CONTROLLING WORKPLACE SAFETY ISSUES IN THE UK

A course book for Unit DN3 of the NEBOSH Level 6 National Diploma for Occupational Health and Safety Management Professionals

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Unit DN3

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The nature of a gas allows it to mix readily and intimately with oxygen (in the air, for example). If the gas is flammable and mixed in the right proportions with air, it will ignite easily, and the flame can travel unhindered and rapidly through its entire volume. Since gases expand rapidly during heating, the sudden increase in pressure, especially if it is contained within a vessel or building, may result in an explosion.

Gases that are lighter (that is, less dense) than air will tend to rise. This means that, if released outside or in well-ventilated spaces, they will disperse as they rise. However, if released in buildings, they could collect and build up in high points, like roof voids if these are poorly ventilated. Methane is an example of a flammable gas that is lighter than air.

Where a gas is heavier (that is, denser) than air, it may tend to sink to the ground where it could collect in trenches, hollows or drains. As gas flows readily, it may easily come into contact with an ignition source. Depending on how far the gas has travelled, this may cause a fire or explosion some distance from the original source of release. It may also be that the collected gas becomes so concentrated that it is no longer capable of igniting. Propane is an example of a gas that is heavier than air.

Due to the relative ease with which gases can be compressed, they are often transported in pressure vessels. This is to reduce the volume required to transport them, and vessels can range from handheld canisters to entire ships carrying natural gas. However, the pressurisation of gas can create additional risks. A pressure vessel that is subjected to heat or impact can rupture, leading to the rapid release of gas as the container depressurises. If the escaping gas contacts an ignition source, the resultant explosion can be highly destructive.

3.3 Specific physical properties of importance to the initiation and propagation of fire and explosion

3.3.1 Flashpoint

The flashpoint of a substance is the lowest temperature at which sufficient vapour is given off to form a mixture with air that can be ignited on the introduction of an open flame. The vapour momentarily ‘flashes’ as the flame is introduced but does not continue to burn. Flashpoint is normally used as a general indication of the flammability of a liquid or gas and is measured using a range of standard methods. It is also used to indicate the flammability of certain solids that vaporise easily when exposed to flames, such as candle wax, naphthalene (used in moth repellents) and camphor (also used in moth repellents as well as medicines).

3.3.2 Fire point

The fire point of a substance is the lowest temperature at which the mixture of air and vapour can continue to burn after an ignition source is removed. The fire point is always higher than the flashpoint, but sometimes by only 10° or 20°C.

Examples of indicative flashpoints and fire points of some common substances are shown in Table 1.

Substance	Flashpoint in ° Celsius	Fire point in ° Celsius
Petrol (gasoline)	–40	–30
Diesel oil	52	64
Wood	300	350

Table 1: Comparison of indicative flashpoints and fire points of common substances

3.3.3 Auto-ignition temperature

The auto-ignition temperature of a material is the lowest temperature for it to ignite without the presence of an external ignition source. The raising of the substance's temperature may be through radiant heat, as in a room where a fire has already taken hold. Temperature can also be raised by compression, such as by the pistons in the cylinders of a diesel internal combustion engine. The heat generated causes the diesel fuel to auto-ignite (no external ignition source, such as electrical spark, is required).

Many materials, whether they are normally solid, liquid or gas, display auto-ignition behaviour. Wood and paint, for example, can auto-ignite, and this was found to be a principal cause, along with a previously unknown phenomenon called the 'trench effect', for the sudden intensification and spread of the King's Cross underground fire in 1987.[2]

3.3.4 Vapour density

Vapour density, or more properly, **relative vapour density**, is the density of a vapour relative to the density of air. Other reference gases are sometimes used, but air is the most useful in practice. For example, the vapour density of ammonia is about 0.6 – that is, it is lighter (less dense) than air and would therefore tend to rise quite readily.

The relative density of vapours and gases is important in understanding where they are likely to collect in the event of a release. Those with a lower density than air will rise and form clouds above the point of release, where they might connect with ignition sources such as flare stacks or electricity pylons. Those with a higher density will sink and may collect in trenches, cellars or pits, where they might connect with ignition sources such as electrical switches or hot pipework.

3.3.5 Limits of flammability

The combustion or explosion of a gas or vapour can only take place when its concentration in air is within a specific range, known as **flammable and explosive limits**, respectively. When there is insufficient gas or vapour in the air, combustion cannot take place because the mixture is said to be 'too lean'. When there is too high a concentration, the mixture is said to be 'too rich'.

These concentration limits vary depending on the specific substance. They can also be affected by factors such as temperature, pressure, droplet size and levels of oxygen in the air.

The lowest concentration in air in which a gas or vapour will sustain a flame, that is to say, will burn continuously, is known as the **Lower Flammable Limit** (LFL). Similarly, the lowest concentration at which a gas or vapour will produce an explosion when an ignition source is introduced to it is known as the **Lower Explosive Limit** (LEL). The highest concentrations at which these events can happen are known as the **Upper Flammable Limit** (UFL) and **Upper Explosive Limit** (UEL), respectively.

Although these two types of value have slightly different usages, for everyday practical purposes they are used interchangeably. Examples of common substances and their flammability ranges (expressed as a percentage of the gas or vapour by volume in air) are shown in Table 2.

Substance	Lower Flammable/ Explosive Limit (LFL/LEL) % in air	Upper Flammable/ Explosive Limit (UFL/UEL) % in air
Acetone	2.6	12.8
Ethylene	2.75	28.6
Hydrogen	4	75
Petrol (gasoline)	1.4	7.6
Kerosene	0.7	5

Table 2: Comparison of lower and upper flammability limits of common substances

While the normal flammability or explosivity of a substance can be determined from this information, which can be found in the safety data sheet for any given substance, it should be remembered that limits of flammability and density in air can vary over time and circumstances. For example, a gas that is heavier than air may initially accumulate in a trench at concentrations below the LFL/LEL, where ignition is not possible. Over time, however, if the gas were allowed to continue to accumulate, perhaps from a leaking valve, the concentration level may increase so that it is within the flammable or explosive range, where ignition is possible.

Equally, if a vapour were allowed to accumulate in an area subject to extremes of heat, perhaps in the boiler room of an industrial facility, then it could reach a temperature where auto-ignition is likely. Flammable substances must also be considered when assessing the potential for fire so that they do not come into contact with sources of heat or ignition (hot surfaces, open flames, sparks and so forth).

3.4 The causes and effects of vapour explosions

3.4.1 Unconfined vapour cloud explosion

When a large amount (generally, many tonnes) of a flammable gas or vapour is released into the atmosphere and mixes with air, it can form an explosible vapour cloud. This cloud may be carried long distances by the wind.

If this vapour cloud is ignited, the resultant flame front can propagate through the cloud rapidly, causing an unconfined vapour cloud explosion (UVCE). The speed of this explosion depends on factors such as the type of substance, size of the vapour cloud and ambient temperature. If the speed of the flame front is subsonic (that is, less than the speed of sound), it is known as a 'deflagration'. If the flame front travels at supersonic speeds (that is, faster than the speed of sound), it is known as a 'detonation'. The mechanisms of flame propagation, as well as the effects, are different in these two cases.

Methods of controlling an explosion include a number of passive and active devices. Using a screw conveyor instead of an open belt conveyor can, for example, limit the possibility of the flame front from an explosion being able to move freely through a fuel source (see Figure 7). Active systems include those that inject a fire suppressant into pipework where an explosion's flame front is detected (see Figure 8), or where a slide valve is forced shut to prevent the flame front travelling further (see Figure 9). Both these systems rely on very sensitive explosion detectors and operate in just a few milliseconds.

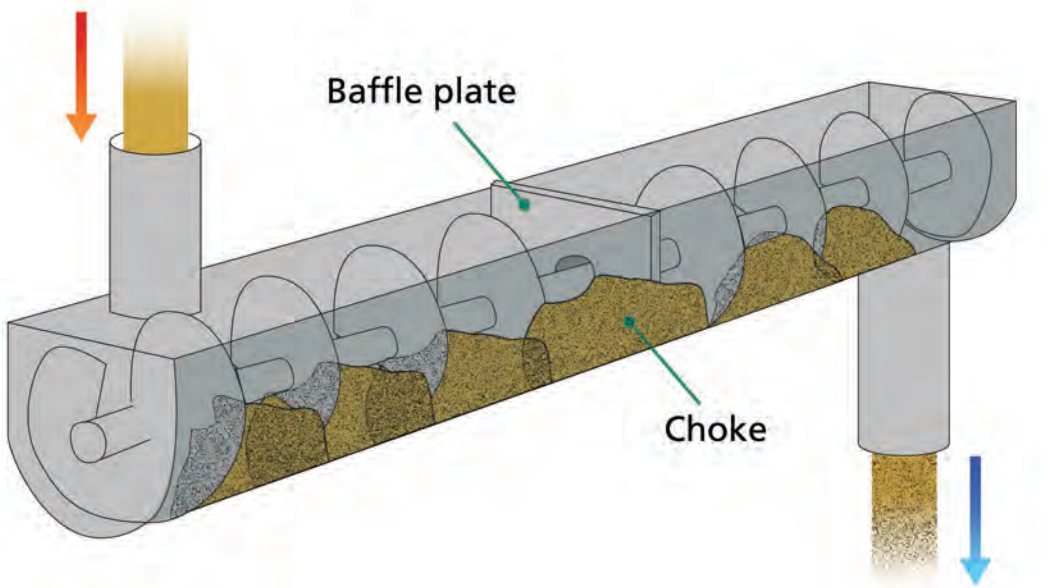

Figure 7: A screw conveyor used to prevent explosion propagation[15]

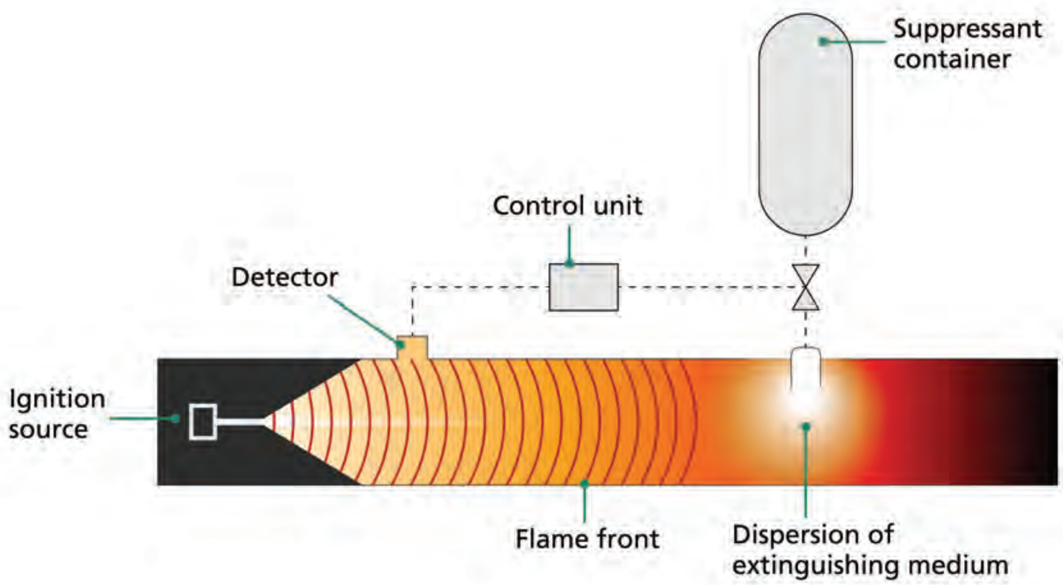

Figure 8: An explosion suppression system mounted inside pipework[16]

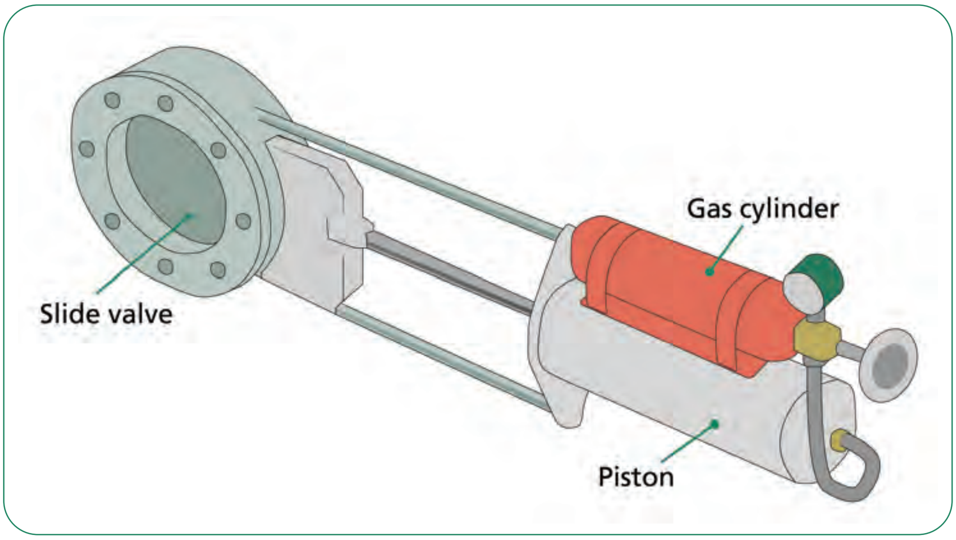

Figure 9: A gas-powered slide valve to seal pipework shut[17]

3.15 The behaviour of structural materials, buildings and building contents in a fire

3.15.1 Fire properties of common building materials and structural elements and level of resistance

The behaviour of building materials in a fire can significantly affect how quickly the fire can spread through a building.

Key considerations include:

- how the material structurally reacts when exposed to fire;
- how well the material prevents heat from a fire passing through it; and
- whether the material is load-bearing and therefore if it fails in a fire it can cause premature collapse of the building.

3.15.1.1 Structural framework

The main materials used for the structural framework of buildings are:

- **Steel:** this is often used in the construction of industrial buildings. In the event of a fire, an unprotected steel frame will begin to deform at a temperature of around 600°C. The effect of deformation can lead to other components of the building taking on stresses that they were not designed for, for example, twisting of a concrete floor. This can lead to a partial or even total collapse of the building and the loss of any fire compartmentation. Steel readily conducts heat.
- **Concrete:** this is commonly used for high-rise buildings and office blocks. Concrete is unlikely to collapse in the event of a fire, but can suffer from mechanical and chemical changes. Mechanical changes include spalling and cracking. Chemically, the aggregates in concrete can change size or decompose, affecting its ongoing strength and watertightness.

The rebar in concrete can also lose its design strength when exposed to high temperatures, further reducing the concrete's overall structural strength.

- **Wood:** this is predominately used in housing construction. As a carbonaceous organic material, wood readily burns. Wood does not distort in the way steel can when exposed to heat, although its structural integrity usually fails dramatically when considerably burned through. The size of timbers used in construction mean they generally require considerable amounts of energy to ignite; however, during construction wooden frames can pose a serious fire risk. Timber conducts heat and can auto-ignite when sufficiently heated.

DEFINITIONS

Spalling is the breaking away of the surface of a material, which can compromise its inherent strength. Spalling can be caused by fire, freezing, impact and weathering.

Rebar is short for reinforcing bar. Concrete has a very high strength in compression but a relatively low strength when being pulled or twisted. Steel rods are used to form a lattice before concrete is poured or cast to substantially improve its tensile strength. This is known as reinforced concrete.

CASE STUDY 8

Windsor Castle fire

This case study illustrates the remarkable resilience of structural timber in a building fire. In November 1992, a fire broke out at Windsor Castle that caused significant damage to the roof structure of the royal kitchen.

It was believed that the roof would have to be fully replaced, rather than restored or repaired. On inspection of the roof timbers, it appeared that, after removing the main charring, some of the wood retained reusable tensile strength, making retention of the wood feasible. The carpentry within the roof timbers dated back to as early as 1337.

This original timber was therefore used and augmented by concealed steelwork so that it was strong enough to house a modern kitchen.

3.15.1.2 Brickwork and blockwork

Clay bricks are inherently fireproof and can withstand extreme temperatures before failing. Failure can occur due to spalling after considerable exposure to heat and particularly in load-bearing walls. Bricks are often used in non-load-bearing applications, for example, as an outer cladding material, supported by an inner framework (often made of concrete, steel or wood). In such cases, failure of the brickwork cladding tends to occur when the supporting inner framework fails.

Blockwork is made of various compositions of concrete that are designed to provide different attributes such as lightweight, thermal insulation or good aesthetics. Blockwork is non-combustible and fire-resistant. All concrete blocks demonstrate good or excellent resilience to fire even when used in load-bearing walls. The degree of fire resistance depends on composition, thickness and type of construction.

Both clay bricks and concrete blocks are relatively poor conductors of heat.

3.15.1.3 Cladding

Cladding is any material that is used for aesthetic purposes on the external walls of a building and is non-structural (that is to say, it has no load-bearing properties). Multi-panel cladding can be made of a variety of materials and in the past has been known to give rise to very

CHAPTER 11: ELECTRICITY

11.1 Introduction

Electricity is the movement of electrons through a conductor. Due to the potential energy involved, working with electricity can be highly dangerous, so robust control measures are required. Control measures may include the use of protective systems and safe systems of work and an appropriate inspection and maintenance strategy.

High voltage systems can be especially dangerous, requiring more stringent control measures than lower voltage systems. Compared to fixed installations, portable electrical equipment carries some specific additional hazards; these are associated with the frequent movement and handling of the equipment as well as with the environment in which it is used.

TIP

The following legislation sets out the requirements for electricity:

- Electricity at Work Regulations 1989.
- Electricity at Work Regulations (Northern Ireland) 1991.
- Electricity Safety, Quality and Continuity Regulations 2002.
- Electricity Safety, Quality and Continuity Regulations (Northern Ireland) 2012.

The HSE has published the following guidance documents on this topic:

- *The Electricity at Work Regulations 1989. Guidance on Regulations* (HSR25).[1]
- *Maintaining portable electrical equipment* (HSG107).[2]
- *Electricity at work. Safe working practices* (HSG85).[3]
- *Keeping electrical switchgear safe* (HSG230).[4]
- *Electrical test equipment for use on low voltage electrical systems. Guidance Note GS38*.[5]
- *Avoiding danger from overhead power lines. Guidance Note GS6*.[6]

ADDITIONAL INFORMATION

The following guidance has been published by HSENI for use in Northern Ireland:

- *Electrical Safety. Make It Your Priority*.[7]
- *Working in Proximity to Low Voltage Overhead Power Lines*.[8]

11.9.1 User checks

During the life of a building, users will be aware of their surroundings and should carry out informal checks on electrical equipment, reporting hazards where required, such as cracked socket outlets or exposed wiring.

Minor repairs will always be necessary as part of a maintenance strategy. A method of reporting issues in a way that will ensure the fault is repaired quickly must be available, but no formal method of recording user checks is required.

User checks are also essential when working with portable appliances, with users actively responsible for checking that there are no signs of damage to a piece of equipment before plugging it in. User checks may include checks for cable damage or damage to the plug, such as a cracked casing or bent pins.

Any damaged equipment must be withdrawn from use and clearly labelled for repair by a competent person.

11.9.2 Formal visual inspections

A formal visual inspection will be part of the planned maintenance, which is carried out by competent persons. Formal visual checks examine the parts of the installation or equipment that can be seen without having to disrupt the operation of the equipment or expose any live conductors. There are various issues that the person doing the inspection should look out for. These include:

- evidence of inadequate joints, such as taped joints in the cable;
- ensuring the outer sheath of the cable is effectively secured where it enters the equipment;
- whether the equipment has been subjected to conditions for which it is not suitable, such as wet or dusty environments;
- damage to the external casing of the equipment; and
- evidence of overheating, such as burn marks or discolouring.

Formal visual checks can also involve checking the integrity of containment systems, conducting thermographic surveys or looking inside an enclosure (only if it is rated as IP2*x*, where a person is unable to insert a finger into the live sections) to examine the state of the connections.

For portable appliances, formal visual inspections are carried out as part of the testing regime. Each test will begin with a thorough visual inspection to see if there is any immediate risk, such as damaged insulation or exposed conductors. A visual inspection will include a check of the fuse to ensure it is the correct size. If it is possible to access the inside of the plug (some moulded plugs do not allow the covers to be removed), a check will be made to ensure it is wired correctly.

Any equipment identified as damaged or defective during the formal visual inspections should be removed from use or switched off and labelled as 'out of service'. Maintaining a record of formal visual inspections is a useful and proactive method of reviewing the effectiveness of the maintenance strategy, although there is no legal requirement to produce a record of these inspections.

ADDITIONAL INFORMATION

A **thermographic survey** uses a special camera that takes the temperature of the article and maps it onto a screen so that a visual image of the temperature differences of pieces of equipment can be seen. An example of the camera image is shown in Figure 2 with a scale on the right-hand side showing the range of temperatures.

This is a useful diagnostic tool when electrical equipment cannot be switched off for formal tests and inspections, because the electrical equipment or installation can be assessed without any physical contact to determine whether the connections may be loose or if there is a risk of overheating.

Loose connections will overheat due to arcing, which can lead to fires. A thermographic camera is able to visualise any increase in heat and record a thermal image to capture the overheating cables and connections, allowing rectification works.

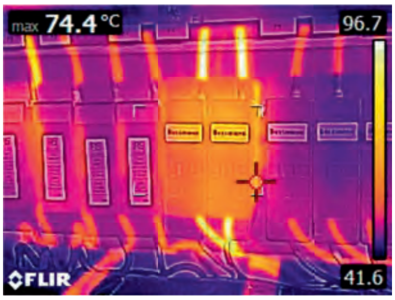

Figure 2: Typical thermographic camera image

Credit: Heather Beaumont

The thermographic survey must be carried out carefully as the circuit is normally live when the work is carried out. The temperatures are mapped using direct line of sight to the equipment being surveyed; therefore, metal panels are usually removed, which introduces a risk of exposed live conductors. Electrical switch panels can be manufactured with secondary panels inside the main enclosures that allow the positioning of a camera but preventing access to live equipment (IP2*x*-rated equipment).

11.9.3 Combined inspections and tests

Not all faults can be detected by visual checks. Some faults on electrical systems require the installation to be tested, as well as areas taken apart to examine behind covers. These are known as combined inspections and tests, where some electrical test instruments are connected to test wiring and earths, and internal inspections of equipment and connections are carried out by removing covers and checking the tightness of terminals.

How much of the installation is tested as part of a combined inspection and test should be carefully considered and is dependent on factors such as:

- the age and general condition of the system;
- the type and use of the installation;
- the ambient environmental conditions;
- the effectiveness of ongoing maintenance;
- the period of time since the last inspection; and
- the size of the installation.

Not all circuits will be taken apart and tested, but a sample of each type of circuit will be designated for thorough testing. If anything significant is found during the inspection, more areas may need to be inspected.

Combined inspection and testing should be carried out by someone who is competent to assess the risks that may be posed by a failure, because the results may require interpretation and appropriate electrical knowledge.

Combined inspection and testing for portable appliances involves a visual inspection to ascertain the condition of the equipment and any flexible cables. The inspection should also verify the equipment's earthing continuity (a test of the soundness of insulation between the current-carrying parts and any exposed metal that may be touched).

Part of the combined inspection and testing programme will be portable appliance testing (PAT). These tests are carried out with a specific test instrument known as a PAT tester, which will issue a pass/fail result for the appliance. A piece of equipment should be immediately withdrawn from use if it fails a PAT.

11.9.4 Records of maintenance and tests

Once an inspection has been carried out, it is good practice to keep records of those inspections.

The HSE recommends that all maintenance and initial test results are kept for the working life of an installation.[13] This enables the condition of equipment and deterioration to be compared and the effectiveness of maintenance to be monitored.

There are three main types of record issued to map the history of an installation. The first is an **Electrical Installation Certificate**. The results of inspections and initial verification tests are recorded on an Electrical Installation Certificate. This allows subsequent periodic test results to be compared with the initial results. The second is a **Minor Electrical Installation Works Certificate**. When an alteration or an addition is made to an existing installation, it must be inspected and tested to ensure that the alteration does not impact the safety of the existing circuit. There is no requirement to inspect the whole installation, but any observed departures are to be recorded and issued on a Minor Electrical Installation Works Certificate.

The final type of record is an **Electrical Installation Condition Report**. Part of the maintenance of an installation is periodic inspection and testing, which is necessary to check that the safety of the installation has not been compromised. An Electrical Installation Condition Report is issued once the testing is complete. Any required actions are highlighted, along with their urgency. This completes the record for the building, and this information may be referred to on subsequent tests.

It is good practice to retain records of installation testing as this demonstrates that testing has been carried out and that the installation has been checked to be in a safe condition. The same applies to portable appliance testing records. The competent person conducting the test will often refer to the original test certificates for the installation and any other tests carried out, such as minor works, to ensure their results fall within the expected parameters of the original design and build.

ADDITIONAL INFORMATION

Portable appliance testing (PAT) is another form of testing. This is not a legal requirement, but it is carried out in order to demonstrate compliance with EAWR. Under these Regulations, employers must ensure that any electrical equipment that has the potential to cause injury is maintained in a safe condition.

PAT records are usually downloaded from the testing tool into a suitable database. Dutyholders under EAWR[14] who are responsible for large quantities of equipment may choose to label equipment to indicate that it has been tested and passed as safe, as well as when the next test is due.

The HSE's document *Maintaining portable electrical equipment* (HSG107) provides information and support on the practicalities of maintenance regimes for portable equipment.

For further information, see section D: Portable electrical equipment.

11.9.5 Frequency of inspection and testing

The frequency of periodic inspection and testing of an installation is determined in accordance with the type of installation and equipment, its use and operation, the frequency and quality of maintenance and the external influences it is subjected to.

The results and recommendations of the previous report, if any, should be taken into account as part of a risk assessment to determine the correct frequency for inspection and testing. BS 7671 recommends that most commercial buildings, hospitals and educational

In addition, workers have the right to be consulted about matters that will affect their health, safety and welfare.

ADDITIONAL INFORMATION

Further information on the role of each dutyholder is available in the guidance written by members of the Construction Industry Advisory Committee and published by the Construction Industry Training Board (CITB). The guidance is available on the CITB's website.[10]

12.6 When does CDM apply?

CDM applies to construction works (as outlined in 12.3: Construction work), whether or not the construction project is 'notifiable'. The Regulations specifically focus on planning the construction project, which includes the design and construction phases. The focus on planning and design is important because it takes a preventive approach by 'designing out' any problems before projects begin.

The Regulations set out what each dutyholder must do to comply with the law to ensure projects are carried out in a way that ensures health and safety. The dutyholders include clients, designers, principal designers, contractors and principal contractors.

Some projects are 'notifiable' under reg 6 of CDM. A project is notifiable if it meets one of two criteria, which are if the construction work is scheduled to:

- last longer than 30 working days **and** have more than 20 workers working simultaneously at any point in the project; or
- exceed 500 person days.

Person days are calculated by multiplying the number of workers expected to work on the project by the number of days they are scheduled to work (this includes weekends and bank holidays).

For example, if 10 workers are expected to work on the project for 50 days, this would equal 500 person days (10 × 50).

The regulatory bodies that must be notified are the HSE (for general construction projects) or, for more specialist projects, the Office of Rail and Road (ORR) and the Office for Nuclear Regulation (ONR). Notification must be made by the client using the form F10 (each regulator has its own version of the form on its website). The notice must be in a format that can be easily understood and be clearly displayed in the construction site office so that it is accessible to anyone working on the site.

TIP

The details that must be included when a project is notified using the F10 form are set out in Schedule 1 of CDM.

APPLICATION 1

Which of the following projects does CDM apply to?

1. The renovation of a small shop by three men, with the project scheduled to last for five working days.
2. The building of a new hotel, which is scheduled to last three months and will involve 150 workers working on site simultaneously.
3. Building a network of new private roads around a warehouse complex (three warehouses made of a brick base and metal sheets). The project is scheduled to take 28 days and will involve 18 workers simultaneously.
4. The alteration of a deconsecrated church into 30 individual flats/apartments. The project will take six months, and 36 workers will be on site simultaneously.
5. Constructing a new railway tunnel that will run through a hillside. The project is scheduled to take up to one year, and 100 workers will work on the project simultaneously.

12.7 Use of CDM to make projects work well

The aim of CDM is to improve health and safety in the construction industry. To help ensure this and to make projects work well, CDM imposes specific legal duties on some people in relation to various stages of a construction project; these people are known as dutyholders (see 12.5: Dutyholders). The Regulations help all dutyholders in any construction project to:

- plan and co-ordinate the work so that the risks involved are managed from start to finish;
- appoint the right people for the job at the right time. Having the right people complete each element of a project is essential to success;
- co-operate and co-ordinate their work with others. It is essential that there is effective communication to ensure health and safety;
- have the right information about the risks and how they are being managed;
- communicate information effectively to those who need to know. Effective communication is important to ensure that everyone understands the risks and the measures that must be put in place to control them effectively;
- consult and engage with workers about the risks and how they are being managed. This should be a two-way process whereby workers' views and suggestions are considered.

Managing health and safety in construction (L153) identifies key elements to securing construction health and safety. One of these is to manage the risks by applying the general principles of prevention. CDM does this by putting a duty on designers (reg 9(2)) and principal designers (reg 11(2)) to apply these principles when deciding what measures are required to control the risks to health and safety in a particular project. The general principles of prevention can be summarised as 'eliminate, reduce or control' risks (see the Additional information box that follows for more detail). These principles are set out in Schedule 1 of the Management of Health and Safety at Work Regulations 1999 (MHSWR) but can be applied to any work where preventive and protective measures are required.

Another key element is appointing the right organisations/people at the right time. CDM requires that dutyholders are appointed to construction projects, and it is essential to the success of the project that these appointments are made at the appropriate time. For example, the client must ensure that designers/principal designers are appointed before the construction phase. This is to ensure they have enough time to carry out their duties to plan and manage the pre-construction and construction phases. It is also important to ensure that the right people are appointed. Those who are involved in appointing people to the project must ensure that they appoint people with the necessary skills, knowledge and experience to carry out the work safely. This will help to ensure good health and safety performance throughout the project.

Providing everyone with the supervision, instruction, training and information they need is also important. Regulation 15(8) of CDM requires contractor(s) to provide their workers with supervision, instructions and information. The level of supervision provided will depend on the level of risk as well as the level of skills, knowledge, training and experience of the workforce. For example, it would be expected that a young, inexperienced apprentice will require more supervision than a worker who has had experience of working on different construction projects for a number of years. The information and instruction that must also be provided is discussed further in 12.10: Duty to provide comprehensible information and instruction to relevant parties when required. Dutyholders must also co-operate with one another and co-ordinate to ensure health and safety. This is discussed in 12.8: Duty to co-operate and communicate between all parties on site.

Consulting and engaging with workers when making decisions about health and safety is also important. This applies to construction workplaces in the same way it does to general workplaces. Regulation 14 of CDM places a duty on principal contractors to consult with the workforce (or their representatives) on any matter that may affect the health, safety or welfare of the workers. For more information on consultation, see *Principles of workplace health and safety in the UK*, Chapter 11: Consultation.[11]

ADDITIONAL INFORMATION

There are nine principles of prevention. These are set out in Schedule 1 of the MHSWR and must be applied when an employer is implementing preventive and protective measures (under reg 4 of MHSWR). In order, these are:

(a) avoiding risks;
(b) evaluating the risks which cannot be avoided;
(c) combating the risks at source;
(d) adapting the work to the individual;*
(e) adapting to technical progress;**
(f) replacing the dangerous by the non-dangerous or the less dangerous;
(g) developing a coherent overall prevention policy;***
(h) giving collective protective measures priority over individual protective measures; and
(i) give appropriate instructions to employees.

* The work should be adapted with special regard being given to:

- the design of the workplace;
- the choice of equipment; and
- the choice of working and production methods.

** These adaptations are with a view to alleviating monotonous work and work at a predetermined work-rate and to reduce their effect on health.

*** The policy must cover:

- technology;
- organisation of work;
- working conditions;
- social relationships; and
- factors relating to the work environment.