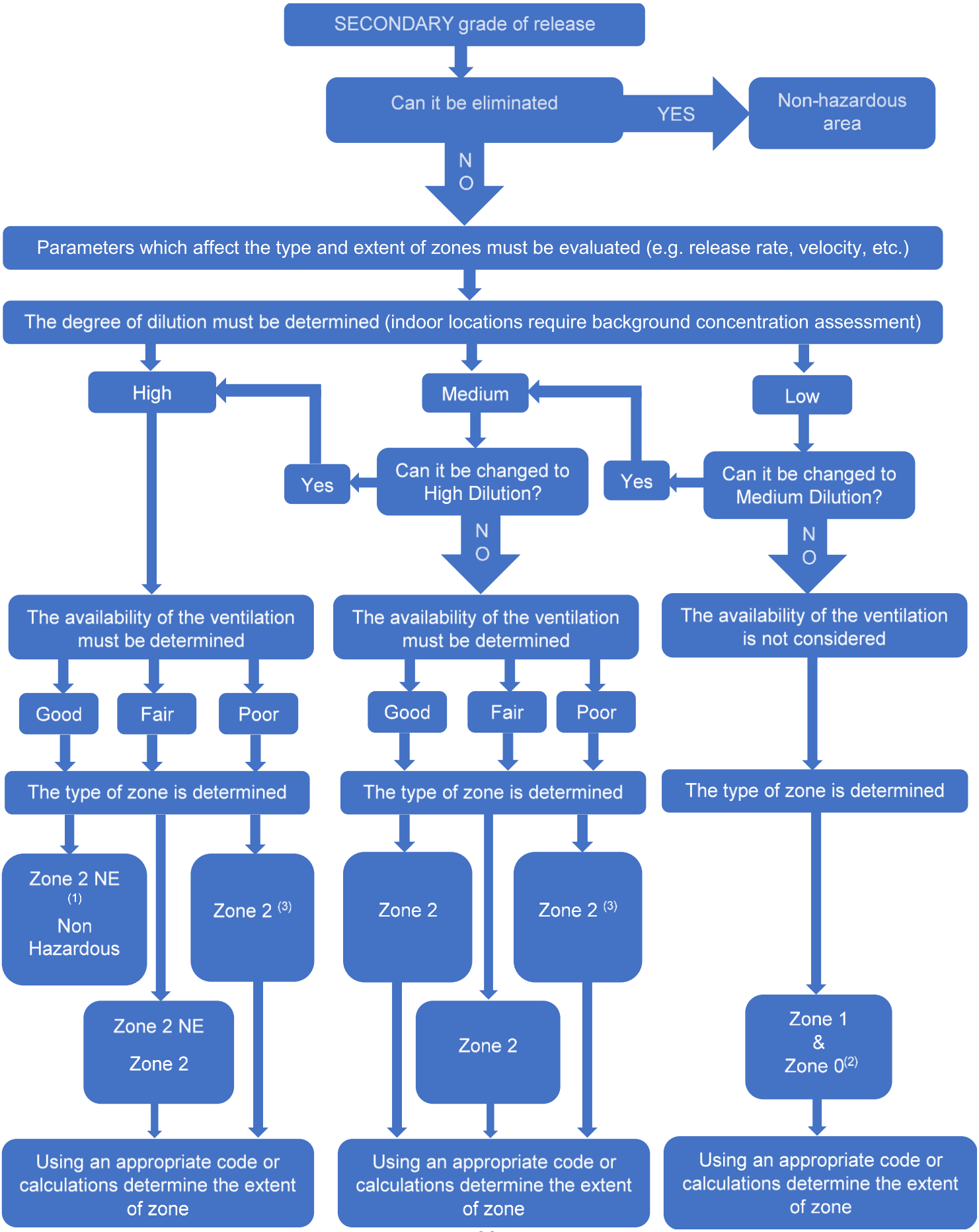
When areas have been identified as hazardous, employers should either place signs indicating the locations where an explosive atmosphere may occur and the need for special precautions, alternatively they would need to able to demonstrate that other methods are employed to ensure that persons are alerted to the hazardous locations and special entry requirements.

The above symbol is the warning sign for places where explosive atmospheres may occur.

SCHEMATIC APPROACH TO CLASSIFICATION



SCHEMATIC APPROACH TO CLASSIFICATION FOR SECONDARY GRADE RELEASE



Note 1 Zones NE indicate the theoretical zones which would be of negligible extent under normal conditions.

Note 2 Will be Zone 0 if the low dilution is so weak and the release is such that in practice an explosive atmosphere exists virtually continuously i.e. approaching "no ventilation" condition

Note 3 The zone 2 area created by secondary grade of release can exceed that attributable to a primary or continuous grade of release

This guidance was prepared by Business Edge Ltd on behalf of, and in conjunction with, a number of FETA groups.