7 Chemicals

Introduction

This section seeks to provide useful information to enable employers to manage chemical hazards in the workplace and comply with the Chemical Agents Regulations 2001 and other relevant chemical regulations.

Today, almost every business uses chemicals. Even in the cleanest, most modern office, employees are exposed routinely to inks, toners and adhesives not to mention a wide range of materials used in cleaning and maintenance. Exposure to chemicals in the workplace can cause many different types of harm, ranging from mild irritations to cancer.

Managing chemicals and their associated hazards in the workplace will bring real benefits to a business. In addition to improved employee safety and health, cost savings can be achieved by limiting economic losses through effective work practices such as correct storage, handling, use and disposal procedures. Potential harm to the environment will also be reduced.

In what forms do chemicals exist?

Chemicals can exist in the form of:

- Solids such as dusts, fumes, fibres (e.g. wood dust, bitumen fumes and asbestos fibre).
- Liquids, mists (e.g. liquid bleach and mineral oil mist).
- Gases, vapours (e.g. carbon monoxide gas and solvent vapour).

What chemicals are hazardous?

Any substance, in gas, liquid or solid form, which has the potential to cause harm, is referred to as a hazardous or dangerous substance. Such substances include those:

- Brought directly into the workplace and handled, stored and used for processing (e.g. solvents, cleaning agents, glues, resins, paints).
- Generated by a process or work activity (e.g. fumes from welding/soldering, dust from machining of wood, flour dust, solvents).
- Generated as waste or residue (e.g. fumes from soldering irons, carbon monoxide from exhausts).

Substances can be considered hazardous not only because of what they contain (i.e. their chemical ingredients) but because of the form or way in which they are used at the workplace.

In addition to their effects on human health, some chemicals also present physical hazards such as the potential to ignite or support combustion of other substances (oxidiser) and the potential to explode. The physical, environmental and human hazards of a chemical substance must be considered when conducting a risk assessment in the workplace.

How do chemicals enter the body?

In order for a chemical to become hazardous to a person's health, it must first contact or enter the body and the chemical must have some biological effect on the body. Table 7.1 lists the four major routes.

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Table 7.1: How Chemicals Enter the Body	
Inhalation	Breathing in contaminated air is the most common way that workplace chemicals enter the body
Skin contact	Some chemicals, by direct or indirect contact, can damage the skin or pass through the skin into the bloodstream
Ingestion	Workplace chemicals may be swallowed accidentally if food or hands are contaminated
Injection	Injection can occur when a sharp object (e.g. needle) punctures the skin and injects a chemical directly into the bloodstream

Table 7.2: Effects of Chemicals on the Body	
Carcinogen	A chemical that causes or potentially causes cancer (e.g. asbestos, formaldehyde)
Corrosive	A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact (e.g. hydrochloric acid)
Irritant	A chemical that is not corrosive, but that causes reversible inflammatory effects on living tissue at the site of contact (e.g. strong solvents)
Mutagen	A chemical that damages chromosomes (e.g. benzene)
Sensitiser	A chemical that will cause an allergic reaction in a substantial number of exposed people (e.g. isocyanates)
Teratogen	A chemical that causes birth defects (e.g. thalidomide)

The eyes may also be a route of entry. Only very small quantities of chemicals in the workplace enter through the mouth or the eyes.

Regardless of the way the chemical gets into the body, once it is in it can be distributed to anywhere in the body by the bloodstream. In this way, the chemicals can attack and harm organs that are far away from the original point of entry.

What are the effects of exposure to hazardous substances?

Hazardous chemicals are classified depending on how they affect human health, see Table 7.2.

Chemicals may target specific organs such as the eye, skin, blood, liver, kidneys, nervous system and lungs.

Acute effects are those that show up immediately after a chemical exposure occurs. A good example of an acute effect is the spillage of acid on the skin – a chemical burn will occur immediately.

Chronic effects are those that occur after a significant amount of time passes and usually are the result of multiple exposures over a period of time. Cancer is a typical example of a chronic effect because cancers caused by chemical exposures often do not show up until twenty or more years after the initial exposure.

Some common examples of the effects of hazardous chemicals include:

- Skin irritation, dermatitis or skin cancer from frequent contact with oils.
- Injuries to hands and eyes from contact with corrosive liquids.
- Asthma resulting from sensitisation to isocyanates in paints and adhesives.
- Long-term disability from lung diseases following exposure to dusty environments (e.g. exposure to respirable crystalline silicate).
- Death or injury from exposure to toxic fumes (e.g. carbon monoxide).
- Cancer causing death many years after first exposure to carcinogens at work (e.g. asbestos).

What are the factors affecting response to a substance?

- **Dose:** The amount of exposure to a chemical is the single most significant factor of concern. There is a level of exposure for most chemicals below which no adverse effects are likely to be observed.

See Occupational Exposure Limit Values below.

- **Toxicity:** Chemicals vary widely in how toxic (poisonous) they are. Exposure to small amounts of highly toxic chemicals can be a greater danger than exposure to large amounts of less toxic chemicals.
- **Duration and frequency:** One-time exposures that are of short duration are of less concern than multiple exposures of longer duration, all other factors being equal. Thus, when there has been a chemical exposure, it is important to know its duration and frequency.
- **Synergistic effects:** Synergism occurs when exposure to two or more chemicals at a time results in health effects that are greater than the sum of the effects of the individual chemicals. For example, there is a much higher incidence of lung cancer resulting from occupational exposure to asbestos in smokers (compared with exposed non-smokers).
- **Individual characteristics:** Each person is unique. While there are many similarities in response to chemical exposures, responses may vary dramatically among individuals. For example, males and females can react differently and special concern is afforded to pregnant employees. Some individuals are allergic or hypersensitive to certain chemicals.

What are Occupational Exposure Limit Values?

Occupational Exposure Limit (OEL) Values for hazardous substances are important information for risk assessment and management.

An exposure limit is the concentration – either in parts per million (ppm) or milligrams per meter cubed (mg/m3) – of a chemical in the workplace air to which most people can be exposed without experiencing harmful effects. However, the values should not be taken as sharp dividing lines between safe and unsafe exposures. See Table 7.3 for details of the OEL for acetone.

The absence of an exposure limit for a chemical substance does not imply it is harmless. It may be that there is not enough information available to determine an exposure limit for that particular substance.

OELs have only been set for a limited number of the substances currently used in the workplace. Binding and indicative limit values are laid down in European directives. Ireland has established its own national OELs, which include more substances than the directive. Employers must ensure that the exposure of the employees does not exceed the national limits.

The HSA's Code of Practice for the Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001 (SI No. 619 of 2001) gives the official list of OELs and is revised biannually.

Table 7.3: OEL for the Chemical Acetone

Substance	Einecs No.	CAS No.	Occupational Exposure Limit Value (8 hour reference period)
Acetone	200-662-2	67-64-1	500 ppm or 1210 mg/m3

What are hazard labels?

All substances and preparations that are classified as dangerous under the Classification, Packaging and Labelling (CPL) Regulations require a hazard label.

The label is the first and often the only information on the hazards of a chemical that reaches the end user. The rules for classification and labelling have been in place for many years. They are now set to be replaced over a phased period by a new single direct-acting regulation known as 'CLP', which covers both substances and mixtures (previously preparations).

CLP will be fully operational by 2015. The classification and labelling principles will remain the same with the most notable difference for the end user being the change in shape and colour of the symbol along with some new global terminology, see Table 7.4.

Table 7.4: Comparing Current CPL and New CLP Regulations

CPL	CLP
Symbol 	Pictogram 
Risk phrase	Hazard statement
Safety phrase	Precautionary statement
Preparation Indication of danger (e.g. Irritant)	Mixture Signal word (Danger/Warning)
Annex I	Annex VI
Dangerous	Hazardous

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Table 7.5: Acetone Hazard Labels under the Current CPL and New CLP Regulations

CPL ACETONE 605-001-00-8		CAS No. ACETONE 605-001-00-8
		
Irritant	Highly Flammable	Danger
Risk phrases: Highly Flammable, Irritating to eyes. Repeated exposure may cause skin dryness or cracking. Vapours may cause drowsiness and dizziness.		**Hazard statement:** Highly flammable liquid and vapour. Causes serious eye irritation. Repeated exposure may cause skin dryness or cracking. May cause drowsiness or dizziness.
Safety phrases: Keep out of the reach of children. Keep container in a well-ventilated place. Keep away from sources of ignition. No smoking. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. If swallowed, seek medical advice immediately and show this container or label.		**Precautionary statements:** Keep out of reach of children. Store in a well-ventilated place. Keep away from heat/sparks/open flames/hot surfaces. No smoking. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison centre or doctor/ physician. IF SWALLOWED: Rinse mouth. Immediately call a poison centre or doctor/physician.

How will hazard labels change under the new CLP regulations?

Table 7.5 lists the information contained on the CPL and CLP hazard labels for acetone, highlighting the key changes under the new regulations.

What is a Safety Data Sheet (SDS)?

Suppliers of chemicals must provide an up-to-date Safety Data Sheet (SDS) if a substance or preparation is 'dangerous for supply'.

An SDS is not a risk assessment. It provides information on chemical products to help users of those chemicals to make a risk assessment. It describes the hazards each chemical presents, as well as providing information on handling, storage, disposal, control measures and emergency measures in case of accident.

An SDS must contain information set out under sixteen fixed headings (see Figure 7.1). Some may appear complicated but you can find the most important information under the following sections:

- Section 2 describes the hazards to human health and the environment associated with the use of the chemical.
- Section 8 describes exposure controls and protective measures.
- Section 15 specifies the dangers.
- Sections 4, 5 and 6 contain useful information for emergencies.

Safety Data Sheets must be supplied free of charge, on paper or electronically, at or before the first delivery. They must be kept in a central place for consultation by employees and supervisors.

What is REACH?

REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) is the system for controlling chemicals in Europe. It became law in Ireland on 1 June 2007.

One of the main elements of REACH is registration of substances, which obliges manufacturers and importers of substances to register chemicals with the European Chemicals Agency (ECHA). This information concerns the hazards of each substance and whether it could pose risks when being used. Manufacturers and importers of certain dangerous substances need to assess the exact nature and extent of these risks in a 'chemical safety assessment'.

Under REACH, downstream users (i.e. those who use a substance or preparation for industrial or professional activities) will receive information on dangerous substances and preparations, including risks from their use and measures to control these risks, in Safety Data Sheets. Some SDSs will have an annex called an exposure scenario. This exposure scenario will give more specific information on how to use the substance or preparation safely and how you can protect yourself, your employees, your customers and the environment from risks.

Figure 7.1: 16 Headings of a Safety Data Sheet (SDS)

1. Identification of the substance/preparation and the company/undertaking
2. Hazards identification
3. Composition/information on ingredients
4. First aid measures
5. Fire-fighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls/personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other information

Further information about the content requirements for Safety Data Sheets can be found in Annex II of the REACH Regulation.

If your use is not covered, either communicate with your supplier with the aim of having your use covered by an exposure scenario or develop your own chemical safety report. You must comply with the risk management measures and with any restrictions on the use of the substance. Downstream users must also communicate certain information upstream and downstream in the supply chain.

Downstream users are required to:

- Follow instructions in the SDSs received and in the exposure scenarios which will be attached to some SDSs.
- Contact suppliers if there is new information on the substance or preparation or if you believe that the risk management measures are not appropriate.
- Provide customers with information on hazards, safe conditions of use and appropriate risk management advice for your preparations, if you are a formulator.

What is a Chemical Risk Assessment?

Chemical risk assessment forms an integral part of controlling health risks in the workplace. There are four main steps involved.

Step 1: Make an inventory
Chemical inventories are a very important tool and the first step in effective chemical management. Make an inventory of the substances used in your work processes (e.g. solvents) and those generated by the work processes (e.g. dust, residues, waste). It should be designed to systematically identify hazardous substances present in the workplace. Table 7.6 shows a simple inventory.

Chemical inventories can be developed to identify redundant chemicals, reduce purchasing costs, enable stock and quantity control, identify unknown substances, record hazard classification of substances, assess current storage arrangements, and avoid accidents, fire and explosion from incompatible materials. They will also assist those businesses that must comply with REACH, by listing suppliers, registration numbers, quantities etc.

Step 2: Collect information
Collect information about each substance, i.e. the harm it can do and how this can happen. Safety Data Sheets, which must be provided by the supplier of a chemical, and labels are an important source of information.

Step 3: Assess exposure
Assess exposure to the identified dangerous substances, looking at the type, intensity, length, frequency and occurrence of exposure to employees, including combined effects of dangerous substances used together and the related risk. Find out if substances have occupational exposure limits (OELs). Consider any physical or environmental hazards.

Table 7.6: Inventory of Hazardous Substances

Hazardous Product Used	Hazardous Substance Produced (if applicable)	Operation/ Activity	Hazardous Component	SDS Available?

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Step 4: Decide on and implement suitable control measures

Irish legislation sets a hierarchy for exposure control measures to be applied if a risk assessment reveals risks:

1. Elimination of the hazard by changing the process or product.
2. Substitute another, non-hazardous or less dangerous chemical.
3. Where 1 and 2 are not possible, control measures should be implemented to remove or reduce the risks to employees' health.

The following control hierarchy should be followed:

a. Enclosure/isolation of hazard: design work processes and controls, and use adequate equipment and materials, to reduce the release of dangerous substances (e.g. total or partial enclosure).
b. Ventilation of area: use, for example, extraction equipment and/or general ventilation.
c. Use personal protective equipment (PPE): where exposure cannot be prevented by other means, use PPE including respirators, safety glasses, gloves, overalls, protective creams and lotions.

Further measures include:

- Personal hygiene practices: have basic rules for using chemicals at work such as washing, removing and separately washing contaminated protective clothing, replacing PPE at regular intervals.
- Chemical emergency procedures: draw up an emergency plan covering procedures for spillages, first aid, emergency exits etc.
- Organisational control: through, for example, chemical inventories, labelling, provision of SDSs, training and consultation of staff, providing risk information using Hazcom instructions, instructions from manufacturers, systems of work and handling procedures, safe storage and transfer, health and medical surveillance if appropriate, record keeping and monitoring and use of data.

A combination of the above measures is normally required to control risks. The control measures must remain effective by introducing a regular inspection, testing and maintenance system for plant and equipment (including any PPE). For example, local exhaust ventilation equipment should be examined at suitable intervals against its specification to ensure its continued effectiveness.

Who should do the risk assessment?

In many cases, you and your employees have the best knowledge and understanding of your work processes and are therefore best placed to carry out the risk assessment. If specification of the control measures is not straightforward, or if complex risks have to be assessed, you may need to engage competent specialist expertise to assist in the task.

The risk assessment must be recorded and made available to employees. The law requires that the control measures are identified in writing (paper or electronic format). The risk assessment should be a 'living document' that is reviewed if situations change or if there is reason to think that it is no longer valid.

When is health surveillance required?

The need to monitor employees using health or medical surveillance will need to be determined based on the risk assessment. It may be appropriate when:

- Employees work with substances that have been assigned a Biological Limit Value (e.g. working with lead).
- The exposure of an employee to a hazardous chemical agent is such that an identifiable disease or adverse effect may be related to the exposure (e.g. dermatitis, asbestosis).
- There is a reasonable likelihood that the disease or effect may occur under an employee's particular conditions of work.

What is a Hazcom instruction?

A Hazcom instruction is an important tool in conveying risk information to employees. It should be simple in layout and use easy to understand language. As previously stated, a Safety Data Sheet can be difficult to use for this purpose. A Hazcom instruction should include, as a minimum, the following information

- Name (substance identification).
- Hazard identification.
- Safety measures and safe-handling procedures.
- Accidental release measures.
- First aid procedures.
- Appropriate methods of disposal.

It should describe the workplace operation and be signed by the user. Hazcom instructions can also take the form of pictograms to illustrate good work practices, see Figure 7.2.

What is asbestos?

Asbestos is the name for a group of naturally occurring mineral fibres, which are strong and both heat and chemically resistant. There are three main types of asbestos found in Ireland: chrysotile (white asbestos), amosite (brown asbestos) and crocidolite (blue asbestos). Breathing in air containing asbestos fibres can lead to asbestos-related diseases.

What are the health effects from exposure to asbestos?

Exposure to asbestos can cause cancers of the chest and lungs and there is no cure for these illnesses. There is usually a long time delay between first exposure to asbestos fibres and the diagnosis of a disease. This delay can take from fifteen to sixty years. There are no known safe levels of exposure but clearly the more asbestos fibres you breathe in, the greater the risk to your health.

Where can asbestos be found?

Most asbestos-containing materials (ACMs) were installed from the 1960s to the mid-1980s, with asbestos cement in use until 2000. The use of asbestos and ACMs was banned on a phased basis, with a general prohibition taking effect in 2000. However, products or materials containing asbestos, which were already installed or in service prior to these regulations, may remain in place until they are disposed of or reach the end of their service life. Figure 7.3 (see over) shows typical locations for the most common ACMs.

Who is at risk from asbestos?

Nowadays, the people most at risk from exposure to asbestos include general maintenance staff, construction workers, plumbers, electricians, fitters, cabling engineers, computer installers, demolition workers and asbestos removal workers. ACMs can be inadvertently disturbed during maintenance, repair or refurbishment works on a building.

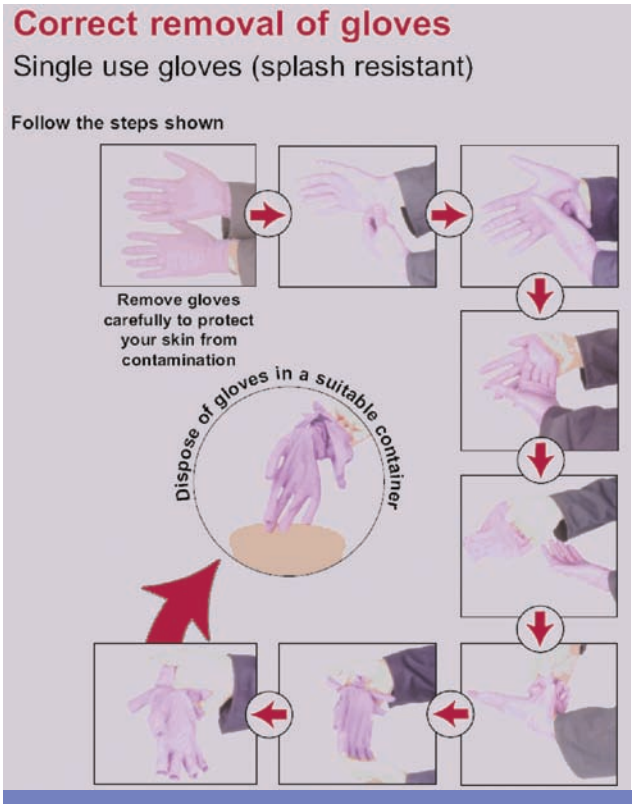

Figure 7.2 *Courtesy of HSE (UK)*

For example, drilling, cutting or other disturbance of existing ACMs can release asbestos fibres into the air, which may then be inhaled.

What precautions should be taken?

It is essential that you take adequate precautions to ensure that employees are not exposed to asbestos fibres during any maintenance, repair or refurbishment work. Therefore, asbestos-containing materials must be identified by a competent person prior to any work commencing. Removal must only be carried out by a competent or specialist contractor depending on the type of asbestos.

What legislation applies to chemicals in Ireland?

Irish legislation aims to minimise the health risks from dangerous chemical substances in the workplace. It places elimination and substitution at the top of the hierarchy of control measures for protecting employees from dangerous substances and preparations. The most relevant pieces of Irish legislation are:

- Safety, Health and Welfare at Work Act 2005.
- Chemicals Act 2008.
- REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals).
- Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001.
- Safety, Health and Welfare at Work (Carcinogens) Regulations 2001.
- Safety, Health and Welfare at Work (Exposure to Asbestos) Regulations 2006.
- Classification, Packaging and Labelling of Dangerous Substances Regulations 2003.
- Classification, Packaging and Labelling of Dangerous Preparations Regulations 2004.
- Classification, Labelling and Packaging of Substances and Mixtures Regulation 2008.

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Figure 1 Asbestos building
Typical locations for the most common asbestos-containing materials

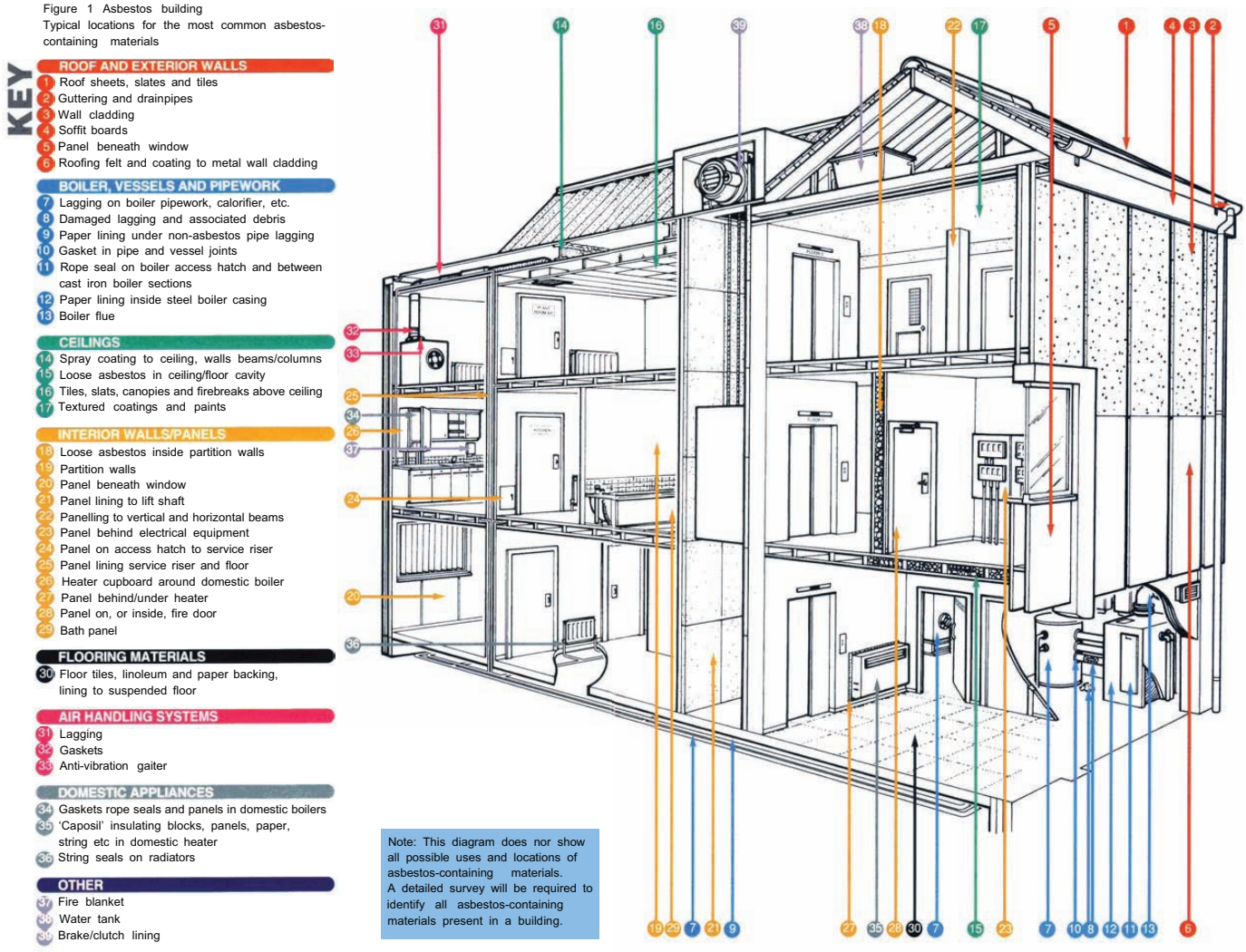

Figure 7.3 *Courtesy of HSE (UK)*

Contacts/References

See the HSA's website (www.hsa.ie) for copies of:

- **2007 Code of Practice for the Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001.**
- **Guidelines to the Safety, Health and Welfare at Work (Chemical Agents) Regulations, 2001.**
- **Short Guide to the Safety, Health and Welfare at Work (Chemical Agents) Regulations, 2001.**
- **Use Chemicals Safely.**
- **Guidelines on Working with Materials Containing Asbestos Cement.**
- **'Safety with Asbestos' (Information Sheet).**
- **Risk Assessment of Chemicals Hazards.**
- **Guidelines on Occupational Dermatitis.**
- **Guidelines on Occupational Asthma.**
- **'Carbon Monoxide' (Information Sheet).**

Further information is available from:

- **HSA website on REACH: www.reachright.ie.**
- **REACH Helpdesk. Lo-call: 1890 289389. Email: reachright@hsa.ie.**
- **CLP Helpdesk. Lo-call: 1890 289389. Email clp@hsa.ie.**
- **The European Chemicals Agency (ECHA) produces guidance documents and factsheets on REACH, including guidance for downstream users. Website: http: //echa.europa.eu/home_en.asp.**