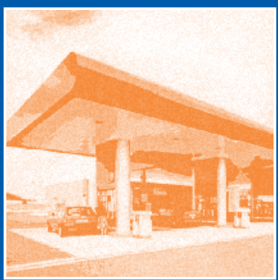
Design, construction, modification, maintenance and decommissioning of filling stations

3rd edition



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3rd edition

APEA/EI

DESIGN, CONSTRUCTION, MODIFICATION, MAINTENANCE AND DECOMMISSIONING OF FILLING STATIONS

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However, it should be noted that the above organisations have not all been directly involved in the development of this publication, nor do they necessarily endorse its content.

The **APEA** is a UK based organisation with worldwide membership. It draws membership from those in the retail petroleum industry who are involved with the design, construction and operation of filling stations. The membership includes regulators from national and local government authorities, oil companies, equipment manufacturers, suppliers, service and installation organisations and contractors. The APEA was founded in 1958 and has the same objectives as today:

- The advancement of scientific and technical knowledge
- The supply and interchange of information
- Uniformity of standards interpretation and application

The APEA is consulted by governments and standards authorities in this specialist field.

It also runs training courses, provides technical advice and holds an annual conference.

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FOREWORD

This publication provides information for those involved in the design, construction, modification, maintenance and decommissioning of facilities for the storage and dispensing of vehicle fuels (at either retail or commercial premises), hereafter referred to as filling stations. In addition it will be of interest to those involved in the enforcement of regulations applicable to such sites.

It has been produced jointly by the Association for Petroleum and Explosives Administration (APEA) and the Service Station Panel of the Energy Institute (EI). Considerable technical input has also been provided by the UK Health & Safety Executive and other industry stakeholders in the UK.

This edition replaces that published by APEA/EI in 2005. Changes have been made to the content to reflect changes in technology and legislation since publication of the last edition.

Although the information is largely based on experience from the UK, and makes frequent reference to legislation applicable in the UK, it is anticipated that the general principles will be applicable in most regions internationally. Those involved in the design, construction, modification and maintenance of filling stations outside of the UK should comply with any legislation applicable in that country.

The information contained in this publication is not intended to be prescriptive, nor to preclude the use of new developments, innovative solutions or alternative designs, materials, methods and procedures, so long as such alternatives are able to provide at least an equivalent level of control over the identified safety, pollution and health hazards to that provided by this guidance, and in doing so achieve compliance with any relevant legislation.

In the preparation of this publication it has been assumed that those involved in the design, construction, modification, maintenance and decommissioning of filling stations will be competent to do so and able to apply sound engineering judgment.

The content of this publication is provided for information only and while every reasonable care has been taken to ensure the accuracy of its contents, APEA and the EI cannot accept any responsibility for any action taken, or not taken, on the basis of this information. Neither the APEA nor the EI shall be liable to any person for any loss or damage which may arise from the use of any of the information contained in any of its publications.

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Suggested revisions are invited and should be submitted to:
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or
The Association for Petroleum & Explosives Administration, PO Box 106, Saffron Walden, CB11 3XT.

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APEA	Association for Petroleum and Explosives Administration
CFOA	The Chief Fire Officers Association
DFA	Downstream Fuels Association
EA	Environment Agency
ECA	Electrical Contractors Association
EI	Energy Institute
FEF	Forecourt Equipment Federation
HSE	Health & Safety Executive
NICEIC	National Inspection Council for Electrical Installation Contracting
PEIMF	Petroleum Equipment Installers and Maintenance Federation
RMIP	Retail Motor Industry Petrol
SELECT	The Electrical Contractors Association of Scotland
UKLPG	UK Liquefied Petroleum Gas
UKPIA	UK Petroleum Industry Association

Both the APEA and EI are grateful for the significant contributions to revising the text and steering the update made by:

Ray Blake (CFOA), Gareth Bourhill (APEA), Ian Buckland (HSE), Bob Cairney (SELECT), Bob Conlin (APEA), John Dallimore (John Dallimore & Partners), Terry Hedgeland (Consultant), Patrick Howley (Total UK Limited), Martin Hunnybun (EI), Phil Lambeth (BP Oil UK Ltd), Roger Marris (CFOA), Mike Melnyk (FEF), Phil Monger (RMI/PEIMF), Louise Morgan (APEA), Peter Prescott (Coteba), Hylton Reid (NICEIC), Ian Richards (Total UK Limited), David Stefanowicz (ECA), Andrew Sykes (EI), Jamie Thompson (APEA), Steve Wenham (Environment Agency), Rex Wheeler (Consultant), Richard Wigfull (UKLPG).

1 SCOPE

This publication:

- Provides technical guidance on the storage and dispensing of petroleum products including petrol, diesel, autogas (also known as LPG) and biofuels (blends of petrol or diesel containing up to 10 % biomass derived component), used as fuels for motor vehicles, primarily at filling stations to which the general public have access.
- Provides technical information in an Annex on the storage and dispensing of biofuels with greater than 10 % biomass derived component.
- Covers civil, mechanical, hydraulic and electrical installation issues for the planning, design, construction, commissioning, modification, maintenance and decommissioning of filling stations.
- Provides information aimed at minimising the risks from fire and explosion, to health and to the environment.
- Describes good practice and certain legal requirements, particularly those applicable in the UK.
- Is primarily intended to be applicable to both new sites and existing sites that are modified/refurbished. The guidance should also be useful in assisting the duty-holder to undertake periodic review of their risk assessment(s) required under specific legislation applying to the facilities.
- Provides general principles that may be applicable to other types of installation where fuels are stored and dispensed for non-retail use.

This publication does not:

- Provide technical information on facilities for the storage and dispensing of compressed natural gas (CNG).
- Cover the detailed procedures for the assessment of risk.
- Provide information on operational procedures.
- Cover all potential configurations/types of installations, some of which will have site-specific risks associated with them.

2 RISK ASSESSMENT

2.1 GENERAL

The assessment and control of risks at filling stations not only make good business sense but also are legal requirements throughout Europe. Specifically in the UK, the Health and Safety at Work etc. Act 1974 and the Management of Health and Safety at Work Regulations 1999 contain general requirements for employers and the self-employed to assess the risks to workers and others (including the general public) who may be affected by their undertaking, so that they can decide on what measures should be taken to comply with health and safety law. Guidance on carrying out a risk assessment is contained in HSE *Five steps to risk assessment*. Additionally other specific legislation detailed below requires health and safety and also environmental risks from dangerous, hazardous or polluting substances to be assessed and controlled and it is therefore important that any risk assessment is carried out not in isolation but as part of an overall assessment for a site. Where assessments for different hazards (i.e. fire and environmental) indicate different standards are required then the most stringent control measures of the two should be applied.

The performance objectives and control measures described in this publication are intended to aid the task of minimising risks associated with the storage and dispensing of vehicle fuels. Where possible a choice of control measures, which are all based on current good practice, is given to enable the most appropriate combination of measures to be selected to suit a particular facility or circumstance. The final choice of, or any variations from, recommended control measures should be arrived at only after a careful assessment of the actual risks to people or the environment occurring at each particular facility and checking the relevant statutory legislation will be met. A further assessment will need to be carried out if any significant changes are made either on site or at premises nearby or if it is suspected that the original assessment is no longer valid. This may be because of an incident or a change in standards or accepted good practice.

2.2 FIRE PRECAUTIONS

In addition to normal fire risks, a major concern associated with the storage and dispensing of vehicle fuels is the risk of fire and explosion. The term 'fire precautions' is used to describe the controls that are necessary to: prevent a fire or explosion; deal with the incident should such an event occur; and ensure those present at the time can exit the premises safely. These different but related aspects are commonly considered separately, namely as process fire precautions and general fire precautions, reflecting the different legislation applying to each in the UK. It is important in carrying out the required risk assessments that both aspects are properly considered. Also, in view of the relationship between the two, there may be benefit in carrying these out as a consolidated exercise.

2.2.1 Process fire precautions

These are the special, technical and organisational measures taken in any premises in connection with the carrying on of any work process, including the use and storage of any article, material or substance in connection with or directly from that process, which are designed to prevent or reduce the likelihood of a fire or explosion and to minimise its intensity should such an event occur. Succinctly, in respect of filling stations, they are essentially the precautions required to prevent the outbreak and rapid spread of a fire or explosion due to work activities concerning the receipt, storage and dispensing of vehicle fuels. Specific requirements to assess and control the fire and explosion risks from chemicals, fuels, flammable gases and similar hazardous materials at the workplace are contained in the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR). Guidance on carrying out a risk assessment under these regulations can be found in HSE Approved code of practice and guidance *Dangerous substances and explosive atmospheres*, L138. Guidance on assessing the risk of fire and explosion and means of minimising this at places where petrol is stored and dispensed is contained in the Chief Fire Officers' Association (CFOA) *Petrol filling stations guidance on managing the risks of fire & explosion*. The provisions of Regulation 8 of DSEAR requires assessment and implementation of appropriate arrangements to deal with accidents, incidents and emergencies involving dangerous substances present on the premises. In respect of filling stations, this will specifically include consideration of events such as spills and releases of vehicle fuels.

Note: DSEAR implement in the UK those parts of the EC Council Directive 98/24/EC The protection of the health and safety of workers from the risks related to chemical agents at work concerned with controlling fire and explosion risks and also EC Council Directive 99/92/EC Minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres.

2.2.2 General fire precautions

Separately from those particular precautions discussed above, appropriate measures also need to be taken to address 'everyday' or general fire risks. These include those necessary to prevent fire and restrict its spread and those necessary in the event of outbreak of fire, to enable those present (including the general public) to safely evacuate the premises (i.e. the buildings and outdoor areas, such as the forecourt, forming part of the facility or undertaking). These general fire precautions include the means for detecting fire and giving fire warning, the means for fire-fighting, the means of escape, ensuring escape routes can be used safely and effectively by employees and members of the public visiting the site, and the training of employees in fire safety.

Clearly the presence of vehicle fuels, comprising a blend of flammable components with differing properties including those soluble in water, may influence the form and consequences of any fire and therefore the adequacy of the general fire precautions. It is of critical importance that the presence of dangerous substances is taken into account in determining the general fire precautions necessary. In the UK the general fire precautions requirements are made under the (devolved) legislation of the Regulatory Reform (Fire Safety) Order 2005 (for England and Wales) and for Scotland and Northern Ireland respectively, the Fire (Scotland) Act 2005 and the Fire and Rescue Services (Northern Ireland) Order 2006. The aforementioned regulations are amended by DSEAR to require consideration of any dangerous substances present.

Advice to aid employers (and the self-employed) carry out their risk assessment for general fire precautions and put necessary precautions in place is given (for England and Wales) in the Department for Communities and Local Government (DCLG) publications *Fire safety risk assessment - offices & shops* and, where the filling station comprises a vehicle repair business, *Fire safety risk assessment - factories & warehouses*.

2.3 ENVIRONMENTAL

Many of the controls recommended to prevent fires and explosions will also minimise damage to the environment. Attention will need to be given to diesel fuel when considering environmental risks since it may only have been assigned minimum controls to provide protection against fire and explosion hazards as a result of its low flammability properties. The inclusion of water soluble components such as alcohols in petrol should also be considered. An assessment should be made of the actual risks from spilt or leaking fuel and vapours during normal use, or those which might arise from equipment failure or operator error, to ensure compliance with environmental legislation including the Environmental Permitting (England and Wales) Regulations 2010 (EPR) and the Environmental Protection Act 1990. This assessment should include the environmental setting, and site-specific circumstances such as the proximity of the installation to watercourses, depth and vulnerability of groundwater, sensitive environmental receptors (e.g. sites of special scientific interest (SSSIs), special areas of conservation (SACs), special protection areas (SPAs)) and the site geology in order that the risks from accidental spillage etc. can be identified. The historical use of the site should also be considered, since if the installation is built on the site of a former filling station, the presence of old or redundant tanks may give rise to contamination. Pre-existing hydrocarbon contamination may also be spread further by spillages of petrol with higher ethanol content.

The environmental assessment may indicate the need for measures in addition to those already identified to control safety hazards. Advice on assessing environmental risks can be obtained from the Environment Agency in England and Wales, the Scottish Environmental Protection Agency (SEPA) in Scotland, the Northern Ireland Environment Agency (NIEA) in Northern Ireland, from EI *Guidance document on risk assessment for the water environment at operational fuel storage and dispensing facilities* and EI *Guidelines for soil, groundwater and surface water protection and vapour emission control at petrol filling stations*.

For further guidance on protecting groundwater from stored vehicle fuels in accordance with the EPR reference should be made to:

– DEFRA Groundwater protection code: *Petrol stations and other fuel dispensing facilities involving underground storage tanks*;
– Environment Agency *Groundwater protection: Policy and practice* (Parts1-4);
– Environment Agency Pollution Prevention Guidelines (PPGs);
– Environment Agency *Petroleum hydrocarbons in groundwater: Supplementary guidance for hydrogeological risk assessment*;
– Environment Agency *Remedial target methodology* (RTM), and
– ODPM Planning Policy Statement (PPS) 23: *Planning and pollution control*.

In England and Wales, the Environment Agency regulates operations that could cause pollution through a permit system (issued under the EPR). They also have discretionary enforcement powers. Existing pollution is usually dealt with under the following regimes:

– The Water Resources Act 1991 (Section 161A) and the Anti-pollution Works Regulations 1999 (Works Notices);
– The Environmental Protection Act 1990 (Part IIA);
– The Planning and Development Control regime (for the redevelopment of contaminated sites), and
– Voluntary industry remediation schemes.

2.4 HEALTH

In addition to creating safety and environmental hazards, vehicle fuels can also pose a health hazard if they are inhaled, ingested or come into contact with the skin or eyes. The risks from inhaling or contact with vehicle fuels should be considered in the assessment required under the Control of Substances Hazardous to Health Regulations 2002 (as amended). Exposure to vehicle fuels should be controlled and taken into account in the planning and design of the site. Particular consideration should be given to repair and maintenance activities, spillage clean up and other operations, which could result in frequent or high exposure to vehicle fuels or their vapours and residues. The hazardous characteristics of vehicle fuels and their potential for damage to health are described in Annexes 2.1, 2.2 and 2.3. Further guidance can be found in HSE Approved code of practice and guidance *Control of substances hazardous to health*, L5. Toxicity information on vehicle fuels is contained in CONCAWE product dossiers 92/102 *Liquefied petroleum gas*, 92/103 *Gasolines* and 95/107 *Gas oils (diesel fuels/heating oils)*.

3 HAZARDOUS AREA CLASSIFICATION

3.1 GENERAL

3.1.1 Introduction

The main objective in the safe design and operation of a filling station is to minimise, so far as is reasonably practicable, the releases of flammable fuels or their vapour and to prevent the ignition of any unavoidable or accidental releases that may occur. Hazardous area classification is part of the risk assessment procedure for identifying fire and explosion hazards and is used to determine those three-dimensional spaces where flammable atmospheres may be expected to be present at such frequencies as to require special precautions for the control of potential ignition sources. Such areas are subdivided into zones based on the likelihood of occurrence and duration of a flammable atmosphere.

3.1.2 Legal requirements

Hazardous area classification, as well as being a useful tool for risk assessment, is also a legal requirement under DSEAR for all work activities where dangerous substances, such as petrol and autogas are handled or stored. Hazardous areas need to be defined at new installations before the installation is commissioned and at existing installations before alterations are carried out that change type or quantity of dangerous substance present, its storage or manner in which it is handled. An area classification drawing showing the vertical and horizontal extent of the hazardous areas should be available on the site to which it relates.

3.1.3 Marking of hazardous zones

DSEAR (and equivalent national legislation elsewhere in Europe implementing relevant parts of EC Council Directives 98/24/EC The protection of the health and safety of workers from the risks related to chemical agents at work and 99/92/EC Minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres) require site operators to place the international ATEX 'Ex' symbol, if necessary, at the entry points to hazardous areas in order to provide warning of the potential dangers and of the need to take special precautions. Areas of the forecourt to which the general public have access should already be provided with sufficient warning notices to make customers aware of the hazards and the ATEX 'Ex' symbol need not be displayed in those areas. Further information on safety signs and information notices can be found in Annex 14.12.

3.1.4 Control of ignition sources

All sources of ignition, including sparks of any sort, hot surfaces, smoking material, naked flames, unprotected equipment, etc. should be excluded from hazardous areas. Any equipment, either electrical or mechanical, that is required to be used in a hazardous area will need to be assessed and, where necessary, specially protected in order to control any potential ignition sources. This includes both fixed and portable equipment. Equipment that can cause potential ignition sources supplied for use in hazardous areas after 1 July 2003 has to meet the requirements of EC Council Directive 94/9/EC The approximation of the laws of Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres, implemented in the UK by the Equipment and Protective Systems

Intended for Use in Potentially Explosive Atmospheres Regulations 1996 (EPS) and carry the Ex symbol.

Compliant equipment is frequently referred to as 'ATEX Equipment'. Existing equipment that was supplied or installed before 1 July 2003 can continue to be used provided it is safe. It can be assumed that electrical equipment built, certified and maintained to a pre-2003 protection standard is still safe but any non-electrical equipment may not have been specifically designed for use in hazardous areas and should be assessed to ensure that its continued use does not cause an ignition risk.

3.1.5 Hazardous area definitions (zones)

EI Model code of safe practice Part 15 *Area classification code for installations handling flammable fluids*, (EI 15) classifies hazardous areas into the following zones[1] on the basis of frequency and duration of the occurrence of a flammable atmosphere:

Zone 0 That part of a hazardous area in which a flammable atmosphere is continuously present or present for long periods.

Zone 1 That part of a hazardous area in which a flammable atmosphere is likely to occur in normal operation.

Zone 2 That part of a hazardous area in which a flammable atmosphere is not likely to occur in normal operation and, if it occurs, will exist only for a short period.

Further information on the duration of release and the equivalent zone classification is given in section 1.6.4 of EI 15.

The areas outside these zones are defined as non-hazardous.

An explosive atmosphere is synonymous with the terms 'flammable atmosphere' and 'explosive gas atmosphere' and is defined as a mixture, under atmospheric conditions, of air and one or more dangerous substances in the form of gases, vapours or mists in which, after ignition has occurred, combustion spreads to the entire unburnt mixture.

The diagrams used in this section show the boundaries of hazardous areas and their subdivision into zones using the shading convention adopted in EN 60079-10-1 *Explosive atmospheres. Classification of areas. Explosive gas atmospheres* and shown in Figure 3.1.

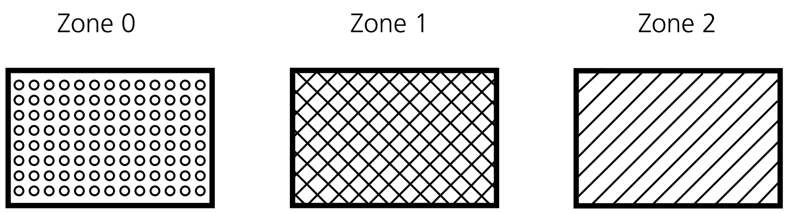


Figure 3.1 Area classification shading convention

1 The zones and methodology defined in this section should be considered equivalent to the zone definitions given in EC Council Directive 99/92/EC and in DSEAR.

3.2 HAZARDOUS AREA CLASSIFICATION BY DIRECT EXAMPLE

3.2.1 Introduction

The guidance provided in this section is based largely on experience but the distances given have been shown to be consistent with the findings of analytical studies carried out in support of EI 15.

This guidance, in conjunction with guidance obtained from suppliers of the equipment involved, is intended to assist in determining the extent of the various zones. In compiling this guidance, consideration has been given to operational factors peculiar to filling stations (e.g. unrestricted access of members of the public and their motor vehicles). Consequently, the extent of some of the zones may be different from those which would apply at a petroleum installation where operational factors (e.g. access limited to appropriately trained persons) are different. This is consistent with the approach recommended in EN 60079-10-1, which describes a method of carrying out an area classification procedure.

All possible sources of release should be identified, assessed and a practical three-dimensional hazardous area envelope devised. This should include zones arising from:

– installed equipment;
– connection and disconnection during the unloading process;
– routine maintenance operations;
– possible spillages, and
– dispensing operations.

The site being assessed should not differ appreciably from the examples below in layout, equipment size or degree of ventilation. Where there are differences, these should be accounted for by considering the individual sources of release.

In particular, the horizontal distances quoted for Zone 2 areas will depend on the likely wetted area of a liquid spillage, and this will vary with paving and drainage conditions and the degree of containment from walls and other obstructions.

The degree of ventilation[2] is also an important factor that will affect the extent and type of hazardous areas. Unless otherwise stated the examples given in this section are of typical zones occurring at filling stations for plant and equipment installed in adequately ventilated[3] positions in open areas[4]. If a location apparently falls within two zones, that location should be regarded as being in the zone with the higher risk.

Further guidance on determining the extent of hazardous areas is contained in EI 15.

3.2.2 Road tanker unloading of petrol

3.2.2.1 General

This section addresses road tankers unloading petrol at filling stations. Specific guidance regarding the unloading process and the assessment of hazards affecting the tanker is given in HSE Approved code of practice and guidance *Unloading petrol from road tankers*, L133. Under ambient conditions, materials handled below their flashpoints, such as diesel, may

2 Degree of ventilation: ventilation is a complex subject and in carrying out an assessment it is necessary to consider both the type of ventilation ('natural' or 'artificial') and within the type, the degree of ventilation to be provided. The different types and degrees of ventilation are described in detail in section 6 of EI 15.

3 Adequate ventilation: natural, artificial or a combination of both, sufficient to avoid persistence of flammable atmospheres within sheltered or enclosed areas but insufficient to avoid their initial formation and spread throughout the area. This will normally be achieved by a uniform ventilation rate of a minimum of 12 air changes per hour with no stagnant areas.

4 Open area: this is the fully open-air situation without stagnant areas where, through natural ventilation, vapour is rapidly dispersed by wind. Typically wind velocities will rarely be less than 0,5 m/s and will frequently be above 2 m/s.

give rise to hazardous areas around equipment in which they are handled under pressure, due to the possibility of mist or spray formation[5]. However, diesel unloaded by gravity should not normally create a situation where a spray or mist is formed.

3.2.2.2 Entry and departure of the road tanker

The area may be considered safe for entry and exit of tankers as long as fill point sealing caps are in position, the access chamber covers are closed (for underground fill points) and providing no spillage has occurred. In the event that any spillage has occurred, this will create a transient[6] Zone 2 hazardous area and the road tanker should not enter the area until the spillage has been cleaned up. If the spillage occurs while the road tanker is parked for unloading, it should remain isolated and not depart until the spillage has been cleaned up. The extent of the hazardous area due to a spillage will be determined by the area of containment and should be classified in accordance with 3.2.2.3(e).

3.2.2.3 Connection, unloading and disconnection of delivery hoses for flammable materials

The hazardous areas shown in Figure 3.2 are based on:

– A road tanker being parked in a designated location as close as reasonably practicable to the tank fill points, which are installed in adequately ventilated positions in open areas.
– Hose runs being confined to a designated 'corridor', with the minimum number of hoses used, to reduce the couplings required.

a. Road tanker and delivery/vapour transfer hoses

Disconnection of the hose from the road tanker, which should precede disconnection from the receiving tank, will expose internal wetted areas of both the hose coupling and vehicle bottom loading adaptor, and drips may also occur. As the hose is lifted and product is drained to the receiving tank, the hose may be moved sideways and/or towards the tank. These sources of release, which are likely to occur during normal operation, give rise to the following zones, as shown in Figure 3.2:

– Zone 1 of nominal 1 m radius around the road tanker bottom loading adaptors, which extends down to ground level.
– Zone 1 of nominal 1 m height above ground and 1 m radius either side of the hose 'corridor' required from the tanker unloading position to the storage tanks.
– Zone 2 of 4 m radius from the tanker unloading connections, to a height of 1 m to cover any small spillages of up to c. 2,5 litres that may occur during the disconnection of hoses.

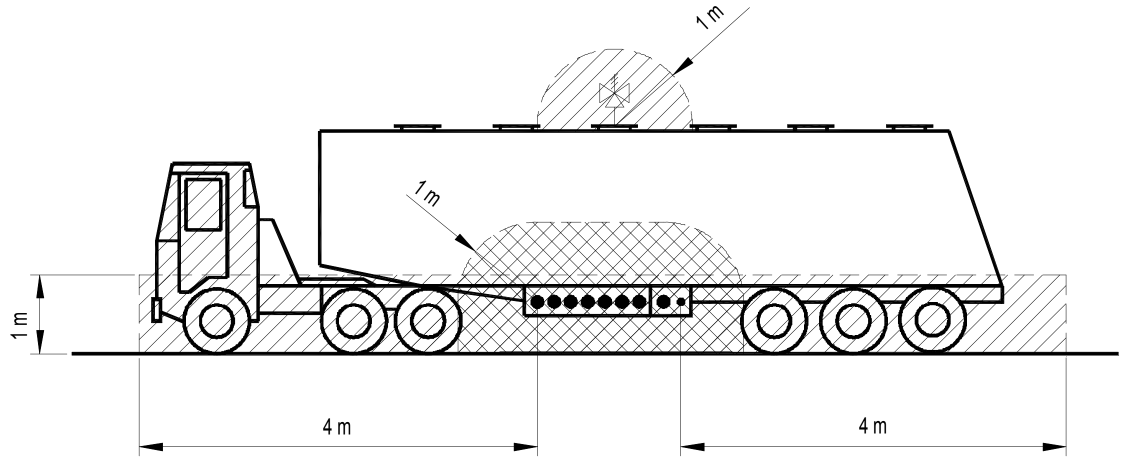
Note: these zones are considered to be transient in the sense that they only exist during and shortly after the unloading process.

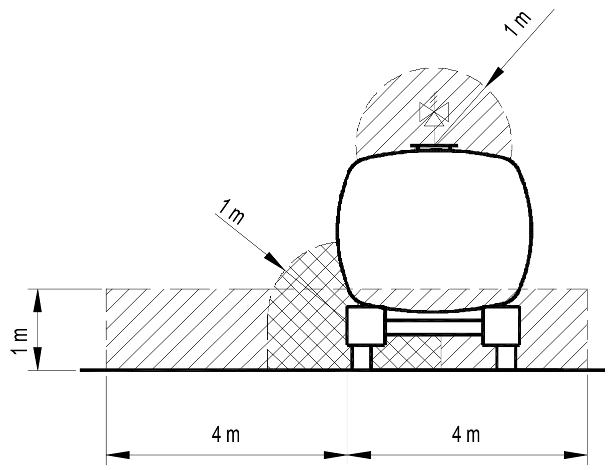
Where vapour recovery between the unloading tanker and storage tank is used, external breathing of the road tanker should not occur. However, under certain conditions (e.g. leaving the vehicle standing boxed-in under strong sunlight), the tanker could emit vapour through its pressure/vacuum (P/V) breather vent. At the frequency that this is likely to occur, this may be considered to have a Zone 2 hazardous area of 1 m radius.

In the event of manual measurement of the road tanker compartment contents (e.g. dipping or sampling), there should be a Zone 1 area of radius 1 m in all directions from the centre of any tank top opening, extending 2 m above the tank shell. Where hatches are open but no manual measurement is taking place, this vertical extent can be reduced to 1 m.

5 Mist or sprays: flammable atmospheres may also be formed where flammable fluids handled below their flashpoints are released in the form of a mist or spray. Such materials, normally regarded as non-hazardous, should be treated as hazardous when they are pumped or under pressure and are capable of producing a mist or spray due to the possibility of a release from a small hole or flange leak.

6 Transient: when there is no spillage the area is non-hazardous.





Note: ullage space in the road tanker should be classified as Zone 0.

Figure 3.2 Typical hazardous area classification of a road tanker during unloading

b. Underground storage tanks and fill points

Removal of the sealing cap from the tank fill pipe prior to hose connection may give rise to a small release of flammable vapour around the fill point.

Unless leakage occurs from the hose couplings or connection points, the completed hose connection between the delivery vehicle and receiving tank comprises a closed system, so that during the period of delivery there is no source of release.

When the hose is disconnected, the wetted surface area of the tank fill pipe will be exposed until the sealing cap is replaced, hence there will be a small release of flammable vapour for a very short duration. In addition, there will be some drainage on disconnection of the hose.

The above sources of release will give rise to the following hazardous areas, shown in Figure 3.3:

- Zone 0 within the tank itself and within any access chamber or pit in which there are tanker delivery hose connection points.
- Zone 1 of nominal 1 m radius from the tank fill point. Where the fill point is located in a pit or access chamber, the radius should be extended from the edge of the sump as shown in Figures 3.3(a) and (b). Note: the above-ground hazardous area for below-ground connection points is determined by the dimensions of the sump containing the connection points.
- Zone 2 with a horizontal radius of 4 m[7] from any above-ground offset tank fill points where spillages will not be caught in an enclosure, to a height of 1 m above forecourt level, as shown in Figure 3.3(c).

Additionally, covered tank access chambers not containing tanker delivery hose connection points used in normal operation should be classified as Zone 1 due to the possibility of leakage from fittings within the chamber.

Note: for diesel fuels, under these low pressure conditions, the generation of hazardous regions by the formation of mists or sprays from leaks is unlikely, so the hazardous areas shown around the fill points and in the pits or access chambers would not apply. The delivery point area may also be treated as non-hazardous but the Zone 0 regions shown inside the tanks should be retained. However, where diesel tanks are manifolded with petrol tanks, or filled from multi-compartmented tankers containing petrol, there may be vapour carry-over. In these cases, diesel fill points should be classified as if they contain petrol.

c. Vapour recovery connection point

Pressure build-up in the vapour recovery system can bypass the poppet valve and cause small releases of vapour when the dust cap is removed prior to connecting the hose. Small releases may also occur during hose disconnection procedures. These releases will give rise to a Zone 2 hazardous area of nominal 1 m radius around the vapour connection point. Part of this area may already be covered by the Zone 1 area relating to the fill point.

d. Above-ground tanks

A different situation to that in (b) arises when a road tanker has to be unloaded into an above-ground tank, and a pump is necessary to provide the required pressure. The hazardous area classification should be determined using the point source approach, taking into account the location of the unloading point and whether the pump is provided on the vehicle or at the installation.

i. The preferred method of unloading is by using a fixed pump at the installation, fed by gravity from the road tanker. This has the advantages that the equipment on the vehicle is de-energised during unloading and the vehicle hoses and couplings are not subject to pump discharge pressures. In this case, the hazardous area classification should be prepared for the coupling points and hose draining as in 3.2.2.3 (a) above. There will be an additional Zone 2 around the pump, the radius of which will depend on the type of pump installed: for a pump of a high integrity type this will be 4 m. Further guidance on the hazardous area classification of pumps may be found in EI 15. Entry and departure of the vehicle should be controlled by specific site regulations. Reference can be made to HSE Approved code of practice and guidance *Unloading petrol from road tankers*, L133.
ii. Where a static pump is not available and a vehicle-mounted pump is to be used (requiring the engine to be run in order to power the pump and therefore with the road tanker's electrical system live), hazardous area classification will be necessary, for both petrol and diesel (due to the possibility of mist or spray formation from leakage points). The operation itself will give rise to a Zone 2 hazardous area, with the radius depending on the type of pump used. However, again, if the pump is of a high integrity type it will be 4 m[8]. For the hazardous area around any coupling point, see Figure 3.2.

7 Radius of 4 m is suitable for small spills of up to 2,5 litres on unrestricted level surfaces. The zone due to a larger spill may be more accurately determined using 3.2.2.3(e).

8 Valid for a high integrity pump with an outlet pressure up to 5 bar(a).

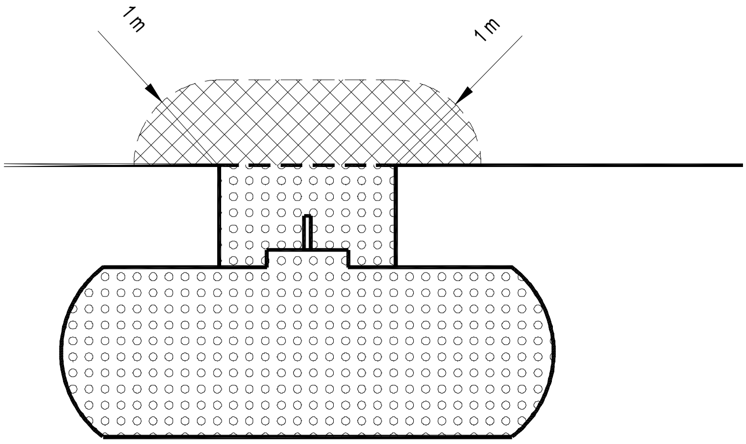


Figure 3.3(a) Fill point/vapour recovery connection in access chamber

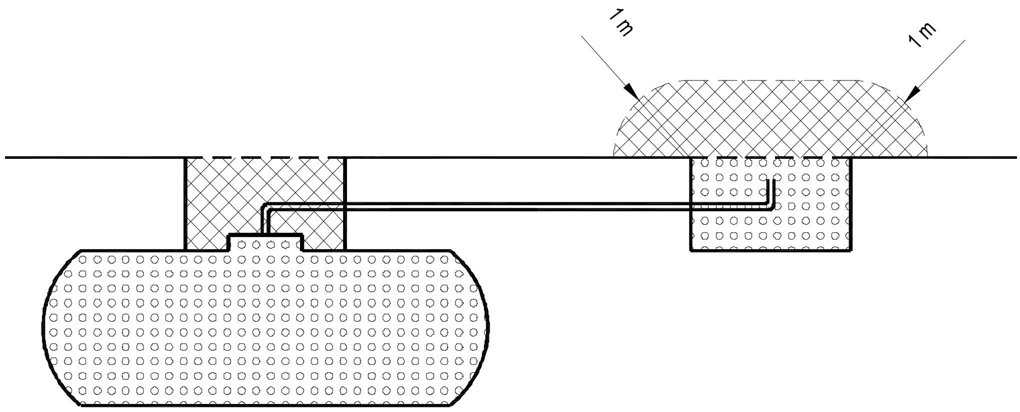


Figure 3.3(b) Offset fill point/vapour recovery connection in access chamber

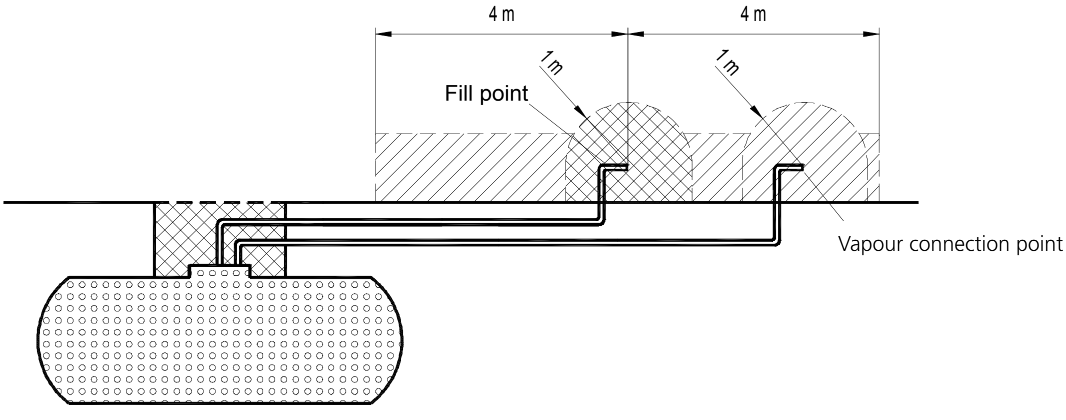


Figure 3.3(c) Above-ground offset fill point and vapour recovery connection

Figure 3.3 Typical hazardous area classification for underground petrol storage tanks and fill points during road tanker connection, unloading and disconnection

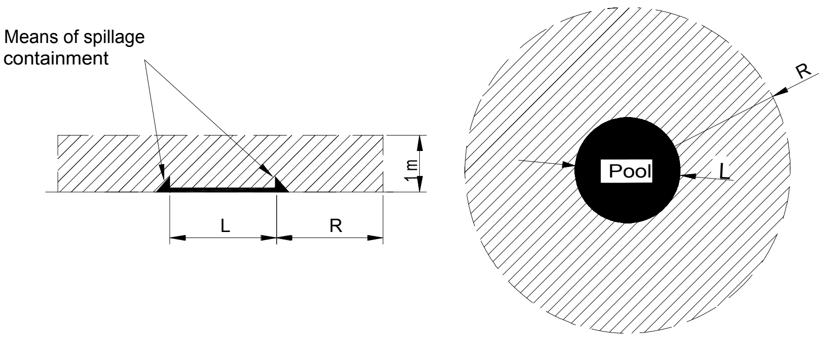
e. Hazardous area due to large[9] spillages of flammable fluid

Large, accidental spillages are unlikely to occur in normal operation and are only likely to occur infrequently. The hazardous area determined for such spillages should be used for the selection of electrical or mechanical equipment that may be installed in that area. The resulting hazardous area should be classified as Zone 2. Should such a spillage occur, the road tanker should not be moved until the area is made safe, and all other vehicles should also be prevented from entering or leaving the site until the spillage has been cleared and the area determined to be non-hazardous.

To determine the hazardous area from significant releases of liquid petrol it is necessary to estimate the likely pool size by taking into account site features such as the slope of the ground, drains, recovery points and retaining walls. The size of the hazardous area can then be derived from the equivalent diameter of the petrol pool, as shown in Figure 3.4, using Table 3.1.

Table 3.1 Zone 2 hazardous area arising from a petrol spillage[10]

Length of spillage, L (m)	Hazard radius, R (m)
Less than 5	3
5 to less than 10	7,5
10 or greater	15



where:

L is the equivalent diameter of the petrol pool

R is the extent of the hazardous area from the edge of the petrol pool in the same direction

Figure 3.4 Typical hazardous area classification for a large spillage of a flammable fluid

9 For the purposes of this publication 'large' is taken to mean greater than 2,5 litres.

10 Based on calculations from EI 15. Distances are suitable for spillages of flammable fluid under normal ambient conditions.

3.2.3 Venting from the storage facilities

Care should be taken to ensure that the hose connection point of the tank vent(s) remains securely closed in the event that vapour recovery is not practised for any reason. Failure to observe this precaution will lead to the discharge of flammable vapour at low level, bypassing the normal tank vent outlets.

Hazardous area classification around vents from underground storage tanks will depend on whether there is a vapour recovery system in place or whether tanks are vented directly to atmosphere.

Systems with vapour recovery fitted will give rise to a Zone 2 hazardous area of radius 2 m around the top of the vent from the system, extending down to ground level. Vent pipes venting directly to atmosphere will give rise to a Zone 1 of radius 2 m around the top of the vent and a Zone 2 extending down to ground level. See Figure 3.5.

Note: the above hazard radii are applicable for all vent pipes up to 80 mm in diameter and tanker unloading rates up to 250 000 l/h. For larger vent pipes and faster filling rates, further guidance can be found in EI 15.

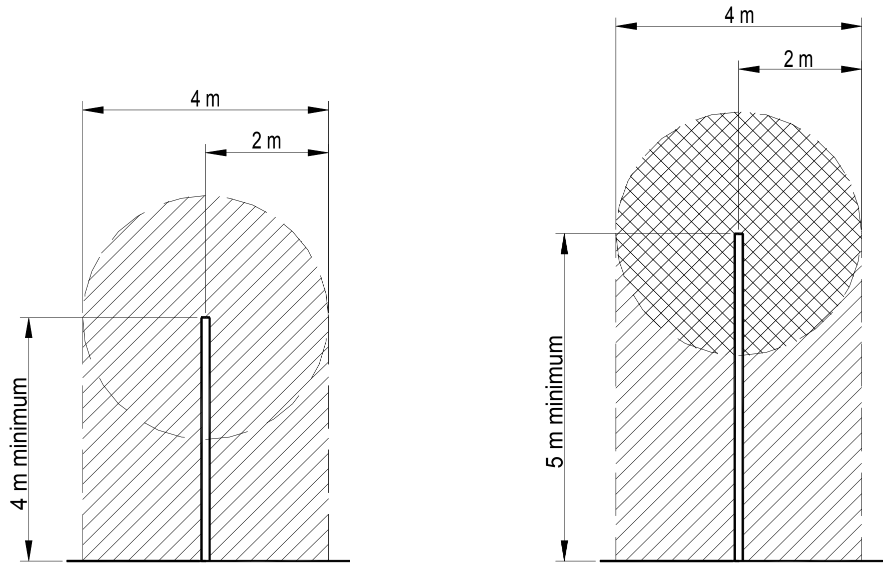


Figure 3.5(a) With vapour recovery **Figure 3.5(b) Without vapour recovery**

Figure 3.5 Typical hazardous area classification around a storage tank vent pipe

3.2.4 Drainage systems

3.2.4.1 Oil/water separator

Surface run-off from areas where spillage of vehicle fuels is possible may be routed via an oil/water separator.

Separator access chambers should be classified as Zone 1 when they are sealed (i.e. gas tight). If a chamber is covered but not gas tight, this will give rise to an additional Zone 2 hazardous area above the cover of radius 2 m from the edge to a height of 1 m, in accordance with Figure 3.6.

Where vehicle fuels are not removed directly following spillage, the ullage space in the separator will be classified as Zone 0 giving rise to a Zone 1 hazardous area of 1 m radius around the top of the separator vent. See Figure 3.6.

Where vehicle fuel is emptied directly following spillage, the ullage space in the separator may be classified as a Zone 1 giving rise to a Zone 2 hazardous area of radius 1 m around the top of the separator vent.

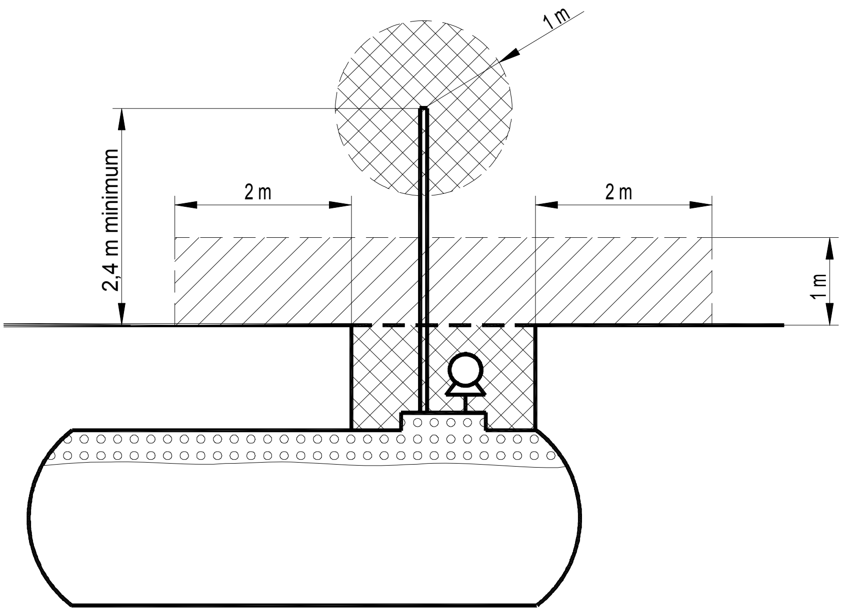


Figure 3.6 Typical hazardous area classification for an oil/water separator

3.2.4.2 Constructed wetlands

Surface run-off from areas where spillage of vehicle fuels is possible may be passed through a constructed wetland for treatment. Under normal circumstances there should be no release of flammable materials, as small quantities of fuel will be held and broken down within the soil around the roots of the plants. However, in the event of a large spillage, for instance during a road tanker delivery, the wetland may contain free flammable material, until such times as it can be safely removed.

The whole of the wetland and a nominal 4 m extension (to a height of 1 m) from the edges should be classified as Zone 2. If the surface level of the wetland is below the surrounding ground level then any enclosed volume will be Zone 1 with a 4 m Zone 2 hazardous area surrounding the outside edge of the wetland, as shown in Figure 3.7. If the wetland is contained by a perimeter that is higher than the surrounding ground level, then the Zone 1 will apply to the top of that perimeter (i.e. higher than the surrounding ground level).

Access chambers for any valves should be classified as Zone 1. If the cover to the chamber is not gas-tight, this will give rise to an additional Zone 2 hazardous area above the cover of a radius of 2 m from the edge to a height of 1 m.

Any retaining vault associated with the reed bed will have the same function as a storage tank and should be classified accordingly.

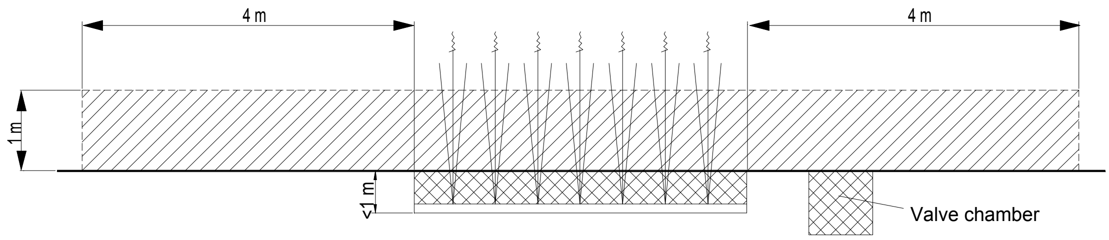


Figure 3.7 Typical hazardous area classification for a constructed wetland

3.2.5 Petrol dispensers

3.2.5.1 General

Reference should be made to the dispenser manufacturer to determine the likely sources of release from a dispenser, based on the relevant standard to which it was designed and constructed. For new dispensers the manufacturer or supplier should provide a diagram with the unit showing the zones in and around the unit. The zoning within and immediately above the housing of dispensers (both petrol and autogas) will depend on their internal construction (e.g. employing vapour barriers). Details of the dispenser internal zoning and its vapour barriers are necessary when more accurate determination of the external zones around the dispenser is required, as opposed to the generic examples given in this section (or other user codes).

Figures 3.8 to 3.12 are intended to assist in the selection of electrical and other equipment suitable for operation in the vicinity of petrol dispensers. Figures 3.8 to 3.11 summarise the hazardous areas arising around specific equipment. Figure 3.12 shows how these separate areas are aggregated together and indicates the extent of the transient hazardous areas that occur during dispensing which are not applicable as vehicles enter or leave the site. The figures can be used to assess the risks of other potential ignition sources in the area.

They should not, however, be used to determine construction requirements of dispensers as these will have been designed and assessed against relevant national, European or International Standards in accordance with section 9.

3.2.5.2 Dispenser housing

Figure 3.8 shows the extent of hazardous areas around a dispenser housing, which applies to petrol dispensers either with or without Stage 2 vapour recovery installed. Figure 3.8(a) shows the extent of hazardous areas without a vapour barrier; Figure 3.8(b) shows the reduction in the area when there is a vapour barrier. The Zone 2 hazardous area may vary between 0 - 200 mm depending on the standard of construction of the dispenser housing. Where necessary, reference should be made to information from the dispenser manufacturer.

When the nozzles are not withdrawn for refuelling, the limited hazardous area around the dispenser enables vehicles to enter the filling station without passing through any hazardous areas.

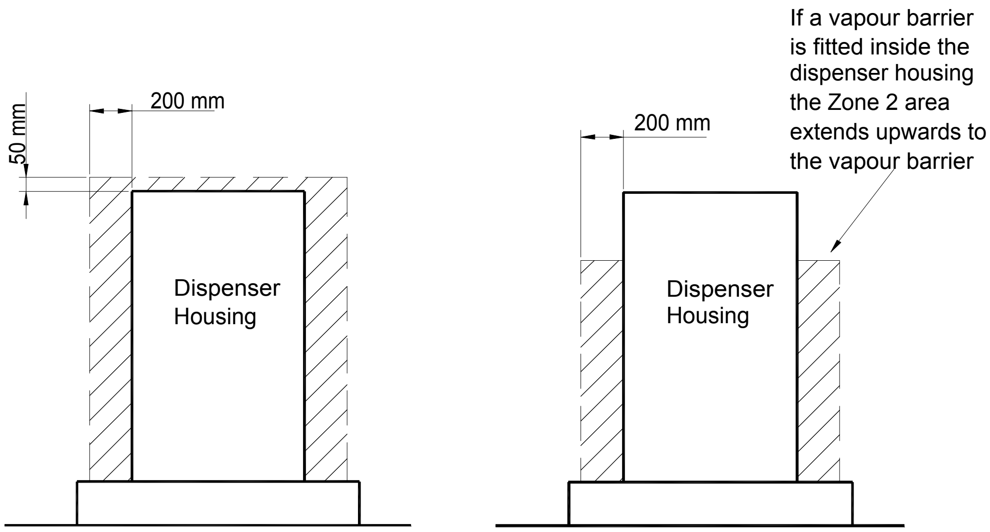


Figure 3.8(a) Without a vapour barrier **Figure 3.8(b) With a vapour barrier**

Figure 3.8 Typical hazardous area classification around a petrol dispenser housing

3.2.5.3 Hazardous area around external dispenser air separator vent

Figure 3.9 illustrates the extent of the hazardous area around an air separator vent on the outside of a petrol dispenser (either with or without Stage 2 vapour recovery installed). The Zone 1 hazardous area extends 250 mm horizontally, down to ground level, and 100 mm vertically above the vent.

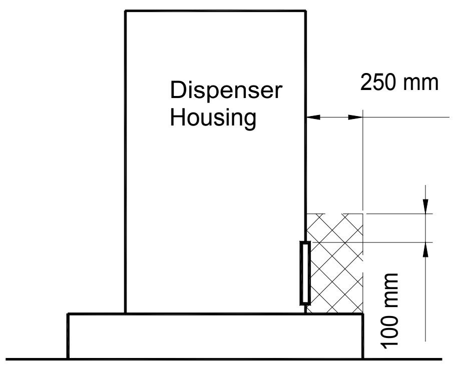


Figure 3.9 Typical hazardous area classification around an external dispenser air separator vent

3.2.5.4 Hazardous area around a vehicle fill pipe during refuelling

When a nozzle is inserted into the vehicle fill pipe and the nozzle trigger is operated, flow of petrol begins and vapour is displaced from the vehicle's tank.

Where the dispenser/filling station is fitted with Stage 2 vapour recovery, displaced vapour is recovered by the nozzle and very little is displaced to atmosphere. The hazardous area in this case will be Zone 2 as shown in Figure 3.10(a).

Where Stage 2 vapour recovery is not installed, then, as petrol enters the vehicle tank, vapour is displaced to atmosphere and, because it is heavier than air, it rolls down the side of the vehicle and drops towards the ground. The hazardous area in this case will be Zone 1 as shown in Figure 3.10(b).

The height of the hazardous area created by the refuelling operation is dependent on the height of the vehicle tank fill point. A minimum of 1,2 m is considered sufficient to allow for varying heights of vehicle tank fill points.

The typical hazardous area classification in Figure 3.10 does not take account of leakage due to hose or nozzle failure. Providing the dispenser is taken out of service immediately, the duration and likely frequency of a leak under these circumstances may be considered to be too low to require hazardous area classification.

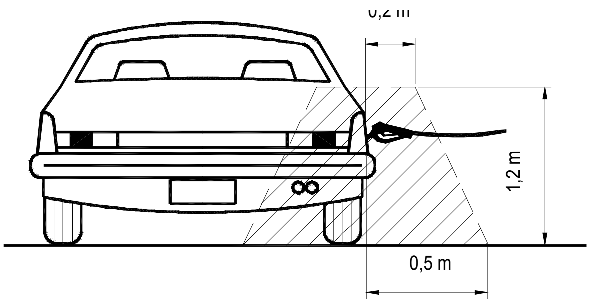


Figure 3.10(a) Nozzle fitted with Stage 2 vapour recovery

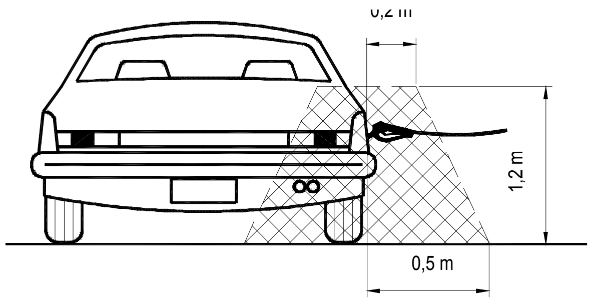


Figure 3.10 (b) Nozzle without Stage 2 vapour recovery

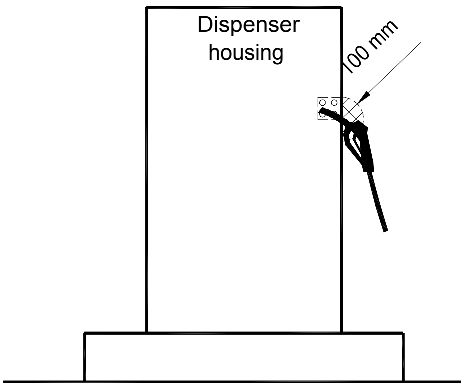
Note: 1,2 m allows for those cases where the hose is lifted over the vehicle on its return to the nozzle housing and for vehicles with a high fuel tank opening.

Figure 3.10 Typical hazardous area classification around a nozzle during vehicle refuelling

3.2.5.5 Return of nozzle to dispenser housing

On completion of vehicle refuelling, liquid and/or vapour will be present in the nozzle when it is withdrawn. This gives rise to a small Zone 1 area around the nozzle until it is returned to the nozzle housing on the dispenser. However, over 100 mm from the nozzle housing this may be considered a Zone 2 due to the likelihood of it existing at any number of points within the locus of the hose length. As the nozzle will always be returned to the same position, a Zone 1 hazardous area will arise within a 100 mm radius around the dispenser nozzle housing. The area within the nozzle housing should be classified as Zone 0.

These are only normally relevant for the design of the dispenser, but should be considered if electronic displays are mounted on the nozzle.



Note: any unclassified electrical equipment should be located at a safe distance above the nozzle housing.

Figure 3.11 Typical hazardous area classification around nozzle spout housing

3.2.5.6 Composite hazardous areas around dispensers during refuelling

Figure 3.12 shows the typical composite hazardous areas around a dispenser with two side mounted hoses. It is based on:

– A dispenser **without** a vapour barrier, **with** an external air separator vent.

– A standard dispenser hose length of 3,6 m.
The vehicle refuelling location is not the same for every refuelling operation, but is restricted by the distance to which the nozzle may be extended. Since a vehicle may park in various positions the hazardous area created by the refuelling operation shown in Figure 3.10 will occur wherever the vehicle is parked. This results in a composite hazardous area which extends from the maximum length of the hose all the way back to the dispenser.

– A small hazardous area around the nozzle after refuelling, as described in 3.2.5.5.
Again, since the vehicle may park in various positions, the hazardous area created by the nozzle will occur wherever the vehicle is parked all the way back to the dispenser as it is being returned to the housing. In addition, since the release volume is relatively small, this, together with the variety of parking positions, significantly reduces the frequency of the release occurring in the same position every time and allows the Zone 1 which would otherwise occur all the way back to the dispenser, to be downgraded to a Zone 2, except where the nozzle nears the dispenser housing, as the nozzle will always be returned to the same position. Note: the Zone 2 hazardous area created by the nozzle is enveloped by the hazardous area created by the refuelling operation.

Note: where a dispenser is fitted with a vapour barrier, consideration should be given to the hazardous area associated with the nozzle after vehicle refuelling as it is returned from the vehicle tank fill point to the dispenser nozzle housing.

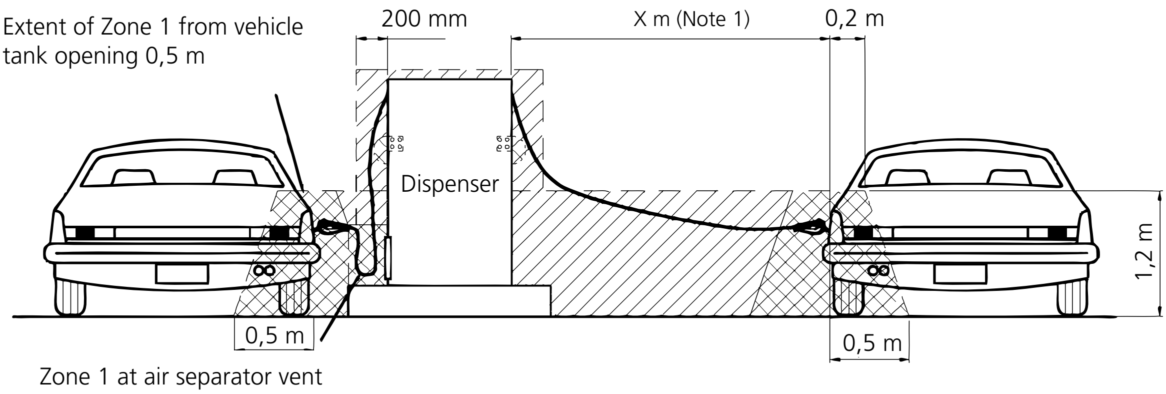


Figure 3.12(a) Without Stage 2 vapour recovery installed

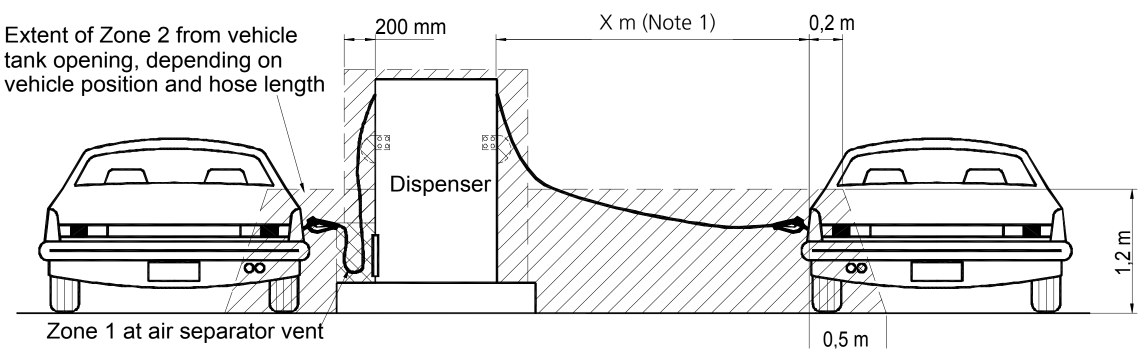


Figure 3.12(b) With Stage 2 vapour recovery installed

Figure 3.12 Typical composite hazardous area classification around a dispenser[11] during refuelling

Note 1: Size of hazardous area equal to length of dispenser hose

3.2.6 Autogas[12]

3.2.6.1 Road tanker unloading

Road tankers delivering autogas to retail facilities should be assessed for hazardous area classification together with the provisions of safe entry of vehicles covered in 3.2.2 (e.g. in the event of a spillage of flammable materials at the site).

Whilst road tankers delivering liquid fuels are discharged under gravity at ambient conditions, autogas will be at its vapour pressure at ambient temperature and will therefore have to be pumped into the storage vessel but without the need for vapour recovery and without creating vapour discharges to atmosphere.

11 As described in 3.2.5.6.

12 Hazard radii distances due to small losses have been derived using *Aeroplume* dispersion model.

Delivery of autogas is typically from a rigid tanker with an onboard discharge pump. Providing the pump is of a high integrity type, this will give rise to a Zone 2 hazardous area around the pump. In cases where an external pump is used for delivery, a Zone 2 hazardous area will be present around any hose connection points around the tanker and the pump will require classification at its fixed location. Further details of pump classification can be found in EI 15. It should be noted that road tankers used for autogas are highly variable in design and the site operator should ensure they are advised of the type of tanker likely to deliver to their site and be provided with a hazardous area classification drawing of the tanker which may be used. Hazardous area classification of the site will be incomplete without this.

The hazardous areas around the delivery area will need to take account of the hazardous areas created during unloading of autogas. This includes (but is not limited to) hazardous areas around hose reels, gauges, pumps and relief valves on the tanker. The integrity level of these fittings and components will impact upon any associated hazardous area.

3.2.6.2 Autogas storage[13 14]

For autogas storage in buried storage vessels, typical classification is given in Figures 3.13(a) and (b). For cases where storage is above ground, typical classification is given in Figure 3.13(c).

Buried storage vessels will have vessel access chambers which should be classified as Zone 1 hazardous areas. Where connections are made (e.g. fill point or ullage level indicator operation), this will create a transient Zone 2 hazardous area of 1,5 m above ground around the access chamber during the unloading operation. Where fill points and ullage level indicators are offset (above ground), these will give rise to Zone 2 and Zone 1 hazardous areas respectively of 1,5 m[15] radius, see Figure 3.13(c).

Relief valves with a soft seat, which are regularly maintained and tested, are not considered under the design relief condition for area classification purposes; however, fixed electrical equipment should not be installed within the direct path of discharge. To allow for small, infrequent leakages they should be classified with a Zone 2 hazardous area of 0,5 m radius. Where other types of relief valves are fitted, this hazard radius should be increased to 2,5 m.

Provided autogas storage facilities are purged with nitrogen prior to filling and emptying, within the vessel the ullage should never contain a flammable atmosphere due to air, and therefore the ullage space can be considered as non-hazardous. Where nitrogen purging is not used, the ullage space within in the vessel should be classified as Zone 0.

Where it is necessary to classify single flanges they should have a Zone 2 hazardous area of extent appropriate to the integrity of the flange and process conditions encountered in the pipework, the extent of which should be at least 1m.

3.2.6.3 Autogas dispensers[14]

The design of autogas dispensers incorporates such safety measures as back-check valves, hose breakaway couplings (safebreaks) and other isolating valves to limit releases during normal operation to those associated with the filling hose. Dispenser hoses with self-sealing valves in the filling nozzle limit the loss of autogas on disconnection to 10 cm^3. However, this can occur at any position between the dispenser and the full extent of the hose and is therefore classified as a Zone 2 hazardous area equivalent to the length of the hose, to a height of 1,2 m above ground (i.e. typical height to which the hose will be handled during the refuelling operation).

Dispensers with hydrostatic relief valves should only give rise to infrequent releases of autogas into the dispenser casing due to the valve lifting. Whilst this results in the inside of the dispenser casing being classified as Zone 1, the resultant hazardous area around any casing vents will be limited to a Zone 2 of 1 m[16] radius around the apertures.

13 In addition to hazardous areas there is also a 'separation distance' around the storage vessel and the main components. For further information see UKLPG CoP 1 and 20.

14 Area classification is typical only. Site-specific conditions may lead to changes in the size and extent of hazardous areas.

15 Valid for losses up to 100 ml.

16 This is equivalent to a leakage of 0,01 kg/s of autogas. A 1,5 m radius is suitable for losses within the casing of autogas at 10 bar(a) of up to 0,015 kg/s.

With adequate low-level venting of the dispenser casing, autogas should not be vented from the upper part of the dispenser. However, to ensure uncertified electrical equipment is not mounted on the hydraulic part of the dispenser casing, a nominal Zone 2 of 150 mm should be applied surrounding the casing.

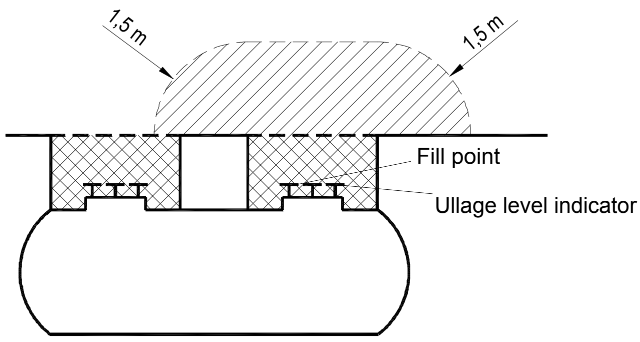


Figure 3.13(a) Buried

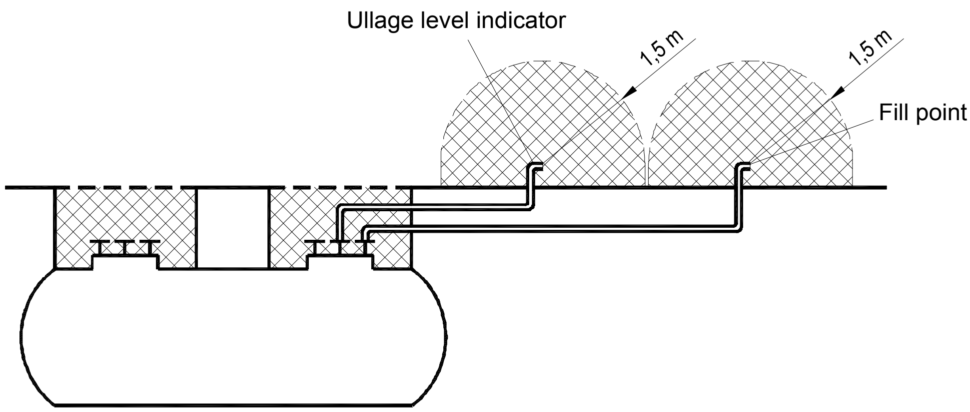


Figure 3.13(b) Buried with offset fill point and ullage level indicator

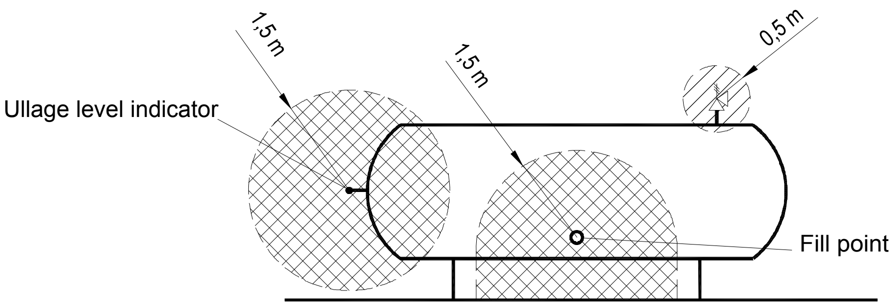


Figure 3.13(c) Above ground

Figure 3.13 Typical hazardous area classification for autogas storage

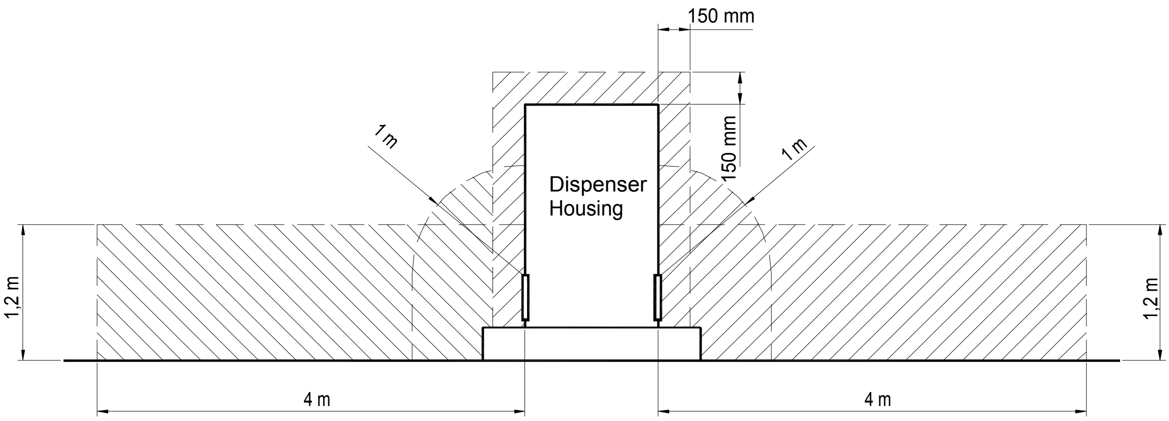


Figure 3.14 Typical hazardous area classification around an autogas dispenser during refuelling

Notes: 1. Area within dispenser casing defined by manufacturer.
2. Suitable for dispensers using hose lengths of up to 4 m.

3.2.7 Buildings and kiosks with openings in a hazardous area

For kiosks and any other small buildings with openings in a hazardous area the appropriate zone should be applied throughout the building, to its full height, as vapour in a confined space is unlikely to remain at low level. Further guidance on ventilation options may be found in EI 15.

3.2.8 Pits, trenches etc.

Any pit, trench or depression below the surrounding ground level that is wholly or partly in a Zone 1 or Zone 2 hazardous area should be classified as Zone 1.

4 PLANNING AND DESIGN

4.1 GENERAL

Any site chosen for a filling station should be sufficiently spacious to allow it to be designed to minimise the risks from vehicle fuels to any person likely to be at or near the filling station. The locations of tanks, fill points, vent pipes, dispensers, road tanker delivery stands and buildings should be designed to provide for satisfactory means of escape for persons in the event of a fire or other incident, for hazardous areas to be protected from sources of ignition, and for safe access, routing, parking and exit of customers' vehicles, service vehicles and road tankers. The general principles of the section should equally be applied to refurbishment of sites.

4.2 INITIAL PLANNING

Prior to drawing up plans for the site, a health, safety and environmental risk assessment should take into account:

– The nature, location and depth of any waste disposal (landfill) and land contamination.
– Any subterranean water courses, aquifers, culverts, pipelines or mine workings.
– Any cuttings or tunnels and any basements or cellars directly beneath or adjacent to the filling station.
– Surface waters and groundwater.
– Protected environmental areas, for example a site of special scientific interest (SSSI).

Wherever possible the filling station should be so arranged that there are no overhead conductors (electricity or telephone lines etc.), which at their maximum horizontal swing pass within 3 m of a vertical projection upwards from the perimeter of hazardous areas (e.g. dispensers, vent pipes, tanker stands).

Exceptionally, and only after agreement with all relevant authorities (e.g. overhead line operator), the site may be located beneath suspended overhead conductors provided that precautions are taken to avoid danger from falling cables, the possibility of stray currents in the metalwork and the possibility of direct contact by delivery personnel using dipsticks on tops of tankers. For details see section 14.3.1.

The nature of the previous uses of the land being redeveloped should also be identified and assessed, including where necessary a soil vapour survey. When redeveloping existing sites remediation may be required. Reference should be made to:

– EI *Guidelines for investigation and remediation of petroleum retail sites*;
– DEFRA & Environment Agency *Model procedures for the management of land contamination* (Contaminated Land Report 11), and
– ODPM Planning Policy Statement 23: *Planning and pollution control*.

Consultations between the developer and responsible public authorities or other organisations will usually be necessary. These will include the appropriate water company, the appropriate environment agency, the Environmental Health Authority, and the petroleum enforcing authority. For site-specific investigations in the UK, the local Environment Agency[17] office should be contacted.

17 Environment Agency (England & Wales), Scottish Environmental Protection Agency (SEPA) or Northern Ireland Environment Agency (NIEA).

The storage and handling of dangerous substances being carried out on land or in buildings or other structures close to the boundaries of the filling station will need to be taken into account. The locations of tanks and other equipment, and the services at the filling station should be chosen to minimise the effects of fire or explosion upon adjacent premises and to avoid jeopardising the means of escape of persons at the filling station or at adjacent premises. Consultation may be necessary with the occupiers of premises within 30 m of the site.

Due regard needs to be given to any National Planning Policy Statements currently in force. Initial planning needs to take into account the guidance in section 14 on electricity supplies and electrical equipment, and the need for co-ordination between all persons involved in the development of the filling station (e.g. the developer, contractors, operator, installers and suppliers of equipment, electricity and vehicle fuels). In particular, the requirements of the Construction (Design and Management) Regulations 2007 should be taken into account.

Initial planning should take into account the requirements of the Disability Discrimination Act 1995, 2005 and 2010 to make services accessible to disabled customers. Comprehensive practical advice is given in the Centre for Accessible Environments/UKPIA *Making goods and services accessible to disabled customers*. In England and Wales, reference should be made to the Environment Agency *Groundwater protection: policy and practice* (GP3) suite of documents during initial planning.

4.3 PERMITS

The requirements of current petroleum regulations should be complied with in respect of the provision of information and details of the proposed installation to the relevant enforcing authorities before work is to commence on site. Normal building control clearance will need to be obtained and the Building Control Authority will need to be notified of any demolitions. Environmental permits covering discharges from all interceptors will be required.

It is recommended that as early as possible during the planning stage the enforcing authorities should be advised of the proposals.

In the event that alterations need to be made, such revisions should be submitted to the relevant enforcing authority and copies of all such information should be made available to the site operator.

4.4 LAYOUT OF FACILITIES

4.4.1 Petrol and diesel fuel storage tanks

It is important in choosing the site for vehicle fuel storage tanks to consider the potential incidents that might threaten the installation, or ensue as a consequence of loss or spillage of fuel. The more obvious of these, such as vehicle impact, threat from fire and accumulation of flammable vapour can be avoided by locating the tank underground, clear of any building foundations or underground features, such as drains and tunnels.

Where an above-ground tank is considered for the storage of petrol it should be located and protected in accordance with the recommendations and relevant regulations (e.g. Control of Pollution (Oil Storage) (England) Regulations 2001) in section 8. Fuel storage tanks should be located in a manner to allow safe access and subsequent removal if required. Locations will be defined by the hazardous area classifications (see section 3) and any additional separation distances appropriate for the site.

4.4.2 Fill points

The fill points for storage tanks, whether offset or direct fill, need to be located so that any spillage of fuel and its subsequent ignition should not pose an immediate threat to members of the public, whether on the site or not, or forecourt or delivery staff. Regard also needs to be given to ensuring that any flammable concentrations of vapour resulting from the normal filling operation, or any spillage, cannot reach potential ignition sources, or accumulate in either buildings or locations outdoors where they might pose a danger. This may be achieved by locating filling points in the open air, remote from other buildings or other obstructions that might otherwise adversely affect the ventilation, and by providing drainage facilities to minimise the spread of any spillages and prevent them reaching the public highway, emergency equipment, private vehicles on the forecourt, occupied buildings and the road tanker itself.

Fill points should be positioned to allow the tanker to discharge without being at risk from other vehicle movements. Fill points and the associated delivery stand areas should not lie on the line of slip or access roads, particularly slip roads from high speed carriageways. The hazardous area created by the fill points should be wholly contained within the boundaries of the site (see section 3). It is recommended that the fill points are not located within 4 m of the public thoroughfare or property boundary. This distance may be reduced if an imperforate wall of fire-resisting construction (e.g. brick or concrete block) is provided which is at least 2 m high and extends sideways along or parallel to the boundary so that the distance measured from either side of the fill point, around the wall to the boundary, is not less than 4 m.

The risk assessment has to specifically address the nature and use of adjacent property. Separation distances in addition to those set out below may be appropriate additional controls for higher risks.

Where the wall forms part of an occupied building, the separation may need to be increased to prevent any fire readily spreading into the building. A method to prevent this is to increase the distance to any part of the building which is not of fire-resisting construction. Generally 4 m is recommended, but where the building is a domestic premises or premises housing vulnerable populations (i.e. schools, hospitals, old people's homes and other residential accommodation), an increased separation distance of 12 m is recommended.

Such walls should provide a minimum of 30 minutes' fire resistance in respect of integrity, insulation and, where applicable, load bearing capacity.

Where the wall separates vulnerable populations from the dangerous substance, the fire resistance provided should be a minimum of 60 minutes.

4.4.3 Pipework

Pipework from tanks to offset fill points, dispensers and vent pipes should be routed and located to ensure protection from external effects or interference and allow access if required.

4.4.4 Storage of other dangerous substances

Specific risk assessment has to be carried out for all dangerous substances stored or handled on a site (e.g. LPG cylinders) and this has to address the additional risks presented by their proximity. With regard to autogas, see section 7 for specific guidance on separation distances and other site layout and design considerations. Autogas installations will be subject to the Pressure Systems Safety Regulations 2000 and will require a Written Scheme of Examination (WSE) drawn up by a competent person before commissioning.

4.4.5 Vent pipes for underground petrol storage tanks

The vents are provided in order to allow air to be drawn into the tanks as liquid is dispensed and as an emergency pressure release for the tank vapour recovery system. The hazardous area created by the tank vent point should be wholly located within the site. The risk assessment should specifically address the nature and use of adjacent property. Locations should be chosen taking into account conditions at or near the filling station which could adversely affect dispersal of any discharge and cause a flammable atmosphere to reach a source of ignition (e.g. the nature, height and location of surrounding developments, the direction of prevailing winds and the possibility of unusual air currents caused by high buildings, the proximity of possible ducts for vapour such as roof gutters, down pipes, chimney stacks, ventilation shafts, trees, narrow passages and gaps between buildings).

Vent pipes should extend to a height greater than the maximum liquid level in any road tanker likely to deliver petrol to the associated tanks and, in any event, should not be less than 4 m above ground level (5 m for non-emission control systems). The vent discharge point on an emissions control system should not be within 3 m in any direction of opening windows or any other opening to a building. It should not be located less than 2 m from a boundary (3 m for non-emission control systems), but where there is an imperforate wall at the boundary extending from ground level and for at least 2 m in any direction from the vent discharge point (3 m for non-emission control systems), it may be located close to the boundary. Increased separation distances should be assessed from powered air intake points for buildings or heating systems. Where no vapour recovery system is present the separation distances should be based on the 2 m radius Zone 1 hazardous area around the vent emission point.

4.4.6 Flame arresters

Flame arresters should be used at all vapour recovery points. All flame arresters should be constructed and installed in accordance with EN ISO 16852 *Flame arresters. Performance requirements, test methods and limits for use*. There are two options for flame arresters:

- end-of-line flame arresters, or
- inline flame arresters.

Each flame arrester should either be integrated with a poppet valve or installed behind the poppet valve. Other sections in this publication highlight the need for flame arresters, and their maintenance and testing. Further information can be found in EN ISO 16852.

4.4.7 Electrical ducts

Duct systems for underground electrical cables should always allow for the provision of mechanical seals to prevent transfer of vehicle fuels in liquid, gas or vapour form. Where it is not practicable to provide mechanical seals, a suitable compound or other material resistant to vehicle fuel has to be used that will provide a seal against the transfer of vehicle fuel in liquid, gas or vapour form. The installation should be designed to ensure that the number and routing of ducts limits the number of cables per duct to below the capacity of the sealing system proposed. Note: foam filling of ducts does not provide an appropriate sealing method.

Duct systems have to be designed to positively prevent vehicle fuels in liquid, gas or vapour form entering any building (e.g. including kiosks and car wash plant rooms etc.). An example of this would be to terminate the duct above ground level at an external location adjacent to the building, with the cables etc, entering the building at an elevated level (e.g. 1 m above ground). Both the duct exit and building entry should be sealed. Any exposed duct, cables and aperture to buildings should be protected against mechanical impact, climate degradation and vandalism. Such protection has to allow natural ventilation.

Wherever possible ducts should be laid with a fall away from buildings.

It is preferable that as far as practicable ducts are routed so that cables serving equipment in non-hazardous areas are **not** routed under hazardous areas. Note: this will reduce the amount of testing and inspection required annually to comply with sections 14.10.1.2 and 14.10.3.3 (c).

Consideration should be given to installing spare ducts for future services when constructing or modifying a site.

4.4.8 Dispensers

Similar considerations apply to the locations of the dispensers as to the locations of the petrol storage tank fill points. The positioning and location of dispensers on site relative to structures, the boundary and other equipment will be determined by the hazardous area of the dispenser in use at its maximum hose reach. The hazardous area of the dispenser has to be wholly contained within the site boundary and should not encroach on any openings into occupied buildings.

For occupied buildings, either on site or at the site boundary, a minimum separation distance of 3 m is recommended, provided there are no openings in the wall within 4 m of the dispenser which could allow flammable concentrations of vapour to enter the building. This distance may be reduced further if the building is of 30 minutes' fire-resisting construction. Separation distances to domestic premises, or premises housing vulnerable populations, should take account of the possibility of fire affecting a vehicle parked at the dispensing position. In such cases a minimum separation distance of 9 m is recommended unless the building is protected against the entry of fire (i.e. of 30 minutes' fire-resisting construction).

Dispensers should be located:

– In the open air where they will be adequately ventilated.
– Such that vehicles can be parked easily alongside without restricting the movement of other vehicles.
– So that hoses do not have to be stretched and are not likely to be damaged by contact with canopy stanchions or other obstructions.
– So that projecting hoses are protected from passing vehicles.

At attended self-service filling stations the dispensers should in addition be installed to facilitate their supervision and control from the control point at all times.

The attendant at the control point should have a clear view of the forecourt and the dispensers when no vehicles are present. The attendant in control needs to be able to have visibility of operations on both sides of lane orientated dispensers. The view from the control point should not be obscured by a road tanker properly positioned for unloading.

Closed-circuit television (CCTV) can be useful as a supervisory aid and should be considered as a way of observing dispensing activities at specific islands. Where the site layout does not allow a clear view from the control point supervision may be provided by means of an interactive CCTV system which is designed to specifically focus on fuelling activities. Where CCTV is used cameras should be sited to provide clear appropriate views of dispensing positions and the monitor has to be positioned such that the attendant has a clear and unobstructed sight at the time of authorisation. Particular care needs to be taken when locating components to avoid the impact of glare on cameras and the monitor from local site or street lighting or from sunlight.

4.4.9 Hydraulic efficiency - Accessibility for maintenance

It is important at the planning stage of the development to take into consideration the hydraulic efficiency of the vehicle fuel pumping system and the accessibility of valve and gauge chambers etc. In this respect, the fuel containment system should be designed so as to facilitate:

- The protection of the tanks and pipework from the potential mechanical damage of the imposed loads of vehicular traffic. This will necessitate the excavations for the tanks and pipework being of a depth to allow for a finished surface cover that will provide the desired level of protection.
- The hydraulic efficiency of the vehicle fuel pumping system. This is especially important where centrifugal pumps are used to draw fuel to the dispensers (see section 8.3.5.3.)
- A fall back of all the vehicle fuel and vapour pipework towards the tank.
- Safe working access to chambers containing valves, gauges and leak test connections etc.

A particular constraint for suction systems is the maximum hydraulic head generated to lift the fuel out of the tank and overcome the flow friction losses in the pipework system. On suction systems atmospheric pressure effectively pushes the fuel out of the tank towards a vacuum being created in the pumping unit of the dispenser. If the pressure in the pumping unit is too low then the fuel in it begins to vaporise resulting in a loss of flow and potential damage to the pumping unit. The difference between atmospheric pressure and this minimum achievable vacuum is the maximum hydraulic head. As a general rule the maximum hydraulic head should not exceed 4,25 m. The pump suppliers will be able to advise the particular figure for their models. It should be noted that these guidance figures are valid at 20 °C at sea level. Increased temperature and elevation will reduce the maximum hydraulic lift limits.

The flow friction losses in the pipework system are a function of the flow rate, pipe material and diameter, pipe length and the number of fittings in the pipe run. Pipework suppliers should be able to provide charts relating flow rate to the friction head loss for their pipework system.

Allowing for pipework head losses, there is an increased risk of suction systems failing to operate properly if the vertical difference between the bottom of the tank and the pump inlet is allowed to exceed 4 m. Where the building site is on a gradient, the positioning of the underground storage tanks (in relation to the lie of the land) will be critical if the above objectives are to be achieved. Pressure fuel systems which use pumps located in the tanks are not affected by these constraints.

4.4.10 Road tanker delivery stands

The road tanker stand for delivering vehicle fuels into storage tanks should be in the open, away from buildings (excluding canopies), dispensing activities and emergency escape routes, and be large enough to allow a road tanker to be positioned wholly within it during delivery (i.e. normally not less than 15 m long and 5 m wide at any point). The location chosen should allow for the road tanker to gain access without the need to reverse onto the site and should also provide a clear exit route in a forward direction. The road tanker discharge area needs to be substantially level but incorporate drainage designed to intercept the largest likely spillage. The tank fill points should be located in accordance with 4.4.2.

The facilities provided to enable driver-only deliveries to be made should be located so as to be readily accessible to the driver and as near as practicable to the road tanker delivery area. Ideally, the facilities, including the emergency telephone and fire-fighting equipment, should be in one place and positioned for ease of access and control of the delivery by the driver at all times. Unless there are other facilities on site always readily available, they should be positioned so that any possible spillage of petrol will not expose the driver to risks of fire or explosion.

4.4.11 Vehicle movements on site

The site layout has to be designed bearing in mind the required vehicle routes around the forecourt for customers using the site facilities and for vehicles making deliveries. Particular attention should be paid to the siting of parking areas, car valeting and car wash facilities and delivery vehicle unloading areas relative to each other and to the main vehicle flows on and off the site through the fuel forecourt. The layout should aim to avoid route conflicts and should be enhanced if necessary by the provision of extended sight lines, speed restrictions and appropriate signs and markings. Where more than one vehicle may deliver fuel to the site at the same time provision has to be made for the simultaneous safe emergency exit of both vehicles. Unloading locations for the two vehicles have to be adequately separated to ensure that an incident on one does not affect the safe operation of the other and should be reflected in the risk assessment.

4.4.12 Forecourt canopy and drainage

The need for the openings to the storage tanks, offset fill points, pipework and dispensers to be in the open air does not prevent the location of a canopy over a filling station forecourt, provided that the dimensions of the canopy do not adversely affect the ventilation of, or access to, the equipment.

Consideration should be given to environmental risk during planning of drainage facilities. Drainage systems and oil/water separators should be installed and located so they will prevent the drainage of vehicle fuel spillages, or water contaminated with vehicle fuel, from entering water courses, groundwater, public drains or sewers or from otherwise escaping from the filling station. The design of the drainage system should take account of the soluble fraction/content of the fuels intended to be handled. Water draining from the car wash facilities should not pass through the oil/water separators, as detergent inhibits oil separation. Clean water from roofs and canopies should also not be routed through oil/water separators but may be discharged direct into surface water sewers or public drains. The oil/water separator ventilation pipe(s) should extend to not less than 2,4 m above ground level, and be positioned to take account of its hazardous area (see section 3).

4.4.13 Fire-fighting equipment

The engineering controls detailed in this publication are intended to help to prevent vehicle fuel leaks and fires. Advice is not provided on general fire precautions (see section 2.2.2). The requirements for general fire precautions at premises where one or more persons are employed are made under the Regulatory Reform (Fire Safety) Order 2005 (for England and Wales) and for Scotland and Northern Ireland respectively, the Fire (Scotland) Act 2005 and the Fire and Rescue Services (Northern Ireland) Order 2006. Further advice on general fire precautions can be obtained from the Department for Communities and Local Government (DCLG) in the publication entitled *Fire safety risk assessment - offices & shops* (and where the filling station comprises a vehicle repair business, the *Fire safety risk assessment - factories & warehouses*).

In the UK the standard for the supply and servicing of portable fire-fighting equipment is BS 5306 *Fire extinguishing installations and equipment on premises. Commissioning and maintenance of portable fire extinguishers. Code of practice.*

At all filling stations a supply of dry sand or similar sorbent material should be provided to clean up small spills and leaks of vehicle fuel. The supply should be kept in a container with a close fitting lid and be provided with a means of application. Normally one full bucket of sorbent material is sufficient for every two dispensers (including multi-fuel dispensers), and these buckets should be located so that they are readily accessible to both the forecourt staff and the general public.

Additionally, to prevent any small incipient fire spreading to the petrol facilities, a number of fire extinguishers should be provided as recommended in Table 4.1. It is recommended that these extinguishers should be dry powder with a capacity of at least 4,5 kg. Dry powder extinguishers are preferred as they are more effective in the hands of the general public than foam. Dry powder is in addition more generally usable than foam, which cannot be used in temperatures below -5 °C. Extinguishers should be located in a position where they are readily available for use at all times when the filling station is open, preferably not on a dispenser island or locations where they may be subject to theft or misuse. The provision of these extinguishers may also meet the duty-holder's obligations for general fire precautions in compliance with the above-mentioned fire safety legislation.

Table 4.1 Portable fire extinguishers

Number of dispensers or multi-fuel dispensers	**Number of extinguishers required**
Up to four	At least two
For each additional two dispensers or multi-fuel dispensers	One more

4.4.14 Warning and information notices

The use of conspicuous and clear notices helps the safety of operations at filling stations by providing clear information and warnings or advice on the actions to be taken in the event of emergencies. Details of required electrical signage are provided in section 14.9.11 and details of signage for vapour recovery facilities in section 10.2.11.

Tank identification should include:

- tank number;
- maximum working capacity, and
- fuel grade.

For additional notices required on sites with autogas facilities see Annex 14.12.

The following information should be included at each fill point, vent or vapour recovery connection point. Where there is an offset fill point the same information should also be displayed on the appropriate tank near the tank lid:

- Where tank vents are manifolded each tank should be fitted with a warning notice (see section 10.2.11).
- The suction lines at the tank should be labelled with the dispenser number they serve.
- Where overfill prevention devices are fitted identification of such should be made on the fill pipe.
- Each vent should be labelled to identify which tank it serves.
- Each vapour recovery connection point should be clearly labelled as to which tank or tanks it serves (see section 10.2.11).
- When underground offset fills are fitted additional notices should be provided to identify the vapour recovery hose connection point.

See Annex 14.12 for both style and colour for notices.

5 ACCEPTANCE AND VERIFICATION/COMMISSIONING

5.1 GENERAL

Before accepting the 'as-constructed' site for commissioning, the site operator or the site operator's architect should ensure that the finished facility, whether new, redeveloped or modified, together with any safety related systems, has been built, and all equipment installed, in accordance with the design and specifications criteria. A maintenance and review schedule plan should be in place for the site leak detection systems.

Any details, referred to in section 4.3, should be amended to include any modifications implemented during construction, to produce final record drawings, which should then be passed to the site operator.

5.2 REQUIREMENTS FOR ACCEPTANCE

The complete works should be in accordance with drawings and specifications and of an acceptable quality.

Vigilance during the construction process is necessary and the site owner and operators should satisfy themselves as to the competence of the contractor, the effectiveness of site inspections and the suitability of equipment.

5.2.1 Site inspections

All work during construction or redevelopment requires adequate supervision. This normally involves site inspections by the site owner or developer or their appointed representative. The degree of inspection required will depend on the type of work carried out, the competence of the persons carrying out the work and the policy of the developer. Arrangements for inspection, including visits by the enforcing authority, should be agreed by all interested parties prior to starting the work.

5.2.2 Plant and equipment

Where possible, only materials and equipment conforming to relevant national, European or International standards should be selected. Where plant or equipment not covered by any standard is proposed, the supplier should be able to demonstrate that it is fit for purpose and meets the performance requirements detailed within this guidance or otherwise identified by the risk assessment.

5.2.3 Requirements for autogas

Autogas installations are subject to the Pressure Systems Safety Regulations 2000 and require documentation to be drawn up by a competent person before the commissioning process. For further information see UKLPG Codes of practice.

5.3 VERIFICATION AND COMMISSIONING

5.3.1 Verification

Verification is part of the commissioning procedure that should be carried out before the filling station, or part of the site where changes have been made or new equipment has been installed, is brought into use. The purpose is to ensure the fire and explosion risks from potentially flammable atmospheres will be properly controlled. Verification procedures are required by legislation (Dangerous Substances and Explosive Atmospheres Regulations 2002) and in their entirety will also include consideration of the operational and work procedures together with any emergency arrangements that are necessary to ensure the installed plant and equipment can be operated correctly and safely. Verification carried out during commissioning should include the review of measures to ensure that:

- Records show that the storage tanks and all associated vehicle fuel and vapour pipework are leak tight.
- A hazardous area classification drawing has been prepared and a visual inspection has been carried out to confirm that equipment is of the correct type and category for the zone where it is installed.
- Equipment in the hazardous areas has been installed correctly and has been tested.
- All warning and information notices are in place.
- All electrical and other ducts from hazardous areas are properly sealed.
- Vapour emission control systems have been tested for integrity and operate correctly.
- Gauging and leak detection/leak monitoring systems operate correctly.
- Drainage systems, including oil/water separators, are complete and tested.
- All emergency equipment has been installed and is in working order.
- The electrical installation has been completed and relevant documents issued.
- The system is appropriate to the fuels being stored.
- The environmental risk assessment has been properly undertaken.

Some of the verification checks can be carried out at an early stage, for example during the design, but others can only be carried out during commissioning or even after the first fuel delivery.

The site operator should ensure that a competent person carries out the verification. The site operator may be the competent person but the help of others may also be needed, including the site designer, the installer of the equipment, test companies or an independent person or organisation. The person or persons involved must have practical and theoretical knowledge of the fire and explosion hazards arising at filling stations, which may have been obtained from experience and/or professional training.

5.3.2 Commissioning

In addition to the measures listed in the verification procedure, the following elements of the site should also be checked as part of the commissioning process prior to the first delivery of fuel:

- Access chambers tested for integrity (see section 8.3.4).
- Site cleared of rubbish, weeds or long grass, contractors' plant and equipment.
- All means of escape from buildings clear, unobstructed and available for use.
- All tanks, fill points, vents and associated equipment correctly marked and identified.
- Tanker standing area, entry and exit complete.
- All forecourt surfaces completed and all hot work finished.

The site is then ready to receive a delivery of fuel, after which the dispensers, tank gauges, pump control systems and all operating valves and components within the installation can be checked, adjusted and commissioned in accordance with the manufacturers' requirements to ensure correct and proper operation of the installation.

5.3.3 Receiving the first delivery of petrol (at sites fitted with vapour recovery systems)

In order for a manifolded vapour recovery system to operate correctly and safely, there has to be a liquid (petrol) seal between the bottom of the drop tube and the ullage space of all the (manifolded) tanks. Clearly this is not possible with a new installation or where tanks have been temporarily decommissioned for maintenance purposes etc. It is, therefore, important that the first delivery of petrol is carried out with great care to avoid the release of large volumes of vapour through the fill pipe openings of the tanks and the risk of injury from the release of fill pipe caps under pressure.

A safe method of introducing petrol into tanks is to unload 1 000 litres of petrol into each tank (i.e. one tank at a time), until all the tanks are charged with sufficient petrol to provide a liquid seal at the bottom of the drop tube. The vapour transfer hose has to be connected at this initial commissioning stage of the delivery and the fill pipe caps of the tanks not being filled have to be in the closed position. After this stage of the commissioning procedure has been completed, the remainder of the product from the tanker can be unloaded in the normal manner.

5.4 COMPLETION OF THE VERIFICATION/COMMISSIONING PROCESS

5.4.1 Final check

On completion of the commissioning activities, and prior to general use, there should be a final check for evidence of leaks from any equipment containing fuel. It should also be confirmed that all results and certificates from testing and commissioning operations are available and have been given to the site operator.

5.4.2 Record keeping

It is an essential practice to maintain records of the results of initial tests and commissioning procedures for future reference. Copies of the records should be kept in a site register, or retained electronically, together with other relevant documents, for the filling station. By comparing these with future test results or other information (e.g. from maintenance work) it will be possible to identify any changes in the performance of the equipment, which may indicate a potential risk to safety.

6 CONSTRUCTION AND CONSTRUCTION SAFETY

6.1 GENERAL

Contractual work on filling stations is normally of a construction, electrical or mechanical nature. The work can range from a new build, a complete knock down and rebuild or major modernisation to minor improvements and maintenance. Because of this range the level of controls needed to minimise the risks will depend on the actual hazards arising. For example there would normally be more risks associated with entering an excavation or a tank than painting the windows of the kiosk. There may, however, be unexpected hazards and the painter, for example, would need to be made aware that there are certain hazardous areas on an operating forecourt where a blow lamp cannot be used.

The integrity and safety of a filling station is dependent upon the construction and installation being carried out according to the agreed design and specifications. Only competent persons, against clear instructions and plans, should carry out any work on site and it is the site operator or developer's responsibility to ensure that this is the case.

All work carried out on site should be assessed by the contractor together with the site operator (or their appointed agent) to determine the risks arising from the planned tasks, including any risks arising from the storing or dispensing of petroleum or other flammable products or any other activity. Allocation of responsibility between the site operator and the contractor will vary, and should be discussed and agreed before any work commences on site.

Whilst the principal focus for assessing risks will be safety, potential impacts on the environment should also be considered. For example, work plans should take account of the appropriate means of disposal of water from excavations or contaminated spoil.

Variations in working practices between different contractors and site operators for the same basic work tasks on filling stations can lead to inconsistencies in safety and performance standards. To promote consistency in construction and maintenance activities, EI *Code of safe practice for contractors and retailers managing contractors working on filling stations* provides details of safe working practices.

6.2 LEGISLATION

All of the above work activities fall within the scope of the Health and Safety at Work etc. Act 1974, the Management of Health and Safety at Work Regulations 1999 and the Electricity at Work Regulations 1989 (EWR). All of these are concerned with securing the health, safety and welfare of people at work, and also with protecting those who are not at work, from risks arising from work activities. The majority of these activities will also be covered by the Construction (Design and Management) Regulations 2007 (CDM). Additional regulations may apply such as the Confined Spaces Regulations 1997, DSEAR and the Control of Substances Hazardous to Health Regulations 2002 (as amended) (COSHH). This list is not exhaustive. Therefore, whether they are planners, contractors or site operators, those concerned should ensure that any other relevant legislation, guidelines and good industry practices are followed.

6.2.1 Construction (Design and Management) Regulations

6.2.1.1 Description

The Construction (Design & Management) (CDM) Regulations 2007 were introduced to improve co-operation and co-ordination between parties in non-domestic construction projects with the aim of ensuring the health and safety of construction workers and those affected by such work. To this end the Construction (Health, Safety and Welfare) Regulations 1996 were incorporated into the CDM regulations.

These regulations place a duty on all clients to check the competence and resources of all parties, allow sufficient time for planning and implementation, provide pre-construction information and ensure suitable management arrangements are in place including the provision of welfare facilities.

Duties are placed on all designers to eliminate hazards where possible, reduce risk during design and provide information on any residual risks.

Contractors' duties under these regulations include planning, managing and monitoring work, checking competence of all parties, training their own employees, providing information as appropriate and ensuring adequate welfare facilities are available. All contractors should comply with Section 4 of the regulations which details duties relating to health and safety on construction sites.

It should be noted that the above duties apply to all non-domestic construction projects. However, where a project is expected to last more than 30 days or involve more than 500 person days it becomes notifiable and further duties are imposed.

Where a project is notifiable the client should formally appoint a CDM co-ordinator and principal contractor for the duration of the project and ensure that the construction phase of the project does not start until a construction phase plan and adequate welfare facilities are in place.

The appointed CDM co-ordinator should ensure that the HSE is notified with details of the project using Form F10 which can be provided in hard copy or electronically via the HSE web site. The CDM co-ordinator should advise and assist the client, pass on pre-construction information, co-ordinate and liaise on health and safety aspects of design work, facilitate communication between parties and prepare a health and safety file for the completed project.

Principal contractors should prepare, develop and implement site rules and a construction phase plan which should be made available to other parties as appropriate. Additionally they should display the F10 notification, conduct site inductions and provide any further information and training required, secure the site and ensure that suitable welfare facilities are available throughout the project. The competence of all appointees should be checked, liaison with the CDM co-ordinator maintained and consultation with workers on health and safety matters implemented. It should be noted that the principal contractors should gather information for the health and safety file for their activities and from other contractors to be passed to the CDM co-ordinator for compilation into the health and safety file for the project.

Other contractors should co-operate and co-ordinate with the principal contractor including the provision of details on anyone they engage in the work and any information needed for the health and safety file. Contractors should also report any shortcomings in the construction phase plan and its implementation and inform the principal contractor of any reportable accidents, incidents or dangerous occurrences.

HSE Approved code of practice *Managing health and safety in construction*, L144, provides practical guidance on complying with the duties set out in the Regulations.

6.2.1.2 Construction phase plan

A construction phase plan is required which identifies the hazards and assesses the risks relating to the project, including the risks they create for others. Using this information, the principal contractor should develop a plan suitable for managing health and safety in the construction phase of the project, which includes incorporating information and guidance provided by the client and CDM co-ordinator.

The construction phase plan is the foundation for good management and clarifies:

– who does what;
– who is responsible for what;
– the hazards and risks which have been identified, and
– how the works are controlled.

6.2.1.3 Health and safety file

At the end of the construction phase, normally at practical completion, the CDM co-ordinator should hand over to the client a health and safety file. This is a record, compiled as the project progresses, which details relevant information that will help reduce the risks and costs involved in future construction work, including cleaning, maintenance, alterations, refurbishment and demolition. Clients therefore need to ensure that the file is prepared and kept available for inspection for any such work. It is a key part of the information, which the client, or the client's successor, should pass on to anyone preparing or carrying out work to which the CDM regulations apply.

6.2.2 Electricity at Work Regulations

Any construction or maintenance work on or near electrical equipment, systems or conductors comes under the scope of the Electricity at Work Regulations 1989 (EWR). All such work should be carried out to ensure, as far as reasonably practicable, the safety of people who may use the facilities and also those carrying out the work. The risks to be controlled include those arising from contact with live parts and also from fires or explosions caused by poor electrical installations or the ignition of flammable materials, such as petrol, autogas or their vapour.

Guidance on the appropriate standards for electrical supplies and equipment at filling stations and during maintenance activities is contained in section 14. Guidance on the use of electricity on construction sites can be found in HSE HSG141 *Electrical safety on construction sites*, and in BS 7375 *Distribution of electricity on construction and demolition sites. Code of practice*.

6.2.3 Management of Health and Safety at Work Regulations

The Management of Health and Safety at Work Regulations 1999 require all employers and self-employed persons to assess the risks to workers and others who may be affected by their undertakings so that they can decide what measures need to be taken to fulfil their statutory obligations. One of the requirements of these Regulations specifically covers the exchange of information and co-operation between two or more employers when they share the same workplace. This includes the co-operation and co-ordination between the site operator and contractors, and between different contractors when they are working on the same site.

6.2.4 Confined Spaces Regulations

All work carried out in a confined space should be in accordance with the Confined Spaces Regulations 1997. A confined space is defined as any enclosed or partially enclosed space where, due to the lack of natural ventilation or the presence of contaminants, the atmosphere is, or may become, injurious to the health and safety of persons entering. A confined space for example, can be any pit, tank, access chamber or excavation.

The contaminant in the case of a filling station will usually be petrol or a gaseous vapour. However, the work which is being carried out in a confined space could also lead to oxygen deficiency (i.e. welding or the presence of other contaminants such as solvents, glues etc.).

Further information can be found in EI *Code of practice for entry into underground storage tanks at filling stations*.

6.2.5 Dangerous Substances and Explosive Atmospheres Regulations

The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) are concerned with the protection against risks from fire, explosion and similar events arising from dangerous substances used or present in the workplace. They set minimum requirements for the protection of workers from fire, explosion risks related to dangerous substances and potentially flammable atmospheres. The regulations apply to employers and the self-employed. They also require co-operation between all contractors and sub-contractors.

All work where dangerous substances are present, including construction and maintenance activities, should always be carried out under a documented risk assessment and an appropriate system of work (i.e. safety method statement (SMS) or, when appropriate, a permit-to-work (PTW)). Further information on how DSEAR apply to maintenance activities is detailed in HSE Approved code of practice and guidance *Safe maintenance, repair and cleaning procedures*, L137.

6.3 SAFETY METHOD STATEMENT

A key element for safe working on filling stations during construction or maintenance is a detailed statement of the method to be used for each particular task. This safety method statement (SMS) should identify the actions to be taken in respect of identified hazards, and form a reference for the supervision of the contractors on site. The SMS is a document that records how the work will be carried out once the associated hazards have been identified.

On receipt of an instruction to carry out work the contractor should first complete a risk assessment of the task to determine whether it is a high, medium or low risk. On completion of this assessment the SMS can be compiled. Generic SMSs can be used for regular operations carried out by the contractor. Contractors' site personnel should have copies of all generic SMSs so they can be inspected by the site operator and adapted, if necessary, to suit individual site conditions. The SMS can form part of the Health and Safety Construction Phase Plan required by CDM and DSEAR.

The SMS would normally accompany, or form part of, each work application. The purpose of the work application is to list the tasks in a logical sequence, which may or may not include tasks specifically carried out for safety purposes. The purpose of the SMS is to identify the measures necessary to control the identified hazards. The contractor should show clearly in the compilation of the SMS that all the hazards have been identified and that these hazards are to be competently and correctly controlled.

The responsibility for the development of the SMS lies with the contractor, who should, if necessary, act in conjunction with the site operator regarding site details, specific precautions or specialist information. The site operator has an obligation to inform the contractor of any other work that may be carried out at the same time to ensure this is taken into account.

Contractors need to be competent in issuing their own SMSs, and to employ staff who are able to understand and work to them. All contractors and sub-contractors should be able to show evidence of safety training for all of the workforce engaged in work on the filling station. Although not a legal requirement in the UK, it is good practice to request that all contractors carrying out works on forecourts have at least one operative who has a record and validation of training that is acceptable to the client (e.g. a valid Retail Safety Passport) present during every activity, throughout the duration of the work.

SMSs need to be clear and concise to enable all persons concerned, including site operators, to understand and monitor the safety issues that have been highlighted.

The essential items to be included in a SMS are as follows (a suggested format is shown in Annex 6.1):

– An outline description of the intended task and its component parts.
– Precise details of the equipment/plant to be worked on, and its location.
– The sequence and method of work.
– A classification of the skills that will be required to deal with, in a safe and efficient manner, the hazards identified during preparation of the SMS.
– Details of any isolations (e.g. tank, electrical isolation).
– Materials to be used and their storage (if relevant to the safety of the work site).
– The identification and specifications of any protective clothing required.
– Material movement procedures (e.g. the use of mechanical handlers or cranes).
– Details of hazardous substances to be stored or used and relevant precautions to be taken as required by COSHH.
– Details of dangerous substances and flammable atmospheres and relevant precautions to be taken as required by DSEAR.
– Reference to specific safety procedures covering known hazards.
– Methods for the containment and disposal of waste and debris.
– Any other safety considerations that are outside the jurisdiction of the contractor but are seen as necessary for the overall safety of the task (e.g. risks posed by other works, or the need for favourable weather).

When considering likely hazards full reference should be made to the following:

– Hazardous area drawing (e.g. a site plan indicating the hazardous zones of the filling station).
– Underground services survey drawing.
– Existing procedures.
– Adjacent works, and the information contained in associated documents.
– Relevant legislation and guidance.
– Relevant industry codes of practice.

6.4 PERMIT-TO-WORK

All work on a filling station should be subject to formal control procedures in order to meet legal obligations.

Regulation 6 of DSEAR requires employers, so far as is reasonably practicable, to take measures consistent with the risk assessment and appropriate to the operation to control the hazards and potential hazards arising from work in areas where dangerous substances are present or during work activities that involve hazardous substances. This includes the use of safe systems of work, possibly including permit-to-work (PTW) systems.

Where the work is identified as a high risk activity, employers should ensure that strict controls are in place and that the work is carried out against previously agreed safety procedures by implementing a PTW system.

High risk activities will normally include:

- Hot work on or in any plant or equipment (including containers and pipes, e.g. storage tank, pipeline etc.) remaining *in situ* that contains or may have contained a dangerous substance.
- Carrying out hot work or introducing ignition sources in areas that are normally designated as hazardous.
- Hot work in the vicinity of plant or equipment containing a dangerous substance where a potential outbreak of fire caused by the work might spread or threaten personnel.
- Entry into, and work in, a confined space which contains or has contained a dangerous substance or where the work activity introduces a dangerous substance into the confined space.
- Opening or breaking into plant and equipment, or disconnecting a fixed joint that contains or has contained a dangerous substance.

A PTW is a documented system, formally written or computer based, used to control work that is potentially hazardous. It consists of a standard procedure which specifies the work to be done, the precautions to be taken and the control measures and conditions to be observed together with authorisation for that work to be carried out by certain people and within a specified time frame. It also requires declarations from those carrying out the work to ensure they understand the potential hazards and the limitations of the proposed work.

The PTW forms an essential part of a safe system of work for many types of activities and may reference a SMS to specify the work, the hazards and the required control measures. It allows work to start only after safe procedures have been defined and it should provide a clear record that all foreseeable hazards have been considered. PTWs should not, however, be automatically applied to all activities on filling stations as their overall effectiveness may be weakened by inappropriate and excessive use.

Further guidance can be found in HSE HSG 250 *Guidance on permit-to-work systems - a guide for the petroleum, chemical and allied industries*. Legal requirements are specified in HSE Approved code of practice *Safe maintenance, repair and cleaning procedures*, L137. Paragraphs 42-44 of L137 provide specific advice on the operation of PTW systems by contractors and sub-contractors. A model PTW can be found in Annex 6.2.

Note: a permit-to-work is not in itself sufficient for every type of task. Where entry into an underground storage tank is expected a specialised PTW, a confined space entry permit is required. The guidance in EI *Code of practice for entry into underground storage tanks at filling stations* should be followed. Similarly for hot work, a hot work permit is required. A model hot work permit can be found in Annex 6.3.

6.5 ENVIRONMENTAL CONSIDERATIONS

Many construction activities have the potential to adversely impact on the environment. Contractors should consider the potential for the proposed operations to cause pollution and ensure that waste is managed in accordance with the duty of care. Water from excavations on site has the potential to be polluted and should be monitored and disposed of appropriately and any hazardous materials used on site, such as paints and solvents, should be stored securely. Further information on construction is contained in the Environment Agency Pollution Prevention Guidelines *Working at construction and demolition sites*, PPG 6.

7 STORAGE AND DISPENSING OF AUTOGAS

7.1 GENERAL

Autogas for use in motor vehicles has been encouraged in several countries as an alternative vehicle fuel, because of its cleaner burning characteristics and environmental benefits. Autogas may be sold alongside other vehicle fuels at filling stations or at dedicated autogas stations. Autogas installations at filling stations have to be considered in the same manner as any other part of the installation. In the UK autogas used is commercial propane in accordance with BS 4250 *Specification for commercial butane and commercial propane*.

In the UK all filling stations storing and dispensing autogas are covered by the DSEAR, whether dedicated to those fuels alone or in combination with petroleum. Other health and safety legislation also applies. Where autogas facilities are installed at a filling station the petroleum enforcing authority is responsible for ensuring compliance, under Dangerous Substances and Explosive Atmospheres Regulations (DSEAR), for autogas on forecourts.

This section reflects good practice and recognised standards for the installation of systems for the storing and dispensing of autogas at filling stations. For further information refer to the UKLPG Codes of practice and information sheets listed in 7.3.

7.2 CONSULTATION

The following authorities will need to be consulted before any installation commences:
- The Planning Authority, and
- The Petroleum Enforcing Authority.

The Health & Safety Executive (HSE) or the local environmental health authority do not need to be directly consulted where autogas is installed at a petrol filling station.

7.3 DESIGN

For details of appropriate design requirements for autogas facilities reference should be made to UKLPG Codes of practice, and where necessary, UKLPG Information Sheets:
- UKLPG Code of practice 1 *Bulk LPG storage at fixed installations Part 1: Design, installation and operation of vessels located above ground*;
- UKLPG Code of practice 1 *Bulk LPG storage at fixed installations Part 3: Examination and inspection;*
- UKLPG Code of practice 1 *Bulk LPG storage at fixed installations Part 4: Buried/ mounded LPG storage vessels;*
- UKLPG Code of practice 3 *Prevention or control of fire involving LPG;*
- UKLPG Code of practice 17 *Purging LPG vessels and systems;*
- UKLPG Code of practice 19 *Part 1 Liquid measuring systems for LPG. Flow rates up to 80 litres per minute in installations dispensing road vehicle fuel;*
- UKLPG Code of practice 20 Automotive LPG refuelling facilities;
- UKLPG Code of practice 22 *LPG Piping system design and installation*, and
- UKLPG User Information Sheet 024 *Preparation, installation, inspection, testing and maintenance of rubber hoses, up to and including 76 mm internal diameter in accordance with BS EN 1762.*

Health and safety and/or petroleum inspectors seeking to ensure compliance with UK law may refer to UKLPG Codes of practice as illustrating good practice.

Autogas systems are 'pressure systems' and have to conform to the requirements of the Pressure Systems Safety Regulations 2000 (PSSR) and the requirements of DSEAR for design, installation and maintenance.

New dispensers have to meet the requirements of the EC Council Directive 94/9/EC (ATEX Equipment Directive), carry the CE marking for group II category 2 equipment and have been certified by a notified body.

At present autogas dispensers fitted in the UK do not have to comply with the requirements of the Measuring Instrument Directive (MID) and non MID compliant dispensers can be fitted on forecourts where MID compliant fuel pumps are fitted.

7.4 STORAGE

7.4.1 Storage vessels

Storage vessels should be designed and constructed in accordance with the Pressure Equipment Regulations 1999 (PER) to a recognised pressure vessel code. Autogas storage vessels are designed either for above ground or buried/mounded use. In the latter case the storage vessel is either buried (completely underground) or mounded (partially underground, but fully covered by the backfill). Storage vessels should be installed and fitted with appropriate fittings in accordance with UKLPG Code of practice 1 Parts 1 or 4 for above- or below-ground vessels respectively.

Autogas storage vessels should never be filled beyond their maximum fill level (usually 87 % water capacity for above-ground vessels) and all vessels should include a fixed liquid level gauge or other means of preventing overfilling.

7.4.2 Position

The positioning of autogas storage vessels should comply with the relevant UKPLG Codes of practice. Distances from the storage vessel outline (in plan) should be not less than 1,5 m from power cables operating at less than 1 kV (including telephone cables) and 10 m for cables operating at 1 kV or above.

Positioning should take into account access for both the delivery tanker and the emergency services. For further information regarding line of sight between the vessel fill point and the tanker see UKLPG Code of practice 1 Part 1. See also 7.4.4.

7.4.3 Storage vessel protection

Above-ground storage vessels should be placed in a secure compound to prevent unauthorised access. Similar protection should be placed around above-ground equipment on underground and mounded storage vessels. The compound should:

– Provide adequate ventilation (i.E. Be of open mesh on at least two sides).
– Have a height of not less than 1,8 m.
– Be constructed from non-combustible materials.
– Have at least two means of exit, situated to minimise the distance to be travelled to escape from a dead end. Gates or access should open outwards and be easily and immediately opened from the inside. They should not be self-locking, and should provide unobstructed means of escape.

The compound fence should normally be at least 1,5 m (in plan) from the outline of the above-ground storage vessel(s) or the above-ground equipment associated with underground and mounded storage vessels. Site-specific circumstances may require a risk assessment that may result in the variation of the distance of the compound from the vessels. In certain circumstances the distance may be reduced to not less than 1 m but only when this distance is to a firewall.

However, as filling stations should be considered as having uncontrolled public access (i.e they do not have controlled access and a secured perimeter), the fence should be at least 3m from the autogas vessel. This can be reduced to 1,5 m at autogas refuelling sites provided the compound is under constant surveillance.

Constant surveillance is defined in UKLPG Code of practice 1 Part 1 as where the site has attended operation 24 hours a day, seven days a week and the vessel is visible to site staff either directly or via closed circuit television.

Vessel bases should be capable of supporting the weight of the full storage vessel, with the full area under the shadow of the tank surfaced with concrete. The remainder of the compound surface should be of a suitable material to encourage vaporisation/dispersion of any released autogas and to restrict vegetation growth.

A firewall is required to protect the autogas vessel(s) from potential sources of ignition and to ensure an adequate dispersion distance to boundaries and buildings for autogas leaking from the vessel or its fittings, where normal separation distances cannot be achieved.

Storage tanks may be placed underground in order to reduce separation distances.

For mounded and underground storage vessels, above-ground gas diversion walls may be incorporated on no more than two sides to reduce separation distances.

All storage vessel installations should be situated to provide means of access for fire-fighting vehicles. In addition, for above-ground storage vessels, adequate water supplies to maintain the application rate for at least 60 minutes should be provided; these may be taken from the public water supply (e.g. hydrants).

Means should be provided to isolate the storage vessel(s), pump(s) and dispenser(s) from each other in the case of fire, or other emergency incident (e.g. leakage). This may be achieved by the provision of remotely operated shut off valves (ROSOVs) situated in the compound and at the dispenser.

Where storage vessels are situated in such a position that they may be subject to vehicle impact damage, then suitable protection should be provided (e.g. crash barriers or bollards).

LPG cylinders or any other items that are not associated with the autogas installation should not be stored within an autogas compound on a forecourt.

Table 7.1 Distances from buildings, boundaries and fixed sources of ignition

Vessel size (tonnes)	**Minimum separation distance (m)**	
	Buildings, boundary or fixed ignition source	**With firewall** (Gas diversion wall for underground vessels)
0,25 to 1,1	3	1,5
1,1 to 4	7,5 above ground	4 above ground
	3 underground	1,5 underground
>4	15 above ground	7,5 above ground
	7,5 underground	4 underground

Notes:

1. Separation distances are to valve assemblies and flanges for underground or mounded vessel systems and to the vessel surface for above-ground systems. For below-ground or mounded storage vessels a separation distance to the storage vessel surface of 1 m for vessels up to 4 tonnes and 3 m for vessels over this size should be maintained.
2. Separation distances should not be confused with hazardous area classification (see 7.5).
3. Separation distances may be revised subject to the presentation of appropriate acceptable risk modelling data to the enforcing authority.

7.4.4 Separation distances

The separation distances in Table 7.1 (taken from UKLPG Codes of practice) should be observed to ensure clearance from a storage vessel and/or associated equipment to other pieces of equipment, buildings or potential sources of ignition which, if these caught fire, would pose a risk to the storage vessel or the associated equipment.

Guidance on separation distances between components is given in Table 7.2.

Table 7.2 Minimum separation distances

	Autogas vessel[1]	**Autogas vessel fill connection**[1]	**Autogas pump**[1]	**Autogas dispenser**	**Vehicle being filled**
Storage vessel		Nil	Nil but not beneath vessel	0,5 m	3 m
Storage vessel filling connection	Nil		Nil	1 m	3 m
Autogas pump	Nil but not beneath vessel	Nil		Nil	1,5 m
Autogas dispenser	0,5 m	1 m	Nil		Nil
Vehicle being filled	3 m	3 m	1,5 m	Nil	
Underground petrol tank access chamber with fill connection	7,5 m	7,5 m	7,5 m	7,5 m	Nil
Underground petrol tank access chamber without fill connection	3 m	3 m	3 m	3 m	Nil
Above-ground storage tank for flammable liquids	As UKLPG CoP 1 Part 1 Table of safety distances for flammable liquids				
Remote petrol tank fill connections	7,5 m	7,5 m	7,5 m	7,5 m	Nil
Petrol tank vents	7,5 m	7,5 m	7,5 m	7,5 m	Nil
Petrol dispensers - explosion protected	7,5 m	7,5 m	7,5 m	Nil	Nil
Diesel dispensers - explosion protected	3 m	3 m	Nil	Nil	Nil
Parked cars	6 m or separation distance in Table 7.1 if less	6 m or separation distance in Table 7.1 if less	1,5 m	Nil	Nil
Buildings, boundary or fixed source of ignition		As Table 7.1		4 m[2]	4,1 m from vehicle fill point
LPG cylinder storage	Separation distances in UKLPG CoP 7				3m

Notes:
1. These distances apply to above-ground vessels. For underground vessels these distances must be assessed on a site-by-site basis.
2. This distance should be increased to 9 m to living accommodation and 6 m to other occupied buildings, e.g. adjacent properties.

7.5 HAZARDOUS AREA CLASSIFICATION

For details of the hazardous area classification for autogas vessels, dispensers and road tankers during delivery see section 3. For information on suitable electrical equipment see section 14.

Where provisions for storage and dispensing of autogas are to be added to a site dispensing other vehicle fuels, and its hazardous areas overlap the existing hazardous areas for petroleum related equipment, revised or modified zones should be determined.

7.6 INSTALLATION

7.6.1 Vessels

Where vessels are secured, to prevent horizontal movement, the securing should be at one end only.

Assessment should be carried out to check for potential flooding/flotation.

7.6.2 Pumps

Pumps should be suitable for autogas use and installed as close as practical to the storage vessel outlet, but not under the contour of the vessel. Submersible pumps may be used in underground and mounded storage vessels.

Pumps should be fitted with a suitable bypass arrangement. The pumps and their motors should be certified for the hazardous area in which they are installed. Motors should have a suitable index of protection (IP) rating for their location.

For further information see UKLPG Codes of practice 1 and 20.

7.6.3 Pipework

Details of pipework are given in UKLPG Code of practice 22. It should be noted that liquid and vapour return pipework may contain liquid at or above storage vessel pressure. Pipework to BS 1387 *Specification for screwed and socketed steel tubes and tubulars and for plain end steel tubes stuitable for welding or for screwing to BS 21 pipe threads* (replaced by EN 10255 *Non-alloy steel tubes suitable for welding and threading*) and malleable fitting are not suitable.

Above-ground pipework is usually seamless steel with high pressure fittings. Underground pipework needs to be suitable for liquid autogas and for burying. There are several proprietary systems available; some metallic and some non-metallic.

Means should be included in the pipework design to isolate, by remote operation, sections of the system in the event of a fire or other emergency. This can be by suitably positioned remotely-operated shut off valves (ROSOVs) either on the storage vessel or on the pump outlet, or both. Additionally means should be included in the pipework design to isolate locally to and from the dispenser.

These valves have to fail into the closed position and be able to operate over safe operating range (i.e. 0-25 bar, ~20 °C to +50 °C). Solenoid valves should not rely on a differential pressure across the valve to achieve closure.

Sealants used on threaded joints and gaskets for flanges should be suitable for use with liquid autogas over the safe operating range (i.e. 0-25 bar, ~20 °C to +50 °C). Correctly designed and installed flanged joints should not require additional blow out prevention.

The feed to and connections from the autogas dispenser should not be in close proximity to any structure or object that could cause abrasive damage to the connections due to vibration, or when they react as the dispenser solenoid valve closes after each filling operation.

For further information see UKLPG Codes of practice 1, 20 and 22.

7.6.4 Dispensers

Autogas is supplied to the dispenser in liquid form from a pump near to or in the storage vessel. The autogas may enter a vapour separator where any vapour is removed and returned back to the storage vessel via the vapour return pipework. The liquid phase autogas enters the meter through a non-return valve. The metered liquid passes through a differential valve, solenoid valve and then the hose assembly to the filler nozzle.

Autogas dispensers contain flammable liquefied gas under pressure and should only be installed, commissioned and serviced by persons fully trained and experienced in the safe use and handling of autogas and in accordance with applicable European Standards, statutory requirements and UKLPG Codes of practice. Modifications to autogas dispensers may only be carried out following authorisation by the manufacturer and may require changes to the maintenance procedures required by PSSR and DSEAR.

Autogas dispensers may form part of a dispenser for other vehicle fuels where this combination has been certified as meeting the requirements of the ATEX Equipment Directive.

For further information see UKLPG Codes of practice 19 Part 1, and 20.

The information provided for dispensers for other vehicle fuels in section 9, in general also applies to autogas dispensers. The following specific issues should also be noted:

– All dispensers should be operated via a "deadmans" button.
– Dispensers may be placed on the island adjacent to a petrol/diesel dispenser and should be protected against impact by the provision of crash barriers or bollards in the immediate vicinity.
– All dispenser bases should be securely fixed to a mounting island and pipework connections fitted with self sealing shear valves or similar devices in both flow and return connections.
– Self-service dispensers should be sited where they can be adequately viewed and supervised from the console position.
– Each dispenser hose assembly should be provided either with a pullaway coupling or a safebreak connection designed to part at loads typically of 25 kg but not more than 50 kg to protect the dispenser in the event of a 'drive-off' whilst the nozzle is still connected. The coupling has to be designed to part cleanly and seal both ends to prevent loss of contents.
– The hoses should be suitable for liquid autogas and should be to EN 1762 *Rubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase), and natural gas up to 25 bar (2,5 MPa). Specification*.
– Hose end nozzles should not allow flow of product unless connected to a suitable vehicle connection, and once connected should be capable of being latched in the open position.
– All dispensers should be fitted with sufficient valves to allow for safe isolation, testing and maintenance. These should include a suitably sized return to storage vessel connection to allow for dispenser testing.
– For self-service dispensers, a means of communication from the console position to the autogas dispenser should be provided (e.g. via the same loudspeaker system used for petrol dispensers).

7.6.5 Testing/commissioning

Before testing/commissioning, the documentation for the installation should be prepared in accordance with the requirements of PSSR and DSEAR.

7.7 ELECTRICAL INSTALLATION

7.7.1 General

The installation and maintenance should be in accordance with section 14.

7.7.2 Electrical wiring to pumps and dispensers

Emergency switches connected to the site main emergency shut down system should be provided:
- at the control point in the sales building;
- incorporated at the site main exterior emergency switch, and
- in the storage vessel compound adjacent to each exit.

Operation of any one of these switches should automatically switch off the electrical supply to all fuel dispensing systems. The system should only be capable of being reset from inside the console area.

Emergency switches should be clearly labelled. See Annex 14.12.

7.8 FIRE EXTINGUISHERS

The general fire precautions risk assessment should take into account the presence of autogas on site. This should result in the provision of dry powder fire extinguishers complying with EN 3-7 *Portable fire extinguishers. Characteristics, performance requirements and test methods*. Not less than a total capacity of 18 kg and with a rating of at least 21A and 183B should be available at assessed locations. See also section 2.2.2.

7.9 NOTICES

The format of any notices should include pictograms and comply with the requirements of The Health and Safety (Safety Signs and Signals) Regulations 1996. Suitable notices should be fitted where appropriate (e.g. on the vessels, dispensers, emergency switches). For further information see Annex 14.12.

Details of required electrical signage are provided in section 14.

7.10 MAINTENANCE

7.10.1 Examination and maintenance

To conform to the requirements of PSSR a written scheme of examination (WSE), drawn up or certified by a competent person, is required for protective devices and every storage vessel and those parts of pipework in which a defect may give rise to danger from a release of stored pressure. Examinations in accordance with the WSE should be conducted by a competent person prior to putting equipment into service and within the intervals specified in the written scheme.

Section 8 of PSSR requires a WSE for periodic examination of a pressure system. However, compliance with the WSE is only part of the maintenance required on the autogas installation. The Regulations also require that "The user of an installed system and the owner of a mobile system, shall ensure that the system is properly maintained in good repair so as to prevent danger".

The autogas installation owner has the responsibility to organise the WSE and ensure suitable maintenance is carried out. Where the ownership is split (e.g. the vessels owned by the gas supply company and the installation owned by the site) then the operator must ensure that the complete installation is covered.

In addition to the WSE, and in order to comply with the relevant regulations (i.e. DSEAR, PSSR and the Provision and Use of Work Equipment Regulations 1998 (PUWER)), a written maintenance schedule is also required for the parts of the installation operating under pressure.

Examination, inspection and maintenance should only be carried out on any pressure part of an installation by competent personnel who know and understand the potential hazards involved.

A typical outline written maintenance schedule is shown in Table 7.3. Items marked with a * will usually be included in the WSE. For further information on maintenance of installations see UKLPG Code of practice 1 Part 3.

7.10.2 Electrical checks

For details of the maintenance of electrical installations see section 14.

Table 7.3 Typical equipment for inclusion in written maintenance schedule.

Equipment		Annual[2]	In service[2]	Thorough[2]
Base and steelwork		Visual		
Storage vessel[1]		Visual		Test
Storage vessel signs[1]		Visual		
Storage vessel fittings[1]	- Fill - Isolation valve - Relief valve* - Pressure gauge (where fitted) - Drain	Test Test Visual Visual Visual	May be included*	Change Change Change* Change
Filter			Test	
Pump	 – Internal bypass valve – External bypass valve	Test Test Test		
Pipework			Test	
Hydrostatic relief valve		Visual		Change
Test point valves (where fitted)		Test		Change
Underground pipework				Test
Cathodic protection (where fitted)		Test		
Dispenser	- Filter - Measure - Overall - Shear coupling	 Test advised[4] Visual Visual	Test	
Hoses[3]		Visual	Change	
Hose safebreak (breakaway/pullaway coupling)		Test[5]		
Nozzle		Test[6]		

Notes:
1. Storage vessel maintenance is often carried out by the autogas supplier.
2. The above is only for guidance, the actual intervals should be specified by the competent person who prepares the WSE.
3. EN 1762 *Rubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase), and natural gas up to 25 bar (2,5 MPa). Specification* requires a test at periods not exceeding 12 months for hoses < 25 mm inside diameter.
4. Procedures for testing for measure should take into account typical volumes dispensed and the flow rate applicable to the installation under normal conditions.
5. Only couplings that are designed to be re-assembled can be tested. For non-reusable couplings the checks can only be visual.
6. Nozzle maintenance at intervals not exceeding that recommended by manufacturer.

8 CONTAINMENT SYSTEMS

8.1 GENERAL

8.1.1 Introduction

The containment system comprising the storage tanks and all associated fuel and vapour pipework should be designed, installed and maintained to provide maximum assurance that fuel will not be lost from the system.

A risk assessment taking account of local safety and environmental risk will determine the 'level of protection' that should be included in the design of the containment system and the selection of the most appropriate tank and pipework systems. The term 'level of protection' refers to leak prevention and leak detection or a combination of both.

The failure of a single-skin tank is likely to result in loss of fuel to the ground although the immediate failure may well see water ingress into the tank. The focus of controls on existing single-skin tanks is to ensure early detection of possible failure allowing swift action to be taken to minimise adverse impact. Double-skin tanks provide continuous monitoring of both the fuel and the secondary containment system allowing alarm on the failure of either and time for action before fuel can escape the system. The focus of controls for double-skin tanks is on the maintenance and operation of the containment monitoring system. Above-ground tank and containment systems can also be used to minimise issues arising from unstable ground conditions or for short term installations. Designs should take account of the additional fire and explosion risks of above-ground storage and the focus of controls for above-ground tanks is on physical protection and containment monitoring.

Underground pipework has, in the past, been most frequently responsible for leaks of vehicle fuels, leading to pollution of the environment, contamination of groundwater and fire and explosion risks created sometimes at locations remote from the point of release. Corrosion of steel pipework systems was the main cause. Underground pipework systems which are not susceptible to external corrosion are now recommended. The focus for design should be on considering any requirement for containment and for control on maintaining an appropriate level of monitoring taking due account of both the use of the pipes and their location.

For tanks and pipe systems the introduction of fuels blended with alcohols, FAME and other biomass derived components presents additional questions of internal and external material compatibility. Designers should seek and provide assurance that the main components and all associated seals, gaskets, connections and fittings of the planned containment system will be suitable for use with the liquid, vapour and void spaces over the fuels to be contained. See also section 13.

The guidance in this section is considered to provide good practice for the design, construction, installation and maintenance of the containment system for petrol and diesel fuels within the scope of EN 228 *Automotive fuels. Unleaded petrol Requirements and test methods* and EN 590 *Automotive fuels. Diesel. Requirements and test methods*. Information on containment systems for higher blend biofuels is provided in Annex 2.4. For autogas containment systems see section 7.

The guidance for above-ground tanks in this publication is applicable to tanks in the open air only. The placing of tanks inside structures is outside of scope as the normal practices around hazardous area classification and safe working procedures will not apply. Where site designs consider placing tanks inside structures, site-specific assessments covering, but not limited to, the following are likely to be requested by the regulating authorities:

- additional risk assessment of hazards relating to operations in and around the enclosed or semi enclosed space;
- a quantified hazardous area assessment;
- safe access for inspection and maintenance;
- fire detection and fire-fighting systems;
- spill control, drainage and fire-fighting water management, and
- physical/mechanical protection of equipment

8.1.2 Essential requirements

The tanks and pipework should be designed, constructed, installed and maintained to provide safe containment of the hazardous products in them. Design should focus on preventing release of vehicle fuel or its vapour as a result of failures of the system caused by corrosion, chemical degradation or foreseeable mechanical damage such as those from imposed loading or subsidence or by impact damage. Designs should also allow for the safe maintenance and testing of the containment system without allowing spillage or uncontrolled losses. In addition, a properly designed and installed system should minimise hydraulic losses and maximise dispensing efficiency. The appropriate connections for filling, venting, dispensing, discharge and vapour return lines, contents measurement, testing, leak detection and overfill prevention devices to the tank access lid should form an integral part of the overall design of the system.

Tank systems should be designed, constructed, and installed so as to provide protection to the public and environment against release of product. When properly installed the complete system should retain its integrity for the entire duration of its design life.

Tanks should have the following essential performance requirements:

- Means to detect any perforation in the tank shell before fuel can escape to the environment.
- Means to prevent degradation due to corrosion, chemical action or fuel incompatibility.
- Means to contain any uncontrolled release of fuel or vapour.
- Accessibility for routine and essential maintenance.

A summary check-list of the key elements to be prepared or taken into account during the design, installation and completion of a containment system is:

- Risk assessment of likely failure modes at location to identify most appropriate containment and monitoring systems.
- Compatibility of all materials with products to be stored and external ground conditions.
- Assessment to review access, spill control and hazardous atmospheres control for maintenance and testing.
- The environmental sensitivity of the site.
- Documented transport, storage and installation procedures, including temporary conditions such as flotation prevention during the tank installation.
- Trained and competent installers for all elements.
- Operating manuals, recommended testing and maintenance requirements for the system collated and provided, together with any training required, to the operator/owner.
- Competent maintenance contractor identified and in place.

8.2 TYPES OF TANKS

8.2.1 General

Tanks for the storage of hazardous products should be designed for the specific application and location planned. Construction standards identified below will identify the key design methods and parameters. However, owners and designers should assess their specific needs for elements such as:

- internal linings;
- safe installation minimising risks from working at heights or within excavations;
- flotation prevention during installation;
- periodic water removal;
- internal pressure containment (nominally atmospheric but components should be suitable for likely operating pressures);
- external coatings;
- cathodic protection on steel tanks, and
- containment monitoring systems (pressure and vacuum limits).

8.2.2 Suitable tank types

Underground tanks for new and refurbished installations should be double-skin with monitored containment. Double-skin steel, double-skin steel composite and double-skin GRP tanks will be suitable for most applications. Existing tanks may also be reused, with the application of an appropriate double-skin lining system, in accordance with EN 13160-7 *Leak detection systems. General requirements and test methods for interstitial spaces, leak protecting linings and leak protecting jackets*. Above-ground tanks will usually be steel and should be provided with suitable monitored bund/containment and appropriate protection against fire or physical damage.

8.2.3 Construction standards

Tanks for the storage of hazardous products at filling stations should be certified as having been manufactured and installed in accordance with the appropriate following standards:

- EN 12285-1 *Workshop fabricated steel tanks. Horizontal cylindrical single skin and double skin tanks for the underground storage of flammable and non-flammable water polluting liquids.*
- EN 12285-2 *Workshop fabricated steel tanks. Horizontal cylindrical single skin and double skin tanks for the aboveground storage of flammable and non-flammable water polluting liquids.*
- UL 1316 *Standard for Safety glass-fiber-reinforced plastic underground storage tanks for petroleum products, alcohols, and alcohol-gasoline mixtures.*
- UL 2085 *Standard for safety protected aboveground tanks for flammable and combustible liquids.*

Any tank constructed of other materials should provide an appropriate level of safety and environmental protection, based on an assessment of the risks applicable to the installation and for the design life of the installation. The tank manufacturer should demonstrate compliance with essential requirements of any relevant EC Council Directives.

8.2.4 Certificate of conformity

Tanks should have a certificate of conformity supplied by the manufacturer to confirm compliance with the requirements of the appropriate EN standard to which they were designed and constructed. Where there is no appropriate EN or International Standard, the manufacturer should supply a certificate indicating to what specification it has been manufactured. The certificate may include details of class, certifying authority's approval number, client, job number and site. it should also have details of the number of compartments and their capacity, test pressure of tank and of skin, exterior finish, interior finish, thickness of any exterior protective coating and interstitial space volume. It should be signed on behalf of the manufacturer.

Tanks and/or lids are normally supplied with provision for the connection of fill, vent, discharge and vapour return lines as well as contents measurement, testing, leak detection, overfill prevention and an inspection or entry cover. The connections form an integral part of the overall design of the pipework system.

8.3 UNDERGROUND TANKS

8.3.1 General

The installation of tanks underground provides protection from physical damage and against radiated heat or direct flame impingement reducing the risks of consequent spillage, fire and explosion. Underground installation also allows for gravity discharge of tankers rather than pumped or pump assisted discharge again reducing the risk of spillage and maximising the ground space available to maintain safe vehicle movements and allow for other forecourt facilities.

Underground installation however makes it difficult to inspect the tank to check for external degradation requiring the provision of secondary walls and monitoring systems to minimise the risk associated with loss of containment. Examples of typical installations of steel and GRP tanks are shown in Figures A8.1.1, A8.1.2, A8.1.4 and A8.1.5 in Annex 8.1.

8.3.2 Selecting an appropriate type of tank

It is recommended that double-skin tanks are used for new installations.

Double-skin tanks can be constructed in any of the materials described in 8.3.2.1 to 8.3.2.3. They provide suitable protection because of their ability to contain any release of fuel from the primary tank shell and, in addition, incorporate a monitoring system to warn of a failure of either skin.

8.3.2.1 Steel

Steel tanks are prone to corrosion and subsequent failure, although modern coatings offer very good protection. For double-skin steel tanks, the inner skin and inside of the interstitial space remain unprotected. Corrosion inhibitors should always be incorporated if a liquid leak detection system is used. Any liquids introduced into the interstitial space should comply with the requirements of EN 13160-3 *Leak detection systems. Liquid systems for tanks*.

Tanks manufactured to EN Standards will be supplied with an appropriate external coating to protect against corrosion. The degree of protection offered, and therefore the operational life of a steel tank, depends on the quality of the coating and its integrity. Cathodic protection (CP) may also be used to prevent external corrosion (see 8.3.3).

8.3.2.2 Glass reinforced plastic (GRP)

Tanks constructed of GRP do not fail due to corrosion, but changes in fuel specifications can affect performance. It is important to check the specifications of the GRP tank to see what fuel types it has been manufactured and tested to EN 976-1 *Underground tanks of glass-reinforced plastics (GRP). Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels* may not cover newer fuel specifications. Their performance relies particularly on their design and quality control of the manufacturing process. Tanks to be used for underground storage of vehicle fuels should be manufactured in accordance with the requirements of UL 1316.

Inadequate installation or unexpected ground movement may impose abnormal stresses on the tank. In extreme conditions, generally coupled with manufacturing defects, this can lead to excessive stress concentrations, which can cause catastrophic failure of the tank shell. Internal dimensions of tanks at a number of locations along its length should be recorded on completion of installation and retained with the site records to provide future reference against which to compare any movement.

8.3.2.3 Composite

Tanks manufactured from composite materials are intended to combine the strength and resilience of steel and the corrosion and degradation resistance of GRP. They should be double-skin. The necessity for additional protection measures will be determined from a consideration of the risks to safety or the environment at a particular location and the properties of the composite tank itself.

8.3.3 Corrosion protection

Steel tanks are generally protected against corrosion by the application of an external protective coating. Such coatings are specified for tanks that comply with EN 12285-1. Protective coatings are a passive way of preventing corrosion and if damaged during installation can leave the tank vulnerable to corrosion. It is therefore important that coatings are inspected for damage and consideration should be given to testing for thickness and continuity prior to installing the tank. Any damage should be made good in accordance with the manufacturer's recommendations.

Active protection for tanks (and steel pipework) against external corrosion can be achieved by the installation of a suitable cathodic protection (CP) system. There are two types of CP available, a 'sacrificial anode system' and an 'impressed current system'. The most effective corrosion protection is provided when high quality coatings and an appropriate CP system are used in combination.

For onshore applications sacrificial anodes are magnesium or zinc and details of the necessary type and size should be sought from the tank manufacturer or CP engineer. Tanks protected in this way should be electrically isolated from pipework and conduit through the use of isolation bushings or flanges. Steelwork on either side of such isolation bushings may be at different electrical potentials and such actions should be discussed and agreed with the electrical designer to ensure that an unsafe condition cannot arise. A method of testing to confirm the continued effectiveness of the system should be provided.

The installation of an impressed current system should only be carried out by a competent corrosion or CP engineer working in close liaison with the electrical designer and the manufacturers of any equipment installed within or on the tanks (e.g. leak detection or tank gauging systems). For detailed guidance on the safe and effective installation of CP systems see section 14 and EI *Guidance on external cathodic protection of underground steel storage tanks and steel pipework at petrol filling stations.*

8.3.4 Tank access chambers

Tank access chambers should be designed and installed so as to:

- Prevent the ingress of surface or groundwater and to retain any spilt fuel. They may incorporate a single wall or an inner and outer chamber. In the case of a chamber consisting of a single wall the integrity of the chamber and its joints to the tank, pipework and ducting entries should be verified on completion of installation by vacuum testing. This is not necessary for the outer wall of a chamber where the inner wall provides leak-tight integrity.
- Avoid the transmission of forecourt loads directly through the chamber walls to the underground tank shell.
- Allow safe access for the connection of delivery and vapour recovery hoses, the replacement, repair and maintenance of tank and pipework fittings. Covers should be easily removable for the periodic inspection of the chambers and the enclosed tank and pipework fittings.
- Access chamber frames and covers in vehicle movement areas should comply as a minimum with the requirements of C250 (or higher as appropriate for the location) in EN 124 *Gully tops and manhole tops for vehicular and pedestrian areas*. The chambers and covers should be of dimensions that will allow the disconnection and removal of the tank lid and associated pipework fittings.

8.3.5 Installation of underground tanks

Proper installation is essential to ensure the continued operational safety and effectiveness of the tank for the duration of its design life. A tank should also be installed in such a way as to enable its easy removal without jeopardising the safety or integrity of adjacent tanks or infrastructure.

Typical installation details for double-skin steel tanks are shown in Figure A8.1.1 in Annex 8.1 and in Figure A8.1.2 for double-skin GRP tanks.

8.3.5.1 Tank handling

Tanks should not be dropped, dragged or handled with sharp objects. Any movement of tanks on site should be accomplished with appropriate equipment. They should be stored on a level surface free from sharp protrusions and supported to prevent local damage. To prevent rolling, chocks faced with cushioning materials, where they are in contact with the tank, should be used to secure tanks. Tanks should never be rolled to move them.

Steel tanks should not be lifted with a chain around the tank shell but by the lifting lugs installed by the manufacturer.

GRP or composite tanks should only be lifted by means of webbing loops passed around the anchorage positions marked on the tanks or such lifting points as identified by the manufacturer.

8.3.5.2 Preparation

The sub-soil conditions should be examined in order to determine any special precautionary work which might be necessary to reduce the possibility of structural failure.

Foundations for underground tanks should support the tank securely and evenly to prevent movement, uneven settlement or concentrated loading that could result in unacceptable stresses being generated in the tank shell.

8.3.5.3 Excavation

Particular care should be taken where it is proposed to carry out tank excavation works, especially in the vicinity of existing buildings or structures. Generally, the sides of the excavation should be adequately shored or sloped to a safe angle (less than the angle of repose for the material) to provide stability to the surrounding ground and prevent material falling into the excavation. Further guidance is given in HSE HSG 150 *Health and safety in construction*.

The base of the excavation should provide a firm continuous level support for the tank. Ledges or high spots, which might stress the tank, should be avoided. A suitable bed of selected backfill or cushioning material is normally placed on the base prior to location of the tanks to prevent abrasion damage and provide even support for the tank shell.

Tanks installed underground should be at such a level that a fall back to the tank is provided for all pipework.

With suction systems, care should be taken to ensure that the tank is not so deep or so far away from the dispenser pump that the efficient operation of the pump is impaired. For further details see section 4.4.9.

8.3.5.4 Observation Wells

Where observation wells are installed, they should have a minimum diameter of 100 mm and should be designed to allow percolation of water and fuels through slots in the well wall.

Observation wells provide a means to:

- detect product released from the installation;
- provide a point for product recovery, and
- provide a means of monitoring liquid or vapour caused by spills from overfills or leaks from pipes.

Note: observation wells also create a direct pathway to groundwater, and so adequate maintenance of lid seals is essential.

8.3.5.5 Water ingress in excavations

During installation works and in subsequent normal operation, empty or near empty tanks may be subjected to uplift if there is water ingress into the excavation. Uplift forces can be considerable and an adequate means of preventing flotation of tanks should be provided. Examples of methods of avoiding flotation of tanks include strapping and burial. Most commonly used are straps and fastenings, which should be made of materials which are non-abrasive, do not corrode or degrade and are suitably fixed into or under the base of the tank or to sleepers. Straps should be sufficient in number and have adequate strength (along with the base or sleepers attached to the tank) to resist the maximum flotation force and ensure that the tank remains firmly fixed in position.

During construction it is preferable for backfill to be in place before any water enters the excavation. Dewatering the tank installation area may be achievable but where this is not practical tanks may be temporarily ballasted with water. In the case of GRP tanks, care should be taken to ensure that the water level in the tank is increased to coincide with the level of the backfill so as to avoid distorting pressures on the tank.

Note: where tanks are ballasted with water during installation or as a means of temporary removal from service it is essential that all free water is removed on completion of the works before operational fuel is introduced. Some fuels are highly sensitive to water which can allow the initiation of microbiological growth in petrol and diesel, and may cause phase separation in petrol.

Once installation is complete, flotation prevention is also assisted by the weight of the overburden including any paving over the tank. Other contributory factors include the weight of the tank, the attachment equipment and the friction between tank and backfill.

8.3.5.6 Pre-installation inspection

Before and during the positioning of a tank in the excavation it should be examined for any damage or defect to the surface or coating. Any damage should be made good so as to restore the surface or coating to its original manufacturer's specification. Any damage to GRP tanks should be referred to the manufacturer for repair or replacement as necessary.

8.3.5.7 Backfill

Backfill material should fulfil the following requirements:

– be non-cohesive and chemically inert;
– be non-damaging to the environment;
– be free flowing to aid placing and full compaction;
– give adequate support and restraint to the tank shell;
– not damage the protective or outer coating;
– allow easy removal of the tank at the end of its operational life, and
– provide an anti-flotation burden over the tank.

Commonly, non-cohesive granular materials are used as backfill and some suitable sands and gravels are specified in EN 976-2 *Underground tanks of glass-reinforced plastics (GRP). Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels* and EN 12285-1.

The tank backfill material should be placed carefully and evenly around the tank ensuring full compaction until raised to a level not exceeding the tank access chamber attachment flange.

Any temporary shoring used during installation should be removed in such a manner to ensure that the backfill remains adequately compacted. Additional backfill may be required to fill any voids behind the shoring. Alternatively, appropriate permanent shoring may be left in place.

8.4 ABOVE-GROUND TANKS

8.4.1 General

Above-ground tanks are normally only used at filling stations for the storage of high flashpoint fuels, and have the advantage of being easily inspected for corrosion or other forms of degradation or impact damage. They should be provided with secondary containment (or a bund) to contain any leakage of fuel, including any spillage that may occur during delivery. This may be a legal requirement in some regions (e.g. in England under the Control of Pollution (Oil Storage) (England) Regulations 2001 and in Scotland under the Water Environment (Oil Storage) (Scotland) Regulations 2006). Further guidance on the storage of flammable liquids in above-ground tanks is contained in the Environment Agency Pollution Prevention Guidelines *Above ground oil storage tanks,* PPG2.

HSE HSG 176 *The storage of flammable liquids in tanks* provides some additional guidance but covers industrial applications and its scope specifically states it does not apply to petroleum kept in fixed tanks at filling stations.

Typical installation details for an above-ground diesel tank are shown in Figure A8.1.3 in Annex 8.1.

8.4.2 Tanks for diesel, gas oil and kerosene

8.4.2.1 General requirements

Tanks for high flashpoint fuels such as diesel, gas oils and kerosene should be constructed to comply with the requirements of BS 799-5 *Oil burning equipment. Carbon steel oil storage tanks,* Construction Industry Research and Information Association (CIRIA) C535 *Above-ground proprietary prefabricated oil storage tank systems*, EN 12285-2 or fire rated tanks in accordance with UL 2085.

All tanks should be located where they can be inspected externally for corrosion or leaks and suitably protected against corrosion for the duration of their operating life.

Every part of the tank, including all valves, filters, the fill point and the vent pipe, should be contained within a secondary containment system. Alternatively, double-skin tanks may be appropriate, provided adequate precautions are taken to prevent overfilling, spillage containment, there is protection against impact damage and all entries into the tank are above the maximum liquid level within the tank. Details of these requirements are included in EN 12285-2.

Protection against impact damage can be achieved through the use of bollards, posts, kerbs, railings or similar barriers.

8.4.2.2 Corrosion protection

Metallic components of above-ground tanks in contact with the soil or exposed to the weather will corrode unless protected. Therefore adequate corrosion protection, usually in the form of coatings, should always be provided. Any coatings should be inspected for thickness, continuity and hardness prior to installation.

Fibreglass coating material may be used internally or externally on base plates, tank bottoms and shells as a corrosion barrier and may be used in conjunction with a CP system.

8.4.2.3 Lightning protection

Tanks should be earthed to protect them from lightning damage. In general, such lightning protection systems should be earthed locally to the tanks and be segregated from the electrical earthing system for the site.

8.4.3 Tanks for petrol

8.4.3.1 General requirements

Currently there is no European Standard for fire-protected above-ground petroleum storage tanks for filling stations but it is feasible to design a suitable installation that provides the necessary safeguards. Tanks designed to UL 2085 provide a minimum of two hours' fire resistance protection and the (US) Petroleum Equipment Institute Recommended practices PEI RP 200 *Recommended practices for installation of aboveground storage systems for motor-vehicle fuelling* offers guidance on the installation of fire protected tanks.

Where above-ground tanks are being considered, an assessment should be carried out to identify the hazards and quantify the risks arising from or associated with:

- fire and explosion;
- emergency venting;
- environmental pollution;
- spill containment (if necessary);
- leaks;
- pumped deliveries;
- security;

- attempted theft;
- impact damage;
- malicious damage;
- maintenance, repair and replacement of ancillary equipment;
- operation, and
- decommissioning.

Adequate control measures to address the above items should be incorporated into the design of the tank and its installation. At present most petrol tankers are not normally fitted with cargo pumps and it may be necessary to provide a separate fixed pump as part of the storage installation for delivery purposes. In all such cases the delivery pipework should be designed as a pressure system and include appropriate control measures to prevent the tank being over-pressurised or overfilled.

Protected tanks used to store petrol should have a closed secondary containment with a class 1 leak detection system fitted. This ensures the tank is under test the whole of its working life and in the event of a failure of either the inner or outer tank skin the system will alarm and prevent product from being released

Open bunds should not be used because they create a fire and explosion hazard by trapping petroleum liquids or vapours.

8.4.3.2 Emergency relief vents to prevent explosion

Where the dependency for emergency relief venting is placed upon pressure-relieving devices, the total venting capacity of both normal and emergency vents should be sufficient to prevent a pressure build-up in a fire situation which would rupture the shell or heads of a horizontal tank.

An emergency relief valve should be provided for each tank/compartment and also the interstitial space.

The total emergency relief venting capacity should be not less than 200 mm in diameter in total for a compartment up to 45 000 litres, and have a pressure relief setting of 70 mbar. For guidance applicable to larger tank compartments see (US) National Fire Protection Association (NFPA) 30 *Flammable and combustible liquids code*.

Emergency relief devices should be vapour-tight and installed in the top of the tank above the maximum liquid level.

8.4.3.3 Location of tanks for petrol

All tanks should be located where they can be inspected for signs of damage or degradation. At filling stations where the public have access, they should not normally be inside buildings, but be located in the open air in a well ventilated area and constructed to an insulated and fire protected design.

The minimum separation distances for protected above-ground tanks based on NFPA 30A *Code for motor fuel dispensing facilities and repair garages* are shown in Table 8.1, represented in Figure 8.1. It should be noted that these distances do not take into account any tank openings, fill pipes, vents, or emergency vent positions, and these should be subjected to a risk assessment prior to installation.

In the absence of other security measures all tanks should be located within a secure compound. Unprotected tanks should be separated in accordance with the distances set out in HSE HSG 176 *The storage of flammable liquids in tanks*.

Table 8.1 Minimum separation requirements for protected above-ground tanks (based on NFPA 30A)

Individual tank capacity (litres)	Minimum distance to buildings, site boundary and public thoroughfare (m)	Minimum distance from nearest dispenser (m)	Minimum distance between tanks (m)
> 45 000	4	0	1
Notes: 1. Fill points and vents to above-ground tanks should be located in accordance with the guidance detailed in section 4 (see 4.4.2 and 4.4.5) and so that their hazardous zones (see section 3) are within the site boundaries.			

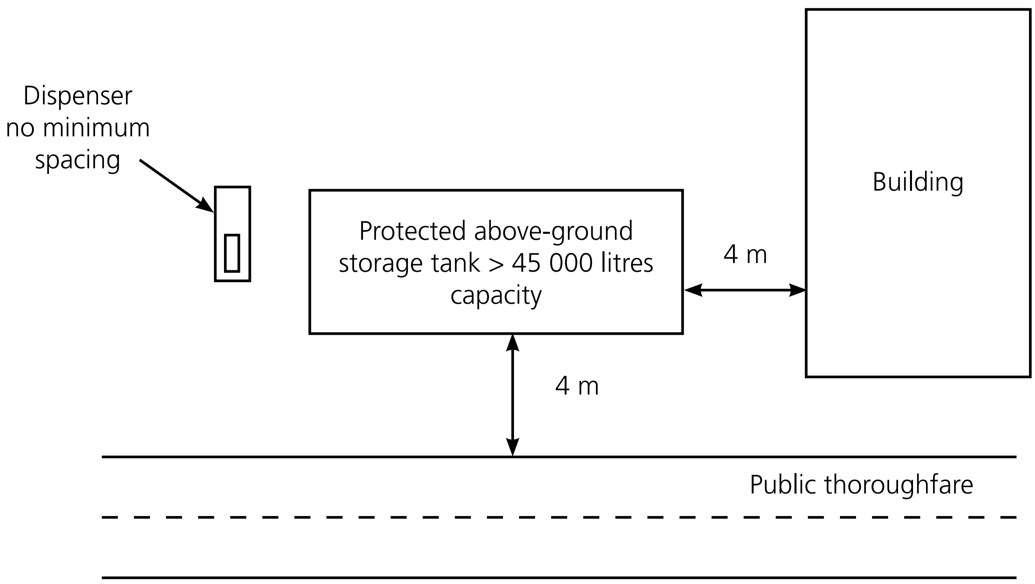


Figure 8.1 Minimum separation requirements for an above-ground tank > 45 000 litres capacity

8.4.3.4 Insulated and fire protected tanks

Protected above-ground tanks tested and constructed in accordance with UL 2085 should have the following fire resistive properties:

- prevent release of liquid;
- prevent failure of primary tank;
- prevent failure of the supporting structure;
- prevent impairment of venting for not less than two hours, and
- limit the increase in temperature of the stored fuel when tested using the fire exposure test.

Insulated and fire protected tanks are normally contained within a jacket which prevents the inner tank from reaching a critical temperature when the outer is exposed to fire. They can also provide protection against a projectile, vehicle and fire-fighting (water jet) impacts. UL 2085 addresses test criteria covering such requirements.

Note: UL 2085 does not allow for the enclosure or partial enclosure of tanks within structures, as the testing conducted covers fire tests in a pool fire in the open air. The guidance in this section is not applicable to such cases.

See 8.1.1 for an indication of further information which may be requested by regulating authorities and note that fire survival times may be affected by enclosure of tanks within structures.

8.4.3.5 Ancillary equipment for above-ground petrol tanks

– *Measures for dealing with the returning of fuel when carrying out dispenser measure checks*

Consideration should be given to the provision of a safe system that may be used to return fuel to an above-ground tank compartment, such as when dispenser measure checks have been carried out, or when draining delivery hoses in the event of the failure of the cargo pump.

Methods may include the installation of a suitably sized dump tank, which will require a separate high level vent; this should not be included within the main tank vapour recovery system. The fill pipe to the dump tank should have an internal pipe reaching the bottom of the tank.

There should be a safe method of emptying the tank(s) into an above-ground storage tank compartment by the provision of an ATEX certified pump and associated pipework system. The dump tank should be provided with an appropriate contents measuring system.

Note: Dump tanks in excess of 200 litres will require secondary containment. Dump tanks should be designed to enable the return of fuel during weights and measures testing and cover the number of hoses that may be utilised during a delivery.

– *Petrol transfer pumps*

Above-ground petrol tanks may require the installation of a transfer pump to allow a conventional gravity road tanker to make a fuel delivery. These petrol transfer pumps should preferably be in the open air, or in a well-ventilated enclosure. A risk assessment should be carried out to determine the potential for a pump failure to cause a spark and a consequential flash-back to either the road tanker or storage tank compartments. Where a pump failure may occur, flame arresters complying with EN ISO 16852 *Flame arresters. Performance requirements, test methods and limits for use* should be fitted to the inlet and outlet of the pump.

– *Overfill prevention systems*

An overfill prevention system should be fitted to the tank and be compatible with a cargo pumped delivery. An example two stage system with suitable warning and overfill prevention functions is a gauge linked high level alarm which activates at 93 % of safe working capacity (SWC), and a separate independent system which shuts the power to the cargo pump serving a particular tank compartment when 95 % of SWC has been reached.

8.4.4 Installation of above-ground tanks

8.4.4.1 Sub-soil conditions

The sub-soil conditions should be examined in order to determine any special precautions necessary to ensure the continued stability of the tank.

8.4.4.2 Foundations

Foundations for above-ground tanks should support the tank securely and evenly to prevent movement, uneven settlement or concentrated loading that could result in unacceptable stresses being generated in the tank shell. Foundations for small vertical tanks are typically constructed of reinforced concrete and should be well drained to prevent the accumulation of water, which could accelerate corrosion.

The manufacturer often provides horizontal tanks with prefabricated saddles. For tanks where saddles are not provided they may be constructed of steel or reinforced concrete. In this case care should be taken to isolate the tank shell from the saddle by use of insulating material to reduce the risk of corrosion.

8.4.4.3 Spillage containment and control

For diesel, gas oil or kerosene a suitable spillage containment area could be a bund area around above-ground tanks and associated pipework. Bunds are a form of secondary containment designed to retain fuel spills and releases from tanks, pipework and associated equipment. Impermeable bund areas should retain accidental spills and prevent them from entering the ground. They should be designed to retain 110 % of leaking or spilled product which is open to atmosphere and be maintained appropriately. Unconfined spills may present a fire hazard and a contamination risk to the environment, and are dangerous and difficult to control.

Guidance on the design, construction and the drainage of bunds is given in HSE HSG 176 and in the Environment Agency Pollution Prevention Guidelines *Above ground oil storage tanks,* PPG2. These documents should be referred to at the design stage and their recommendations followed for any proposed installation of above-ground oil storage tanks.

8.5 TYPES OF PIPEWORK

8.5.1 General

The term pipework covers:

- pressure delivery pipes (pressure pumping systems);
- suction delivery pipes (i.e. suction pumps in dispensers);
- siphon transfer pipes;
- tank fill pipes (i.e. offset or remote fills);
- tank internal pipework for filling, fuel suction or siphons including any fittings such as mechanical overfill prevention devices and vapour retention devices;
- vapour return pipes for Stage 2 vapour recovery;
- separate secondary containment systems;
- tank vent and vapour return pipes;
- above-ground tank vents and manifolds, and
- all associated valves, fittings, connections and couplings.

8.5.2 Selecting pipework function design

8.5.2.1 General

The pipework system should be designed to safely and efficiently transport liquid fuels and fuel vapours. Joints between pipe, bends and fittings which can be mechanically dismantled should not be buried, but should remain visible and accessible in a containment chamber. The system should be designed to allow for leak tightness testing and to ensure it can be made safe by draining and purging and testing when required.

Pipework has to be fit for the application for which it is to be used in terms of:

- structural strength relative to internal pressures and external loading;
- robustness for handling and installation;
- reliability of assembly;
- full internal compatibility with the fuels and fuel vapours to be carried, and
- external compatibility with the materials to which it might reasonably be exposed in the ground and in chambers during its service life.

Pipework certified in accordance with the requirements of EN 14125 *Thermoplastic and flexible metal pipework for underground installation at petrol filling stations* can be taken as fit for use with EN 228 and EN 590. Suitability for fuels containing higher alcohol or fatty acid methyl ester (FAME) content should be certified by the system supplier.

8.5.2.2 Suction systems

Suction systems draw fuel from the tank by means of a pump located in the dispenser housing. A non-return valve should be provided in a suction pipe system at the connection point to the dispenser, above the leak plate, to ensure that the suction pipe remains primed whilst the dispenser is at rest. It is important that non-return valves are not installed in any other location in a suction system. Where for system design purposes an intermediate or tank lid check valve has to be used fuel will be retained under a positive hydrostatic pressure and it should be considered as a pressure pipe and provided with leak containment

It is good practice to install a lock down valve fitting at the tank lid and an access plug at the connection to the dispenser to allow subsequent testing of the lines without the necessity for disconnection of pipework or fittings.

The system design should aim to minimise the vertical lift from the tank bottom to the dispenser inlet and the friction head losses of the pipe system layout

All internal suction pipes should terminate 35 mm or more above the bottom of the tank internal fill pipe so a liquid seal is maintained. The bottoms of internal suction lines may be fitted with suitable deflection devices to minimise the uplift of sediment and reduce the introduction of vapour into the suction lines.

8.5.2.3 Pressure systems

Pressure systems use submerged turbine pumps to generate flow and maintain a positive pressure in the pipework between the tank and the dispensers. Multiple dispensers are commonly linked to a single pressure fuel pipe. Pressure pipe systems are also used with remote pumping units with pumped or gravity feeds from an above-ground tank.

Pressure lines should be installed with a means of containing any release of vehicle fuel due to a leak in the line and be equipped with a suitable system to detect such a failure. The leak detection system should be able to isolate the power supply to any pumping unit and give immediate warning to the operator.

Valves should be installed to facilitate hydraulic isolation of each individual dispenser and sited immediately adjacent to each pumping unit. Where a gravity feed system is installed a valve arrangement should be provided to allow the isolation of the storage tank from pipework.

Means should be provided for draining all pipework, ideally back to the storage tank, and to allow subsequent testing of the lines without the necessity for disconnection of pipework or fittings.

Table 8.2 Principal differences between suction and pressure systems

Suction system	**Pressure system**
Vehicle fuel is drawn through the line by atmospheric pressure as a result of the partial vacuum created within the line by a low pressure pump located within the dispenser.	Vehicle fuel is pumped along the line to the dispenser under pressure created by a high pressure pump located either within the storage tank or between the storage tank and the dispenser.
Should there be a leak in the line, the non-return valve located under the dispenser allows fuel (or water) to drain back towards the tank. Depending on the position and severity of the breach in the pipework there should be limited loss of fuel to the environment. Water ingress or repeated difficulty in pump start-up are key symptoms of a suction line failure.	Should there be a leak in the line fuel will be forced out under pressure resulting in considerable loss in a short time. For this reason lines should have secondary containment and be equipped with an impact valve at ground level.
More pipework is necessary as each pump generally needs a dedicated suction line from the tank.	Less pipework is necessary as lines can be spurred off a single main feed for each grade of fuel.
A separate pumping unit is required for each grade at each dispenser. Failure of a pump puts only that dispenser out of use.	Fewer pump units are required as the pump in the tank can supply a number of dispensers. Failure of a pump isolates that storage tank and every dispenser fed from it.
Suction pumps are generally less reliable in operation than submerged pressure pumps and require more maintenance.	Pressure pumps submerged in fuel are generally more reliable than suction pumps, require less maintenance and have a longer life.

The pressure line into each dispenser should be fitted with a double poppet impact valve with fusible link at ground level and an isolating valve immediately beneath it so that outflow of fuel under pressure is prevented in the event of impact to, or fire at, the dispenser.

The inlet port of the pumping unit should be located at least 150 mm above the bottom of the tank in order to ensure a liquid seal is maintained. Some means of stopping take off from the tank while the fuel level is still above this inlet is desirable as pump life may be significantly reduced if it is allowed to run dry.

Where above-ground storage tanks are installed the pipework from the tank to the remote pump should have secondary containment outside the tank bund with suitable leak monitoring. The use of double-skin or secondarily contained pipework is considered good practice. The pipework within the tank bund does not require separate secondary containment.

Each remote pump should be fitted with an emergency impact safety cut-off valve fitted to its discharge side incorporating a fusible link designed to activate on severe impact or fire exposure.

Internal pipework within the storage tank should be installed as for suction systems so as to maintain a liquid seal and to minimise the uplift of sediment.

It is important for designers and operators to understand that mechanical or electronic leak detection systems on a pressure line will only operate when the submersible pump is not running. Therefore on a busy site where the pump is running for long periods the detection systems may not detect a leak and other leak detection systems should be used (see section 11).

8.5.2.4 *Vent and vapour recovery systems*

A venting system is an essential element of the fuel installation that allows for the displacement of vapour (either to atmosphere or back to the road tanker) during the unloading process and the ingress of air into the tank when fuel is dispensed. The system should be designed and installed to prevent any build-up of excessive pressures exceeding the design limits of the tank. Normally, atmospheric vents will be at least 50 mm nominal pipe size.

Vent pipes should be fitted as near as possible to the highest point of any installed tank or compartment. The open ends should be constructed so as to discharge upwards in the open air. Petrol tank vents should be fitted with a flame arrester approved to EN ISO 16852, integrated into the P/V valve (end of line flame arrester) or fitted separately behind the P/V valve (inline flame arrester), that will not jeopardise the tank's ability to breathe.

Pipework used for tank vents, vapour return lines in the Stage 1b vapour recovery system or vapour recovery pipes as part of a Stage 2 vapour recovery system should be fully compatible with the fuels to be carried. Pipes should allow for falls to the tank or an accessible trap to allow for the drainage of condensation which will be a combination of fuel vapour and water vapour from air drawn into the vent system. Vent and vapour recovery pipework should be periodically tested to ensure no loss of vapour to the environment or the ingress of water to the system.

Above-ground vent and vent manifolds must be fire resistant and generally fabricated as a steel assembly. Jointing materials and gaskets used in the assembly must be fully compatible with the fuels and fuel blends to be carried in the system.

For further guidance on venting systems for the control of vapour emissions see section 10.

8.5.2.5 *Offset or remote fill pipes*

Pipes for gravity filling of tanks must fall directly to the tank to avoid any sections containing trapped fuel. Fuel will be under a positive pressure during unloading and will be lost from the pipe in the event of any failure. Fill pipes must be periodically tested to minimise the risk of significant loss to the environment or the ingress of water to the system. In high risk locations fill pipes should be contained (e.g. double-skin) and monitored.

For details of offset fill assemblies and tank internal fill assemblies see 8.5.4.1

Pumped fill pipes must be double-skin as they will retain fuel between deliveries. A positive isolation valve should be provided at the connection to the pump and a non-return valve at the connection to the tank.

8.5.2.6 *Siphons*

A siphon is used where it is required to interconnect two or more tanks so that they operate as a single unit. Such installations will result in different operational procedures when filling and discharging these tanks. When installed with suction systems it may be necessary to provide a separate priming arrangement on the siphon.

When siphoning systems are used in conjunction with a pressure system they should comply with the pump manufacturer's specification, which will include the provision of an automatic priming arrangement.

Siphon lines within tanks should extend to the same level as the bottom of the fill pipe.

Siphons will transfer fuel between tanks as soon as a differential head is present. When intending to fill both tanks in a siphon connected system these should be done simultaneously to ensure available ullage in the connected tank is not reduced by the action of the siphon. Valves should be installed in siphon lines to allow for the isolation of any interconnected tanks, when simultaneous filling is not used.

Siphon pipework should be designed as suction pipes.

For further information see CFOA Information note: *Petrol filling stations - siphon systems.*

8.5.3 Selecting appropriate pipework material

8.5.3.1 General

Steel, GRP, polyethylene and composites including combinations of other plastic or metals are materials used for pipework. The inclusion of sections particular to these materials is not intended to exclude the use of alternatives, which may be equally suitable. Pipe systems should be certified in compliance with EN 14125. GRP pipes complying with UL 971 *Standard for safety nonmetallic underground piping for flammable liquids* may also be used.

All pipework and fittings should be constructed of materials fit for the purpose and, if vulnerable to external corrosion or environmental degradation, should be suitably protected.

Conductive and non conductive systems should not be mixed in single installations. There must be no isolated conductive elements within a pipe system. Conductive systems should be bonded to site earthing systems and tested for electrical continuity.

Additional protection will be necessary in certain conditions, as defined by the risk assessment for the site, including where:

- pipework or fittings may be subject to corrosion;
- there is uncertainty about whether system integrity can be retained for the full operational life;
- there is a particular risk to safety (e.g. the proximity of a cellar, underground railway etc.);
- the potential for pollution of the environment is assessed as sufficiently high, and/or
- there is the potential for pollution of groundwater.

In such cases, some form of secondary containment may be an appropriate control measure, and is recommended as good practice in the UK.

8.5.3.2 Steel

When used underground, all pipework should be provided with a durable protective coating, CP or secondary containment, see 8.3.3. Experience has shown that surrounding galvanised pipe with sulphate-resisting concrete does not afford adequate protection and this form of installation should not be used.

Because of the risk of leaks, joints in pipework should be kept to a minimum. Where they are necessary, it is preferable to use welded joints. Flanged joints or screwed joints should only be used where they can be visually inspected and are normally confined to above-ground use or where they are contained within leak-proof chambers.

Where steel pipework with screwed joints is most commonly used at tank lids and requires the use of elbows or other fittings, any jointing compounds used in the incorporation of such fittings should be of a type suitable for use with the fuel and fuel blends to be carried by the system.

8.5.3.3 GRP

GRP pipework, specifically designed and tested for use with vehicle fuels, has been used for suction, offset fill, vent and vapour recovery pipework installed underground. GRP pipework should meet the requirements of EI *Performance specification for underground pipework systems at petrol filling stations*.

It should be noted that GRP pipes are brittle and may be easily damaged. For this reason they should be handled with care at all times and should not be dropped. Pipes should be stored on a level surface free from sharp protrusions and adequately supported to prevent load or impact damage. Pipes should not be stored vertically.

8.5.3.4 Polyethylene

Polyethylene pipework certified in accordance with EN 14125 for use with vehicle fuels may be used for all underground applications.

Polyethylene pipe is subject to some thermal movement and in some cases to a small amount of elongation after prolonged contact with vehicle fuels. The fuel pipework layout should accommodate such possible growth by avoiding direct entry of straight runs into chambers or connections.

Manufacturers' instructions must be strictly adhered to during installation with particular attention placed on joint preparation in advance of thermo-welding. Components from different suppliers must not be mixed without the specific approval of the suppliers and confirmation that they meet the requirements in EN 14125.

8.5.3.5 Continuous flexible composite

Pipes manufactured from specially developed thermoplastic composites, or other combinations of materials, are available for underground pipework applications. They should be used as a continuous length of pipe with no joints between the connections to the tank and dispenser.

They may be supplied either as a single pipe for use with a suction system, or with a continuous plastic secondary pipe, for use with pressure systems. In the case of the latter the secondary containment forms an integral part of the design and generally includes tank and dispenser chambers.

Manufacturers' instructions must be strictly adhered to during installation with particular attention placed on maintaining line and level. The inherent flexibility of such systems precludes the need for special precautions against the damaging effects of ground movement and pump surges.

8.5.3.6 Other materials

Pipework of other materials may include flexible metal systems, in either single or multi-layer construction, with external corrosion protection and composite pipes consisting of plastic and metallic layers to combine the advantages of both materials.

Any such systems may be appropriate for use as underground pipework. As a minimum requirement it is recommended that the supplier should be able to demonstrate that the pipework system can fulfil the requirements of EN 14125.

8.5.4 Ancillary equipment

A number of ancillary features form an integral part of the pipework system, including those detailed in 8.5.4.1 - 8.5.4.5. They should all have similar performance characteristics to the pipework in terms of their ability to withstand operational loads and resist degradation for the lifetime of the installation.

8.5.4.1 Tank fill points/delivery hose connections and internal fittings

Connection points for the tanker delivery hose may be constructed above ground or in a chamber below ground. They may be fitted directly onto the internal fill pipe projecting from the tank or onto an offset fill at a location remote from the tank. The internal fill pipe should be installed vertically within the tank, be continuous and be vapour-tight. It should terminate near the bottom of the tank but no closer than a quarter of the diameter of the pipe. All other internal pipework should terminate above the level of the bottom of the fill pipe to maintain a liquid seal under operating conditions.

The fill points should have suitable fittings to enable secure leak-proof connections to be made to the delivery hoses. Such fittings should also have provision for a locking device that will prevent unauthorised access.

Where fill points are installed in underground chambers the termination height below ground level should be such as to enable reasonable, safe access during delivery. Safety platforms may be appropriate in the case of deep chambers and will minimise the likelihood of a driver slipping/falling and inadvertently dropping or allowing the hose end to impact steelwork in the chamber which may cause a thermite spark to occur.

Where fill points are installed above ground, the height of the fill point should be below the minimum height of the delivery tanker bottom loading adaptor to ensure proper draining of the hoses.

Fill lines should be fabricated from materials with adequate strength and durability to withstand the operating pressures, structural stress and exposures to which they could be subjected.

A device may be fitted to the fill pipe within the tank to help reduce the generation of vapour during tank filling.

A means of removing accumulations of water from the tank should be provided. In underground tanks this is normally via the fill pipe either directly or, in the case of offset fills, via a plug in a 'T' fitting at the top of the vertical leg of the fill in the tank access chamber. The plug should only be removable by the use of tools.

Fill points for any heating oil storage on site should have significantly different connections from those used for petrol to prevent the accidental crossover of fuel. A smaller diameter and a square thread form are normal provisions for heating oil fill pipe fittings.

8.5.4.2 Spill prevention

Provisions should be made to contain any spills which occur during road tanker unloading. Staff trained in delivery and emergency response procedures should supervise all deliveries; Environment Agency Pollution Prevention Guideline *Incident response planning*, PPG21, provides guidance on developing emergency plans.

Provision should be made to contain any accidental spills or leaks which occur during deliveries and direct them to the appropriate drainage system. Where flow back is possible, as with an above-ground tank, a gate valve and a non-return valve should be fitted at the fill point connection.

It may be necessary to provide additional protection to contain a potentially large-scale spillage during tanker delivery. Containment at the delivery point can be achieved in a number of ways including the use of drainage grids, gullies, kerbs or drainage mats. Smaller losses can be contained using, for example, drip trays under delivery pipes; these should be checked after each delivery and emptied as necessary. Alternative methods may be appropriate depending on whether the delivery point is above or below ground or made directly into or offset from the storage tank.

It is good practice to have proprietary spill clean-up products on site to soak up small spills. There is a variety of products available, some of which can reduce the amount of vapour released from volatile spills. Once used, these products must be disposed of in accordance with current waste management legislation.

8.5.4.3 Valves

Valves are required to ensure safe and correct operation of the pipework system and should be designed and fabricated from suitable materials, having adequate strength and durability to withstand the operating pressures, structural stress and exposures to which they may be subjected.

Non-return valves, often referred to as check valves, are used to prevent the flow back of fuel. In suction systems a check valve is installed in the suction pipework generally located within the dispenser housing or directly below it. This ensures that the suction pipe remains primed whilst the dispenser is at rest. In above-ground storage tank installations, where fill connections are below the level of liquid in the tank, a conventional valve and a non-return valve should be fitted at the fill points.

Isolating valves should be installed to allow tanks and pipework to be isolated, tested and secured. Each fill line and pressure line from an above-ground tank should be provided with a valve located as close as practicable to the shell of the tank. It is recommended that isolating valves be installed immediately upstream of impact valves, dry-break fittings, pressure regulating valves, pumps and other equipment which could release fuel when serviced.

Pressure-regulating valves should be installed in an above-ground tank installation directly prior to the pump inlet to allow flow only when the pump is operating and, when fitted with an automatic shut off facility, to prevent any siphoning occurring. The valve should be installed in conjunction with an impact valve.

Impact valves should be installed immediately upstream of any equipment, fed by a pressure line, which may be vulnerable to impact. Such valves incorporate a weakened section that will shear in the event of any significant impact, causing it to close, and also a fusible link which closes the valve in the event of fire.

8.5.4.4 Pipework connection chambers

Where mechanical pipework connections are made underground a pipework connection chamber should be installed. The chamber should be designed and installed to:

- allow for safe access for maintenance and inspection of the connections;
- prevent ingress of water;
- prevent the passage of any vehicle fuel outside of the chamber, and
- include leak detection facilities (if necessary).

8.5.4.5 Overfill prevention devices

Overfill prevention devices may be fitted to above-ground or underground tanks. They are designed to automatically prevent the liquid level in the storage tank exceeding the maximum filling level. Two types are available:

- Type A where normally a mechanical valve is situated in or on the tank and is independent of the delivery system, they are designed to restrict or stop flow in the event of an overfill.
- Type B where their operation relies on the road tanker or supply system and stops delivery into the tank.

Where overfill prevention devices are fitted they should comply with EN 13616 *Overfill prevention devices for static tanks for liquid petroleum fuels.*

8.5.5 Installation of pipework

8.5.5.1 General

Generally, suction or pressure pipework, with the exception of part of the fill and vent pipes, is installed underground. This is because it simplifies forecourt design, provides uninterrupted space at ground level and obviates the need for special protection measures against fire, impact and degradation caused by ultra-violet light. The disadvantages are that there may be a hostile environment underground, particularly for ferrous materials and any degradation of, or leak in, the pipework is not visible. Above-ground pipework has the advantage of being able to be visually inspected for deterioration or leakage but it is vulnerable to damage. Proper installation is essential to ensure the continued operational safety and effectiveness of the pipework for the duration of its design life. Suppliers of pipework approved to EN 14125 should provide comprehensive installation instructions. For other systems further general guidance is given in 8.5.5.2 and 8.5.5.3. When designing the layout of pipework and distribution systems it should be arranged in a logical manner that facilitates easy access and inspection.

Figures A8.1.1 to A8.1.7 in Annex 8.1 show typical installations for pressure and suction lines.

8.5.5.2 Above ground

All above-ground pipework and associated fittings should be provided with protection against fire, impact or environmental degradation. Currently it is normal practice to use steel pipe and metallic fittings above ground. Low melting point materials such as GRP, polyethylene and other plastics should only be used if adequately protected. Provision for containment of loss from above-ground pipe sections should be incorporated in the facility design with suitable monitoring. All such pipework should be firmly supported by hangers, supports or brackets. Pipework adjacent to traffic areas should be protected from collision damage.

8.5.5.3 Underground

For the underground installation of pipework it is important to ensure that:

– Storage and handling of pipework on site does not cause damage to, or contamination of, pipework and fittings, particularly where joints are to be made.
– The ground is prepared before pipework installation commences. Areas of low strength, which may be susceptible to differential settlement, should be infilled with a suitable granular material and compacted. Where ground conditions may cause migration of backfill the excavation should be lined with a geotextile membrane. The liner should extend to the highest level of the backfill material with any overlaps being at least 300 mm. Where ground conditions are not considered to be adequate, and when using flexible pipework systems, it may be appropriate to install a continuous sub-base.
– For continuous flexible composite pipework there is a firm bed (with a fall back to the tank) that will prevent depressions or low points occurring during the working life of the pipework.
– Precautions are taken when installing pipework on sites where vehicle fuels are, or have been, stored as there is always the risk that flammable atmospheres may be present, particularly in excavations, pits or chambers below ground. Any electrical apparatus used should either be certified for use in flammable atmospheres or, if not so certified, should be located away from any such potential hazards.
– All pipework is surrounded with a suitable backfill material, normally to a minimum thickness of 150 mm. A suitable backfill is a non-cohesive granular material such as that referred to in 8.3.5.7.
– The surface of the forecourt or driveway above any pipework is designed and reinforced to distribute the weight of any vehicles passing over to relieve the pipework from direct loading.
– Pipework is not built into concrete access chamber or other walls. Where existing access chambers are to be used the wall should be sleeved to provide a clearance passage for the pipe and finished with a liquid-tight sealing arrangement resistant to vehicle fuels.
– All pipework is laid with a continuous fall back to the storage tank to ensure that the

pipe contents drain into the tank in the event of pipe failure or when disconnecting pipework to undertake maintenance work. It is essential that high or low points in pipework are avoided as they form vapour or liquid traps which will impair the effective operation of the system.

- All vapour return pipework from dispensers to the storage tank is laid with a continuous fall back to avoid liquid traps which would cause the Stage 2 vapour recovery systems to become ineffective. Vapour return pipes should not be brought above ground and connected into the vent stack as a means to return vapour to the storage tank.
- Where there is a transition from GRP, polyethylene or composite pipework used below ground to above-ground steel pipework, a special adaptor fitting is used and the vertical upstand adequately supported to prevent movement and transmission of any load to the underground pipework. Similarly, flexible connections should always be used between steel or GRP pipework and tanks and dispensers.
- Where joints are made using a thermosetting epoxy resin for GRP or by electrofusion of the material in polyethylene pipework, any electrical equipment used in flammable atmospheres is designed and certified for use in such locations. Note that flammable atmospheres may exist in excavations on existing sites in addition to the normally designated areas.
- Installation is in accordance with the manufacturer's recommendations.

8.5.6 Identification markings

All installed pipework should be clearly identified and tagged where it is visible in chambers to show its function. Further details are given in section 4.4.14. Each fill point should be labelled with the number, grade and working capacity of the tank to which it is connected. Vent risers should be labelled with the corresponding tank number at a conveniently visible location near to ground level.

8.5.7 Electrostatic hazard

The flow of vehicle fuels through pipework can generate an electrostatic charge which, if not allowed to dissipate to earth, may build up on the surface of the pipe wall or any isolated metal elements and have the potential to create a spark when an earthed conductor is brought into close proximity to it. Guidance on the avoidance of hazards due to static electricity is provided in EI Model code of safe practice Part 21 *Guidelines for the control of hazards arising from static electricity.*

Specific requirements for thermoplastic and flexible metal pipework for underground installation at filling stations are provided in EN 14125. Detailed provisions for protection against static electricity are given in section 14.4.7 and it is recommended that the pipework designer should liaise closely with the electrical designer in respect of electrostatic hazard in pipework systems.

8.5.8 Record drawings

The site plan should be amended or redrawn after any alterations from those shown on the original drawings of the tank, pumps or pipework layout.

8.6 TESTING OF CONTAINMENT SYSTEMS

8.6.1 Initial testing prior to commissioning

8.6.1.1 General

Before any tank or pipework is brought into service it should be checked by a competent person to confirm its integrity. All new tanks are tested by the manufacturer prior to delivery and should be accompanied by a test certificate. Testing of tanks prior to commissioning, therefore, should only be necessary if there is evidence of damage to the tank either in transit or during installation. Various methods may be used to fulfil this requirement. All tests should be fully documented including a clear indication of the scope, type and results of the tests. Copies of all such test certificates should be given to the site operator.

8.6.1.2 Double-skin tanks

All new double-skin tanks manufactured in accordance with relevant European Standards are tested by the manufacturer prior to delivery and should be accompanied by a test certificate. Further testing should only be necessary if there is evidence of damage to the tank either in transit or during installation. Any monitoring devices should be checked for correct operation in accordance with manufacturer's instructions before fuel is delivered.

8.6.1.3 Above-ground tanks

A hydrostatic test should be performed, checking for evidence of leaks whilst under pressure. Alternatively, suitable precision test methods may be employed in accordance with the tank manufacturer's instructions and subject to meeting the tank's design limitations.

Note: for all pressure tests a pressure relief valve set to operate at 10 % above test pressure should be incorporated in the test rig. The pressure reading should be taken from a suitable gauge sited on the tank top. A 150 mm dial size or digital gauge is recommended.

8.6.1.4 Pipework

Pipework systems manufactured to comply with EN 14125 will provide guidance on testing pressures and durations particular to those systems. For other systems general guidance is provided as follows:

- *Non-pressure lines* (i.e. suction, offset fill, vent and vapour recovery pipework) should be subjected to air pressure, in accordance with the manufacturer's recommendations but not less than 0,7 bar(g), maintained for 30 minutes. The gauge should record no loss of pressure during this time. Whilst under pressure each joint and all elbows and fittings should be wiped with soapy water or other appropriate test medium and checked for signs of leaks evidenced by the appearance of bubbles.
- *Pressure lines* should be tested in accordance with the manufacturer's recommendations but at not less than twice the working pressure. After pressure stabilisation the test should be continued for 30 minutes. Tests should be hydrostatic or if air pressure is used suitable protection against explosive release should be provided at joints and end fittings. The gauge should record no loss of pressure during the test with no evidence of leaks from any visible joints or fittings.
- *Secondary containment pipework* should be tested by subjecting the interstitial space to an air pressure test in accordance with the manufacturer's recommendations but not less than 0,35 bar(g) maintained for 30 minutes. The gauge should record no loss of pressure during this time. Whilst under pressure each joint and all elbows and fittings should be wiped with soapy water or other appropriate test medium and checked for signs of leaks, evidenced by the appearance of bubbles. Secondary containment pipe used as part of a class 1 pressure leak detection system will be operated at 1 bar above working pressure of the contained pipe and the pipework should be tested to match.

Alternative options for methods of test include:

- hydrostatic pressure of 1 bar(g) applied on lines full of water;
- gas low pressure testing using a helium/nitrogen mix in association with a helium-sensing device, or
- any other line testing system having a performance capability at least equal to any of the above.

8.6.2 Leak testing for existing operational sites

8.6.2.1 General

Any physical testing of tanks or pipework that contain or have contained petrol has the potential to create a hazard. In consequence, it is essential that the following precautions be observed before any such work is authorised:

- all test systems to be used are supported by fully documented procedures;
- all equipment is appropriately certified for use in hazardous areas, and
- all operatives are adequately trained and certified as such.

It is essential that any potentially hazardous operations (e.g. overfilling or pressurising tanks) should be the subject of a detailed SMS before any work starts. Ideally, the process should have an appropriate quality assurance certification such as EN ISO 9001 *Quality management system. Requirements*.

8.6.2.2 Tanks

If a leak is suspected, or a tank has been out of use for a period of time, or excavations have taken place close to the tank, the tank should be tested using a method appropriate to the installation. Test methods based on precision testing techniques should be used wherever possible. Such forms of testing take account of some of the many uncontrolled variables, which a simple hydrostatic test cannot, including:

- thermal expansion of any fuel in the tank;
- evaporative losses;
- the compressibility and thermal expansion of any other medium being used;
- the effects of surrounding groundwater level, and
- the properties of the medium in which the tank is installed.

Precision testing techniques are therefore more reliable and have a greater probability of identifying a leak or false alarm.

In the absence of UK, European or petroleum industry standards, tank testing methods are generally certified as meeting the requirements of the (US) Environmental Protection Agency (EPA) *Standard test procedure for evaluating various leak detection methods*. Certification will be from an accredited EC or US test house that will issue a Certificate of Conformity for the system. The requirement of the EPA protocol is for a tank testing system to detect a leak rate of 0,38 l/hr or more within a 95 % probability of detection accuracy whilst operating a false alarm rate of 5 % or less. It is therefore possible for a tank to 'pass' a tank integrity test in accordance with the EPA protocol, but still be releasing up to nine litres per day of vehicle fuel into soil and groundwater. Some site operators may wish to seek guidance from operators of the tank testing system as to the actual leak detection threshold achievable by the method.

If for any reason a test is conducted under conditions outside the limitations of the evaluation certificate, the test report will need to state the limitation(s) that have been exceeded together with details of any supporting calculations or increase in the data collection period etc. to confirm that the test complies with the EPA protocol.

8.6.2.3 Pipework

If a leak is suspected, pipework should be tested using a suitable method appropriate to the installation. Typical test methods include those in 8.6.1.4 except that the use of the soapy water test is not possible on buried lines and an inert gas should always be used instead of air for pressurisation. Any water used should be disposed of either through the forecourt oil/water separator or as contaminated waste.

8.6.2.4 Ventilation and offset fill pipework

Ventilation and offset fill pipework should be periodically leak tested if the pipework is not protected by leak detection or provided with secondary containment. The recommended intervals for leak testing are:

– For conventional steel or GRP pipework or other systems incorporating joints below the ground, every five years until year 30 and then every two years thereafter.
– For continuous flexible pipework (including those with thermo-welded joints), every 10 years.

8.7 RECEIVING FIRST DELIVERY OF VEHICLE FUEL

When tanks that are empty are filled for the first time following new construction or modification it is important to ensure that enough fuel is put in them to seal the internal fill pipes. This is an important safety requirement.

8.8 MAINTENANCE

8.8.1 General

Only people who are competent in such work should undertake maintenance. Work should only be undertaken with the prior authorisation of the site operator (or appointed agent) who has the responsibility to control the activities of people working on the site. The authorisation should state clearly the scope of the work to be done and define the period for which it is valid. If the nature of the work does not create a hazard, the authorisation may cover the whole duration of the work. All work should be controlled to minimise the risks to site staff, visiting contractors and members of the public from fire or explosion hazards, to ensure the safe containment and control of vehicle fuels and their vapour and to ensure the continued integrity of plant, equipment and services.

Hot work or any activity likely to cause sparks should not be carried out in, or close to, a hazardous area. If hot work is necessary within a hazardous area, then written permission in the form of a PTW should be given by a person competent to give such authority. Before issuing a PTW, the competent person must detail the necessary control measures to ensure the work can be carried out safely. Further guidance on procedures for carrying out maintenance activities safely can be found in section 6 and in EI *Code of safe practice for contractors and retailers managing contractors working on filling stations*.

Records of all maintenance work carried out should be completed showing the extent of work, faults detected and rectification or modification carried out. Such records should be prepared by the contractor and handed to the site operator for retention, on completion of the work. The site plan should be amended or redrawn after any alterations to tank, pumps or pipework layout, including any changes to the grades of fuel stored in tanks.

8.8.2 Tanks

8.8.2.1 Water monitoring

The accumulation of water in the tank storage system may lead to a number of problems including degradation of fuel quality, microbial contamination and internal corrosion of the tank shell. An effective maintenance regime that involves monitoring of the system integrity and regular water detection and removal in diesel may prevent such problems arising. Note: that water will not be detectable by dipping in alcohol blended fuels as it is fully soluble in the alcohol component of the fuel. For further details see EI *Guidelines for the investigation of the microbial content of petroleum fuels and for the implementation of avoidance and remedial strategies* or the (US) Steel Tank Institute's *Keeping water out of your storage system.*

8.8.2.2 Cleaning

Cleaning of underground tanks (i.e. removal of solid and liquid residues) may be necessary for a variety of reasons. Only competent contractors should undertake such a procedure. Prior to commencement of work it is necessary to carry out a risk assessment for the planned work and determine the extent of any hazardous areas that may be created. For all gas freeing and cleaning operations, detailed guidance on appropriate procedures, equipment, precautions and methods is given in HSE Guidance note *Cleaning and gas freeing of tanks containing flammable residues,* CS15. When entry into the tank is necessary regulations for working in confined spaces will apply and the work should be carried out in accordance with any national Approved code of practice or guidance. In all cases a SMS should be prepared before work commences (see section 6 and EI *Code of practice for entry into underground storage tanks at filling stations*), and for opening or entry into tanks a PTW system should be in place. Cleaning should only commence after the surrounding area has been cleared of all possible sources of ignition, the tank has been emptied and all pipework connections have been isolated from the tank. To avoid the tank being inadvertently filled any offset fill point should be locked and marked with a warning label. In most circumstances, the filling station will need to be closed during the operation. Practical advice on identifying hazards and implementing appropriate control measures and systems of work during maintenance and other non-routine activities, together with advice on hot work and on PTW systems on identified high risk activities can be found in HSE Approved code of practice and guidance *Safe maintenance, repair and cleaning procedures*, L137.

8.8.3 Pipework

There should be a maintenance regime in place that ensures that all exposed sections of pipework and ancillary fittings (i.e. valves etc.) are visually checked for signs of damage, degradation or corrosion. Valves should be operated to check that they function correctly. Any signs or evidence of damage, degradation or corrosion should be investigated by a competent individual and repairs/replacements carried out as necessary.

8.9 REPAIRS AND MODIFICATIONS

8.9.1 General

Prior to undertaking any repairs or modifications a risk assessment should be carried out and work planned to include the identified control measures. Systems and procedures should be introduced as necessary (see section 6) so that all people involved are aware of their duties and responsibilities and can perform the work safely. Repairs and modifications, particularly those involving work on pipework and tanks that have contained petrol, may need to be agreed with the relevant enforcing authority prior to commencing work, except in emergencies where notification may be sufficient.

8.9.2 Tanks

8.9.2.1 General

Generally any corroded or defective tank or pipework should be replaced. Where a compartment of a multi-compartment tank is found to be leaking, the whole tank should be considered to be defective and all fuel should be uplifted from each compartment in the tank. No compartment of the tank should be used until a competent person has inspected the tank. A detailed inspection and assessment by a competent person may indicate that repair rather than replacement is feasible.

A comprehensive inspection report should be prepared that includes details of:

– tank age;
– type of backfill;
– prevailing ground conditions;
– visual examination of the internal surface;
– location and extent of corrosion or defect;
– the cause (internal or external), and
– readings from extensive ultrasonic thickness testing of the whole tank.

An assessment should be provided of the anticipated continuation of the corrosion and the effects this might have on the likely future integrity of any repair. A risk assessment may indicate the need to take steps to abate the continued corrosion by, for example, a suitable system of cathodic protection (CP).

8.9.2.2 Single-skin tanks

Only competent contractors who specialise in this type of work should carry out repairs. The SMS for the work should provide well documented procedures covering safety and all factors involved with the repair together with the standards to be achieved at each stage of the work and how these will be assessed.

8.9.2.3 Double-skin tanks

It will be necessary to determine whether the leak is in the outer or inner skin and what caused the fault before deciding on an appropriate course of action. A leak in the inner skin, providing its position can be determined, can be repaired by patching or alternatively by lining the tank. A leak in the outer skin will necessitate replacing the tank or lining it with a double-skin system where the interstitial space can be monitored.

For a recommended procedure if the interstitial monitoring alarm activates see section 11.7.

8.9.3 Pipework

8.9.3.1 General

Any defects in pipework found during either testing or inspection should be brought to the attention of the site operator together with recommendations for remedial action. This could include a recommendation to take the pipework out of use. Before pipework is modified or extended it should be tested for integrity and where possible inspected. If such pipework shows signs of corrosion, deterioration, damage or adverse falls it should be replaced (but see 8.8.3). After the modification or extension has been carried out the pipework system should be tested before being brought back into use.

8.9.3.2 Steel pipework

Where steel pipework is repaired or extended this should be by means of a permanent joint (i.e. socket or welded joint). If this is not practicable then a long thread and back nut (i.e. removable) may be used provided the joint is located in an inspection chamber for accessibility and inspection.

Generally welding is not undertaken on filling stations that have been operational because of the risk of flammable atmospheres being present. If, however, welding is considered necessary it is essential to ensure that all necessary precautions are taken to provide gas free conditions and that a PTW is issued by a competent person before work starts. Reference should be made to HSE Guidance note *Cleaning and gas freeing of tanks containing flammable residues,* CS15, and section 6. Practical advice on identifying hazards and implementing appropriate control measures and systems of work during maintenance and other non-routine activities, together with advice on hot work and on PTW systems on identified high risk activities can be found in the HSE Approved code of practice and guidance, L137.

When working on any existing steel pipework (including the flexible pipe connecting the dispenser to the suction line), an earthing bridge should be fitted across any joint or section of pipework before it is disconnected or cut. The purpose of the bridge is to maintain earthing continuity to avoid the risk of incendive sparks should stray currents be flowing in the pipework. To ensure continuity the bridge connection should be attached to clean uncoated metal. This will necessitate the reinstatement of any pipework coating and protection when the work is completed to reduce the risk of corrosion to the steel at that point.

8.9.3.3 Non-metallic pipework

Where repairs or modifications to non-metallic pipework are required they should be carried out according to manufacturer's recommendations and the advice contained in 8.5.5.3.

8.9.3.4 Dropped suction lines

The term 'dropped suction line' is used to describe a short riser pipe that interrupts the continuous fall of suction pipework from the pump to a tank. Dropped lines should not be incorporated into suction pipework on new installations but may be used in certain exceptional circumstances as a method of overcoming inadequate fall back from pump to tank or insufficient cover on the pipework on existing sites. Where a dropped suction line is installed the following provisions should be incorporated:

– A permanent notice bearing the words 'beware dropped line' should be fastened to the termination points on the relevant suction pipework (i.e. the angle check valve housing or line test T-piece fitting in the access chamber and the flexible connector in the pump housing).
– The vertical section of dropped line should be located in either a dropped line dedicated liquid-tight access chamber or liquid-tight tank access chamber.
– The vertical section of the dropped pipework should be provided with a removable plug at its base to facilitate draining. There should be sufficient space underneath the drain plug to enable collection of liquid.
– The forecourt surface and reinforcement should be reinstated to provide the required standard and necessary load-bearing protection for the pipework.
– The site plans should be annotated accordingly.

9 DISPENSERS AND CONTROL EQUIPMENT

9.1 GENERAL

The design of dispensers for fuelling vehicle tanks will vary depending on the system used to transfer vehicle fuel from the storage tank to the dispenser. This may be accomplished by suction or pressure or a combination of the two, as described in section 8. With suction systems, the pump is incorporated within the dispenser housing, whereas with pressure systems, the pump is located elsewhere, either within the storage tank or at a location above or adjacent to it and remote from the dispenser. Further details are given in 9.2.

Considerations affecting the location of dispensers, site layout, relationship with buildings and positioning of control equipment are covered in section 4. Section 3 gives guidance on hazardous area classification for dispensers.

Throughout this section reference is made to:

- EC Council Directive 94/9/EC The approximation of the laws of Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres, (implemented in the UK by the Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996).
- EN 13617-1 *Petrol filling stations-Safety requirements for construction and performance of metering pumps, dispensers and remote pumping units*.
- EN 14678-1 *LPG equipment and accessories-Construction and performance of LPG equipment for automotive filling stations. Dispensers*.

From 1 July 2003 in the UK new petrol and autogas dispensers have had to meet the requirements of the ATEX Equipment Directive and carry the CE marking for Group II Category 2 equipment and have been certified by a Notified Body. All new equipment has to comply with any applicable EU Directives that are mandatory on the date that the equipment is placed on the market. A manufacturer/importer or someone marketing a dispenser should supply with the unit a diagram showing the hazardous area classification in and around the unit.

9.2 DISPENSING SYSTEMS

The various configurations of equipment that may be used to transfer vehicle fuels from a storage tank to a dispenser are described briefly in 9.2.1 to 9.2.6.

9.2.1 Suction systems

A suction pump is incorporated within the dispenser housing which draws vehicle fuel through a suction line from the storage tank. A non-return valve is normally located at the base of the dispenser to retain prime.

9.2.2 Submersible pumps

An integral motor and pumping unit is located in the fuel storage tank. The pump pressurises fuel supply pipework to one or more dispensers, which do not themselves contain pumping units. Pressure monitor, air separator and other control mechanisms are usually located on the tank top.

9.2.3 Remote pumps

A pump, located above or adjacent to the storage tank and remote from the dispenser, draws fuel from the tank under suction and simultaneously pressurises fuel supply pipework to the dispenser, which does not itself contain a pumping unit.

9.2.4 Gravity fed systems

A system where the dispenser is fed from an above-ground storage tank. In such cases a pressure-regulating valve is normally located upstream of the dispenser.

9.2.5 Dispersed dispensers

Systems in which a suction dispenser additionally supplies one or more remotely located hose and nozzle assemblies via pressure pipework. Such systems may typically be used for commercial vehicle refuelling where it is required to fill tanks on both sides of the vehicle with single computation for payment.

9.2.6 Autogas dispensers

Autogas systems are pressurised systems with either a submersible pump or a remote pump located adjacent to the storage tank. These pumps pressurise a liquid feed pipe to a dispenser. A separate return line connects the dispenser to the vapour space in the autogas storage tank.

9.3 STAGE 2 VAPOUR RECOVERY

The principles of Stage 2 vapour recovery are covered in section 10. Any new dispensers intended for use with Stage 2 vapour recovery, whether as an active or a passive system, have to be certified to the ATEX Equipment Directive, as noted in 9.1. Older dispensers should have been previously assessed for compliance with BS PAS 022 *Specification for construction of vapour recovery systems installed in petrol metering pumps and dispensers* by a recognised certification authority.

9.4 SELECTION OF DISPENSERS

Dispensers have to meet the essential health and safety requirements of the ATEX Equipment Directive. One way of demonstrating conformity is by meeting the specifications detailed in EN 13617-1 for petrol dispensers or EN 14678-1 for autogas dispensers. In addition compliance with EN 13617-1 for petrol dispensers demonstrates compliance with other safety features covering use on filling stations.

Standards of construction for dispensers have progressed and many units, which are still operational, were built to a different standard than required by the ATEX Equipment Directive. Many older petrol dispensers were built to BS 7117-1 *Metering pumps and dispensers to be installed at filling stations and used to dispense liquid fuel. Specification for construction* and possibly earlier standards. This older equipment can still be used and does not have to meet the requirements of the ATEX Equipment Directive. They can also be sold on, provided they are not sold as new equipment (see 9.7.3). Where these older dispensers are being re-installed they should continue to comply with their certified standard and should be installed in accordance with the manufacturer's instructions (see 9.5).

9.5 INSTALLATION OF DISPENSERS

9.5.1 General

Dispensers should be securely mounted and, preferably, be protected against damage from vehicles (e.g. by use of an island or barrier). All pipework connections to the dispenser should be liquid- and vapour-tight. Electrical connections should be made in accordance with the manufacturer's instructions and should maintain the integrity of the explosion protection.

In addition the features and accessories described in 9.5.2 to 9.5.8 should be included as an integral part of the installation of dispensers on both new and refurbished sites.

9.5.2 Pipework connections-suction

For rigid suction systems, pipework connections are generally made via a flexible connector. A non-return valve (which may be separate from, or integral to, the dispenser) should be located above the island and within the dispenser (see 9.5.5).

9.5.3 Pipework connections-pressure

For petrol and diesel pressure systems, the pipework should be designed to incorporate isolating valves, shear valves and leak detection systems where it connects to the dispenser.

Shear valves for pressure systems should be in accordance with EN 13617-3 *Petrol filling stations. Safety requirements for construction and performance of shear valves*.

For autogas installations the pipework should be designed to incorporate isolating valves and shear valves (or excess flow valves).

9.5.4 Leak-proof membranes and sumps

Petrol and diesel dispensers with suction systems should include a leak-proof drip tray or membrane arrangement beneath the dispenser to ensure that vehicle fuel from internal leaks flows onto the forecourt surface where it is observable. With pressure systems, leak-proof sumps may be used instead of, or in addition to, a drip tray. Sumps provide convenient access below the dispenser to any isolating and impact check valves and for the connection of pipework. Where a drip tray is fitted in conjunction with a sump, it should always allow access to under-pump valves.

Under-pump sumps are likely to contain vapour. To reduce the likelihood of a potential explosion hazard or ground contamination, special precautions will be necessary. Consequently, under-pump sumps should be:

- impervious to the fuel;
- adequately protected against corrosion;
- sealed at all pipe entries to prevent fuel leakage into the ground and ingress of groundwater;
- sealed at all entry points for cables and ducts;
- for petrol and diesel, fitted with an appropriate leak detection device, and
- designed to allow easy removal of any fuel or water that may accumulate.

9.5.5 Non-return or check valves

Non-return or check valves are required on each line of a suction system to prevent the fuel within the dispensers draining back to the storage tank resulting in the loss of pump prime. In order to reduce ground contamination and a safety hazard in the event of a suction line leak, they should be fitted within the dispenser housing and not at the storage tank. New dispensers manufactured in accordance with EN 13617-1 do not have to be supplied with check valves; if not supplied with the dispenser they should be supplied by the installer and be installed within the dispenser housing.

When replacing dispensers at existing sites, check valves fitted at the storage tank should be removed. If this interferes with the correct operation of existing dispensers (e.g. on shared suction lines), those dispensers should also be fitted with under-pump check valves.

On installations where some dispensers do not have under-pump check valves, a legible and durable warning label should be fitted to the appropriate pipework in the tank access chamber indicating the location of the check valve (e.g. check valve in Pump XX).

9.5.6 Safe break (breakaway coupling)

It is recommended that all new dispensers be fitted with a safe break (breakaway coupling) on each nozzle or hose line.

When used, safe breaks on new dispensers and safe breaks used for replacements should conform to EN13617-2 *Petrol filling stations. Safety requirements for construction and performance of safe breaks for use on metering pumps and dispensers.* Refurbished dispensers to BS 7117-1 have to include safe breaks in order to maintain compliance with their original certification.

Safe breaks may be fitted to the dispenser within the length of the delivery hose, between the hose and the delivery nozzle, or between the hose and dispenser delivery pipe. On petrol and diesel dispensers, safe break couplings should not be re-used after separation.

9.5.7 Hoses

Hoses should be marked to indicate compliance with:

– For non-vapour recovery hoses: EN 1360 *Rubber and plastic hoses and hose assemblies for measured fuel dispensing systems. Specification.*
– For vapour recovery hoses: EN 13483 *Rubber and plastic hoses and hose assemblies with internal vapour recovery for measured fuel dispensing systems. Specification.*
– For autogas hoses: EN 1762 R*ubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase), and natural gas up to 25 bar. (2,5 MPa). Specification.*

Hoses should not exceed a length that would cause a hazard. Hose reach is typically between 3 and 4 m from the dispenser housing. The use of hoses with a reach in excess of this should be subject to a risk assessment. Manufacturers should provide guidance on how such longer hoses can be protected from damage.

9.5.8 Automatic nozzle

An automatic nozzle should be fitted to each dispenser, and for new dispensers this should comply with EN 13012 *Petrol filling stations. Construction and performance of automatic nozzles for use on fuel dispensers*. Automatic nozzles complying with that standard have the following safety devices:

– Automatic shut-off device which stops fluid flow when the spout is immersed in the fluid.
– Altitude device which prevents the operation of the nozzle when the spout axis is above the horizontal.

For autogas dispensers a nozzle should be fitted to each dispenser, and for new dispensers this should comply with EN 13760 *Automotive LPG filling system for light and heavy duty vehicles. Nozzle, test requirements and dimensions*.

9.6 CONTROL SYSTEMS

9.6.1 General

The dispensing arrangements can operate in a variety of ways via an electronic control system, whether the mode of operation is: attended service (AS); attended self service (ASS); unattended self service (USS), or an unmanned site (UMS). For AS and ASS this will usually be the console used by the site operator to control the operation of the forecourt and may feature a keyboard or a touch screen. For USS and UMS it will usually be a terminal which may be activated by credit, debit or fuel cards transactions in order to limit access to children and minimise misuse.

The following terms are used as descriptors of the various methods of operation.

9.6.2 Attended service (AS)

A filling station that is designed and constructed to function so that a trained attendant operates the dispensing equipment.

9.6.3 Attended self service (ASS)

A filling station that is designed and constructed to function with customers operating the dispensing equipment under the supervision of a trained attendant.

ASS may include pay at pump facilities with pre-authorisation. However a trained attendant will be available to supervise up to eight dispensing operations at any one time and have the ability to stop any unsafe operation of the dispensers.

When under ASS operation, the attendant will be available to intervene where any unsafe activities are about to, or are taking place, and to assist any customer with physical disabilities or a customer who is encountering difficulties in operating the dispenser.

9.6.4 Unattended self service (USS)

A filling station that is designed and constructed so as to function with customers operating the dispensing equipment without the supervision of a trained attendant. Unattended self-service will normally be an evening/night operation of an ASS site where, to provide a service during periods of low customer volume (i.e. less than 120 transactions per hour), dispensing positions are made available when the forecourt shop is closed, and staff are not available for immediate supervision of dispensing activities.

9.6.5 Unmanned site (UMS)

A filling station that is designed and constructed so as to function without the day-to-day presence of staff, other than for routine safety/security checks, cleaning and scheduled maintenance work etc, sometimes referred to as 'automated sites'. Unmanned sites may be located within the curtilage of a supermarket, or may be in a stand-alone position. At unmanned sites, customers operate the dispensing equipment without the supervision of a trained attendant. Typically, an unmanned filling station would not have a shop associated with the forecourt operation.

In all cases, certain features should be built into the control system to control the risks to health, safety and the environment. The controls will vary depending on the intended mode of operation, the type of equipment and the vehicle fuel being dispensed. The engineered controls necessary for varying modes of operation are described in 9.6.8 and 9.6.9 and summarised in table 9.1.

9.6.6 Autogas

Customers should not be allowed to dispense autogas at UMS or sites when operating in USS mode. Trained attendants must be present on site during the dispensing of autogas.

9.6.7 Risk assessment

It is a legal requirement under the terms of DSEAR that a suitable and sufficient site-specific risk assessment must be carried out. In addition to any assessment required by paragraph 4.2, it will be necessary to carry out an additional site-specific assessment when deciding on the suitability of a filling station to operate in USS or UMS modes. In this case the risk assessment should be undertaken in two phases:

9.6.7.1 Phase 1

The risk assessment should be an assessment of the risks of damage being sustained to the dispensing and safety equipment by the actions of vandals and other persons of an unruly nature. Sites where vandalism has occurred or is likely to occur (if it is open for business without any supervision) should only be considered suitable for USS or UMS operation where effective control measures can be employed to deter damage to equipment.

9.6.7.2 Phase 2

This should comprise a more detailed assessment which considers:

- The site's location, to determine if any incidents arising during dispensing can be contained within the curtilage of the site.
- The total number of all dispensing operations carried out and/or the throughput of petrol and diesel anticipated for an ums or for the periods of time that a site is to be operated in uss mode.
- The range and location of equipment/facilities and a response procedure to deal with foreseeable emergency incidents.
- Proposed 'management' and 'engineered' control measures including those built into the installed equipment.
- Road tanker deliveries, but only in respect of deliveries that may take place when the site is in UMS or USS operation.

9.6.8 Engineered control measures

The following is a list of basic engineered control measures that should be applied to UMS and sites when operating in USS mode:

- Limiting devices on each dispenser set to prevent the continuous operation for more than three minutes and a continuous outflow of more than 100 litres (or the equivalent monetary amount).
- Removal of any latching mechanisms fitted to nozzles. The nozzle may be equipped with a device to aid the lever whilst in the open position, but without latching or compromising the dead man function.
- Adequate illumination of the dispensing area and the position(s) of the emergency equipment.
- Restricting the sale of fuel to credit, debit or fuel card transactions only, in order to avoid access by children and minimise misuse.
- Displaying a notice detailing the restrictions on the types of containers that can be filled with petrol.
- A CCTV system as per Table 9.1.

For application see Table 9.2.

9.6.9 Enhanced (engineered) control measures

Enhanced control measures will normally comprise some form of remote monitoring and supervision of a site. The important feature of remote supervision is a permanently manned control centre (referred to as alarm response centres in BS 5979 *Remote centres receiving signals from fire and security systems. Code of practice*) with:

- A live CCTV system that covers the dispensing areas and the emergency cabinet.
- An alarm to sound at the monitoring point when the emergency stop button is used.
- A two way communication with customers on the forecourt.
- The capability of closing the site, or switching off the power to one or all of the dispensers.
- The capability of contacting the emergency services covering the county or area where the site is located.
- The capability of dispatching a trained responder to the site.

Note: there are remote surveillance systems available that include a 'prompt' feature to highlight activities on site which could require intervention by trained control centre staff. The 'prompts' would/could include:

- Failure of CCTV camera(s), requiring a closure to be instigated by the control centre.
- A discriminating movement/mass/action system (e.g. to prompt if there is no vehicle adjacent to the dispenser when a fuelling transaction is initialised, or if people are moving about on the forecourt but making no effort to operator a dispenser).
- A variable pre-set frequency prompt (e.g. at every tenth transaction, to ensure that control centre staff monitor the general site conditions from time to time).
- Abnormal dispenser running time (i.e. if the dispensing is stopped by the 100 litres or three minute limiter).
- Repeated rapid nozzle removal and replacement.
- Repeated authorisation attempts at payment system.
- Opening of emergency cabinet and/or operation of emergency switch.
- Operation of customer communication system.
- Activation of a fire, smoke and/or vapour detection system.

For application see Table 9.2.

Table 9.1 Engineering controls

Type/mode of operation	**Engineered control measures** (Note: all sites should have telephone with a 999 facility)
All types and modes of operation	– Provision of fire extinguishers and supply of dry sand or sorbent material; signage; lighting; replacement clothing and eye washing facilities.
ASS	– As above plus latch pins removed from nozzles and 100 litres limit per transaction. – Each attendant should only be able to authorise up to eight dispensing operations at any one time.
ASS with pre-authorisation (pay at pump)	– As above plus three minute time limit on each transaction. – Pre-authorisation system to allow only 10 transactions or operate for only 10 minutes before being reset by the authorisation of a transaction.
Alternating between **ASS** with or without pre-authorisation and **USS at times of low number of transactions** (normally overnight). (Normally a supermarket store with adjacent forecourt with shop, with less than 120 transactions per hour)	– As ASS with pre-authorisation pay at pump when forecourt is under immediate supervision. – When operating USS as per above plus: – Transaction limit reduced to 100 litres. – Live CCTV monitoring from adjacent premises (main store), if there is no direct vision of forecourt from monitoring point. – Immediate direct communication with customer available. – Customer emergency stop button provided. – Alarm must sound at monitoring point within the adjacent premises when emergency stop button used. – Instructions to customers sign.
Site located in rural location where the provision of a filling station would not be commercially viable, as a service to the community with up to four dispensing positions and a response to emergencies provided by trained person(s) nearby (by local agreement)	– Transaction limit reduced to 100 litres. – Emergency phone available to call trained person to the site or the emergency services. – Emergency stop button provided. – Instructions to customers sign.

Type/mode of operation	**Engineered control measures** (Note: all sites should have telephone with a 999 facility)
Site located in a isolated location as a service to the community with up to four dispensing positions and a response to emergencies provided by the emergency services by local agreement	– Latch pins removed from nozzles. – Transaction limit reduced to 100 litres. – Three-minute time limit on each transaction. – Observation of the site to be prompted by intuitive CCTV system alarming at control centre. – Immediate direct communication with customer available. – Customer emergency stop button provided. – Control centre to be able to open a cabinet containing eye wash facilities and replacement clothing. – Instructions to customers sign.
USS or automated site with more than four dispensing positions	– Latch pins removed from nozzles. – Transaction limit reduced to 100 litres. – Three minute time limit on each transaction. – Observation of the site to be prompted by intuitive CCTV system alarming at control centre. – Immediate direct communication with customer available. – Customer emergency stop button provided. – Alarm must sound within the adjacent premises to alert trained person. – Instructions to customers sign.
USS or automated site with petrol/diesel and autogas dispensers	– The dispensing of autogas should not permitted on USS or UMS sites.

Table 9.2 Application engineering of controls

Site scenario	**Likely engineered control measures required subject to risk assessment**
Site located with contactable trained person nearby and with good emergency services response time	Engineered control measures (as defined in 9.6.8).
Site located with no trained person contactable nearby or site with longer emergency services response time	Enhanced control measures (as defined in 9.6.9).
Any site with more than four fuelling positions available	Enhanced control measures (as defined in 9.6.9).

9.7 MODIFICATIONS AND REPAIR

9.7.1 Repair or refurbishment to certificate

Repairs should be made in such a way that the dispenser remains in accordance with its certification documentation. This is known as repair to certificate. Dispensers repaired in this manner may keep their original type plate carrying certification details after the repair.

Similarly, where a dispenser is not necessarily faulty but is being refurbished or overhauled, it may be possible for the work to be carried out so that it still complies with its certification documentation, and the dispenser may keep its original type plate.

9.7.2 Reworked dispensers (repaired or refurbished to standard)

Replacement or additional approved parts which are not part of the original certified design may also be used to repair or refurbish a dispenser provided that the parts return the dispenser to serviceable condition and conform to the relevant standard to which the apparatus was originally designed. Dispensers repaired in this way are normally referred to as 'reworked to standard'. The dispenser should be clearly marked as having been reworked to standard, and by which company. Where the original type plate is removed, the new marking of the dispenser should indicate the original certificate number and standard to which the dispenser was manufactured, but should always clearly identify that it is a reworked dispenser.

Any repairs, refurbishment or reworking should be carried out by a competent person. A record of all work carried out should be available with the dispenser or at its installed location.

9.7.3 Substantial modifications to dispensers

The ATEX Equipment Directive applies when substantial modifications are made to equipment for use in potentially flammable atmospheres. Note: this applies to dispensers certified to the directive, and to equipment that was certified to earlier standards, such as BS 7117-1. Under the directive dispensers are regarded as Category 2 equipment, and Category 2 will apply to substantial modifications. The design of such modifications should be covered within an ATEX assessment from a notified body.

Note: the overall modified dispenser does not necessarily have to carry an ATEX certificate unless a substantial modification has been made; but the modification itself has to be in accordance with the requirements of the Directive.

Guidelines on the application of Directive 94/9/EC of 23 March 1994 on the approximation of the laws of Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres defines substantial modifications as "Any modification affecting one or more of the essential health and safety requirements or the integrity of a type protection". Examples of substantial modifications specific to dispensers include:

– addition of vapour recovery system;
– modifications where additional 'Ex' safety concepts are added to the dispenser, and
– modifications where the overall hazardous area zoning of the dispenser is changed.

9.7.4 Testing dispensers following modification or repair

After maintenance, repair or modification work has been carried out on a dispenser it should be tested to establish that the equipment is working satisfactorily paying due regard to the site conditions and the nature of the work carried out. Particular attention should be paid to:

- flow rate;
- noise and vibration;
- leakages in both the fuel and vapour recovery systems (where applicable);
- correct operation of the display;
- correct operation of all controls;
- correct functioning of the nozzle and any automatic shut-off device;
- properly resealed ducts where repair work involved disturbing or replacing any cabling in ducts, and
- accuracy of measure.

9.8 DISPENSING FUELS CONTAINING BIOMASS DERIVED COMPONENT

9.8.1 Equipment and materials compatibility

For existing dispenser systems, the original equipment manufacturers (OEMs) or service provider should be contacted to determine the compatibility of materials used in the system, and to assist in determining a suitable maintenance regime.

Prior to the installation of any new dispenser systems, the OEMs should be contacted to determine the compatibility of the components intended for use in the system with fuels containing biomass derived components, and to assist in determining a suitable maintenance regime.

9.8.2 Labelling

The OEM and/or local Trading Standards Officer (TSO) should be contacted for clarification on current legislative requirements for labelling of the dispenser system.

For fuels outside the scope of EN 228 A*utomotive fuels. Unleaded petrol. Requirements and test methods* and EN 590 *Automotive fuels. Diesel. Requirements and test methods* labels detailing specific warnings and limitations on usage in order to avoid damage to vehicle engines may be required.

10 VAPOUR RECOVERY SYSTEMS

10.1 GENERAL

This section provides information for the design, construction, modification and maintenance of systems for the recovery of vapour during the unloading of petrol from road tankers (Stage 1b) and refuelling of customers' vehicles (Stage 2). These systems are intended to minimise, as far as is practicable, the emission of petrol vapour to atmosphere. In the UK Stage 1b and Stage 2 vapour recovery systems are processes controlled under the Pollution Prevention and Control Act 1999.

The Environmental Permitting (England and Wales) Regulations 2010 and parallel regulations in Scotland and Northern Ireland require a permit for sites which operate such systems.

Prior to the installation of any new vapour recovery system, the original equipment manufacturers (OEMs) should be contacted to determine the compatibility of the components intended for use in the system with fuels containing bio components.

For existing dispenser systems, the OEMs or service provider should be contacted to determine the compatibility of materials currently in use in the system, and to assist in determining a suitable maintenance regime.

10.2 STAGE 1b VAPOUR RECOVERY SYSTEMS

10.2.1 Basic principles

The control of vapour displaced from the filling station storage tanks during the unloading from a tanker is normally achieved by diverting vapour displaced through the tank vents via a pipe/hose system back into the road tanker for removal from site and subsequent recovery at a distribution terminal. Systems exist to maximise the retention of vapour on sites and/or to allow processing of vapour back into liquid on sites. Proprietary requirements of the manufacturers of these systems should be strictly adhered to. Irrespective of any on-site retention or processing systems the road tanker should always be connected to a vapour return connection on the site to allow the safe recovery of vapours which bypass the proprietary systems. The essential features of filling station vapour recovery are as indicated in Figure 10.1.

The driving force for a vapour recovery system is the difference between the increase in pressure in the storage tanks as they are filled with fuel and the decrease in pressure in the tanker as the fuel leaves the compartment. The vent and vapour recovery pipework must be designed to minimise any pressure losses during the flow of vapour through the pipe system. The safe release of any excess pressure accumulated in the system is accommodated by use of a pressure/vacuum (P/V) valve at the end of the vent.

Vapour recovery at sites requires suitable service equipment to be installed on road tankers. Comprehensive details can be found in EI *Petroleum road tanker design and construction.*

Fuel delivery pipework may be installed at filling stations, having either direct or offset fill points. Where multi-hose discharge is planned, since there is only one connection on the vehicle for the return of vapour, it is necessary to manifold the petrol storage tank vent pipework into a single vapour return for connecting to the vehicle by hose.

Where it is decided not to manifold the vent pipework, it will be necessary to unload one road tanker compartment at a time. In this case, the vapour transfer hose is connected to the vapour return connection of the storage tank being filled. Vent pipework can then remain dedicated to specific tanks.

For sites undergoing significant modification/refurbishment, existing dedicated vent pipework for each storage tank should be replaced by a pipework system where all the pipework is manifolded together. For new sites either a below ground, above ground high level or above ground low level manifolding system is recommended.

It is recommended that the vapour recovery system for petrol and the venting of diesel tanks are not combined, thus preventing mixing of vapour. Petrol vapour introduced into a diesel tank ullage space can give rise to an unexpected flammable atmosphere, and may modify the flashpoint of diesel.

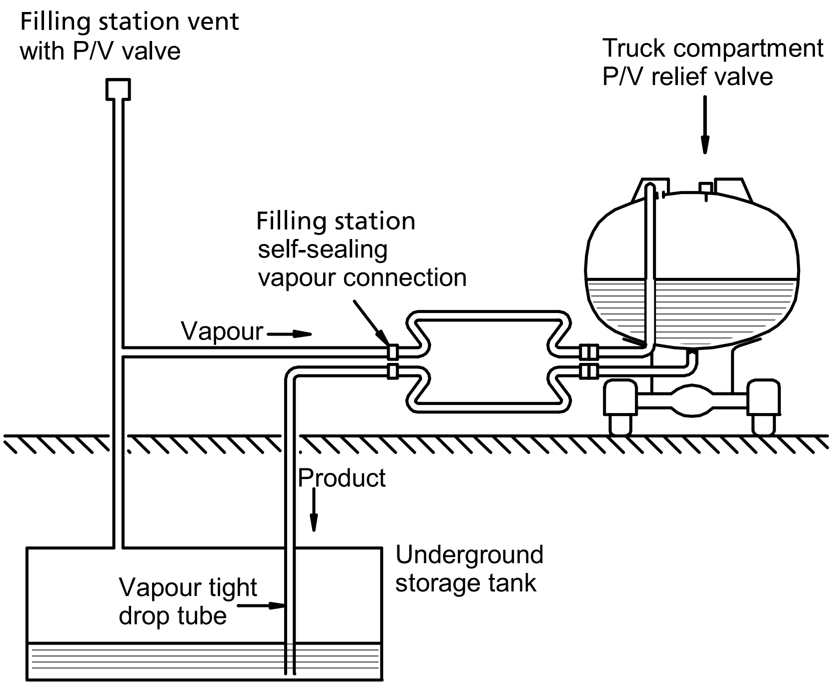


Figure 10.1 Schematic of Stage 1b vapour recovery

Each element of the petrol storage installation will have an effect on the overall operation of the vapour recovery system, as described in this section.

Vents must be clearly marked to identify to which tank they are connected. Normal tank breathing, to allow for fuel draw down as it is dispensed or for the relief of excess vapour pressure developed during non operating periods, can be achieved either using the P/V valve on its own or with a suitably designed orifice flow control in parallel with the P/V valve operating as a safety relief.

If tanks are reallocated from diesel to petrol or vice versa it is important to check that the vents are connected correctly.

At many new sites, vapour return pipework is typically below ground, large bore and manifolded.

10.2.2 Overall layout of the vapour recovery system

Wherever possible the vapour return connection should be located adjacent to the storage tank fill point.

The grouping of the fill points and the position of the manifolded tank vent connection point on the filling station forecourt should be consistent with the direction the delivery vehicle is facing during unloading.

The vent stack, which contains the P/V valve, where fitted, should be designed to be at the opposite end of the manifold to the vapour hose connection. This reduces the possibility of a venture effect drawing air into the system during high vapour flow conditions.

10.2.3 Materials and sizing of vapour pipework

Vapour pipework may be constructed from a variety of materials, as detailed in section 8. Each installation should be considered individually and the pipework sized to optimise the preferential flow of vapour back to the road tanker. As a general guide, but dependent on pipe length, a 50 mm diameter pipe has been found to be adequate to cater for a single tank flow, and 75 mm diameter pipe for up to three tanks. Therefore for a manifold system suitable for up to three compartments, discharge would include 50 mm diameter vents connecting into 75 mm diameter manifold return pipework.

Vent pipework should be sized for a typical vapour flow rate of 800 litres per minute (l/m) per delivery hose unloading fuel simultaneously (e.g. a three hose simultaneous delivery would require a design for 2 400 l/m).

All vent pipework should be self-draining and installed with a minimum continuous even fall of 1:100 back to the tank as described in section 8.

10.2.4 Manifolding

Manifolding of the vent pipework may take place below ground or above ground at high or low level. As a consequence of manifolding the vents, it is necessary to prevent the contents of a storage tank overflowing through the system into another tank(s) and hence causing inter-product contamination in the event of an overfill situation (see 10.2.6).

Vapour return pipework between the vent manifold and the vapour connection point should be installed with a fall to an identified liquid collection point to allow the collection and removal of any condensed petrol vapour when required.

Any drain that is not connected directly back to the tanks should be designed so that it can be locked off and only used by authorised personnel. Where there is a vapour recovery point below ground or below the level of the manifold, a drain point should be provided. Drain points should be located to allow suitable access for draining.

10.2.5 Vent emission control devices

10.2.5.1 P/V valves

It is good practice for two or more P/V valves or one orifice plate and one P/V valve to be provided in the system to permit tank breathing during normal operation. This ensures that if one valve fails, the other will still operate. In addition P/V valves safeguard the system should the vapour return pipework become accidentally blocked or made inoperable for any reason. P/V valves and orifice plates ensure that the amount of vapour vented to atmosphere during a delivery is minimised. Valves should be located on the manifold vent pipework at its highest point. The siting of the vent stack should follow the requirements of the hazardous area provisions, as set out in section 3.

P/V valves should:

- Bbe sized to fit the vent pipe.
- Have a means of attachment to the vent pipework, which is vapour-tight.
- Be fully opened by a pressure of 35 mbar.
- Be capable of venting the maximum flows expected during normal tank operation.
- Be fully open at -2 mbar (established from typical pressure drops during dispenser operation).
- Allow full flow when all dispensers are operating simultaneously.
- Be resistant to petrol and diesel fuel, oxygenates, fire, weather and corrosion.
- include a flame arrester, approved to EN ISO 16852 *Flame arresters. Performance requirements, test methods and limits for use*, integrated into a P/V valve (end of line flame arrester) or fitted separately behind the P/V valve (in line flame arrester), for new or refurbished sites. (BS 7244 *Specification for flame arresters for general use* remains valid for existing equipment).
- Be fitted with a rain shield. Valves should be designed such that operation is unaffected by ice formation.
- Discharge upwards in order to assist with dissipation of vapour.
- Not be painted.

10.2.5.2 Orifice vent devices and orifice plates

An orifice vent device or orifice plate may be used to allow tanks to operate at or around atmospheric pressure, preventing any issues arising out of positive vapour pressures in the tank ullage space. A suitably sized orifice vent device will prevent the loss of vapour in excess of prescribed limits during road tanker unloading. An orifice vent device should not normally be necessary and so should not be used on sites without stage 2 vapour recovery systems. A P/V valve should always be used in parallel with an orifice flow control device to provide relief of excess pressures which might result in the event of blockage or component failures in the vent and vapour recovery system.

In a Stage 1b vapour recovery system where the P/V valve is installed off a high level vent manifold, or at an equivalent raised height off a low level vent manifold, any orifice flow control device should be installed at a similar raised height. In this type of system the orifice flow control device should be installed at 0,5 m above the height of the coaming on the road tanker.

In a Stage 1b vapour recovery system where a P/V valve is installed at a low level, where a requirement may arise for installing an orifice plate in parallel to the P/V valve, this should be installed on top of a long riser of suitable diameter at 0,5 m above the height of the coaming on the road tanker.

All orifice flow control devices should be fitted with a suitable flame arrester approved to EN ISO 16852 and, where necessary, appropriate weather caps.

10.2.6 Overfill prevention

Methods of preventing fuel entering the vapour return pipework manifold in the event that a storage tank is overfilled include:

- Creating the manifold at a height in excess of the maximum head of fuel in the road tanker compartments (e.g. at least 0,5 m above the top of the tanker). The height of the manifold should take account of any possible fuel surge up the vent pipework that could occur at high unloading rates, or
- For manifolding that is installed at less than the maximum tanker height either:
  - install a liquid-operated overspill prevention valve (e.g. a floating ball valve) in vent pipework from each tank before the manifold, or
  - fit an overfill prevention system to each tank fill pipe in accordance with EN 13616 *Overfill prevention devices for static tanks for liquid petroleum fuels*.

10.2.7 Vapour connection points

Vapour return pipework, whether below or above ground, should terminate in a single 75 mm diameter vapour connection point. This point should be located next to the fill points, as shown in Figure 10.1, and in such a position that the crossing of vapour and fuel hoses is avoided when discharging fuel. At the vapour connection point there should be a self-sealing adaptor with a poppet valve, which only opens when the vapour hose is connected. The adaptor should be designed to mate with the vapour transfer hose end coupling. The adaptor should have a low-pressure drop at design vapour flow rate, and be of such a design that it prevents inadvertent mis-connection with fuel delivery hoses. It should be protected with a lockable, vandal-proof tethered dust cap that is preferably non-metallic. If the cap is metallic the tether should be no longer than 150 mm.

A flame arrester approved to EN ISO 16852 should be integrated into the poppet valve (end of line flame arrester) or fitted behind the poppet valve (in line flame arrester) on all vapour connection points.

The vapour connection point or its dust cap should be colour-coded orange or suitably marked to distinguish it from fuel connection points.

10.2.8 Vapour transfer hose

The vapour transfer hose used for the connection between the vapour connection point and the road tanker is usually brought on site with the road tanker. For further details see EI *Petroleum road tanker design and construction*. If it has to be stored on site it should be in a well ventilated area, as the hose will contain vapour after it has been used.

10.2.9 Vapour retention devices

Devices are available which enable vapour that is displaced during the unloading operation to be retained at the filling station rather than recovered within the road tanker. It is imperative that the fitting of any type of vapour retention device will not adversely affect the safety of the unloading process. It is also important that they do not cause a pressure or vacuum build-up within the storage tanks in excess of the P/V valve settings of + 35 mbar pressure and - 2 mbar vacuum. The advice of a technically competent person and the operator of the intended delivery vehicle should be sought before a vapour retention device is fitted.

10.2.10 Storage tank gauging and alarm systems

Many filling station automatic tank gauging systems will be unaffected by the fitting of a vapour recovery system. However, hydrostatic and pneumatic gauges, where the tank contents are measured as a result of gauging the pressure of a column of liquid, will have the accuracy of their readings affected by the varying pressure conditions which occur in the storage tank as a result of vapour recovery. In this situation the gauge manufacturers should be contacted when a site is converted, as some are able to provide a modification. Alternatively a device which can safely relieve the pressure in the storage tank during tank gauging operations can be fitted, see DEFRA AQ05(08) *Petrol vapour recovery at service stations: Explanatory notes on the use of orifice vent devices, pressure vacuum relief valves and applications for Stage II*.

10.2.11 Signs

At critical points of the vapour recovery system safety signs or notices should be installed. All signs should be permanent, clearly marked and legible from a normal viewing position. Signs should be provided at the positions detailed in (a) to (f) below.

a. Vapour connection point
Adjacent to the vapour hose connection:

CONNECT VAPOUR TRANSFER HOSE BEFORE UNLOADING (TANKER END FIRST)

Where more than one vapour connection point is provided, a sign should be fixed to each point to indicate to which tank the point is connected.

b. Storage tank
In the tank access chamber of each tank equipped with a vapour recovery system:

TANK EQUIPPED FOR VAPOUR RECOVERY

c. Vapour pipework
Adjacent to any vapour pipework within the tank access chamber which is manifolded:

TANK VENTS MANIFOLDED. ISOLATE VENT PIPE BEFORE COMMENCING ANY WORK

d. Fill point
The maximum number of hoses able to discharge simultaneously is to be clearly stated.
Note: the number of discharge hoses that can be used simultaneously is determined by the initial design of the vapour recovery system. This should be checked after construction to ensure that no vapour is emitted at the design flow rates.

MAXIMUM NUMBER OF TANKER COMPARTMENTS TO BE UNLOADED SIMULTANEOUSLY IS X

e. Overfill prevention device
In the tank access chamber or adjacent to the offset fill pipe of each storage tank fitted with an overfill or overspill prevention device or where vapour manifolding has been carried out below ground:

OVERFILL PREVENTION DEVICE FITTED

f. Tank access chamber

Diesel vent pipework should not be manifolded to petrol vent pipework. However, on an existing Stage 1b site it may be necessary to carry out maintenance on vents where diesel has been manifolded with petrol. In this case the following sign should be displayed:

DIESEL AND PETROL TANK VENTS MANIFOLDED. FOR DIESEL TANK, TAKE SAFETY PRECAUTIONS AS FOR PETROL

10.2.12 Testing, commissioning and maintenance

10.2.12.1 Commissioning

Following the installation of a vapour recovery system it is important to check that the system is functioning correctly and that there are no leaks. The specialist installation contractor should check that:

- The components and assemblies are properly installed, free from obstruction, operating correctly and that specification and test certificates are checked to ensure they are appropriate.
- Safety notices are correct, in the right location and legible.
- Vapour pipework has been tested for integrity (see section 8).
- Connections, unions or pipework sections, which cannot be tested, remain visible in access chambers so they can be subject to visual inspection.

10.2.12.2 Testing

A specialist contractor should carry out testing in accordance with Annex 10.3. The results should be recorded to provide a record against which future performance may be assessed.

Experience has shown that a malfunctioning vapour recovery system that has an overall leak rate from the internal fill pipe system of less than 2 l/m (at a test pressure of 30 mbar) will not normally cause any practicable problems during deliveries or give rise to any additional safety problems. It has also been established that a leak rate greater than 5 l/m can give rise to significant problems during deliveries and would normally require urgent remedial work. A leak rate of between 2 and 5 l/m can be problematical and should be remedied as soon as is reasonably practicable.

10.2.12.3 Pressure release valve

If the storage tank vent system is fitted with a P/V valve there is a risk that the underground vapour pipework, the ullage space of storage tanks and the tank vent system may be under pressure. In these circumstances, prior to any work taking place which requires opening of the vapour pipework or the tank ullage space, any dispensers operating with vapour recovery should be disabled and the pressure should be relieved at the storage tank vent system. Where no specific device is incorporated into the tank vent system, any equipment used should be specifically designed to perform this operation and should release the vapour at a high level through a flame arrester approved to EN ISO 16852, preferably at a point in close proximity to the existing tank vent outlet.

10.2.12.4 Maintenance

The satisfactory operation of a vapour recovery system at a filling station is dependent upon the regular maintenance and inspection of the various components in the system. A schedule of maintenance should include the following:

a. *Examination and testing*: A schedule of examination and testing, as detailed in Annex 10.3, should be carried out when any modification is made to the system (excluding routine component replacement) and if any leak or malfunction is suspected.
b. *Routine inspection*: The following components, if fitted, should be inspected periodically to ensure they are not worn, damaged, blocked or leaking, and to ensure their continued correct operation:
   – vent system emission control device;
   – P/V valves and orifice plates;
   – flame arresters - flame arrester elements;
   – vapour transfer hose integrity (where stored on site);
   – vapour transfer hose electrical continuity (where stored on site);
   – vapour transfer hose connectors/dust caps (where stored on site);
   – vapour connection point adaptors including valves and lockable tethered dust caps
   – positioning and clarity of safety signs, and
   – manifold drain.

When the storage tanks vapour spaces are manifolded together it has to be remembered that if work is required on any of the tanks it is essential for safety that the relevant tank is positively isolated from the system.

Records should be made of all maintenance checks and inspections and copies given to the site operator.

10.3 STAGE 2 VAPOUR RECOVERY SYSTEMS

10.3.1 Basic principles

Stage 2 vapour recovery systems are designed to reduce the emission of vapour to atmosphere during filling of customers' vehicle fuel tanks with petrol. As vehicles are filled on the forecourt, the fuel entering the vehicle tank displaces vapour which is captured through the nozzle with the aid of a vacuum pump system and returned to one of the underground storage tanks. Alternative systems are available which process the vapour.

It is recommended that the Stage 2 vapour recovery return line is always connected to the largest petrol tank on a site.

There are currently no performance criteria for safety or efficiency of Stage 2 systems in the UK and the guidance in this section is based on experience elsewhere in Europe. Note: It is essential that if a Stage 2 system is to be installed, a Stage 1b system should either already have been fitted or is fitted simultaneously.

Performance requirements are defined in DEFRA PGN 1/14 (06) *Unloading of petrol into storage at petrol stations*.

10.3.2 Returning vapour to storage tank

10.3.2.1 Vapour return system

Vapour is transferred from the dispenser back to the underground storage tank via fuel compatible pipework. Systems may be manifolded and common practice is to connect back to the largest of the underground petrol tanks. If petrol tanks are connected to separate or individual Stage 1b vapour recovery systems then vapour needs to be returned to the tank or tank group from which the particular dispenser was drawing fuel in order to avoid excess pressure and venting of vapour.

10.3.2.2 Design and installation of active systems

Flow of vapour is regulated by a mechanical or electronic method so that vapour return flow is proportional to the delivered petrol flow on a volumetric basis. Vapour is recovered from the vehicle fuel tank through a special refuelling nozzle designed to return it through an interconnecting flexible co-axial hose. The vapour is returned via an underground pipework system to the storage tank.

10.3.2.2.1 Dispensers

The dispensers should comply with EN 13617-1 *Petrol filling stations. Safety requirements for construction and performance of metering pumps, dispensers and remote pumping units*. They should include:

- Special refuelling nozzles.
- Co-axial hoses for petrol delivery and vapour return.
- A safe break (breakaway coupling) in either the nozzle or hose assembly.
- A non-return valve to prevent the possible flow back of vapour from the storage tank to atmosphere via the refuelling nozzle. This valve may be incorporated within the vapour pump if fitted.
- Additional internal piping, which connects to the dispenser and underground vapour pipework system.
- A shear valve in the vapour pipework at the base of the dispenser.
- A vapour pump and a regulating system.

10.3.2.2.2 Refuelling nozzle

The active system requires a vapour recovery nozzle to provide separate flow paths for petrol and vapour. The nozzle used should have an automatic fuel shut-off and comply with EN 13012 *Petrol filling stations. Construction and performance of automatic nozzles for use on fuel dispensers*.

10.3.2.2.3 Flexible hoses

A co-axial hose complying with EN 13483 *Rubber and plastic hoses and hose assemblies with internal vapour recovery for measured fuel dispensing systems. Specification* and EN 1360 *Rubber and plastic hoses and hose assemblies for measured fuel dispensing systems. Specification* and having one conduit inside the other, should be used. The hose should be system approved and listed on the vapour recovery efficiency certificate. It should:

- be suitable for its intended purpose;
- meet current appropriate hose standard;
- have inner and outer hoses which are non-collapsible and kink resistant;
- have a covering which is resistant to abrasion, and
- have an anti-kinking sleeve fitted at the nozzle end.

10.3.2.2.4 Safe breaks

These are designed to prevent petrol flow in the event of a hose pull away occurring due to a vehicle driving off with the nozzle still inserted in the filler neck and should comply with EN 13617-2 *Petrol filling stations. Safety requirements for construction and performance of safe breaks for use on metering pumps and dispensers*.

The type and location of couplings required will depend on the dispenser, the type of refuelling nozzle and the hoses.

10.3.2.2.5 Non-return or check valve

A non-return valve, sometimes known as a check valve, is required in the vapour pipework to prevent vapour emission when there is no flow. The non-return valve may be located in the vapour pump (if fitted) or in the pipework between the dispenser's shear valve and the safe break. In an active system, a vapour flow control valve performs this function and complies with EN 13616 Class III.

10.3.2.2.6 Shear valve

An automatically operated double-poppetted shut-off valve or shear valve should be positioned in the vapour pipework at the dispenser island level. This is to prevent vapour escape in the event of impact or fire damage to the dispenser. The non-return valve may be incorporated within the shear valve.

10.3.2.2.7 Vapour pump

The vapour pump should:

- either be a separate unit mounted within the dispenser and driven from it, or a larger unit located external to the dispenser with its own power source to which the vapour pipework from all dispensers is connected;
- incorporate flame arresters approved to EN ISO 16852 within the vapour pump;
- produce a vapour flow rate capable of exceeding the maximum petrol flow rate to all nozzles;
- incorporate a pressure relief valve and re-circulatory bypass system, and
- incorporate a non-return valve as described in 10.3.2.2.5.

10.3.2.2.8 Regulating system

If a vapour pump is installed to produce vapour return flow, a regulating system is required, which forms an integral part of the vapour circuit. Its purpose is to ensure that vapour return flow is controlled and regulated automatically in proportion to the fuel delivery rate. The regulating system may be either mechanical or electrical. Figure 10.2 shows a typical arrangement of the main components within the dispenser unit, but it should be noted that other arrangements are possible.

10.3.2.2.9 Vapour return pipework

Pipework size and layout will be determined by the need to minimise resistance to flow and achieve a flow rate through the vapour return pipework which is equivalent to at least the maximum fuel delivery flow rate.

It is recommended that consideration be given to providing a method of diverting the vapour flow to alternative tanks during tank maintenance or to assist with fuel grade changes. This will permit normal operations to continue without the need to take a tank system out of service.

Where tanks are not permanently manifolded but are provided with individual vents, it is essential that the vapour be returned to the tank from which the dispenser is drawing fuel.

Where vapour return pipework is installed in advance of an operational Stage 2 system it is essential that all open ends of the pipework be securely capped.

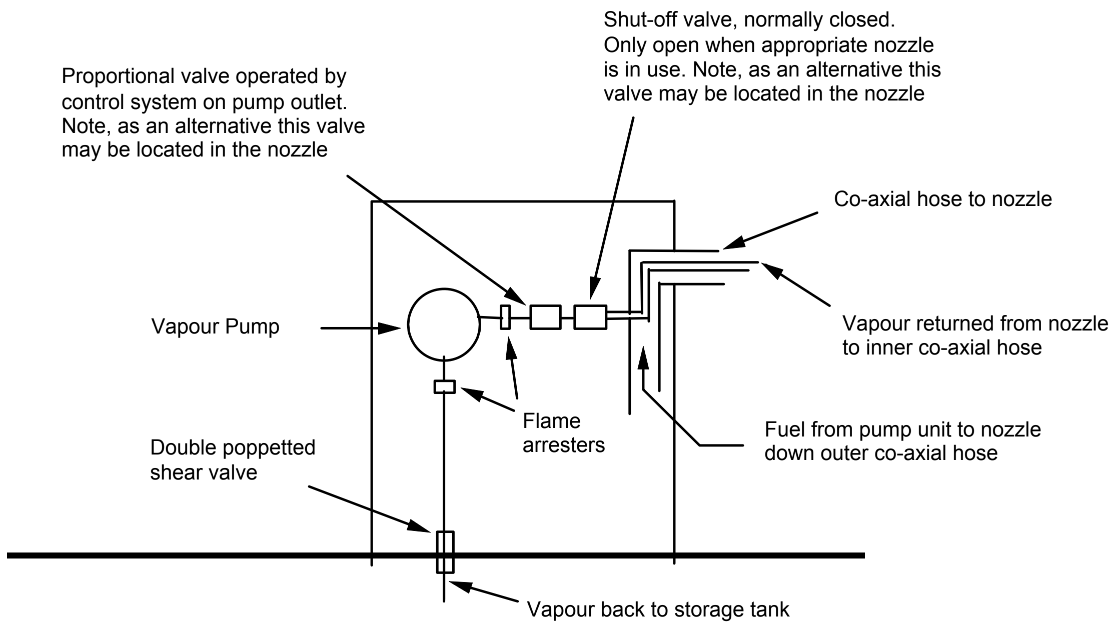


Figure 10.2 Schematic of typical components within the dispenser unit

Pipework should meet the requirements in (a) to (d) below:

a. Above-ground pipework
Within the dispenser, pipework should be installed and certified to the same standard as the original dispenser manufacture, either by on-site modifications or factory build.

Outside the dispenser, any pipework should be suitably protected against impact damage, fire, corrosion etc. It should be laid with a continuous fall back to the tank and with suitable provision at low points to draw off condensate.

b. Underground pipework
This should be self-draining and installed with a continuous fall back to the underground storage tank, (see section 8 for installation and types of pipework). Pipework should not be brought above ground unless the pipework is UV stable.

c. System isolation
Provision should be made to isolate vapour pipework and storage tanks for inspection and maintenance. Isolating valves or similar methods should be adopted and installed at strategic points in the vapour recovery system to enable this to be satisfactorily achieved. The location of these components should be chosen with care to enable individual dispensers and their vapour systems to be isolated from one another.

d. Flame arresters in nozzle lines
Where more than one hose and nozzle combination, which can be operated simultaneously, is connected to a vacuum pump, flame arresters approved to EN ISO 16852 should be installed to prevent a flame carry-over from one nozzle line to another in the event of a fire. Recommended numbers and positions are detailed in EN 13617-1.

10.3.3 Commissioning and testing

Some recommended procedures for commissioning and testing the installation are given in 10.3.3.1 and 10.3.3.2.

10.3.3.1 During site construction
The underground pipework should be tested in accordance with section 8.

10.3.3.2 After completion of site construction
Following the installation it is important to check that it is functioning correctly before being brought into service. In particular, it is important to check that vapour is being returned from the customer's vehicle tank to the storage tank efficiently and without excessive restriction or loss.

For Stage 2 vapour recovery systems, the specialist installation engineer should test to ensure that the correct vapour return and petrol delivery flow rate exists. Where an electronic regulating system is installed this should be checked by carrying out a test where no fuel is delivered but where the flow rate is simulated by electronic pulses.

All equipment in the vapour recovery system should be tested in accordance with the manufacturer's recommendations.

10.3.4 Calibration

If a monitoring system is fitted, the vapour recovery calibration should be checked every third year. Where monitoring is not fitted vapour recovery calibration is checked annually.

10.3.5 Maintenance

An appropriate maintenance schedule should be in place to cover any equipment provided. It is recommended that a specialist contractor periodically inspects the following components to ensure that there are no signs of wear, damage, blockage or leakage and that they operate correctly:

– Flame arresters. A periodic visual inspection should be carried out.
– Co-axial vapour hoses. Hoses, nozzles, safe breaks should be periodically inspected at least as part of the maintenance programme.
– Vapour pump operation. Operation should meet requirements of DEFRA PGN 1/14 (06).
– Regulating system. System should meet requirements of DEFRA PGN 1/14 (06).
– Fuel/vapour refuelling nozzle. This requires a vapour pump and a regulating system.
– Non-return valves. These may be vapour control valves in an active system.
– Isolation valves.
– Shear valves.

Records should be made of all maintenance checks and inspections, and copies given to the site operator.

10.3.6 Maintenance operations on sites fitted with Stage 2 vapour recovery

Where maintenance is to be carried out on tanks or pipework forming part of the vapour recovery system particular attention needs to be paid to ensuring the safe release of excess pressures before commencing works and to the prevention of uncontrolled vapour losses from the system. Stage 2 vapour recovery systems should be isolated, disconnected or rendered inoperable while works are progressed. Further information can be found in Forecourt Equipment Federation (FEF) *Code of Practice. Design, Installation, Commissioning, Operation and Maintenance of Stage II Vapour Recovery Systems*.

11 LEAK CONTAINMENT AND LEAK DETECTION SYSTEMS (INCLUDING TANK CONTENTS MEASUREMENT SYSTEMS AND WETSTOCK CONTROL)

11.1 GENERAL

11.1.1 Scope

This section provides guidance on the main types of leak containment and leak detection systems available and items that should be considered when deciding on the type of system to give the appropriate level of safety and environmental protection for the identified risks.

Tank contents measurement using dipsticks and automatic tank gauges is also described.

Information on the control of release of vapour from single containment systems, namely tank ullage spaces and vent and vapour recovery systems, is provided in section 10.

Systems applicable to autogas are not covered in this section.

11.1.2 Legal framework

By following the guidance in this section the filling station operator should be able to demonstrate compliance with the statutory duties under health and safety and environmental law. The following regulations and guidance are applicable to leak detection and leak containment systems.

11.1.2.1 Health and safety

- CFOA *Petrol filling stations guidance on managing the risks of fire and explosion.*
- The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR).
- The Petroleum (Consolidation) Act 1928 (PCA) (as amended by DSEAR).

11.1.2.2 Environmental

- DEFRA Groundwater protection code: *Petrol stations and other fuel dispensing facilities involving underground storage tanks.*
- Environment Agency Pollution Prevention Guidelines *Safe operating of refuelling facilities,* PPG7.
- Environment Agency *Wetstock reconciliation at fuel storage facilities. (An operator's guide).*
- EI *Guidance document on risk assessment for the water environment at operational fuel storage and dispensing facilities.*
- EI *Guidelines for soil, groundwater and surface water protection and vapour emission control at petrol filling stations.*
- Environmental Damage (Prevention and Remediation) Regulations 2009.
- Environmental Permitting (England and Wales) Regulations 2010.
- Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy. (The EU Water Framework Directive (WFD)).
- Water Resources Act 1991.

The Environmental Damage (Prevention and Remediation) Regulations 2009 "…require operators…to prevent or limit the environmental damage they cause…" specifically implementing the "polluter pays principle". "The emphasis should be on proactively putting in place appropriate pollution prevention measures to reduce risks…"

11.2 CLASSES OF LEAK CONTAINMENT AND DETECTION

11.2.1 General

The leak containment and detection systems described are generally in accordance with EN 13160 Parts 1-7 *Leak detection systems.* Some changes and additions have been made which are of particular relevance in the UK. The EN standards cover classes 1-5, whereas this section extends the range of systems to include class 6, wetstock control and class 7, rate of decay of pressure in pressure systems, which is covered by EN 15268 *Petrol filling stations. Safety requirements for the construction of submersible pump assemblies*. Table 11.1 below cross references EN standard classes with those in this section. The unit of measure used in this section, which is most easily identified in daily reconciliation terms, is litres per day (l/d) where a day is defined as a 24 hour period. Note: In some cases litres per hour (l/h) and litres per minute (l/m) have also been used.

The methods of containment (classes 1-3) and detection (classes 4-7) are described in 11.2.2 and 11.2.3. Tables 11.1, 11.2a and 11.2b provide a brief summary of the various classes of system currently available, their method of operation, detection capability and conditions of use/factors for consideration. The minimum standards stated are those deemed to be reasonably practicable, subject to the site risk assessment. One means of demonstrating the performance capabilities of any of these classes of systems is certification by an independent test house.

Table 11.1 Comparison with CEN standard classes

APEA/EI class	CEN	CEN class
1: Interstitial monitoring using air pressure or vacuum	EN13160-2	Class 1, A1 - A6 Pressure & Vacuum systems, for double-skin systems
2: Interstitial monitoring using a liquid	EN13160-3	Class 2, A7 Liquid systems for double-skin tanks
3: Liquid/vapour monitoring in interstitial spaces or sumps	EN13160-4	Class 3, A8 - A9 Liquid & Vapour systems for sumps and interstitial spaces
4: Automatic Tank Gauge (ATG) based leak detection	EN13160-5	Class 4 Cat A & B1 / B2, A10 - A11 ATG leak detection systems
5: Monitoring well with sensors	EN13160-6	Class 5, A12 Sensors in Monitoring Wells
6: SIR based wetstock management systems		SIR systems accredited to USEPA standard
7: Submersible pump pressure system leak detection	EN15268	Submersible pump pressure systems with ELLD. MLLD not covered.
	EN13160-2	Class 1
	EN13160-4	Class 3 for double-skin pipes.

11.2.2 Classes of leak containment system

Classes 1-3 are designed to detect a leak from the primary containment system and contain fuel by a secondary system and should not allow a release of fuel to ground. These classes are therefore considered to be leak containment and/or prevention systems, unlike classes 4-7 which are leak detection systems. Whenever it is reasonably practicable to do so leak containment systems should be installed to eliminate the risk of a release of fuel to ground. Environmental regulators may require new build sites or those undergoing significant redevelopment, which are within a source protection zone 1 (SPZ 1) to incorporate leak containment systems in accordance with Class 1, 2 or 3 and may require the same on other sites outside SPZ 1 but representing a significant environmental risk.

Table 11.2a Leak containment systems

Class	Description	Detection capability/ scope	Conditions of use/factors for consideration
1	Interstitial monitoring using air pressure or vacuum	Detects leaks in double-skin equipment, irrespective of fuel level	– It needs to be linked to a control unit with audible alarm – An appropriate maintenance inspection regime should be implemented
2	Approved interstitial tank monitoring using a liquid	Detects leaks in double-skin underground storage tanks, irrespective of fuel level. A leak in the external skin will cause a release of interstitial monitoring liquid to ground	– System may require 'topping up' on occasion, particularly after initial commissioning – System should be linked to a monitoring console that provides audible alarm notification automatically – An appropriate maintenance inspection regime as recommended by the manufacturer or regulatory authority should be implemented
3	Monitoring using liquid or vapour hydrocarbon sensors in interstitial spaces or sumps	Detects liquid leaks in the inner skin of double-skin equipment below the liquid level. Secondary skin failure and leaks above the liquid level may not be detected	– Sensors should be positioned at appropriate locations where any leak from the primary system will accumulate – Sensors which do not discriminate between hydrocarbon and water may be susceptible to false alarm due to water ingress – False alarms may occur where residual levels of fuel or vapour are present after a previous leak – Requires sumps to be liquid-tight to prevent a release to ground – System needs to be linked to a control unit with audible alarm – An appropriate maintenance inspection regime should be implemented

11.2.3 Classes of leak detection system

Classes 4-7 are designed to detect a leak after fuel has been released from the system[18]. For existing installations comprising single containment (wall or skin) tanks or pipework a leak may occur causing release of fuel to ground. The outcome of the risk assessment will indicate the likely impact of any such leak to ground and this guidance is intended to help to determine the most appropriate class of leak detection to be adopted. The class of leak detection system will be determined by its capability to detect a leak sufficiently early.

An effective leak detection system should provide early warning of a potential problem to enable prompt corrective action to be taken. Careful consideration should be given to the fail-safe features of any leak detection system, to ensure that safety and the surrounding environment remain properly safeguarded in the event of component failure or inadvertent disabling of the system.

Wetstock control systems under classes 6a and 6b are most likely to be carried out via remote monitoring either by a third party service provider or in-house company facility. These systems therefore rely on resources dedicated to leak detection, notification and subsequent protective actions and so reduce the dependency on filling station staff always being fully aware of, and competent in, the operation of on-site leak detection equipment. It should be emphasised however that the use of external parties does not remove the duties and responsibilities on the filling station operator for health, safety and environmental protection.

18 It should be noted that classes 4, 6 and 7 initially detect a 'loss' which may be due to a number of factors. The outcome of follow-up procedures (see 11.7), will then determine whether the loss is actually a leak. This should be noted where the term 'leak detection' is used in this section.

Table 11.2b Leak detection systems

Class	Description	Detection capability			Conditions of use/factors for consideration
		Leak	Detection period	Scope	
4a	Approved[1,3] ATG Dynamic reconciliation	96 l/d (4 l/h equivalent sudden leak)	24 hrs	Detects leaks below liquid level in tanks. Leaks in offset fills and suction lines may be detected if the fuel delivery ticket volumes are manually entered into the ATG	– For A classification sites, only an approved class 4a system is acceptable. – Requires a reconciling ATG with interface to a pump controller. – Requires accurate tank calibration. The ATG may create its own tank chart to give more accurate tank volumes. – Ensure reconciliation functionality is activated. – Performance is enhanced if dispenser meters are calibrated to 'strike' (zero) at the time of ATG commissioning. – Requires tanks and lines to be confirmed tight at time of installation/commissioning. – Has to be able to lock out un-probed tanks (e.g. autogas). – Site staff training required on how to access and interpret reports. – The system should be configured to provide a threshold alarm 19,2 l/d over a period of 14 days. – In the event of a threshold alarm the site operator has to determine what proportion of the reported variance is normal and what could be due to a leak. – Suitable ATGs will quantify the causes of normal variance (not related to a physical leak), including delivery variance (by input of 'ticketed delivery') and temperature variance (by continuously calculating the effect of temperature change in the volume of stored fuel). The level of detail and analysis of the causes of variance provided by the ATG will depend on the manufacturer and model type used. – Where the residual variance exceeds the threshold of 19,2 l/d the site operator should commence an investigation accordingly. – Site operators should be adequately trained to understand and interpret warnings, alarms and reports in order to conduct an investigation in a timely manner. – In the absence of such adequately trained site staff, the site operator should engage the services of a suitably competent third party to remotely monitor all warnings and alarms and take appropriate investigative action.
		48 l/d (2 l/h equivalent sudden leak)	7 days		
		19,2 l/d (0,8 l/h equivalent sudden leak)	14 days		

Class	Description	Detection capability			Conditions of use/factors for consideration
		Leak	Detection period	Scope	

4b	Approved[1] ATG Statistical quiet period	18 l/d	24 hrs	Detects leak in tank below liquid level	– Ensure this functionality is activated.
					– Designed for 24 hr sites where static tank testing would be disruptive to trading.
					– The system should notify the operator via an alarm when there have been insufficient inactive periods to perform the test. The operator should then schedule a static tank test in accordance with 4c.
					– Site staff training required on how to assess report results.
					– Individual approvals should be checked to confirm suitability for site configuration:
					  – Throughput limitations.
					  – Maximum tank capacity.
					  – Tank manifolds.

4c	Approved[1] ATG Static tank test	9 l/d	Up to 6 hrs	Detects leak in tank below liquid level, during the period of the test	– Ensure this functionality is activated.
					– Where 4b (statistical quiet period) testing is not activated then a static test should be scheduled to run on a weekly basis.
					– The test should be run at a time when the tank contents level is at its normal maximum operating level.
					– Check the ATG manufacturer's minimum operating requirements, specific to the model of ATG, to perform a valid test. This will cover criteria such as:
					  – Test duration (typically 6sixhrs).
					  – Minimum tank contents (typically 40 % of capacity).
					  – Waiting time after fuel delivery (typically six to eight hrs).
					– The ATG model along with the in-tank probe type, testing regime and operator procedures should be commensurate with the test leak rate specified.
					– Full records of all test results to be kept on site.
					– Individual approvals should be checked to confirm suitability for site configuration:
					  – Maximum tank capacity.
					  – Tank manifolds.

Class	Description	Detection capability			Conditions of use/factors for consideration
		Leak	Detection period	Scope	
5	Monitoring well with sensors	Indeterminate		Detects release once it has reached the well. Detects leak in tank below liquid level and anywhere in pipework	– Wells should be installed to a depth exceeding the water table range. – The monitoring well should be positioned around the installation to ensure any leakage can find a path to the well. – The type of sensor (liquid or vapour) should be appropriate for the prevailing ground conditions. – Liquid sensors should be hydrocarbon discriminating.

6a	Approved[1] statistical inventory reconciliation (SIR) system with weekly analysis and enhanced 'real time' analysis	9 l/h	14 days	Detects leak in tank below liquid level and anywhere in pipework	– Data have to be recorded and submitted on a daily basis.
					– Requires accurate data.
					– Site operators have a daily responsibility to notice and act upon extreme losses (or gains).
					– Real time analysis should involve
					  – the recording of nozzle sales data for every transaction in conjunction with corresponding tank stock levels
					  – diagnostic tools to pinpoint the source of the leak
					– Where dispensers are fitted with automatic temperature compensation or where Stage 2 vapour recovery is activated the site operator and SIR service provider should take into account a change in wetstock variance trend.

		96 l/d	24 hrs		
6b	Approved[1] SIR system with weekly analysis (this replaces monthly analysis)	9 l/h	14 days	Detects leaks below liquid level in tanks or pipework	– Data have to be recorded daily and processed monthly. – Requires accurate data. – Site operators have a daily responsibility to notice and act upon extreme losses (or gains). – Where dispensers are fitted with automatic temperature compensation or where Stage 2 vapour recovery is activated the site operator and SIR service provider should take into account a change in wetstock variance trend.

Class	Description	Detection capability			Conditions of use/factors for consideration
		Leak	Detection period	Scope	
6c	Daily inventory monitoring Involving statistical trend analysis[2]	See 'conditions of use/ factors for consideration'		Detects leaks below the liquid level in tanks or pipework	– Requires suitably experienced staff on site or remotely based. – Requires accurate data. – The 'normal operating variance trend' and detectable leak rate should be determined and declared for each tank by the site operator – This method would require the use of spreadsheets and charting tools and the comparison of year on year data.
7a	Approved[1] electronic pressure line leak detection (ELLD) on submersible turbine pump (STP) systems	Three levels of test can be configured to perform testing at various l/h leak rates: 11,4 l/h (equivalent 280 l/d), 0,76 l/h (18 l/d) and 0,38 l/h (9 l/d)	From the start of a line test, typically around 1 minute for gross testing (11,4 l/h) and 30 to 90 minutes for precision testing (0,76 and 0,38 l/h), subject to manufacturer specifications and site conditions	Tests pressure system pipework for leaks each time dispensing stops. Automatically shuts down STP if a line test fails. Requires a 'passed test' to restore operation following a failed test.	– Requires sufficient STP idle time (periods of dispenser inactivity) for tests to run to completion. For 0,76 l/h and 0,38 l/h precision tests to be completed there need to be periods of between 30 minutes and 90 minutes of dispenser inactivity. Site operators need to be aware that on busy sites these tests may be less frequent. – Systems should provide a report detailing the recent precision test frequencies and results. This will help the site operator determine whether adequate precision testing is taking place under normal operating conditions. – Precision testing should be set to run continuously to ensure maximum completed tests. – During periods of continuous dispenser use precision testing will not take place, but gross resting (11,4 l/h) will occur more frequently, between dispenses. – Some systems may require lines to be independently confirmed as tight during system commissioning. – Under dispenser shear valves should be fitted. – Forms an integral part of the STP control system. – Systems can alert operators if insufficient time has been available for scheduled line tests, allowing the opportunity to create an idle period. – Some systems can also shut down the STP in the event of low fuel level or water presence, preventing STP damage. – Whilst ELLD tests lines from the STP check valve to the dispenser solenoid, consideration should be given to detecting leaks in the system outside this by the use of tank chamber and dispenser sump monitoring.

Class	Description	Detection capability			Conditions of use/factors for consideration
		Leak	Detection period	Scope	
7b	Mechanical pressure line leak detection (MLLD)	11,4 l/h (equivalent 280 l/d)	Typically less than 24 hrs	Tests pressure system pipework for leaks each time the pump starts, but does not shut down associated pump. Dispensing can continue at reduced flow of 11.4 l/m	– Requires lines to be confirmed as tight at time of installation/ commissioning. – Under dispenser shear valves have to be fitted. – Requires sufficient periods of pump idle time, which can make the system less effective on a busy site. – During periods of continuous dispenser use this leak detection system will not operate. – MLLD units should be checked regularly to ensure reliable operation in the event of a leak. – A leak of < 11,4 l/h could continue undetected indefinitely. – Detecting leaks quickly depends on the site operator being alert to slow flow conditions.

Notes:
1. An approved system is one which has satisfactorily demonstrated its capability of achieving the specified standard of leak detection through accreditation by an independent third party to a recognised standard such as from CEN or EPA. Where no approved systems are available, the system functionality and performance standard should be verified by the supplier to the satisfaction of the regulatory authority.
2. Includes non-approved statistical based methods and methods using cumulative variance trend assessment usually performed by the site operator.
3. For Class 4a systems (ATG Dynamic reconciliation), where no approved systems are available, the ATG should have demonstrated its capability of achieving adequate level measurement accuracy through accreditation by an independent third party to a recognised level measurement standard such as from EN13352 *Specification for the performance of automatic tank contents gauges* or OIML R 85-3 *Automatic level gauges for measuring the level of liquid in stationary storage tanks.*

11.3 RISK ASSESSMENT BASED SITE CLASSIFICATION

11.3.1 General

The choice of system for an application will depend upon the circumstances at a site and its surrounding environment determined by a site risk assessment. The risks of pollution of groundwater, harm to the environment and the harm to people as a result of a leak should be assessed and the higher risk taken as the design criterion. This, together with a consideration of the type, condition, and inherent security of the installation to be protected, with due regard to 'reasonable practicability', will enable an appropriate system to be selected for the assessed risks.

For details of the risk assessment process see section 2. For comprehensive information on environmental risk assessment see:

- EI *Guidance document on risk assessment for the water environment at operational fuel storage and dispensing facilities.*
- EI *Guidelines for soil, groundwater and surface water protection and vapour emission control at petrol filling stations.*
- Environment Agency *Groundwater protection: Policy and practice (GP3) Part 3 - tools.*
- DEFRA and Environment Agency *Model procedures for the management of land contamination* (CLR11).

The guidelines provided in 11.3.2 to 11.3.4 cover the specific risks associated with a leak of hydrocarbon liquid or vapour. For this approach the risks should be assessed in terms of severity of impact of a leak and likelihood of a release occurring.

11.3.2 Severity of impact of a leak

Severity of impact of a leak is intended to allow for variations in the safety and environmental effects of a leak on the surrounding area. The severity of impact can be divided into high, medium or low categories, as in Table 11.3, but there may be gradations between these. Site-specific conditions should be assessed for each of the aspects in Table 11.3. The highest rating given for any aspect should be used as the overall rating for the site. For example if a site is located on a principal aquifer or in a groundwater SPZ, but qualifies in the medium or low categories for all other aspects, then the site should be given a high rating.

Table 11.3 Aspects to consider when assessing the severity of impact of a leak

Aspect	Category		
	High	**Medium**	**Low**
Fire and explosion risk due to below ground features	Where the site is in proximity to a basement, cellar, tunnel	Where a leak could impact on adjacent or neighbouring properties via drains (current or abandoned), cable ducting or due to the permeability of the subsoil	Where a leak would not impact off-site and would be retained within the site boundary without causing significant risk on site
Site throughput or people potentially affected	Site throughput of more that 5 million litres per year OR over 100 people affected	Site throughput of between 0,5m and 5 m litres per year OR between 10 and 100 people affected	Site throughput of less than 0,5m litres per year OR less than 10 people affected
Impact on groundwater	Site located on a principal aquifer, a SPZ or within 50 m of any wells, boreholes or springs or groundwater dependent wetland	Site located on a secondary aquifer or groundwater dependent wetland has been identified	Site located on un-productive strata and no groundwater or associated receptors have been identified by the risk assessment
Impact on surface water	Site located adjacent to a surface water (which may run below the site in culvert) or site has a direct connection to a controlled watercourse from the drainage system on site	Site has an indirect connection to surface water from the drainage system on site	Site located away from surface water and groundwater and with no known connection to surface water systems
Impact on flora and fauna	Where a leak from the site could potentially have a direct impact upon internationally or nationally designated sites, protected habitats or species protected under conservation legislation	Where a leak from the site could potentially have an indirect impact upon internationally or nationally designated sites, protected habitats or species protected under conservation legislation. Also where a leak from the site could potentially have a direct impact on a locally important conservation site	Where a leak from a site has no potential to have a direct or indirect impact upon internationally or nationally designated sites, protected habitats or species protected under conservation legislation or locally important conservation sites

Table 11.4 Aspects to consider when assessing the likelihood of a leak occurring

Aspect	Category		
	High	**Medium**	**Low**
History of previous tank or pipework leaks[3]	The current installation[1] has experienced a previous leak	It is not known whether a previous leak has occurred	The current installation has not experienced a previous leak
Tank and pipework test results	The current installation has experienced a previous test failure	It is not known whether a previous test has resulted in a failure	The current installation has not experienced a previous test failure
Output from a soil condition survey, where one has been carried out[2]	Pitting corrosion likely, stray current present; low resistivity, high chloride/sulfide levels; high moisture content; mixed age tanks; bacterial action present or some or all of these are unknown	No stray current, pitting corrosion possible, low resistivity; uniform composition; low moisture content; mixed age tanks; low chloride/ sulfide levels	Uniform corrosion likely, high resistivity; no stray current; single age tanks; uniform composition; low moisture content; low chloride/sulfide levels
Output from a geological survey or hydrogeological conditions survey where one has been carried out	From a geological survey: indicates a high likelihood of ground movement From a hydrogeological survey: indicates a high likelihood of corrosion of metallic components		From a geological survey: indicates low likelihood of ground movement From a hydrogeological survey: indicates low likelihood of corrosion of metallic components

Notes:

1. The current installation includes any component which formed part of the original installation but which may now have been removed, decommissioned or put temporarily out of use.
2. DEFRA Groundwater protection code *Petrol stations and other fuel dispensing facilities involving underground storage tanks* states: "Corrosion data, once collected, can be analysed using a standard method to determine the probability of a leak caused by corrosion, both at present and in the future."
3. Where the existing underground installation is of a similar age or condition to the part of the system which experienced the leak. Note that the introduction of new fuels including ethanol based fuels may cause incompatibility issues with the materials used including jointing compounds and flange gaskets and may increase the likelihood of a leak.

Table 11.5 Site classification table

		Severity of impact		
		High	**Medium**	**Low**
Likelihood of leak	**High**	A	A	B
	Medium	A	B	C
	Low	A	B	C

11.3.3 Likelihood of a release occurring

Such aspects as the history of previous leaks, tank or pipework precision test failures or results from a soil condition survey may be used to indicate whether a new leak is likely to occur. Site-specific conditions may be assessed for the aspects in Table 11.4. The highest rating given for any aspect should be used as the overall rating for the site.

11.3.4 Site classification

Once the severity of impact of a leak and the likelihood of a leak occurring have been assessed, the site classification can be determined from Table 11.5. The site classification can then be used to select the appropriate leak containment/detection system as shown in Tables 11.6 and 11.7.

11.4 CHOICE OF LEAK CONTAINMENT/DETECTION SYSTEM

Tables 11.6 and 11.7 provide information on the classes and methods of leak containment/ detection suitable for various elements of an installation which may require such protection. They are intended to assist the designer and site operator in making informed decisions as to the most appropriate system. The inclusion of particular systems or methods in the tables does not imply that these should always be used; they are provided for illustrative purposes only and there may be other equally suitable systems available. Some systems are not suitable in all circumstances, for example monitoring wells are ineffective in heavy clay soils. Ultimately, it is for the designer and site operator to determine, and where necessary justify, the most suitable system in the particular circumstances of each site. In some instances, no adequate leak detection system is available and this is indicated by the words 'not applicable' appearing in the tables. In some instances it may not be necessary to consider any form of leak detection at all. In such cases the words 'not necessary' appear in the tables.

The inclusion of Table 11.6 for new installations (including complete redevelopment) and Table 11.7 for existing installations, recognises that the former will generally be provided with a high standard of protection but, in the case of the latter, such systems may not always be reasonably practicable.

Table 11.6 Typical systems for new installations (including complete redevelopment)

Element to be monitored		Site classification		
		A	B	C
A. Tanks				
Steel	- single-skin	not applicable		
GRP or steel with CP[1]	- single-skin	not applicable	class 6a, 6b or 4	
Steel, GRP, composite	- double-skin or - old tank refurbished as double-skin	class 1	as A or class 2	as B
B. Liquid fuel pipework				
Pressure system	- single-skin	not applicable		
	- double-skin	class 1 with 7a	as A or class 3	
Suction system[2]	- single-skin	class 4a[3,5] or 6a[5]	as A or class 6b	as B or class 6c
	- double-skin	class 3	as A or class 4a[3,5], 6a[5], or 6b	as B or class 6c
Siphon system	- single-skin	class 4a[3,5] or 6a[5]	as A or class 6b	as B or class 6c
	- double-skin	class 3	as A or class 4a[3,5], 6a[5], or 6b	as B or class 6c
Offset fill	- single-skin	class 4a[3,5] or 6a[5]	as A or class 6b	as B or class 6c
	- double-skin	class 1	as A or class 3,	as B or class 6c
C. Vapour pipework				
Vent	- single-skin	overfill prevention devices		not necessary
Stage 1b or 2[4]	- single-skin	not applicable	class 5	not necessary
	- double-skin	class 3	class 3	not necessary
D. Sumps and chambers				
Dip, fill, changeover valve chambers, sumps beneath dispensers, etc		class 3	class 3	not necessary

Notes:
1. Cathodic protection should be installed in accordance with EI *Guidance on external cathodic protection of underground steel storage tanks and steel pipework at petrol filling stations.*
2. On all new suction system installations, the non-return valve will be located within the dispenser housing.
3. This class can only be used if the fuel delivery ticket volumes are manually entered into the ATG.
4. Stage 1b and 2 vapour recovery systems should be designed to preclude the possibility of liquid hydrocarbon entering the vapour pipework. Where this is achieved, leak detection is not necessary, and single-skin pipework will also be suitable in situations where the impact of a leak will be high. However, where this cannot be avoided, the stated leak containment/detection systems are recommended.
5. For A classification sites, only an approved 4a or 6a system is acceptable. Non-approved 4a or 6a systems may be considered for B and C classification sites.

Table 11.7 Typical systems for existing installations

Element to be monitored	Site classification		
	A	B	C
A. Tanks			
Steel - single-skin	class 4[4] or 6a[4]	as A or class 6b	as B or class 6c
GRP or Steel with CP[1] - single-skin	class 4[4] or 6a[4]	as A or class 6b	as B or class 6c
Steel, GRP, composite - double-skin or - old tank refurbished as double-skin	class 1	as A or class 2	as B or class 3
B. Liquid fuel pipework			
Pressure system - single-skin	class 7a	(class 4a or 6a) with 7b	as B or (class 6b with 7b)
- double-skin	((class 1, 2, 3, 4a[4] or 6a[4]) with 7b) or 7a		as B or class 7b
Suction system[2] - single-skin	class 4a[2,4] or 6a[4]	as A or class 6b	as B or class 6c
- double-skin	class 3	as A or class 4a[2,4], 6a[4] or 6b	as B or class 6c
Siphon system - single-skin	class 4a[2,4] or 6a[4]	as A or class 6b	as B or class 6c
- double-skin	class 3	as A or class 4a[2,4], 6a[4] or 6b	as B or class 6c
Offset fill - single-skin	class 4a[2,4] or 6a[4]	as A or class 6b	as B or class 6c
- double-skin	class 3	as A or class 4a[2,4], 6a[4] or 6b	as B or class 6c
C. Vapour pipework[3]			
Vent - single-skin	overfill prevention devices		not necessary
Stage 1b or 2[4] - single-skin	class 5	not necessary	
- double-skin	class 3	not necessary	
D. Sumps and chambers			
Dip, fill, changeover valve chambers, sumps beneath dispensers, etc	class 3	not necessary	

Notes:
1. Cathodic protection should be installed in accordance with *EI Guidance on external cathodic protection of underground steel storage tanks and steel pipework at petrol filling stations.*
2. This class can only be used if the fuel delivery ticket volumes are manually entered into the ATG.
3. Stage 1b and 2 vapour recovery systems should be designed to preclude the possibility of liquid hydrocarbon entering the vapour pipework. Where this is achieved, leak detection is not necessary, and single-skin pipework will also be suitable. However, where this cannot be avoided, the stated leak containment/detection systems are recommended.
4. For A classification sites, only an approved 4a or 6a system is acceptable. Non-approved 4a or 6a systems may be considered for B and C classification sites.

11.5 DESCRIPTION OF SYSTEM CLASSES

Sections 11.5.1-11.5.7 provide details of the mode of operation, suitable applications and inherent characteristics of the various classes of leak containment/detection systems. Within each class there may be various alternative systems available from different manufacturers, each with its own particular characteristics. A thorough understanding of those characteristics will be necessary in making the final decision as to which system is best suited to a particular application.

11.5.1 Class 1 systems

This class of leak containment system is considered inherently safe, as it detects leaks above and below the liquid level and operates continuously. The systems work by continuously monitoring the interstitial space in a double-skin pipe or tank. They operate using either pressure or vacuum, and a leak in either skin of the installation is detected by a change in the pressure equilibrium according to parameters set in the detection system.

They can be fitted to new double-skin tanks and pipework or existing tank installations, which are relined and provided with an interstitial space. A facility protected by this system will alarm before any leaked fuel is released into the environment, and such systems are particularly recommended for installation where the severity of impact of a leak is high.

The walls of the interstitial space should be capable of withstanding the working pressure (or vacuum) of the system, and it is important that the design of the tank or pipework system takes this into consideration. For example, a tank with an inner flexible liner would not be capable of being used with a pressure leak detection system. Where vacuum methods are used, they should be designed to prevent the evacuation of the fuel into the leak detection system.

All systems should be maintained in accordance with the manufacturer's instructions and checked regularly to ensure they are functioning correctly.

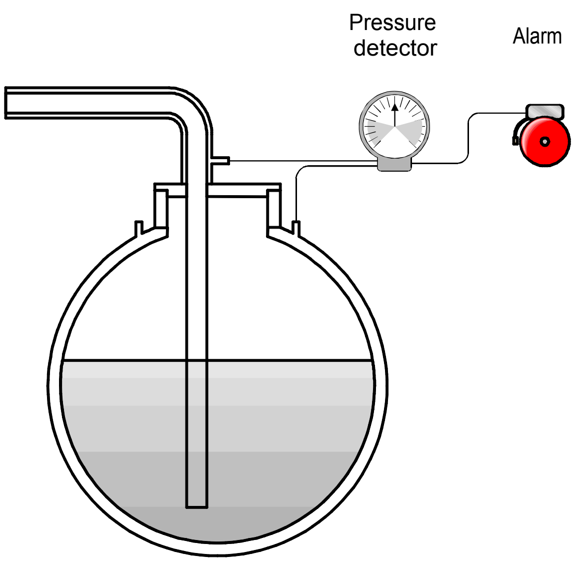


Figure 11.1 Class 1 - Pressurised interstitial space

11.5.2 Class 2 systems

This class of leak containment system is considered inherently safe, as it will detect a leak above or below the liquid level and operates continuously. If a leak occurs in the outer skin, only the leak detection fluid will be released into the environment.

These systems have the entire interstitial space filled with a suitable liquid. A fall in the liquid level beyond set parameters will be detected and an alarm activated.

They are normally installed on new double-skin tanks. They should be provided with a header tank (which also acts as an expansion tank), situated at the highest point in the access chamber, or above ground, to ensure an adequate pressure is maintained in the interstitial space of the element being protected. For some large tanks, it may be necessary to have more than one header tank.

For tanks, systems should be designed so that access to the interstitial space is through the outer skin above the maximum filling level.

The fluid used as the detection medium should cause no harm to the environment if released, and be tested to conform to other requirements to ensure an operational life of 30 years. It is essential that any top up of liquid is of the same type to ensure compatibility. It should also remain a liquid at all temperatures the system is likely to encounter.

The system should be checked regularly in accordance with the manufacturer's instructions.

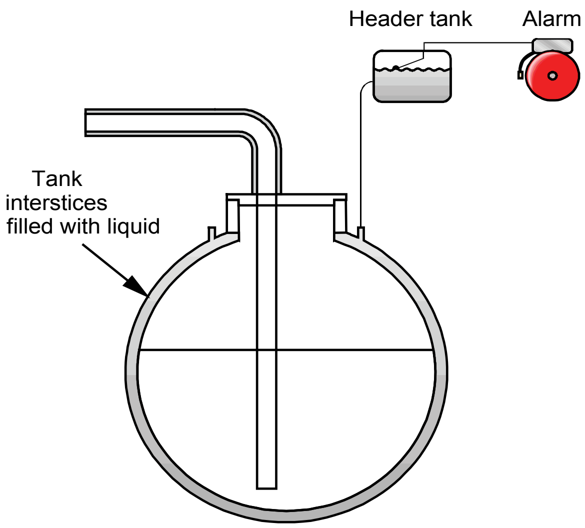


Figure 11.2 Class 2 - Fluid filled interstitial space

11.5.3 Class 3 systems

This class of leak containment system will detect a leak below the liquid level in a tank or in a pipework system. It includes liquid level sensors, liquid discriminating sensors (liquid hydrocarbons versus water) or vapour sensors installed within secondary containment or in the interstitial space of an underground pipework system. These systems provide an early warning signal, indicating that hydrocarbons have been released into the containment system. A further requirement for installations where groundwater levels are high is that the liquid sensors are capable of detecting other liquids (e.g. water), thus identifying any failure of the outer containment skin.

A class 3 system usually provides the most suitable and effective way of monitoring double-skin pipework, under dispenser sumps and tank fill and dip chambers.

The underground installation should be specifically designed to accommodate class 3 sensors, to ensure that all leaks are immediately detected; EN 13160-4 recommends an alarm condition when more than 10 litres of liquid has entered the containment space. There is also a requirement that, in the event of equipment failure, an alarm condition results. The leakage containment or the interstitial space has to be designed to prevent the ingress of groundwater or rainwater. This requires careful design and a high quality installation. Provision for testing has to be made to prove the integrity of the system.

Liquid sensors need to be located at the lowest point within the interstitial space or containment system. The sensors should always be appropriately certified as suitable for use in the hazardous areas for which they are intended, and performance certified by a recognised independent test house.

A leak-indicating unit should be provided to identify the location of the sensor indicating a leak. An audible alarm should also be triggered in the event of a leak. Where pressure pipework is being monitored, the sensor should also trigger a switch to shut down the submerged or remote pump.

Vapour sensors quickly respond to volatile hydrocarbons, but cannot detect a failure in the outer containment system. The presence of groundwater or moisture may adversely affect their performance and their use should, therefore, be avoided where they are likely to come in contact with these.

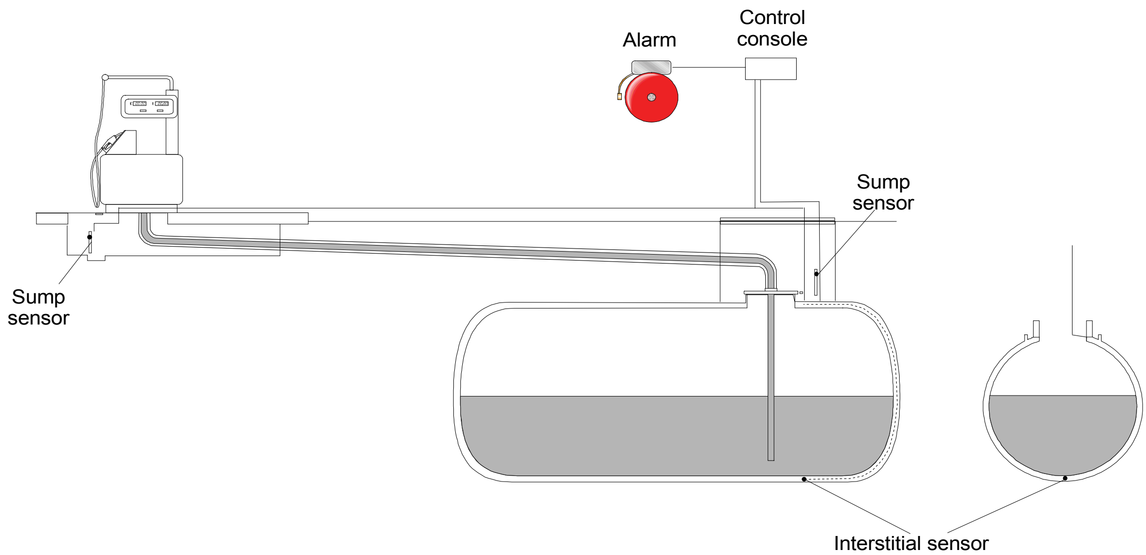


Figure 11.3 Class 3 - Secondary containment and sensors

11.5.4 Class 4 systems

These systems operate in conjunction with an automatic tank contents gauge, using a software program that detects leakage by analysing data from the tank gauge and the dispensers. Third party service providers may either carry out the analysis on site, within the tank gauge or interfaced computer, or remotely. Some tank gauges can also be programmed for automated dial-out to a monitoring centre to report alarm conditions, which can reduce the time taken to detect leaks and other fault conditions.

11.5.4.1 Class 4a-Dynamic leak detection

Approved systems will conform to category A of class 4 of EN 13160-1. The method involves an ATG which can automatically measure the change in fuel level, (normally during times when no dispensers are drawing fuel from the tank and pipework system) and at the same time, take accurate readings of the fuel which has been metered through the dispensers. The tank fuel volume changes are then compared and reconciled with the amounts dispensed to determine whether discrepancies are large enough to be indicative of a leak. Systems of this category may also be useful in detecting other imbalances at the site, such as delivery and temperature variance, dispenser meters that have drifted out of adjustment or faulty valves.

Systems of this category tend to be quite sophisticated, and will vary considerably regarding their capabilities and achievable accuracy. Performance claims will typically be specified in terms of leak rates (l/h) and periods of time required to detect such a leak. Where systems are approved (by US Environment Protection Agency (EPA), European Committee for Standardization (CEN) etc.), the certified probability of detecting a leak P(d) and of false alarm P(fa) will also be published.

Note: for both approved and non-approved systems, it is important to ensure that the system limitations (tank sizes, throughput etc.) are compatible with the proposed application, and that the manufacturer's instructions for use are carefully followed. Failure to do so will compromise the effectiveness and may result in a leak or loss remaining undetected within the specified time period.

11.5.4.2 Class 4b-Statistical quiet period leak detection (tanks only)

This conforms to category B1, class 4 of EN 13160-1. Like static leak detection class 4c, it relies on periods of time when no dispensing from, or delivery to, a tank is taking place, but when the individual quiet periods are not long enough to perform a complete certified static test.

In this case, the measuring system statistically accumulates these shorter periods, and the measurements made during them, to arrive ultimately at a determination of a leak rate, with specified P(d) and P(fa). Normally a threshold P(d) of 18 l/d over a maximum period of 14 days is taken together with a P(fa) of 5 %.

This type of system can be an effective means of detecting leaks in tanks, when the site-operating pattern is such that enough quiet periods occur to enable a conclusive test to be performed. Such systems should have the ability to alert the site operator if the required time period is about to expire, so that steps may be taken to ensure that a completed test can occur.

While systems of this category may tend to perform tests at more frequent intervals than class 4c, it should be noted that these tests are only monitoring tank leaks and not pipework leaks.

The operating pattern of the site should be studied carefully, particularly with respect to the level of activity associated with each tank, to determine whether it is compatible with the performance capability of such systems to ensure that effective leak detection performance can be maintained during the normal operation of the site. A site that is too busy for this method will result in inconvenience to the operator and customers each time the tank or site has to be shut down to perform a complete test.

Any such system should be certified as complying with the requirements of EN 13160-1, and it is important to ensure that all procedures are followed and records maintained in accordance with the conditions of the certification.

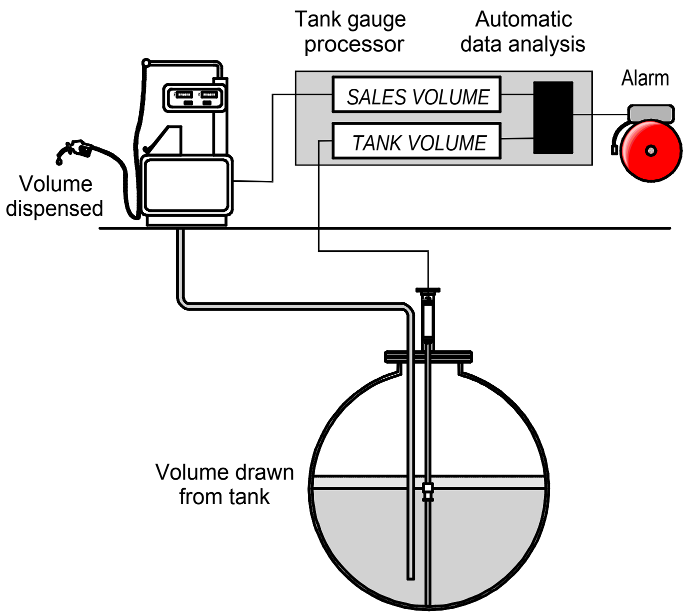


Figure 11.4 Class 4a - Dynamic leak detection

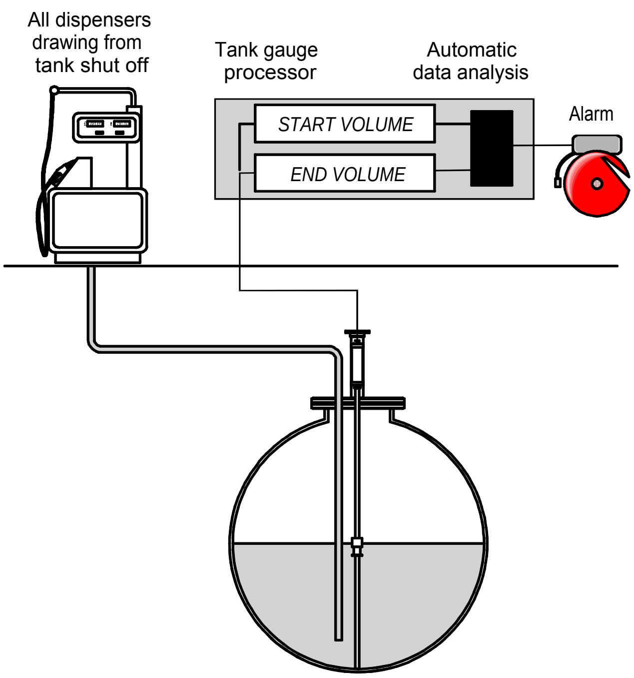


Figure 11.5 Classes 4b and 4c - quiet period or static leak detection

11.5.4.3 Class 4c - Static leak detection (tanks only)

This conforms to category B2, class 4 of EN 13160-1. It relies on there being periods of time during which no dispensing or delivery activity is taking place of sufficient duration for the detection system to perform a complete test in accordance with its prescribed protocol.

The method involves the detection of the very slow changes in level associated with a leak from the tank. Typical systems require a specified amount of time to elapse after a delivery before the beginning of the actual measurements.

Systems of this type are capable of detecting a leak rate of 9 l/d over a period of six hours or less. The time to perform this test will vary depending on the performance level of the system, but usually involves a period of several hours where no delivery has taken place and a number of hours for the test itself. This is because deliveries to the tank create disturbances, including temperature changes, that have to settle before a valid test can be performed.

For sites where this category of system is installed, a predetermined frequency for such test routines is required, typically weekly, monthly or sometimes longer. The level of fuel in the tank is also required to be within specified limits. In all cases, it is essential to ensure that tests are performed at the frequency required, and that adequate and full records are kept. The implications of such requirements and the consequent limitations of such systems on the commercial operation of a site should be carefully evaluated before such a system is installed.

Any such systems should be independently certified as complying with the requirements of EN 13160-1.

11.5.5 Class 5 systems

11.5.5.1 General

Systems of this class detect loss from tanks or pipework below liquid level by sensing or detecting the presence of fuel released into the ground surrounding the installation.

Sensors are installed in monitoring wells suitably located around the perimeter of the installation to ensure detection of fuel before it reaches any area which has to be protected from such leakage. Sensors should indicate conditions that inhibit their hydrocarbon detection capability (e.g. vapour sensors to give a 'water present' alarm if covered in water, and groundwater sensors to give a 'no water' alarm if the sensor detection area becomes dry).

Monitoring wells are suitable for new installations and may be suitable for retrofitting to existing installations. Construction of new monitoring wells at an existing installation should only be undertaken after a soil investigation has confirmed that the ground is suitable for such an installation. Care should be taken to ensure that the well casing and backfill are permeable.

Schedule 40 PVC well screen is normally used, and the well should be bored to at least 50 mm greater diameter than the well screen to allow granular material to be placed in this area. The well should be sealed close to the top to ensure that no accidental contamination from the surface occurs; it should be clearly marked and securely locked. Construction and installation of the wells is critical for optimum performance. A typical installation is shown in Figure 11.6.

The two types of detection system used in monitoring wells are described in 11.5.5.2 and 11.5.5.3. The decision of which to use is dependent on site conditions.

11.5.5.2 Vapour monitoring

Sensors are installed to detect vapour from fuel which has leaked from the installation into the vadose. The vadose, or unsaturated area, is soil below surface level but above any groundwater.

The theory is that vapour travels quickly through permeable soil and is attracted to the well. The following factors should be considered when deciding whether to use such a system:

- the permeability of the soil or backfill material;
- whether background contamination will interfere with the system;
- whether monitors will detect increases in background levels, and
- whether monitors are placed around the installation or between the installation and a feature to be protected.

11.5.5.3 Groundwater monitoring

Sensors are installed to detect fuel on top of groundwater. The theory is that leaks from the installation will reach the water table and then migrate laterally so reaching the well. The following factors should be considered when installing such a system:

- groundwater levels should be higher than 6 m below the surface in all cases;
- the slotted tubes of the well should encompass the high and low levels of water;
- the system should be capable of detecting a minimum of 6 mm of free fuel on the groundwater, and
- wells should be placed within the granular backfill in new installations, or as close as possible to the installation on retrofits.

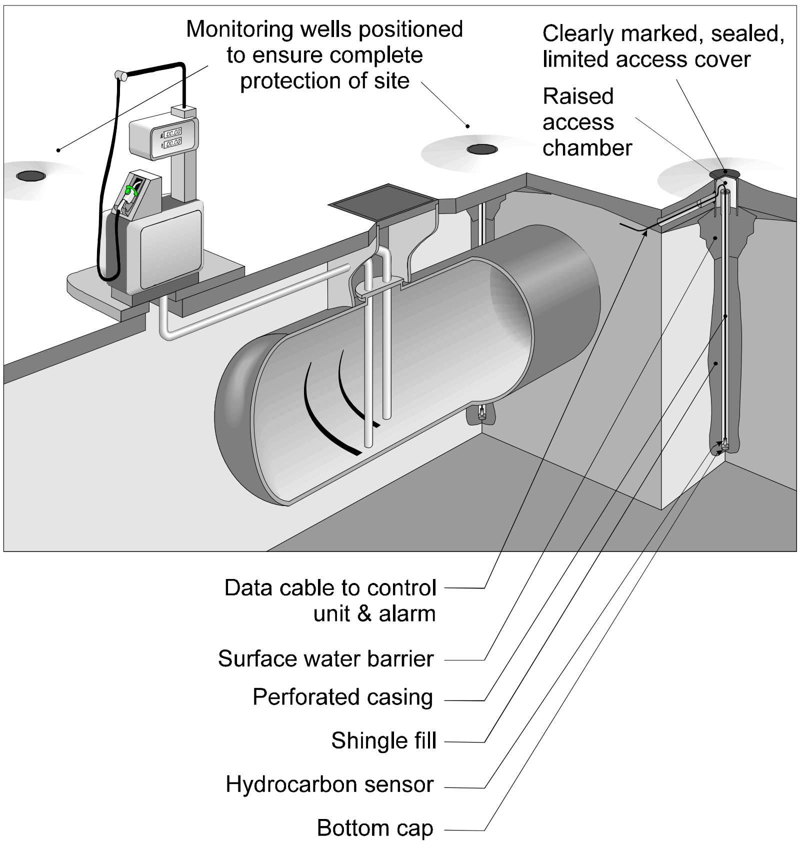


Figure 11.6 Class 5 - Hydrocarbon monitoring wells

11.5.6 Class 6 systems

11.5.6.1 General

Systems of this class detect losses in tanks or pipework by processing and analysing data of change in tank contents, delivery quantities and volume dispensed, using qualified procedures and methods, which will determine statistically the probability of a leak. The tank contents measurements and dispenser totaliser readings are recorded at the end of specified periods, which will be after each sales transaction for real time analysis and at the end of a day for SIR analysis and may be processed on site or at a remote location. This system requires the collection, recording and reconciliation of data to be consistently and strictly managed to a fixed daily routine and to an adequate level of accuracy. For accurate tank contents measurement the tank gauge should be correctly calibrated to the manufacturer's declared level of accuracy and the use of dipsticks should be in accordance with a strict procedure. Such systems should be capable of differentiating between the various causes of wetstock variance (loss or gain) including a probable leak, meter drift, short delivery, dipstick inaccuracies or fraud. The specific rate of leakage detectable, the time period, P(d) and P(fa) are dependent upon a range of factors including tank size, sales volume, temperature effects, contents measurement accuracy and the actual method used as described in 11.5.6.2-11.5.6.4. These methods aim to detect leaks which start at a low level and gradually increase. It should be noted that leaks can sometimes occur suddenly with no warnings present in the previous day's reconciliation data. In these cases, in addition to SIR analysis on a weekly or monthly basis, it is important to check daily data for large unexplained variances and that these are investigated immediately. This can be done either by the site operator or a remote monitoring service provider. For any class 6 system to be effective the analysis process has to be fully supported by follow up loss investigation escalation and incident response procedures. These are addressed in 11.7 and 11.8. An approved system referred to in classes 6a and 6b is one that has satisfactorily demonstrated its capability of achieving the specified standard of leak detection. One way to demonstrate this is to be accredited by an approved independent third party test house. Such test houses currently assess SIR systems against EPA/530/UST-90/007 *Standard test procedures for evaluating leak detection methods: statistical inventory reconciliation methods (SIR)*. The certification criteria require that the system can detect a leak in the applicable portion.

11.5.6.2 Class 6a - Approved SIR system with weekly analysis and enhanced real time analysis

An approved SIR system is one which is accredited to the EPA/530/UST-90/007 or equivalent CEN standard if available. A SIR system uses statistical modelling of each tank to identify a problem when the variance exceeds (loss or gain) the expected trend (or normal operating pattern). For tanks providing sufficiently accurate data these systems have demonstrated their ability to detect a leak of 18 l/d or smaller. As with class 4 tank gauging systems the EPA standard requires that these methods are capable of detecting the specified leak rate with a P(d) of 95 % and a P(fa) of no more than 5 %.

It is important to detect any leak as soon as possible so this class is based on 30 days' data being analysed on a weekly basis. In the event that a leak rate exceeds the specified threshold an investigation can commence within a week.

For this class, weekly SIR analysis is supplemented by real time analysis. This technique involves the analysis of sales volumes and corresponding tank stock levels for every sales transaction and should enable the specialist service provider to pinpoint the cause of a loss very quickly. Sudden leaks will be detected more quickly than class 6b.

11.5.6.3 Class 6b - Approved SIR system with weekly analysis

This class is similar to class 6a but without the real time analysis.

11.5.6.4 Class 6c - Daily inventory monitoring involving statistical trend analysis

This class includes all other methods of leak detection using various forms of analysis and interpretation of daily data. It includes non-approved statistical-based methods and manual methods using cumulative variance trend assessment usually performed by the site operator. It also includes approved SIR analysis performed on a monthly basis. With all of these systems and methods a leak may therefore take significantly longer to detect than a class 6b system.

For this method to be effective the user has to determine the normal operating variance trend or pattern for each tank. When the actual daily and cumulative variances begin to exceed these thresholds the user should commence an investigation. It is still important for the user of such methods to determine and demonstrate what leak rate (in l/d) their method is capable of detecting.

Examples of these methods include manual or automated generation of daily reconciliation forms showing cumulative variances and the assessment of the changes in cumulative variance on a daily, weekly, monthly and rolling period. Charts to enable visual assessment of trends may supplement these reconciliation forms.

Further guidance is contained in Environment Agency *Wetstock reconciliation at fuel storage facilities, an operator's guide* or in EPA/530/UST-90/005 *Standard test procedures for evaluating leak detection methods: Non volumetric tank tightness testing methods*.

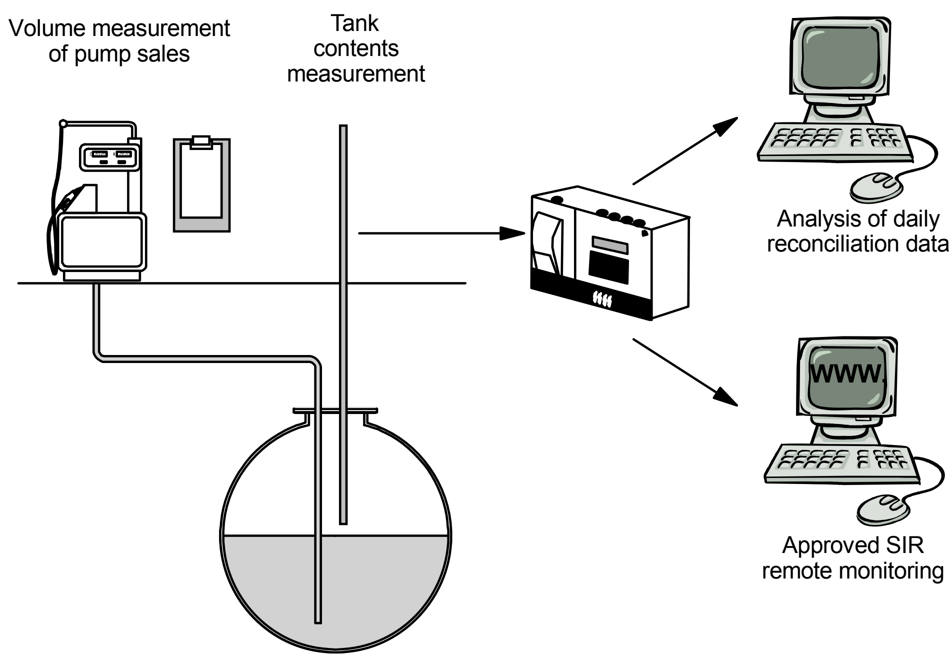


Figure 11.7 Class 6 - Approved SIR and manual systems

11.5.7 Class 7 systems

11.5.7.1 Class 7a-Electronic line leak detection (ELLD)

Systems of this class apply to pressure systems pipework only. All ELLD systems detect leaks by monitoring the characteristics of the line (pipework) pressure when no nozzles are active (i.e. when no fuel is being drawn by any of the dispensers connected to it). These pressure system lines should always have double skins and incorporate automatic positive shutdown when a leak is detected, so any leak is minimised and contained. It is required that the ELLD system be interfaced to the fuel containing part of the containment system, and configured to provide either automatic shutdown of the pump (recommended) or provide alarm indications when a leak is detected.

Capabilities of these detection systems are stated in terms of the rates of leakage detectable in litres per hour (0,38, 0,76 and 11,4 l/h), and the P(d) and P(fa). An important characteristic, and potential limitation, of this type of system is the requirement that all dispensers fed from a single line have to be inactive for a sufficient length of time to meet the specified test performance requirements. The smaller the leak rate threshold, the longer the test will take. Typically, these systems will run an 11.4 l/h test many times a day, even on a busy site. The 11.4 l/h test requires an inactive period of less than 60 seconds. This test, run at an average of once per hour, will limit any leak duration to one hour, as the pump will shutdown automatically when a leak is detected.

Note: the containment system, lines and sumps should be designed to contain such a leak. It is recommended that the sumps and under-pump trays are fitted with sensors to detect fuel, and that these are configured to trigger an automatic shutdown when fuel is detected.

Leak tests at lower thresholds (0.38 and 0.76 l/h) take longer to perform. These tests are referred to as 'periodic' (0,76) and 'annual' (0,38) but can be set to run continuously. The minimum (EPA) requirement is for the periodic test (0,76) to be performed once each month and the annual test (0,38) once a year. It is recommended that UK systems are configured to run the precision tests (0,76 and 0,38) whenever an inactive period occurs. Typically, this will achieve a 0,76 l/h test once at least every 24 hrs and a 0,38 l/h test at least every seven days.

These tests are fully automatic and require no operator input. The shutdown of a line when a leak in excess of 11,4 l/h is detected should always be automatic, with the result available to the site operator. Once a line has failed it has to be investigated and the cause of the failure resolved before the line can be returned to service, as the shutdown or alarm condition will remain until a technician-controlled test at the same leak rate as the failure is performed and is passed.

Note: automatic shutdown at 0,76 l/h and 0,38 l/h can be overridden, but this option should only be used where a proven and robust operational procedure is in place to instigate immediate action to shutdown and investigate the line failure, so minimising the leak. Automatic shutdown at 11,4 l/h is strongly recommended.

ELLD systems have in-built routines to warn operators if a test has not been run in the specified period (i.e. no periodic test in a month). The system will alarm and alert the operator to intervene and run a test.

Some ELLD systems require the line to be proved tight by a certified third party at time of commissioning to ensure a subsequent leak will be detected. Others have algorithms for each specific type and length of pipework, which can identify a leak at the time of commissioning. More information can be obtained from the supplier or manufacturer.

Note: for details of the certified performance (i.e. to EPA) of each ELLD System, their P(d), P(fa), pipework types and lengths supported (flexible, steel, composite etc.), leak rate and test frequency configurations and sensor types, consult manufacturers or their distributors.

11.5.7.2 Class 7b-Mechanical line leak detection (MLLD)

These systems are a mechanical device fitted to the submersible pump which tests the pressure system pipework for leaks each time the pump starts and, if a leak is detected, causes the system flow rate to slow to 11,4 l/m. The leak test is set at a threshold of 11,4 l/h (280 l/d). These devices have to be regularly tested[19] to check they are fully functional.

19 MLLD manufacturers can supply a tester, which will check performance to original specification.

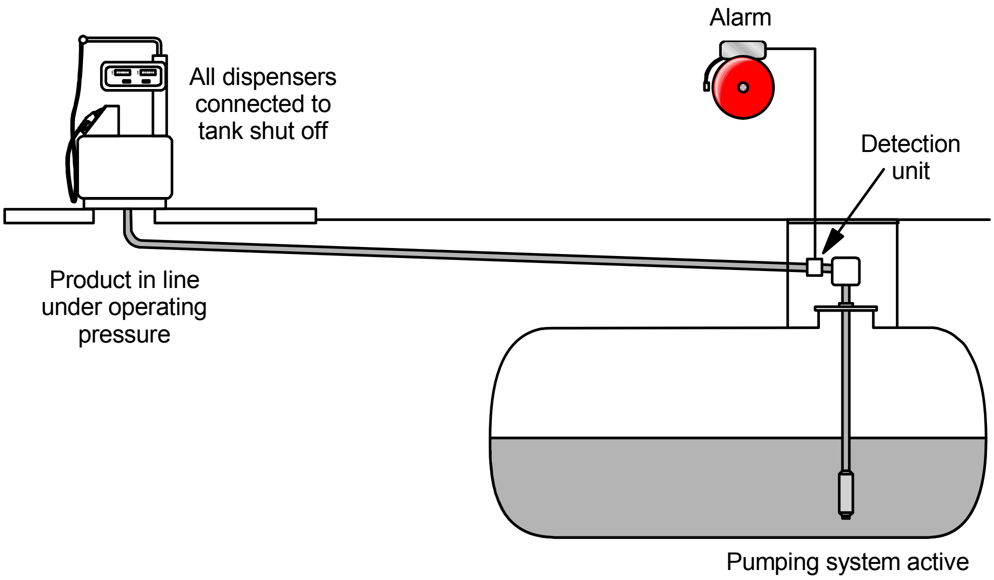


Figure 11.8 Class 7 - Detection of leaks in pressurised pipework

11.6 TANK CONTENTS MEASUREMENT METHODS

All tanks or compartments should be provided with a means for ascertaining the quantity of fuel stored. This may be by use of a dipstick supplied with the tank or by some means of tank contents gauge.

11.6.1 Dipsticks

Dipsticks are a simple means of measuring the height of fuel in the tank from which the volume of fuel can be determined. The graduation marks should indicate volume measurements in litres. Each dipstick should be marked with its tank or compartment number and should show the safe working capacity (SWC). A dipstick is prone to wear through constant usage and may eventually be shorter than its correct length. It should therefore be inspected periodically and replaced if necessary.

Dipsticks should not be left in the fill pipe during a delivery as doing so may cause wear to both the dipstick and the strike plate. For offset filled tanks, where dipsticks are present, they should not be stored in the fill pipe for the same reason.

Whilst dipsticks provide an adequate means of daily and pre-delivery inventory checking, their suitability for use in daily wetstock reconciliation for leak detection purposes will depend on the accuracy of readings taken. Accuracy depends on a range of factors including those shown in Table 11.8. Whilst in certain circumstances accurately taken dipstick readings can be more accurate and reliable than analogue and digital tank gauging systems, if they are to be used for leak detection purposes then all of the factors referred to above have to be taken into account. Consideration should be given to the following operational parameters that may influence the decision whether to install a tank gauging system or rely on a dipstick:

- When the delivery is under the sole control of the tanker driver (gauges are simpler to read and use in all weather conditions).
- Where a vapour recovery system is in operation (and the arrangement is such that pressure within the system may displace the level of liquid in the dip tube).

– Where offset fill systems are installed.
– Where the dipstick would interfere with the operation of an overfill prevention device.

11.6.2 Tank gauging systems

Tank gauge systems should comply with EN 13352 *Specification for the performance of automatic tank contents gauges*. They provide an indication of the quantity of liquid contained in a storage tank without the need to access the tank and take manual dip readings. Like dipsticks, the gauge measures height of fuel in the tank from which the volume of fuel is then determined. The effects of variations in the properties of the fuel and other factors, which will have an effect on the measurement of height and computation of volume, can be taken into account depending on the sophistication of the system used.

Tank gauge systems may interface with other equipment and also be capable of providing automated stock control, overfill prevention and leak detection information. Where a tank gauge is used as the leak detection system it should also comply with EN 13160-5. In these systems, the ability to measure average fuel temperature and to allow for such variations in the computations is desirable for accuracy of stock control. Any electrical or electronic equipment included in such systems and used in hazardous areas should always be certified as appropriate for use in such situations.

Tank gauge systems should be checked for compatibility of use when a vapour recovery system is fitted and should never be installed within a fill or vent pipe.

Table 11.8 Factors influencing accuracy of dipstick readings

Factor	Description
Tank size	Accuracy reduces with increasing tank size (e.g. 5 mm height of fuel (at midpoint) in a 20 000 litre tank = 50 litres approx; whilst in a 60 000 litre tank = 150 litres approx.)
Fuel height	The dipstick accuracy is reduced when the tank is around half full.
Dipstick calibration	How closely the dipstick calibration reflects the tank's actual dimensions and orientation.
Correct length	Any shortening or deformation will create a varying inaccuracy dependent on fuel level.
Dipping procedure	The level of compliance with best practice for accurate dipping. This refers to the number of dips taken, the repeatability of readings, adequate illumination and the timing of the dips in relation to daily reconciliation.
Fuel level at dipping point	Whether the fuel height in the dip tube or fill pipe accurately reflects the fuel level in the tank. This can be at variance where Stage 1b vapour recovery is fitted and a pressure relief valve is either not fitted or not activated.

11.6.3 Calibration

In order to achieve accurate gauge readings across the operating range of the tank it is important to calibrate the system in accordance with the manufacturer's recommendations. For further information see EI HM 3. *Tank calibration. Section 7: Calibration of underground tanks at service stations.*

11.7 LOSS INVESTIGATION ESCALATION PROCEDURE

When a leak detection system of any type detects a potential leak and creates an alarm condition an appropriate loss investigation escalation procedure should always be implemented. As a minimum it should:
- be a process that is easy to understand and follow;
- be written down and available to all relevant staff at all times;
- indicate who should be informed and at what stage;
- identify responsible persons;
- enable a conclusion to be reached/source to be identified, and
- include the quantity of fuel released to ground.

The loss investigation escalation procedure should be reviewed when the site undergoes, or is affected by, a change such as installation modification, a neighbouring development or staff changes. Training should be provided to all relevant staff on an ongoing basis taking into account that long periods can elapse between investigations.

11.8 INCIDENT RESPONSE PROCEDURES

Having an adequate leak detection system in place should ensure a leak is detected early enough to minimise the damage caused. However, there may be an occasion when a leak results in an incident, for example following a sudden release of a significant quantity of fuel (e.g. caused by a dipstick penetrating the bottom of a tank), when hydrocarbon vapour has been detected in adjacent premises or when a tank or line test has resulted in a failure. Every site should have in place incident response procedures. As a minimum they should include:
- all elements identified for the loss investigation escalation procedure;
- a focus on making the site safe as quickly as possible;
- a logical process to identify the reason for loss of containment, and
- a logical process to identify the extent of any environmental pollution that has occurred and to arrange for the clean-up/removal of that pollution.

The incident response procedures may also include steps to be taken and checks to be completed in order to allow the site to reopen for trade. For further information on incident response procedures see EI *Guidelines for soil, groundwater and surface water protection and vapour emission control at petrol filling stations.*

11.9 EQUIPMENT PERFORMANCE, DATA ACCURACY AND STAFF TRAINING

The accuracy and efficiency of leak detection systems are dependent on the knowledge and competence of the forecourt staff in collecting and/or handling data and of their ability to recognise problems and anomalies. All leak detection procedures, therefore, will need to include recommendations for staff training and refresher courses for both new and existing staff.

11.10 EQUIPMENT MAINTENANCE AND INSPECTIONS

An effective inspection and maintenance schedule is essential to ensure the continued reliability of the leak containment/detection equipment. The manufacturer's recommendations should be followed in developing an appropriate inspection and maintenance scheme.

12 CANOPIES AND BUILDINGS

12.1 GENERAL

Buildings, canopies and other structures at filling stations should generally be designed and constructed to comply with the requirements of Building Regulations or Standards put in place by the devolved Authorities in the UK utilising the guidance provided in approved documents (ADs) or technical standards (TSs).

Special risks and design constraints apply in the selection of materials for use at filling stations. A risk assessment should be carried out as part of the design process for all the components of the filling station that considers all additional hazards that may be present. In particular the design should be developed taking account of any additional risks presented by filling stations with regard to fire resistance, means of escape and access for disabled people.

The selection of materials used for cladding and signage should be based on the needs of the specific designs and applications intended. In particular, with relation to performance in a fire, the selection should take account of the most appropriate combination of material properties (i.e. ignitability, toxicity, fire load, smoke generation and surface spread of flame), and avoid a single focus on the latter.

12.2 CANOPIES AND BUILDINGS

12.2.1 Canopies

12.2.1.1 General

While not specifically covered by building regulations or standards, canopies should be constructed of materials that will not contribute to any fire occurring within the underside of the canopy area. In view of the high degree of ventilation and heat dissipation achieved by the open sided construction, and provided the canopy itself is 1 m or more from any boundary, a free standing canopy above a limited or controlled hazard (e.g. over fuel dispensers) would not need to comply with the provisions for space separation. However, any cladding to the canopy itself should not readily contribute to any fire and the selection of materials should inhibit fire growth.

12.2.1.2 Canopy cladding/facias

Cladding to a canopy, including signage, should not be combustible or contribute to the spread of flame.

Subject to the exceptions in (a) and (b) below, canopy cladding should have a surface spread of flame characteristic not inferior to Class E of EN 13501-1 *Fire classification of construction products and building elements. Classification using test data from reaction to fire tests* or equivalent.

a. Canopy facias should have a surface spread of flame characteristic not inferior to Class E of EN 13501-1 or equivalent. The edges of all plastic/acrylic materials should be suitably protected.
b. Lighting units should not be so extensive as to present a fire risk and should be placed to prevent flame spread from one to another. Diffusers of the units should have a surface spread of flame characteristic not inferior to Class E of EN 13501-1 or equivalent.

Where canopy stanchions are part of, or close to, dispensers, any cladding should have a surface spread of flame characteristic not inferior to Class E of EN 13501-1 or equivalent.

Pole and price signs which stand apart from the canopy should have a surface spread of flame characteristic not inferior to Class E of EN 13501-1 or equivalent, unless their proximity to a road tanker delivery stand makes a higher standard necessary.

Lighting boxes installed over dispensers should be small, isolated from the dispensers and positioned to prevent spread of flame from one to another. They should have a surface spread of flame characteristic not inferior to Class E of EN 13501-1 or equivalent, and all exposed edges should be suitably protected with, for example, aluminium. See also sections 14.5 and 14.6.

12.2.2 Buildings

The design and performance of the structures on a filling station should comply with the requirements of the ADs/TSs current at the time of construction/refurbishment.

Particular attention is drawn to documents relating to 'fire spread' which support the regulations (e.g. Building regulations 2000. Volume 2. Buildings other than dwelling houses. Approved document B). The detailed guidance contained therein should be followed in all relevant respects.

- All structural elements shall be constructed of non-combustible materials.
- When joined to a building, canopies designed to protect the face of a building from the effects of a fire at the tanks or dispensers should not be so low as to impede cross ventilation. The standard of fire resistance for such a canopy should be not less than half an hour from its underside.
- If, exceptionally, the canopy is continuous with, or forms part of any other building on, or adjoining, the site, it should have a fire resistance of not less than two hours. Alternatively, consideration could be given to reducing the period of fire resistance if openings are protected by sprinklers or drenchers and where suitable and adequate provision is made for ongoing maintenance.
- Canopy under linings and column and fascia claddings should be constructed of non-combustible materials.
- Signage and lighting elements within the canopy, including those which form part of the cladding, should be designed in accordance with the standards set out in 12.2.3 and in addition should not contribute to any rapid spread of fire from one area of the forecourt to another.
- Where overhead conductors traverse a filling station site, reference should be made to section 14.3.1.

12.2.3 Signage and lighting

Signage and lighting components should be designed and installed by appropriate competent persons. Components should comply with the current versions of the following standards:

- BS 559 *Specification for the design and construction of signs for publicity, decorative and general purposes*.
- EN 60598-1 *Luminaires. General requirements and tests*.
- EN 60598-2-1 *Luminaires. Particular requirements. Specification for fixed general purpose luminaires*.

Signs operating at high voltage (> 1 000 V) should conform with:

- EN 50107-1 *Signs and luminous-discharge-tube installations operating from a no-load rated output voltage exceeding 1 kV but not exceeding 10 kV. General requirements*.
- EN 50143 *Cables for signs and luminous-discharge-tube installations operating from a no-load rated output voltage exceeding 1 000 V but not exceeding 10 000 V.*
- EN 61050 *Specification for transformers for tubular discharge lamps having a no-load output voltage exceeding 1 000 V (generally called neon-transformers). General safety requirements.*

12.2.4 Electrical installations

12.2.4.1 General

The detailed guidance given in section 14 should be followed in order to ensure that potential ignition sources are properly controlled. Key areas to be considered are:

- electrical wiring/distribution systems from sales building to canopy structure;
- canopy luminaires;
- illuminated signs;
- testing and maintenance, and
- lightning protection.

Owners/operators should ensure that they have put in place adequate control and supervision of electrical works to ensure that all installation, testing and maintenance is carried out to BS 7671 *Requirements for electrical installations. IEE wiring regulations* and the requirements of section 14.

12.2.4.2 Canopy luminaires

The lighting manufacturer should permanently fix a label readily visible during re-lamping stating the maximum lamp wattage and lamp type. This label should also include details of manufacturer's name, fitting reference number, nominal voltage and current, and any integral fuse rating.

Luminaires should be fixed into the aperture by clamps or fixings into a metal framework. The incoming cable terminal block should be fused to suit the load of the individual fitting. Lighting units and signs should be designed to prevent insect entry to the fitting. Where this has not been achieved operators have to have in place a suitable maintenance/cleaning programme to avoid the accumulation of potentially flammable materials within the unit.

12.2.4.3 Illuminated signs

All illuminated signs should be delivered with copies of certificates indicating that the following essential electrical tests have been carried out:

- polarity;
- earth continuity;
- insulation resistance for Class 1 units;
- adequacy of equipotential bonding;
- fuse rating, and
- operational check.

For high voltage (HV) cold cathode (neon) lighting, any work should only be carried out by competent persons due to the HV secondary transformer voltages and special terminations etc. The following particular points should be considered:

- all transformers should be fixed securely, labelled for purpose and be readily accessible;
- transformers should be correctly rated for the load;
- all transformers, to EN 50107-1, should have a secondary differentiated switch with open circuit and earth leakage protection, and
- sections of glass tubing should be securely fixed.

For extra low voltage (typically 12, 24, or 48 V) supplies to LED or similar, it is important to note that cables may have to be larger than for normal 230 V installations due to the higher electrical current involved. Note also:

- cables and transformers should be rated to minimise voltage drop over the lengths intended;

– installations should be carried out to and checked for compliance against the supplier's/designer's drawings, and
– secondary circuit monitoring is required for light emitting diode (LED) applications.

12.3 SALES BUILDINGS

Sales buildings are those housing the control point for the dispensers and usually limited consumer goods. Sales buildings situated within 4 m of dispensers or storage tank fill points should be constructed to a 30 minute fire resisting standard. Sales buildings over 4 m from the dispensers or tank fill points should generally be constructed of non-combustible materials. Where the sales building forms part of a larger building, an alternative to providing fire resisting construction would be to provide an alternative means of escape from the building, remote from the dispensers or fill points.

These requirements should also apply to any other buildings on the forecourt.

12.4 KIOSKS

Kiosks are small buildings located near to the dispensers in order to provide weather protection for an attendant. Such kiosks within 4 m of dispensers or tank fill points need not be of fire resisting construction as outlined in 12.3 but they should generally be constructed of non-combustible materials. It is recommended that kiosks are not located in hazardous areas. Kiosks and any other small buildings with openings in a hazardous area should apply the appropriate zone requirements throughout the building, including to its full height, as vapour in a confined space is unlikely to remain at low level. Kiosks should be adequately ventilated to the open air and the floor should be at least 150 mm above the level of the dispenser island to prevent the accumulation of vapour within the kiosk. Where a doorway is in a region where liquid spillage could occur there should be a step, threshold or ramp to prevent liquid running into the building. Further guidance on ventilation options may be found in EI Model code of safe practice Part 15 *Area classification code for installations handling flammable fluids.*

12.5 CONVENIENCE STORES

A building, generally of 60 m^2 or more, intended for use as a shop for consumer goods as well as control of vehicle fuel sales, may attract to the filling station large numbers of customers not associated with vehicle fuel sales. The design of stores and pay points should take account of the tasks which staff have to carry out and additional pay points and trained attendants may be required where the size and activities at the site (e.g. convenience stores, supermarkets, hypermarkets, etc.) could adversely affect the ability of staff to control the forecourt.

As far as possible the location of the building, together with any associated design features, should avoid the possibility of customers not associated with vehicle fuel sales affecting the safe operation of vehicle fuel dispensing or road tanker delivery. Where this is not possible, adequate separation between customers visiting the forecourt and those visiting the shop should be achieved by the provision of clearly marked routes and parking areas. These should not obstruct a clear view of the forecourt as described in section 4.4.11.

All convenience stores have to provide alternative means of escape for both staff and customers away from the forecourt.

13 DRAINAGE SYSTEMS

13.1 GENERAL

This section provides guidance on aspects of forecourt drainage, risks associated with the various underground services on site and the treatment and ultimate disposal of effluent. It should be read in conjunction with Figure 13.1.

13.2 ASSESSMENT OF PROTECTION REQUIRED

At the planning stage, the environmental sensitivity of the site should be assessed, together with an evaluation of any effluent associated with activities on site. A risk-based approach should indicate the suitability of any activity or the level of protection required, to ensure no contamination of the surrounding environment occurs. Factors to consider when assessing the environmental sensitivity of a particular location include:

- Groundwater vulnerability.
- The location of Source Protection Zones (SPZs).
- The proximity to surface waters, such as streams and rivers.
- Access to appropriate drainage services to identify all potential hazards to the aquatic and surrounding environment.
- Treatment or disposal of effluent from site operations (e.g. access to appropriate drainage services is of particular importance when a vehicle wash is to be incorporated).
- Groundwater and surface water abstractions.

The various areas of the site to be surfaced should be ranked according to risk, to determine whether or not contamination by vehicle fuels is likely. The type of surface to be used in those areas should ensure an adequate level of protection is provided. Examples of typical area assessments are shown in Table 13.1. Materials and components are defined in EN 752 *Drain and sewer systems outside buildings*, Building Regulations 2000 Drainage and waste disposal Approved Document H and manufacturers' literature. They provide clear guidance on the selection of drainage materials, design and method of construction.

The drainage system should be designed to convey potentially contaminated materials to suitable disposal points and prevent environmental pollution. This approach should provide a cost-effective solution and enable a comprehensive and effective management regime to be implemented.

It should be noted that the area assessments shown in Table 13.1 are not intended to be definitive. Full consultation should be carried out with relevant authorities to ensure that the risk of contamination of surface water or groundwater is established and the availability and suitability of foul and surface water sewers are known.

In addition, Regulation 5 of the provisions of the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) requires employers and the self-employed to assess risks to employees and others whose safety may be affected by the use or presence of dangerous substances at work. For further information see HSE Approved code of practice and guidance *Dangerous substances and explosive atmospheres*, L138.

Table 13.1 Typical area assessments

Area	Contamination possible	Risk ranking	Surface quality	Drainage routing
Tanker stand area	Yes	High	Impermeable	Via separator
Dispenser islands fill positions	Yes	High	Impermeable	Via separator
Under the canopy	Yes	Normal	Impermeable	Via separator
Vehicle wash entrance and exit	Yes	Normal	Impermeable	Foul sewer
Perimeter roads	Unlikely	Low	Permeable	Surface water drains
Car parking	Unlikely	Low	Permeable	Surface water drains
Site access and egress	Unlikely	Low	Permeable	Surface water drains

13.3 FORECOURT SURFACES

To provide a safe, substantial and economic surface in forecourt areas, the factors in 13.3.1 to 13.3.3 should be considered.

13.3.1 Surface quality

Areas that are liable to contamination should be impermeable to all hydrocarbons and should not allow seepage through or below the surface. These areas should always be protected at the perimeter by a suitable means of restraint such as kerbing, drainage channels or walling, to prevent the flow of contaminants towards permeable surfacing. Typically, concrete or similar highly impermeable materials such as sealed block paving with a concrete sub-base, will fulfil this requirement, provided any associated expansion or jointing material is also impermeable and resistant to degradation by vehicle fuels.

However, the use of block paving has limitations where vehicular weight loading can cause breaches in sealed joints that will eventually provide a path for contamination into the sub-soil. Therefore, if block paving is used, a continuous concrete membrane should be laid, extending at least 150 mm beyond the paving surface. Other areas where hydrocarbons are not immediately present may be surfaced with materials such as hot rolled asphalt, stone mastic asphalt macadam, unsealed block paving, gravel etc.

It should be noted that, as well as the need to prevent fuel contamination of the sub-soil there is a need to ensure forecourt surfaces are sufficiently conductive to allow static electricity to dissipate from vehicles being refuelled. The surface of the refuelling and delivery area should have a resistance to earth (under dry conditions) not exceeding 1 MΩ.

In forecourt areas where a spillage may occur, the sustainable surface water drainage containment should be designed to provide an adequate number of channels, kerbing and gullies so as to limit the surface travel of spilt vehicle fuels and prevent them from reaching areas where surfaces are unprotected or porous.

The tanker stand surface area, usually measuring 15 by 5 m, should be suitable for the axle loading of a fully laden road tanker, typically having a capacity of 41 200 litres, and should be impervious.

13.3.2 Gradients

Forecourt surfaces should be laid to suitable falls and gradients. Surface runs in areas considered as 'normal risk' should be self-cleansing.

13.3.3 Performance of materials

The performance of materials to be used for forecourt surfaces should comply with an appropriate national or European Standard for the type of material proposed as well as with the requirements of the Building Regulations 2000. The skid resistance of all materials should be considered.

Materials should comply with the following relevant standards:

Ready mixed concrete:

– BS 8500-1 *Concrete. Complementary British Standard to BS EN 206-1. Method of specifying and guidance for the specifier*.
– EN 206-1 *Concrete. Specification, performance, production and conformity.*

Block paving:

– EN 1338 *Concrete paving blocks. Requirements and test methods.*
– EN 1339 *Concrete paving flags. Requirements and test methods.*
– BS 7533-1 *Pavements constructed with clay, natural stone or concrete pavers. Guide for the structural design of heavy duty pavements constructed of clay pavers or precast concrete paving blocks.*

Hot rolled asphalt:

– EN 13108-4 *Bituminous mixtures. Material specifications. Hot Rolled Asphalt.*
– BS 594987 *Asphalt for roads and other paved areas. Specification for transport, laying, compaction and type testing protocols.*

Coated macadam:

– EN 13108-1 *Bituminous mixtures. Material specifications. Asphalt Concrete.*

13.4 DRAINAGE SYSTEMS

13.4.1 General

Under no circumstances should any liquid run-off be allowed to leave the site in an uncontrolled manner. It is critical that the entire area where fuel is stored, delivered and dispensed is isolated from direct discharge into the surface water or foul sewer system and protected by a surface impermeable to the vehicle fuels present. Consideration should be given to the factors in 13.4.2 to 13.4.5 to ensure a safe and adequate method of controlling and containing surface run-off.

The colour-coding of access chambers, gullies and other drainage apparatus, to differentiate between surface water drainage and foul drainage is advocated as a means of assisting in the prevention of pollution. The convention is 'red' for foul, 'blue' for surface and a 'red C' for combined systems. A drainage plan for the site should be available at the filling station.

13.4.2 Catchment area

Surface drainage catchment areas may be categorised into contaminated and uncontaminated. All forecourt surface areas where contamination is possible, and any drainage apparatus that could receive contaminated water, should be discharged via a full retention forecourt oil/water separator. Ethanol and other bio components in some fuels are soluble in water. As a consequence these soluble components will not be captured in a separator in the event of a spillage. There is potential therefore for contaminated water to be discharged via the separator. Separators on sites where petrol is delivered, stored and dispensed should have shut-off valves which can be closed in the event of a spillage to prevent contaminated discharges to the environment.

Areas where contamination is unlikely may be treated separately using suitable sustainable drainage techniques or may be discharged via a by-pass type separator.

Uncontaminated rainwater from the canopy, kiosk and other roof drainage may be discharged directly to a watercourse without treatment. Where rodding eyes and access chambers for surface water channel drains have to be located in areas likely to be contaminated then they should be double-sealed to prevent ingress of hydrocarbons.

Connections for the discharge of effluent from the various catchment areas on a typical filling station are shown in Figure 13.1.

The catchment areas should be designed to direct all run-off towards the drainage system in an efficient manner. Materials and joints of channel drains should be designed to ensure that no leakage occurs and be laid to gradients to achieve self-cleansing flow velocities at design conditions.

13.4.3 Containment for tanker delivery areas

Tanker delivery stands should be sized to accommodate the largest tanker with tractor unit plus sufficient margin around the vehicle to contain splashing in the event of a spill.

Tanker delivery stands should be laid to a fall towards the tank fill points thus preventing any spillage from delivery migrating underneath the tanker. Adequate drainage channels/gullies should be provided adjacent to the tank fill points to accommodate a likely spillage from a single hose failure, combined with inability to close footvalves, of 1 000 litres per minute for seven minutes.

For the worst case spillage event of two hoses failing at 1 000 litres per minute for four minutes (vehicle collision half way through discharging) the tanker stand should be capable of holding the residue until such time as the drainage system can accept and convey the vehicle fuel to the oil/water separator unit. Where forecourt gradients require the use of perimeter or cut off drains, such as at a crossover, these should be designed to accept a discharge at a rate of 16 litres/s, for a period of seven minutes, over a 2 m wide section of channel without overflowing. Drainage piping of minimum 150 mm diameter will be required to allow flow to be cleared from channels.

13.4.4 Grating design

Gratings should be sufficiently sized to allow run-off to be intercepted positively and to freely enter the channel. The grating design should not allow the flow of discharge to pass across the main body of the grating. Continuous open slots, to allow discharge to enter the channel, should intercept the flow.

Channels and gratings should be installed and tested to manufacturers' recommendations. All outlets should be trapped, accessible and easily maintained.

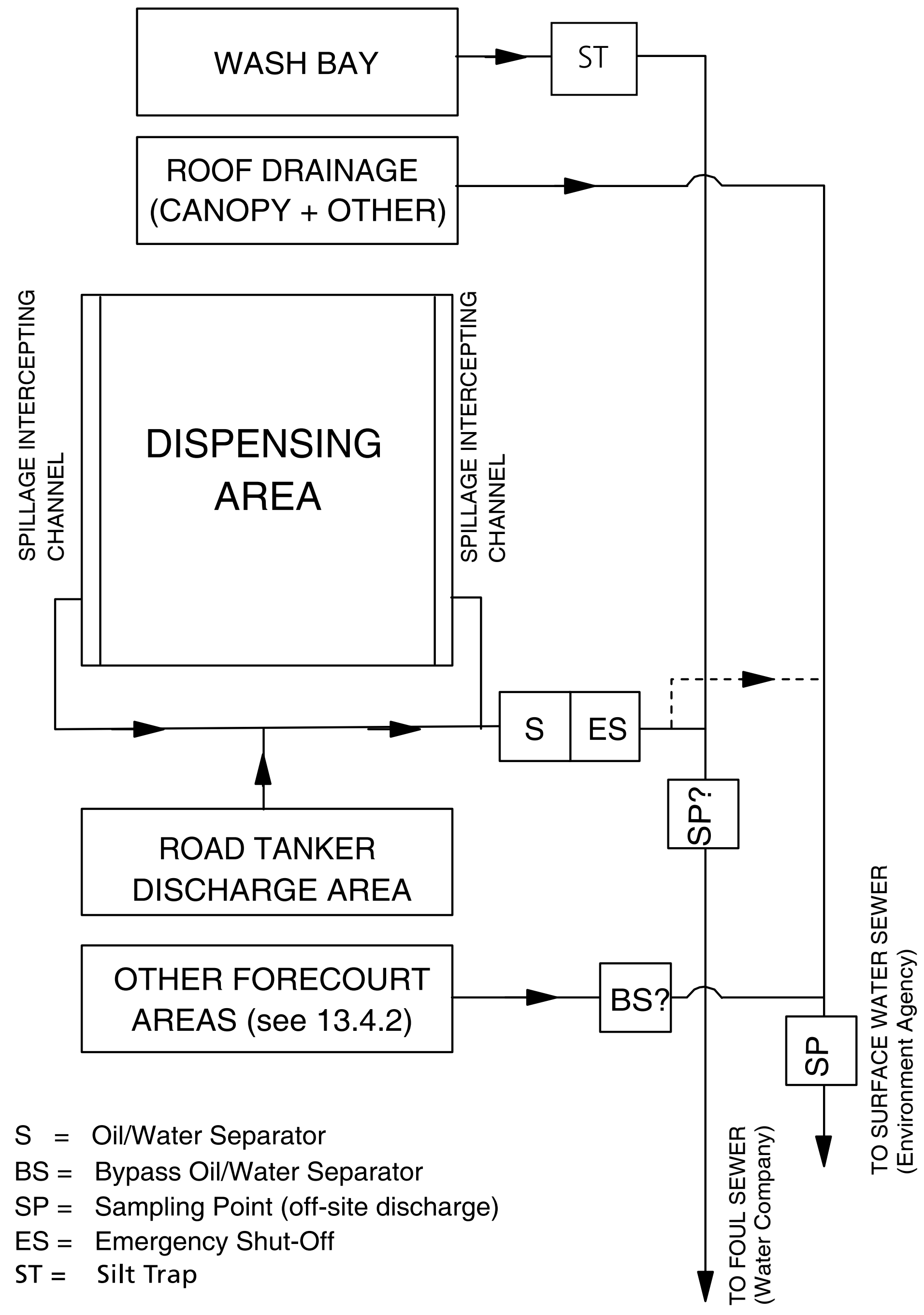


Figure 13.1 Typical discharge arrangements for filling stations

13.4.5 Drainage pipework

When considering the design of drainage pipework, the rainfall, proximity of high buildings and levels of surrounding land should be considered. The drainage pipework should be:

– Sized to suit the storm return periods appropriate to the location and in accordance with the requirements of EN 752 and be capable of transporting a spillage from the tanker stand area at a rate of at least 15 l/s.
– Laid to falls determined from the calculated flow rate.
– Sealed at all joints.
– Resistant to the effects of light hydrocarbon liquids and alcohols when tested as specified in EN 752.
– Tested in accordance with Approved Document H, EN 752 and EN 1610 *Construction and testing of drains and sewers*.
– Certified as complying with the regulations cited above.

Access chambers should be provided at each change of direction or gradient and should be sized in accordance with EN 752 *Drain and sewer systems outside buildings* and Tables 11 and 12 of Approved Document H. All covers and frames in vehicle circulation areas and paved areas should be to the minimum standard of EN 124 *Gully tops and manhole tops for vehicular and pedestrian areas. Design requirements, type testing, marking, quality control.*

The access and egress crossover points should always be protected by a channel line drainage system set at least 300 mm beyond the restraint kerbing or boundary wall. This will prevent the flow from spillage on the forecourt, not otherwise routed to drainage, going beyond the curtilage of the filling station.

A penstock or other suitable valve should be installed in the first access chamber downstream of the separator capable of shutting off all flow and preventing contaminated effluent leaving the site during maintenance or an emergency.

All drainage systems should be installed and maintained in accordance with manufacturers' recommendations.

13.5 CONTAMINATED WATER TREATMENT AND DISPOSAL

13.5.1 General

In order to prevent off-site pollution and the safety risks associated with petrol in drainage systems, an effective drainage system is essential. All potentially contaminated surface water should be provided with some form of suitable treatment, such as an appropriate constructed wetland (see 13.7) or a light liquid separator system that comprises an oil/water separator (Class 1, 5 ppm discharge under test conditions or Class 2, 100 ppm discharge under test conditions), a sludge trap, automatic closure device and alarm, and a sampling chamber. The sampling chamber should be fitted with a manually-operated shut-off valve irrespective of the type of separator used. Bypass separators are not suitable for potential fuel spillage areas.

13.5.2 Oil/water separators

Oil/water separators are designed to prevent hydrocarbons, grit and sediment from leaving the site. Separator systems should be based on the requirements and test methods in EN 858-1 *Separator systems for light liquids (e.g. oil and petrol). Principles of product design, performance and testing, marking and quality control*, with particular reference to material, chemical resistance, separating performance, design and functional requirements.

EN 858-1 refers to two classes of separator. Under the same standard test conditions, Class 1 separators are designed to achieve levels of 5 mg/l oil and Class 2 100 mg/l.

As a minimum, separators should be sized to suit the storm return periods appropriate to the location. In the UK this is normally based on a rainfall rate of 65 mm/h. The inlet and outlet pipework diameters should be sized according to the maximum expected flow rates. Separators should be vented to the atmosphere.

In an oil/water separator, contaminated water is gravity fed into the inlet of the separator where it is mixed, below the static liquid level, with the existing water in the separator. Gross solids and silt settle to form sediment in the bottom. Light liquids with low density (up to 0,95 grams per millilitre (g/ml), such as petrol and diesel) will readily separate from the water to form a floating layer.

Light liquids with higher densities, particularly those in the range of 0,95-0,98 g/ml (such as fuel oil) will take longer to separate from the water and will generally be carried through the natural flow path within the middle fraction of cleaner water. The cleanest water will be at low level within the separator and towards the outlet end. Here the water discharges from the separator through a submerged outlet, in some cases passing through a coalescing filter which helps to separate any remaining vehicle fuels. Further details on the function and types of oil separators are available in Environment Agency Pollution Prevention Guidelines *Use and design of oil separators in surface water drainage systems*, PPG 3.

Separator capacity should be determined by:

– the drainage area feeding the unit;
– the separator performance required, and
– the likely size of spill.

Guidance on the selection of oil/water separators is provided in EN 858-2 *Separator systems for light liquids (e.g. oil and petrol). Selection of nominal size, installation, operation and maintenance.*

The possibility of a large spillage occurring during a road tanker delivery is a foreseeable event that should be taken into account when designing a forecourt drainage system. Although the likelihood of the loss of the entire load from a full compartment of a road tanker is considered to be remote, each site should be individually risk assessed in order to provide the most appropriately sized separator for the location.

13.5.3 Discharge to controlled waters

In the UK it is an offence to cause pollution of surface waters either deliberately or accidentally. Controlled waters include all ditches, watercourses and canals, estuaries, lochs and water contained in underground strata (groundwater).

The formal consent, maybe an environmental permit, of the relevant agency[20] is required for many discharges to surface waters or groundwater, including both direct discharge and discharge to soakaways. Such consents or permits are granted subject to conditions and are not issued automatically. Discharges from a filling station to surface waters or groundwater of anything other than uncontaminated roof water will require consent and treatment to a high standard using, for example a Class 1 separator with coalescing filter, automatic closure device and maximum level alarm or a suitably designed constructed wetland system (see 13.7).

20 The Environment Agency (England & Wales), Scottish Environment Protection Agency (SEPA) and Northern Ireland Environment Agency (NIEA).

The Environmental Permitting (England and Wales) Regulations 2010 (EPR) introduce groundwater authorisations and radioactive substances regulation permits into Environmental Permitting.

For filling stations, if granted, environmental permits for this type of discharge will only allow for small amounts of ethanol and other soluble components in petrol arising from occasional minor splash backs and vehicle overfilling (which may pass through the separator). The loss of larger quantities of ethanol and other soluble components at levels present in larger spillages, or in higher blend ethanol fuels is likely to result in significant long-term damage to the quality and ecology of surface waters and groundwater.

In the UK, the relevant agency[21] should be contacted to ascertain the volume of discharge covered by the environmental permit.

13.5.4 Discharge to foul sewer

The foul water sewer carries contaminated water (sewage and/or trade effluent) to a sewage treatment works, which may either be owned privately or by the local sewage treatment provider. All discharges to the public foul sewer require prior authorisation and may be subject to the terms and conditions of a trade effluent consent. As a minimum, discharges from filling stations to the foul sewer should be treated using a Class 2 separator. The loss of larger quantities of ethanol and other soluble components at levels present in large spillages or in higher blend fuels is likely to result in significant damage to effluent treatment plants. This may result in secondary pollution incidents from untreated sewage being discharged

13.5.5 Discharges to combined sewers

Some older urban areas and city centres are served by a combined drainage, which carries both foul and surface water to a sewage treatment works. These systems often have overflows directly to watercourses during rainfall events and therefore discharges to them should be treated as for direct discharges and passed through a Class 1 separator.

13.5.6 Vehicle wash drainage

Automatic car washes, high pressure hand washes and steam cleaners may produce large volumes of waste water, possibly at high temperatures, contaminated with detergents, oil and road dirt. The wide range of cleaning agents used in the washing process can form stable emulsions. These emulsions take time to degrade and separate into the oil and water phases. This type of effluent is a trade effluent and should be passed through a silt trap before discharging into a separate drainage system to the one used to drain the forecourt. This should be discharged to the foul or combined sewer or contained in a sealed tank for off-site disposal.

Note 1: under no circumstances should waste water from car wash facilities be discharged through the forecourt oil/water separator. Note 2: under no circumstances should waste water from car wash facilities be discharged directly to surface waters and groundwater even if no detergents have been used.

Vehicle wash recycling systems are available which will significantly reduce the volumes of water used and discharged. Their use is recommended by the environment agencies.

21 The Environment Agency (England & Wales), Scottish Environment Protection Agency (SEPA) and Northern Ireland Environment Agency (NIEA).

13.6 MAINTENANCE

It should be recognised that however well it is designed and installed, a drainage system is only as effective as its subsequent maintenance. Maintenance is required to all parts of the forecourt surfacing and drainage systems, in addition to routine visual inspections. It is vital that drainage channels, gullies, silt traps and oil/water separators are regularly inspected and routinely maintained according to manufacturers' recommendations. The frequency should be determined by site conditions but for environmental reasons it is recommended they be inspected at least every six months.

After oil/water separators have been in use for some time, dependent upon the degree of contamination, the contaminated waste will need to be removed. This work should only be undertaken by a registered waste carrier and the action documented according to local legislation or environmental laws.

Note: following removal of contaminated waste, the oil/water separator should be replenished with clean water.

Forecourt maintenance that involves degreasing, either by steam cleaning, using a solvent or a combination of both, should always be carried out with the shut-off valve downstream of the oil/water separator in the closed position to prevent escape of polluting material. It is essential that the oil/water separator be cleaned out before the valve is reopened. Further details on maintenance and use of oil separators are available in Environment Agency Pollution Prevention Guidelines *Use and design of oil separators in surface water drainage systems,* PPG3 and EN 858-2 *Separator systems for light liquids (e.g. oil and petrol). Selection of nominal size, installation, operation and maintenance*.

13.7 CONSTRUCTED WETLANDS AND REED BEDS

13.7.1 Introduction

Constructed wetlands (sometimes referred to as reed beds) are a new innovation to filling stations and may offer an alternative to traditional methods of treating drainage effluent. Bacteria living in the soil around the roots of the common reed *Phragmites australis* or reed mace *Typha latifola* break down any hydrocarbons contained in the draining liquid directed to the wetland so that there is no long-term accumulation of vehicle fuels. Wetlands can be used for a variety of waste water treatment purposes at filling stations. Suitably designed systems can be used to treat foul drainage from the kiosk and affiliated fast food outlets, and to treat surface run-off from the forecourt. They may also be used as a replacement for on-site oil/water separators for oily water run-off. If the system is suitably designed, car/jet wash effluent can also pass through the wetland. The forecourt drainage system is likely to be the same design as one discharging through an oil/water separator with the exception that the surface water will be directed for treatment to the wetland. However, when a wetland is installed without an oil/water separator, it will introduce additional safety concerns, which need to be assessed and effectively controlled.

Constructed wetlands can provide acceptable environmental protection as long as they are suitably designed, installed and maintained. In some situations they may provide better environmental protection than conventional drainage systems. An environmental permit from the relevant agency[22], setting emission standards for any effluent discharge, will be required where the wetland discharges to surface water. If the wetland discharges into

22 The Environment Agency (England & Wales), Scottish Environment Protection Agency (SEPA) and Northern Ireland Environment Agency (NIEA).

a foul or combined sewer, it will be necessary to obtain the permission of the local water authority. A typical constructed wetland design is shown in Figure 13.2.

Constructed wetlands will generally allow for the biodegradation of trace amounts of ethanol and other soluble components in petrol arising from occasional minor splash backs and vehicle overfilling which may pass through the drainage system. The loss of larger quantities of ethanol and other soluble components at levels present in large spillages or in fuels containing a higher percentage of ethanol is likely to result in localised damage to the ecology of the constructed wetland.

The information in 13.7.2 to 13.7.6 provides only generic control measures that should be applied where wetlands are installed at filling stations. At some sites there may be a composite arrangement for dealing with surface water where, for instance, an (existing) oil/water separator or a spillage retention vault intervenes to prevent significant spillages reaching the wetland.

From a fire and explosion aspect, wetlands will not be suitable for all filling stations due to configuration and location. Assessment will therefore be needed on a site-specific basis and the appropriate level of control applied.

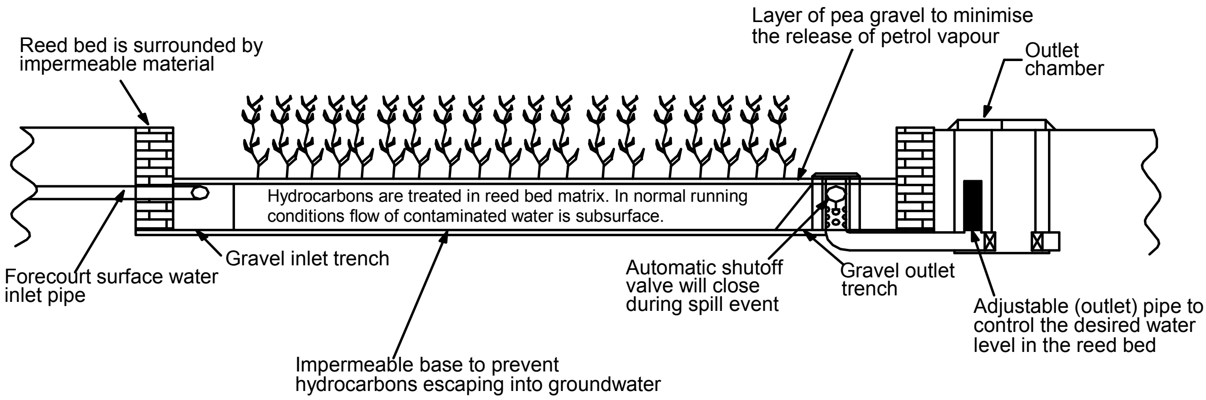


Figure 13.2 Typical constructed wetland design

13.7.2 Containment

A suitably designed and maintained wetland will effectively treat small spillages of vehicle fuels at sub-surface level within the wetland enclosure. However, as noted in 13.5.2 the possibility of a large spillage occurring during a road tanker delivery is a foreseeable event that should be taken into account when designing a forecourt drainage system.

The wetland should be designed and constructed so as to prevent groundwater contamination and also to be capable of completely retaining a sudden release of vehicle fuel. In this respect, the design criteria should make provision for extreme weather conditions such as heavy rainfall and severe frosts. Very large sites, or those in an environmentally sensitive area, may require larger capacity containment. The mechanism(s) installed to prevent the release of a large spillage of petrol or diesel from the wetland have to be automatic in operation and fail-safe. Alternatively, the drainage system could be designed so as to divert any large releases of petrol to a retaining vault (or traditional oil/water separator). The size of the vault should be calculated in accordance with a site-based risk assessment, with the valve diverting the flow of liquid being automatic in operation.

13.7.3 Separation

Unlike oil/water separators where spillages are held in a below-ground enclosed chamber, the wetland system should retain large spillages at sub-surface level. However, the sub-surface retention of any petrol will only minimise and not prevent the release of flammable vapour to atmosphere. In the event of a large spillage occurring during a period of exceptionally high rainfall, petrol may be retained at surface level. The flammable vapour given off by the petrol will be unpredictable in its movement, as weather conditions, the height of the wetland enclosure walls and the density of vegetation will dictate concentration, movement and dissipation. For details of the hazardous area classification for wetlands see section 3.2.4.2. The danger to people and buildings arising from the heat output of a pool fire has to be considered and the most appropriate control measure will be the application of separation distances to fixed plant, buildings and vulnerable populations. It should be noted that application of separation distances is not intended to provide total protection for people, installations and buildings from the effects of a fire. The purpose of a separation distance is to allow time for evacuation and commencement of fire-fighting operations before any vulnerable buildings or installations are affected by the heat of the fire. For wetlands with a surface area of less than 35 m^2 the minimum separation distances should be:

– 6 m from buildings, public thoroughfare and the road tanker stand/storage tank fill points. This distance can be reduced for buildings that are of 30 minutes' fire-resisting construction or where a fire wall is provided to protect vulnerable plant and equipment.
– 12 m from domestic property or premises housing vulnerable populations (e.g. residential homes, hospitals and schools).
– 12 m from autogas storage vessels and LPG cylinders and any other unprotected above-ground storage tanks for flammable liquids/gases.

Where it is proposed to install a wetland with an area greater than 35 m^2, there will need to be a more detailed risk assessment, in consultation with the local fire and rescue service, to determine the most appropriate separation distances.

For details of the hazardous area classification for a retaining vault, which has the same function as a storage tank, see section 3.2.4.2.

13.7.4 Vehicle fuel retrieval and wetland re-instatement

The wetland should be provided with an accessible uplift facility specifically designed to safely remove vehicle fuels in the event of a large spillage. Access for a road tanker should be considered.

13.7.5 Emergency actions

To identify the existence and location of the wetland, which will be essential for those involved in the emergency response in the event of a large spillage occurring, the following notices should be displayed:

– At the storage tank fill point/road tanker stand, a conspicuous notice to communicate 'This site does not have an oil/water separator - petrol spills will be contained at the wetland'.
– At the wetland (on the elevation facing the forecourt), a conspicuous notice to communicate 'Danger - wetland - may contain petrol – smoking and naked lights prohibited'.

13.7.6 Maintenance

The wetland and any associated mechanical devices (e.g. auto shut-off valves) should be maintained in accordance with the designer's/installer's instructions to ensure that the wetland is thriving, functioning correctly and any associated mechanical equipment is in working order. This should include a monitoring programme operated by the site owner/operator and the wetland designer/installer to ensure that the treatment system continues to meet the standards of the Discharge Consent or Permit.

13.8 BUILDING REGULATIONS PART H

Drainage systems are controlled by the building regulations, for which the functional requirements are contained in Approved Document H. Regulation H3-A7 requires full retention Class 1 separators in fuel storage areas and other high-risk areas. These should have a nominal size (NS) equal to 0,018 times the contributing area. In addition they should have a silt storage volume in litres equal to 100 times the NS.

14 ELECTRICAL INSTALLATIONS

14.1 GENERAL

Many electrical installations at filling stations are relatively small. However, to ensure safety it is essential that they are correctly planned, designed, installed, tested and commissioned. Thereafter, regular inspection and testing are required to ensure that they remain in a safe working condition.

Poorly designed or installed or badly maintained electrical facilities may present significant risks of shock, fire or explosion caused by a spark or overheating.

The comprehensive guidance in this section addresses good practice in the planning, design, installation, testing and commissioning of electrical installations at filling stations both new and refurbished, including electrical supplies to, and cabling for, associated equipment such as pump systems, leak prevention or detection, tank gauging, closed circuit television (CCTV) and computer systems.

In the UK all filling stations storing and dispensing autogas are covered by the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR), whether dedicated to those fuels alone or in combination with petroleum. Other health and safety legislation also applies. Where autogas facilities are installed at a filling station the petroleum enforcing authority can take the presence of autogas into account in determining the conditions of the petroleum licence, since the storage and dispensing of this fuel may impact with the storage and dispensing of other vehicle fuels.

The guidance is intended to assist electrically competent persons to provide, maintain or verify electrical installations and equipment at filling stations. The outcome should provide an effective electrical installation and give a site operator confidence to claim compliance with their statutory duties in respect of that installation under:

1. The Electricity at Work Regulations 1989 (EWR), with regard to the overall safety of the electrical installation and associated electrical equipment at a filling station.
2. DSEAR with particular regard to the prevention of fire or explosion due to ignition of a dangerous substance or flammable atmosphere - especially with reference to Regulation 6 and Schedule 1.

Comprehensive guidance is given on inspection and testing of new and refurbished installations, and periodic inspection and testing of existing installations. A model periodic (annual) certificate of electrical inspection and testing is included for certifying that the electrical equipment in, and associated with, hazardous areas at a filling station complies with the requirements of the above statutory regulations. (This replaces the electrical certificate previously required for the petroleum licence.)

Other model forms are also provided for including the outcome of inspection and testing of the electrical installation and equipment including items that are not related to hazardous areas which have to comply with the EWR alone and are not subject to DSEAR.

The guidance is not addressed to site operators or other electrically non-competent persons who may be duty-holders under the statutory regulations. HSE HSR 25 *Guidance on Regulations Memorandum of guidance on the Electricity at Work Regulations 1989* provides duty-holders with comprehensive guidance on the use of electricity in the workplace.

14.2 HAZARDOUS AREA CLASSIFICATION

Section 3 provides information on hazardous area classification and zoning of fuel containment installations at filling stations. It is imperative that any electrically competent persons who provide, maintain or verify electrical installations and equipment in, or associated with, hazardous areas at filling stations have a thorough understanding of hazardous area classification. All references to hazardous areas and zones in this section should be considered with the information provided in section 3.

The zoning within and immediately above the housing of dispensers (petrol and autogas) will depend on the internal construction (e.g. employing vapour barriers). Knowledge of the dispenser internal zoning and its vapour barriers may be required when more accurate determinations of the external zones around the dispenser are required as opposed to the generic examples given in section 3 (or other user codes).

As noted in section 9, a manufacturer/importer or supplier of a dispenser should have supplied with the unit a diagram showing the hazardous zones in and around the unit.

For electrical purposes, all areas of a filling station outside the classified hazardous areas can be considered as non-hazardous unless they are affected by processes or events which create their own hazardous areas (e.g. handling, storage, spills or leaks of fuel).

Electrical equipment in the vicinity of a tanker stand should be selected and located taking into account the hazardous zones created when a tanker is present.

14.3 PLANNING AND DESIGN OF ELECTRICAL INSTALLATIONS

14.3.1 Location of premises

A plan of the filling station site, indicating clearly its boundaries and including the location of fixed electrical equipment (including underground ducts and access points) should be provided. It is recommended that an 'as built' plan be permanently displayed within the premises.

Where the proposed filling station is located adjacent to a generating station or substation an assessment of risk should be carried out by the designer, including consultation with the electricity supplier.

Wherever possible the filling station should be so arranged that there are no overhead conductors (electricity or telephone lines etc.), which at their maximum horizontal swing pass within 3 m of a vertical projection upwards from the perimeter of hazardous areas (e.g. dispensers, tanks, vent pipes, tanker stands).

Exceptionally, and only after agreement with all relevant authorities (e.g. overhead line operator), the site may be located beneath suspended overhead conductors provided that precautions are taken to avoid danger from falling cables, the possibility of stray currents in the metalwork and the possibility of direct contact by delivery personnel using dipsticks on tops of tankers.

A method for achieving this is as follows:

a. The hazardous area associated with the dispensers should be protected by the creation of an electrically bonded and earthed metal canopy over the area.
b. Where an overhead line passes over an area within 3 m of a hazardous area associated with dispensers, to allow for any deflection of the line, an electrically bonded and earthed metal canopy should be created over the hazardous area and extended for a further 3 m laterally beneath the overhead line.
c. All supports for the metal canopy have to be located outside the hazardous area associated with dispensers.

d. The metal canopy should be electrically bonded to an arrangement of earth electrodes distributed around the perimeter of the site surrounding all buried metalwork and tanks on the site to a depth not less than the bottom of the deepest tank.
e. Autogas compounds, vent pipes and tanker delivery stands should be located away from the area beneath the overhead conductors described above.

14.3.2 Site supplies

The site should be supplied by underground cables (power, telecommunications etc.) suitably protected against mechanical and environmental damage and routed outside and not below the hazardous areas. Where the filling station site is supplied via an overhead system, the conductors should be terminated outside the site boundary and the supply continued by means of underground cable(s), suitably protected against mechanical and environmental degradation and routed outside and not beneath the hazardous areas (see also 14.8.6). Note: this may be the responsibility of the service supplier and requires agreement at an early stage.

If the filling station forms part of and adjoins other premises (e.g. a garage or service area), the supply cable(s) may be routed above ground from the other premises but within the confines of, or fixed throughout their length, to the buildings.

The electrical intake and main switchgear position for the installation should be located in an easily accessible low fire risk position outside the hazardous areas and kept unobstructed. This position should be agreed with the relevant enforcing authority. This is the position within the curtilage of the filling station at which electricity is supplied, whether directly from a metered source or via a sub-main fed from elsewhere in more extensive premises. The main switchgear, test socket and main earthing terminal for the filling station will be located at this position, otherwise designated as the 'origin' of the filling station installation (see Figure 14.1).

Where additional equipment, such as that for an autogas installation, is to be installed on an existing filling station an assessment should be made of the incoming electricity supply and main switchgear with regard to its ability to accommodate the proposed additional equipment. Where protective multiple earthing (PME) exists as the means of earthing the site, particular attention should be given to the possible effect of diverted neutral currents passing into hazardous areas and the incorporation of isolation joints in the autogas pipework.

14.3.3 Surge protection

Where the supply to the site is via an overhead line, surge arresters should be provided as part of the installation to protect against the effect of surges on the supply (see also 14.4.6).

14.3.4 Lightning protection

A risk assessment should be carried out by the designer to determine the need for lightning protection of structures at a filling station.

Although not specifically addressing the provision of lightning protection at filling stations, general guidance on the subject is given in EN 62305-1 *Protection against lightning. General principles.*

14.3.5 Protective multiple earthing

Where an existing electrical installation is supplied from a TN-C-S system in which the neutral and protective functions are combined in part of the system to provide PME, stray currents (diverted neutral currents-see Annex 14.3) passing through metalwork located in potentially hazardous areas may pose an increased risk of fire or explosion. Where the installation is supplied from a public low voltage (LV) network described as a TN-S system, the neutral and earth functions may not be separated throughout the system and may behave in a similar manner to a PME system and create similar risks.

To ensure the continued effectiveness of earthing and bonding arrangements an annual inspection/testing regime should be implemented. The annual testing should include the measurement and recording of the value of diverted neutral current. As far as is practicable, measurements should preferably be made at times of anticipated peak loading on the local supply network. All measured values in excess of 100 mA should be the subject of a detailed investigation (see 14.10.3.2 for testing requirements).

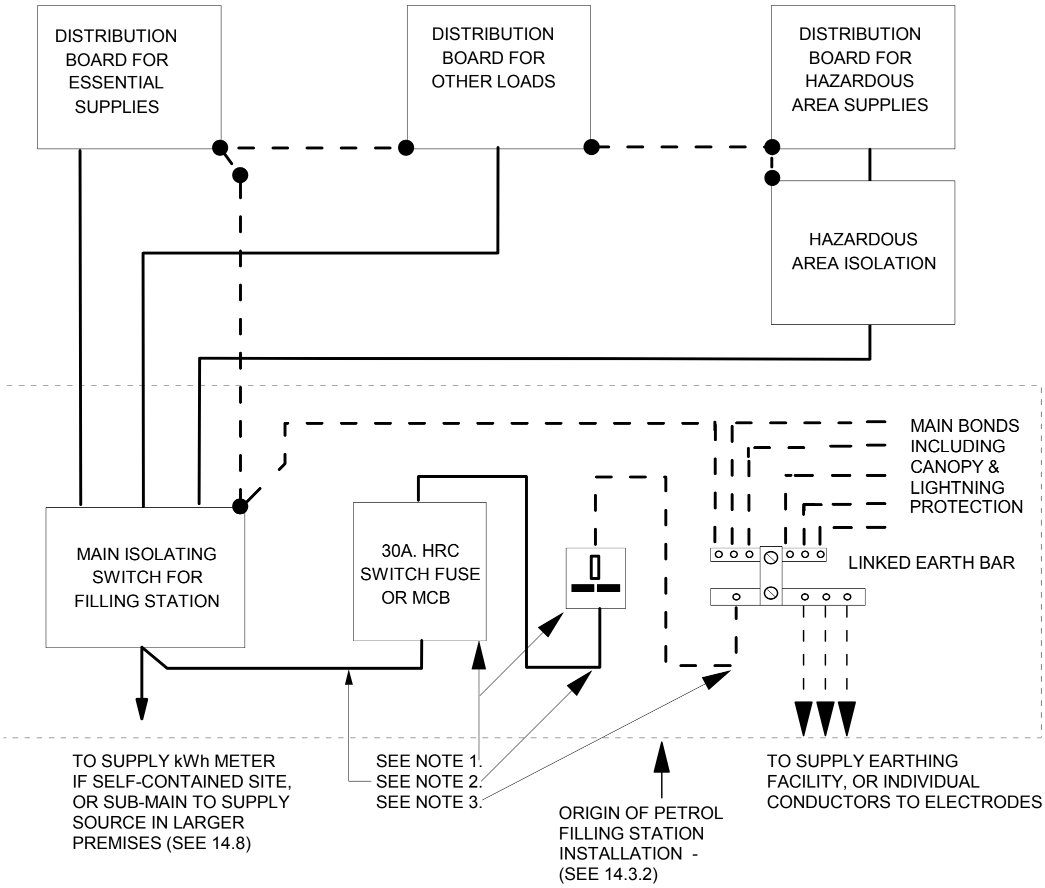
Trends should be established by comparison with previous test results. These may give an indication of possible future changes. An assessment of risk carried out by a competent person may conclude that in a particular case a PME or public supply TN-S earthing facility should be replaced by an earthing facility provided by a TT system or isolated TN-S system.

For a filling station under construction, or where a major refurbishment is being undertaken, an earthing facility derived from the public supply system should not be used (see Figure 14.2.a). Earthing should be derived from an isolated TN-S or TT system (see Figures 14.2.b, c, d or e).

Where the filling station is only part of the premises and the main supply to the premises is provided from a public supply system, the filling station earthing system and extraneous conductive parts should be segregated to minimise the possibility of diverted neutral currents to earth (see Annex 14.3).

A new or refurbished installation should be supplied by one of the following means (not stated in any order of priority):

a. A TN-S system where the earthing arrangements are exclusive to the filling station or to a larger premises of which the filling station forms part (i.e. via an 'own transformer' not shared by other electricity consumers) (see Figure 14.2.b).
   Note: It should always be assumed that the 'distributor's' supply is PME, whether or not a label to identify it as such has been fixed alongside the earthing terminal.
b. A transformer exclusive to the filling station, providing a local TN-S system with its own earth electrode arrangement, independent of the supply network earthing (see Figure 14.2.b).
c. A TT system with earthing arrangements exclusive to the filling station (see Figures 14.2.c or d).
d. Use of an isolation transformer to derive a separated neutral and earth system from a public supply system. Protection of the primary circuit has to be carefully considered and should protect against primary fault current being impressed on the separated earthing system (see Figure 14.2.e).



Note 1: All-insulated lockable protective device, labelled 'THIS DEVICE IS NOT ISOLATED BY THE MAIN ISOLATING SWITCH AND MUST REMAIN LOCKED OR INTERLOCKED IN THE OFF POSITION WHEN NOT BEING USED FOR TEST PURPOSES', and all-insulated (no external metal parts) 13A test socket and mounting box. The device has to satisfy requirements for isolation of phase and neutral conductors and have a breaking capacity not less than the prospective fault current of the incoming supply.

Note 2: Phase (R_1) and neutral 6 mm^2 conductors, insulated and sheathed or enclosed in non-conducting conduit, length not exceeding 3 m.

Note 3: Separate, dedicated 6 mm^2 insulated protective conductor, (R_2). For 6 mm^2 phase, neutral and earth conductors not exceeding 3 m in length, their impedance may be neglected, and no correction to the measured test results is required.

Figure 14.1 Simplified supply arrangements

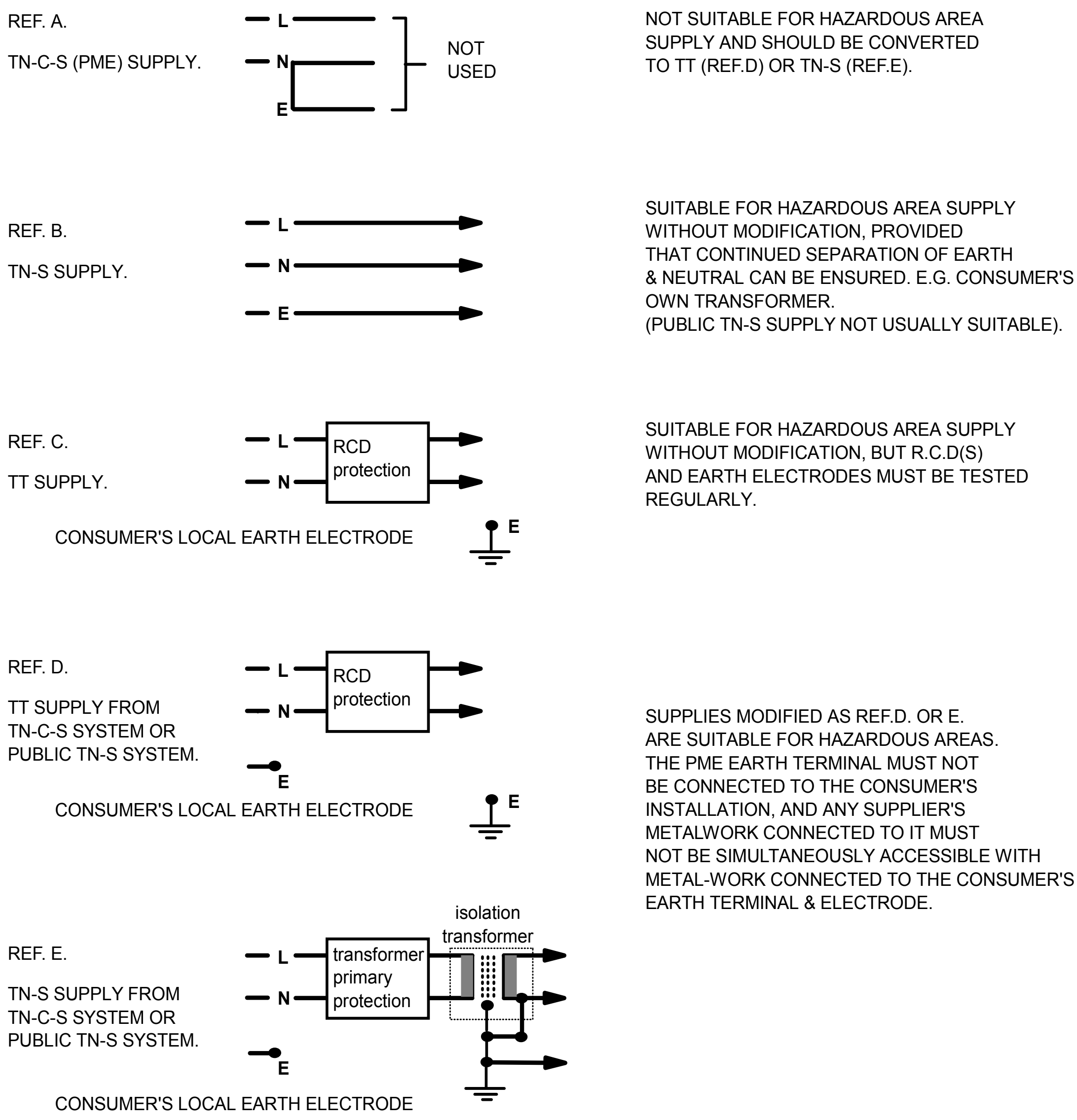


Figure 14.2 Single phase system earthing arrangements (three phase generally similar)

14.3.6 Other earthing requirements

Where provisions for storage and dispensing of autogas are to be added to a site dispensing petroleum and the existing earthing system is connected to a PME terminal, a risk assessment should be carried out to determine any possible adverse effects on the autogas installation. Where the metalwork of the autogas installation is cathodically protected and employs insulating inserts, the effects of diverted neutral currents are likely to be obviated in that metalwork.

14.3.7 Back-up power supplies

When back-up power supplies are provided externally to the fuel dispenser's computer equipment, they should be connected to the equipment located in the hazardous area either by a changeover device located outside the hazardous area or, if the equipment contains its own changeover facilities, by direct independent wiring into the equipment. Adequate and clearly identified isolation facilities should be provided. Where high levels of electrical interference from other equipment or external sources are likely, care should be taken in the design and erection of the installation to minimise the possibility of interference signals affecting the normal operation of the installation (see also 14.4.6).

The designer should ensure that a back-up power supply system provided other than by the dispenser supplier is fully compatible with the system to which it is to be connected.

The designer has to ensure that, when operating on back-up supply, protection against overcurrent and electric shock is maintained.

14.3.8 Exchange of information

The facilities needed at the filling station should be ascertained as accurately as possible by consultation between the client and, as appropriate, the operator (if not the client), the architect, the consultant, the main contractor, the electrical contractor, the dispenser manufacturer and installer, the fire insurer, the enforcing authority, the electricity supplier and any other public authority concerned. Documents should then be prepared and circulated for final written agreement, or comment, showing:

a. Details of the installation proposed, related extraneous-conductive-parts (e.g. pipework and structures) and additional electrical bonding.
b. The accommodation and structural provisions required for the equipment (e.g. siting of switchgear and metering, central control point, emergency switching etc.) and the provision of lighting and adequate access to all equipment.
c. Details of the hazardous areas applicable to the site (see section 3).
d. Chases, ducts, ducting, cable chambers, conduits, channels, trunking and other provisions required for electrical wiring. In particular, duct/ducting capacity for cables should always include for the provision of mechanical seals to prevent transfer of volatile organic compounds (VOCs) in liquid or vapour form; where it is not practicable to provide mechanical seals, suitable compound or other material resistant to VOCs has to be used to provide a seal against the transfer of VOCs in liquid or vapour form, (see also 14.9.5).
e. Details of the methods and locations of sealing against liquid and vapour transfer.

Annexes 14.5 to 14.10 provide 'model' record documents. Completed versions should be kept with the site electrical records.

14.4 SELECTION AND INSTALLATION OF EQUIPMENT

The electrical installation should comply with the requirements of this guidance and BS 7671 *Requirements for electrical installations. IEE Wiring Regulations.*

14.4.1 Equipment in hazardous areas

The electrical installation should comply with the requirements of this guidance and the relevant parts of EN 60079-14 *Explosive atmospheres. Electrical installations design, selection* *and erection*. EN 60079-14 includes the concept of 'equipment protection levels' (for further information, see Annex 14.11).

Equipment should be certified to an explosion-protection standard suitable for the zone in which it is to be used.

New equipment should be constructed to comply with EC Council Directive 94/9/EC The approximation of the laws of Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres, (the ATEX Equipment Directive), which in the UK is implemented by the Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996 (EPS).

Note: These regulations apply to equipment, protective systems, safety devices, controlling devices and regulating devices for use in potentially flammable atmospheres. They require equipment to be safe by meeting the essential safety requirements and following the appropriate conformity assessment procedures specified in the ATEX Equipment Directive so the CE marking along with the certification number issued by the Notified Body, where appropriate, and the distinctive Ex symbol can be affixed.

Where a particular construction standard is mentioned in this guidance, compliance with that standard demonstrates compliance with the ATEX Equipment Directive.

New dispensers have to be certified by a European Notified Body to demonstrate conformity with ATEX. Existing or refurbished dispensers should be certified for conformity against the standard to which they were initially designed (e.g. this may be EN 13617-1 *Petrol filling stations. Safety requirements for construction and performance of metering pumps, dispensers and remote pumping units* (conforms with ATEX), BS 7117-1 *Metering pumps and dispensers to be installed at filling stations and used to dispense liquid fuel Specification for construction* or BASEEFA Schedule of Accreditation SFA 3002 *Metering pumps and fuel dispensers*).

Any additions or modifications to dispensers should be approved by the certification body which originally certified the dispenser to ensure the standard to which it was originally certified is not invalidated (see section 9).

Where the certification number on the equipment is suffixed by an 'x', special installation conditions apply and the documentation has to be consulted before installation takes place.

14.4.2 Equipment in non-hazardous areas

Safety, controlling or regulating devices intended for use in a non-hazardous area, but which are required for, or contribute to, the safe functioning of equipment in a hazardous area (e.g. a variable speed drive controlling an submersible pump) also fall within the scope of the ATEX Equipment Directive.

Where equipment is installed in a non-hazardous area but is associated with, or controls or supplies, equipment located in a hazardous area, in addition to the normal requirements for this equipment, it should be selected and installed so as not to have an adverse effect on the explosion-protection concept of the equipment located in the hazardous area.

Equipment which when operating displaces or ingests air (e.g. vacuum cleaning equipment including the extended hose, car wash, warm air central heating systems or air compressors) should not be installed where it may affect, or be affected by, a vapour laden atmosphere (hazardous area).

The designer should ensure that heating and climate control is provided by fixed rather than portable equipment.

14.4.3 External influences

Each item of electrical equipment has to either have a degree of ingress protection appropriate to the environmental conditions in which it is installed, or be contained in an enclosure providing that level of protection. The method of protection has to take account of any loss of cooling which such secondary enclosure may cause. Particular attention should be given to the prevention of ingress of water and moisture into equipment installed on the forecourt or in other external locations. Guidance on the 'index of protection' indicated by the relevant IP number is given in EN 60529 *Specification for degrees of protection provided by enclosures (IP code).*

The IP number system relates to protection against direct contact with live parts and the prevention of ingress of solid particles, water and moisture. It is not related to, and should not be confused with, types of protection against explosion hazards. In hazardous areas in adverse environments, both forms of protection are necessary, as is protection against mechanical damage (e.g. impact or vibration).

14.4.4 Maintenance considerations

When selecting electrical equipment, the quality and frequency of maintenance which the installation can reasonably be expected to receive during its intended life should be taken into account. The reliability of the equipment should be appropriate to the intended life. All equipment should be designed and installed to allow satisfactory access for operation, inspection, testing and maintenance. A maintenance schedule for equipment should be passed to the site operator.

14.4.5 Test socket

A test socket for measuring the earth electrode resistance, earth fault loop impedance and prospective fault current should be provided at the origin of the installation, as shown in Figure 14.1.

The all-insulated test socket has to be wired to the supply side of the main isolating switch, via an all-insulated device incorporating means of isolation and overcurrent protection, by two cable tails not exceeding 3 m in length, which are either insulated and sheathed or enclosed in non-conducting conduit.

A suitably labelled insulated protective conductor, which is segregated from the earthing arrangements within the electrical installation, should connect the earth terminal of the test socket to the earthing conductor side of the main earth terminal test link (see Figure 14.1).

The isolating device should have locking or interlocking facilities and should be labelled 'This device is not isolated by the main isolating switch and must remain locked or interlocked in the OFF position when not being used for test purposes'.

14.4.6 Radio and electrical interference

The installation and equipment should be designed and installed to comply with the Electromagnetic Compatibility Regulations 2005.

Where an installation may be susceptible to transient voltages or electromagnetic effects which may adversely affect the safe operation or correct functioning of equipment, suitable surge arresters or filtering devices should be provided.

14.4.7 Protection against static electricity

Many existing underground steel containment systems (tanks/pipework) in contact with the general mass of earth form excellent earth electrodes. Because of the continuity of steel pipework, dispenser metalwork and associated electrical protective conductors, an effective path (for installation earth fault current, PME diverted neutral current etc.) is provided to earth. The passage of currents through such equipment is detrimental to the interests of safety and may have an adverse effect on the equipment.

However, with existing installations, providing the continuity of the metalwork meets the recommendations of 14.8.9, the fuel flow rates used are unlikely to cause a build-up of electrostatic charge capable of presenting a hazard.

Steel tanks and pipework are required to be well coated with imperforate corrosion-resistant materials, to prevent electrolytic action. The coatings will usually electrically insulate the metalwork from earth. Alternatively, non-conductive (typically glass-reinforced plastic (GRP)) tanks and/or pipework are employed. With these types of installations the following recommendations apply:

a. Ensure that metalwork of filling station dispensers is connected to the earthing terminal of the associated electrical installation.
b. Electrostatic earth bonding of tank/pipe metalwork should not be connected directly to the earthing system of an electrical installation because of the likelihood of introducing electrical system fault currents etc. into the electrostatic protection earth bonding arrangements.
c. Isolated metal parts of non-conductive tanks/pipework should be electrically bonded together and connected directly to an earth electrode exclusive to those parts, for the purpose of dissipating electrostatic charge. Alternatively, an electrostatic discharge path may be provided by installing a plastic-covered copper conductor of not less than 4 mm^2 cross-sectional area between the bonded isolated metal parts and the earthing arrangements of the filling station electrical installation, via a resistor having a value in the range 100 kΩ to 1 MΩ with a power rating of not less than 2 watts (W), housed in a suitable enclosure.
d. Where well-coated steel tanks/pipework are employed at new sites or sites undergoing major refurbishment, isolating joints (e.g. plastics inserts) should be provided in the pipework near to each dispenser connection to avoid providing a possible path for electrical fault currents, and the tanks/pipework should be connected directly to an earth electrode provided exclusively for the purpose of dissipating electrostatic charge. Such isolating joints will, in any event, be required where tanks and pipework are provided with cathodic protection (CP), which inherently provides a direct connection to the general mass of earth.
e. If CP is not employed, as an alternative to providing an earth electrode exclusive to isolated well-coated steel tanks/pipework, the isolating joints may be sufficiently conductive to dissipate any static charge (i.e. having an electrical resistance in the range 100 kΩ to 1 MΩ). Alternatively an electrostatic discharge path may be provided by installing a plastic-covered copper conductor of not less than 4 mm^2 cross-sectional area between the well-coated steel tanks/pipework and the earthing arrangements of the filling station electrical installation, via a resistor having a value in the range 100 kΩ to 1 MΩ with a power rating of not less than 2 W.

Where installations having an existing integrated earthing system are to be segregated, care should be exercised to ensure that each of the segregated installations is within specification after the change.

For further guidance on controlling static electricity at petroleum installations see EI Model code of safe practice Part 21 *Guidelines for the control of hazards arising from static electricity.*

14.4.8 Cathodic protection

Where CP of tanks/pipework is specified, the necessary documentation and requirements have to be made available to the designer prior to work commencing so that the designer may carry out the necessary co-ordination with other earthing requirements.

Where CP is used, it should comply with EI *Guidance on external cathodic protection of underground steel storage tanks and steel pipework at petrol filling stations.* For new sites and sites under major refurbishment it is considered essential to include isolating joints between the protected tanks/pipework and other forms of electrode connection to earth, to reduce adverse electrolytic effects. This will also relieve the CP system from the effects of currents originating in other earthing systems. For existing sites, where isolating barriers are unlikely to exist, the precise nature of the alternating current (a.c.) supply to the site needs to be established. It is likely that the electrical installation is supplied from a TN-C-S system, in which the protective and neutral functions are combined in part of the system to provide PME. At an existing site the storage tank and associated pipework will be connected to the supply neutral and may also be connected to earth rods/tape and structural steelwork.

In such a situation the CP system will need to be able to provide sufficient current to protect all metallic structures connected to the filling station PME terminal. See section 4.2.3 of EI *Guidance on external cathodic protection of underground steel storage tanks and steel pipework at petrol filling stations.*

The CP system will, subject to ongoing maintenance, inherently provide a sufficient connection to the general mass of earth locally to the protected tanks/pipework for electrostatic discharge purposes.

With the CP system, and the metalwork from which it has been isolated, both connected, directly or indirectly, to the general mass of earth, it is unlikely that dangerous electrostatic charge will develop across an isolating joint. However, where such an earth path is absent or unreliable, the isolated metalwork should be connected together and then connected to the electrical installation main earthing terminal via a resistor having a value of not less than 100 kΩ and not greater than 1 MΩ, with a power rating of not less than 2 W. This will restrict unwanted currents passing along the metallic pipework, whilst facilitating the discharge of any electrostatic charge energy.

The cables installed should be copper-cored, plastic-coated and capable of carrying the largest current likely to occur, subject to a minimum cross-sectional area of 4 mm^2. Where connections are located in a hazardous area (e.g. tank access chamber) appropriate explosion-protection has to be adopted. Test links/points should be located in a non-hazardous area.

WARNING: Protection against electric shock and sparking: Before commencing any electrical work, including inspection and testing, at a filling station, it has to be determined whether or not CP is employed on site. Work on a CP system should be carried out only by personnel having the requisite competence. The presence of cathodically protected metalwork in tank lid access chambers, or elsewhere, in the proximity of other earthed metalwork, including at the head of a submersible pump, from which it is electrically isolated (e.g. by insulating flanges), presents a possible shock hazard, or an ignition hazard should a metal tool or other object bridge the isolating gap. Work on cathodically protected metalwork or any non-CP electrical equipment in a location where CP is present, should be carried out only after the CP system has been de-energised in accordance with the recommendations in section 6.2.6 of EI *Guidance on external cathodic protection of underground steel storage tanks and steel pipework at petrol filling stations.*

14.5 LOCATION OF ELECTRICAL EQUIPMENT

14.5.1 Dispensers for kerosene or diesel

Where kerosene or diesel fuel dispensers are installed within a hazardous area, the electrical equipment should meet the requirements for the appropriate zone.

14.5.2 Battery charging equipment

Battery charging equipment, other than that integral with the dispenser, should not be installed or used within any hazardous area of the filling station.

Where provision is made for charging batteries integral with electrically energised vehicles, the charging equipment should be located so that the cable connection to the vehicle charging inlet is within the non-hazardous area when the cable is fully extended.

14.5.3 Vent pipes

Vent pipes should not be used for mounting or securing luminaires, cables, or other electrical apparatus.

14.5.4 Canopies

Canopies are generally constructed above and clear of hazardous areas related to dispensers etc. Therefore, luminaires mounted beneath or within the underside of a canopy do not normally require explosion-protection. However, care should be taken when siting such luminaires to anticipate hazards (such as breakages) which may be created if tanker dip sticks are used beneath the canopy (see 14.5.6). Hazards may also exist because pressurised jointed pipework has been or will be located in a canopy (Note: A Zone 2 hazardous area may exist in the vicinity of screwed or flanged joints). Also, vapour releases from nearby vent pipes should be considered

14.5.5 Loudspeakers and closed-circuit television systems

Loudspeakers and CCTV systems, including their wiring and connections, should either be installed in a non-hazardous area or be suitably explosion-protected for the zone in which they are installed.

Where a loudspeaker system is intended to warn people on the forecourt in the event of an emergency, the system should be located and wired independently of any dispenser or other explosion-protected equipment and not controlled by the emergency switching system (see 14.6.4 and 14.6.5).

Where an autogas installation is being added to an existing filling station incorporating a loudspeaker warning system, the system should be extended to cover the autogas dispensers.

14.5.6 Luminaires

Dispensing areas of the forecourt and road tanker unloading area should be adequately illuminated at all times of use. A minimum design illuminance of 100 lux at ground level is required in these areas and at the read-out level of any dispenser. At tanker stands this level of illumination should be achieved with the tanker in the unloading position. Further guidance on lighting requirements is available in HSE HSG 38 *Lighting at work*.

Every luminaire installed in a hazardous area should be suitably explosion-protected for the zone in which it is located. Luminaires containing lamps with free metallic sodium (e.g. SOX) should not be located in or above hazardous areas because of the fire hazards if such lamps fall or are dropped. On all luminaires, the maximum permissible lamp wattage should be clearly indicated by a permanent label securely fixed and readily visible when relamping the luminaire. On small illuminated components, the lamp voltage and wattage should be indicated (see also section 12.2.4.2).

14.5.7 Radio frequency transmitting equipment

Where equipment capable of electromagnetic radiation is installed, care should be taken to ensure that it cannot induce a current or charge which could ignite a flammable atmosphere. BS 6656 *Assessment of inadvertent ignition of flammable atmospheres by radio-frequency radiation. Guide* provides guidance on the ignition risks posed by the use of various types of radio frequency transmitters in common use and the extent of potentially hazardous areas which can exist around them. Unless a technical assessment has been carried out by the site operator to show that its operation is safe, such equipment should be prohibited from operating on a filling station forecourt.

14.5.8 Socket outlets

Socket outlets should preferably be installed in a non-hazardous area or otherwise be suitably explosion-protected for the zone in which they are installed, and are required also to have ingress protection suitable for their environment. Socket outlets should be protected by a residual current device (RCD) in accordance with BS 7671.

14.5.9 Portable and transportable equipment

Portable and transportable equipment intended for use in hazardous areas has to be suitably explosion- protected for Zone 1 use. Handlamps, including battery operated units, should be energised from an extra-low voltage (ELV) source.

Portable and transportable equipment should be supplied via a thermoplastic or elastomer insulated flexible cable or cord with a continuous flexible metallic screen or armour and with a polyvinylchloride (PVC), polychloroprene (PCP) or similar sheath overall. The metallic screen or armour should be connected to the circuit protective conductor and not used as the sole means of earthing Class I equipment.

The equipment (other than handlamps) should be supplied at a reduced LV (e.g. 110 V centre point earthed supply) or, if supplied at a higher voltage, be provided with either earth monitoring, protective conductor proving, or a RCD having a rated residual operating current of not more than 30 mA. For further advice see HSE HSG 107 *Maintaining portable and transportable electrical equipment,* and BS 4444 *Guide to electrical earth monitoring and protective conductor proving.*

14.6 ISOLATION AND SWITCHING

14.6.1 General

Where necessary to prevent danger, suitable means have to be available for cutting off the supply of electrical energy to electrical equipment, and for the secure isolation of any electrical equipment from every source of supply of electrical energy. Where standby supplies are installed, they require the same isolation and switching requirements as a main supply. Exceptions to this requirement are detailed in 14.6.3. A typical supply arrangement is shown in Figure 14.3.

Means of isolation and switching has to comply with Regulation 12 of EWR.

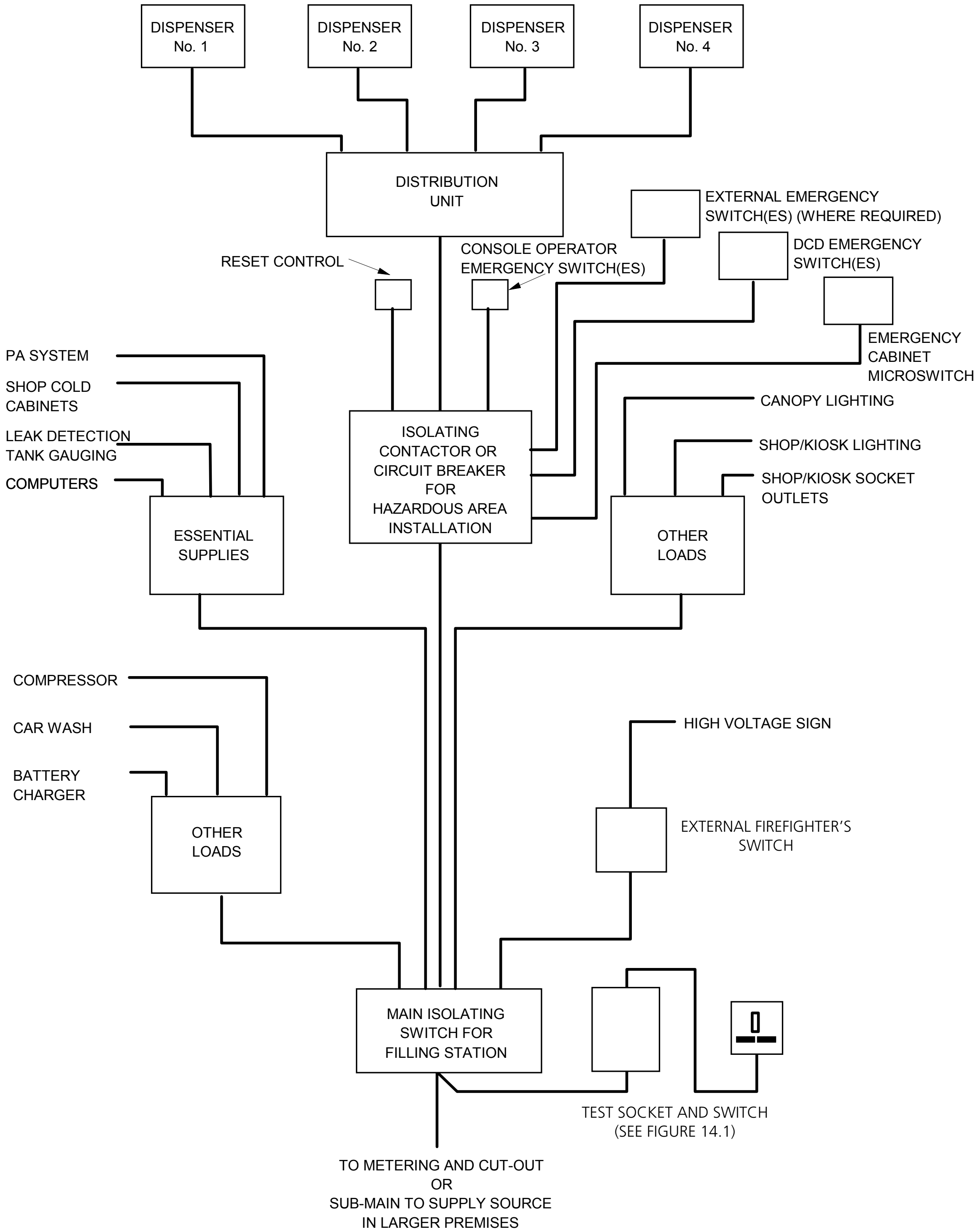


Figure 14.3 Simplified schematic arrangement

Devices for isolation and control of equipment located in a hazardous area should interrupt all live poles, including the neutral, simultaneously. Other than isolating devices located adjacent to pumps, which have to be suitably explosion-protected, devices for isolation and control should be located in a non-hazardous area. Devices for switching off for maintenance purposes are required to have locking-off facilities. Fuse carriers are not acceptable as a means of isolation.

Where a fuel pump (submersible or above ground) is controlled by more than one dispenser, means of isolation of each dispenser has to ensure simultaneous disconnection of all live poles (including the neutral) to the dispenser, including connections with the pump control circuit.

Isolating devices and switches should be clearly marked to show to which equipment they relate and should be located where they can be operated to prevent danger arising. Access for operation should be kept clear and unobstructed. Where equipment cannot be isolated by a single device, unless suitable interlocking is provided, a suitable warning notice, clearly identifying all the isolation devices, should be permanently fixed in a prominent position, visible before access to live parts can be gained. If there are different voltages present within an item of equipment, an appropriately worded warning notice is necessary.

A common device may serve more than one function provided that it satisfies all the requirements for each function (e.g. the requirements for isolation and emergency switching may be satisfied by using a 'no-volt release' circuit breaker operated by emergency switches (trip buttons) and incorporating the required characteristics of an isolator). The means of resetting the circuit breaker should be inaccessible to unauthorised persons.

14.6.2 Main switchgear

Main switchgear should incorporate the main isolating switch and the means of secure isolation required by Regulation 12 of EWR. All live conductors of the installation, including the neutral, are to be interrupted simultaneously.

14.6.3 Pump motors, integral lighting and other hazardous area circuits

Every circuit to hazardous area equipment and associated equipment which is not intrinsically-safe should be provided with an isolating switch or isolating circuit breaker in the non-hazardous area for isolation of the equipment from the source of electrical energy. (Note: this includes power, data, audio and other telecommunications circuits e.g. card readers and integral speakers etc.)

Where the equipment is supplied from more than one source of electrical energy (which may include a central control point or pump-based battery back-up) suitable warning notices should be fixed within the housing and adjacent to any external isolating devices.

Where a time delay is required for display retention for statutory metrology purposes or for the discharge of energy storage devices before working on equipment, a suitable warning notice should be fixed where it can be seen before gaining access to live parts.

14.6.4 Emergency switching

An emergency switching device should be provided to cut off all electrical supplies, including data circuits to all metering pumps/dispensers and associated equipment, including those for autogas installations; other than certified intrinsically-safe equipment. Means of operating the emergency switching device should be provided:

a. At each control console operator position at self-service filling stations.
b. At each entrance/exit of an autogas compound.
c. In a non-hazardous area adjacent to the tanker stand, where an autogas vessel and fill point are installed underground.
d. Within a driver controlled delivery (DCD) facility.

Note: where the site is unattended, partially unattended, or attendant operated, an emergency switching device has to be provided in the forecourt area, outside of the hazardous areas, visible from all dispensing positions and readily accessible for rapid operation in emergency (i.e. it should not be positioned more than 2 m above the ground). On large sites a number of suitably located operating means may be required to ensure rapid operation of the emergency switching device.

Where dispensers incorporate loudspeakers, the supply to the loudspeaker system has to be interrupted by the emergency switching arrangement.

The operating means (such as handle or pushbutton) for the device is to be coloured red against a yellow background. Resetting this device alone should not restore the supply. The separate single means of restoring the supply should be manual and located within the building where it is inaccessible to unauthorised persons.

A conspicuous, durable and legible notice has to be fitted adjacent to every operating means of the emergency switch device, as prescribed in 14.9.11.

14.6.5 Central control point

In order to satisfy statutory requirements, the main electrical switchgear/distribution board should be readily accessible so that an attendant can, if necessary, switch off the supply to any circuit or equipment on the filling station site. It should not be located in a locked room (e.g. manager's office) so that it is not readily accessible to the attendant. The equipment may, for example, be located in an 'electrical cupboard', inaccessible to the public, but accessible to an attendant.

Where the main switchgear/distribution board is not readily accessible to the attendant(s) controlling sales operations from a central location or locations, a means should be provided at each location, in addition to the emergency switching arrangements required for hazardous area circuits, for controlling the electricity supply to all forecourt circuits. This could be achieved, for example, by employing a switch or switches controlling a circuit breaker or contactor.

Such means should not be provided for intrinsically-safe circuits; emergency lighting or loudspeaker warning circuits (see 14.5.5).

14.6.6 High voltage illuminated signs

The construction and installation of high voltage (HV) illuminated signs should comply with BS 559 *Specification for the design and construction of signs for publicity, decorative and general purposes*. The signs should not be located in the hazardous area.

A firefighter's isolating switch should be provided in a conspicuous external position, outside the hazardous areas, to disconnect all live conductors of the supply to such signs and associated control equipment. A conspicuous, durable and legible notice bearing the words 'HIGH VOLTAGE SIGN FIREFIGHTER'S SWITCH' should be fixed adjacent to it. Unless agreed otherwise with the local fire and rescue service, the switch should be installed at not more than 2,75 m above the ground or standing beneath the switch and should be of a type suitable for operation by a firefighter.

The 'ON' and 'OFF' positions should be clearly legible to a person standing beneath the switch, with the 'OFF' position at the top. The operating means (e.g. handle or lever) should be coloured red against a yellow background and have the facility for latching or restraining it in the 'OFF' position.

14.6.7 Leak detection and tank gauging

Supplies to essential monitoring equipment, such as leak detection and tank gauging systems, should be installed via individual, dedicated, final circuits. Miniature circuit-breakers feeding such circuits should be clearly labelled and marked "Do not switch off" and preferably be secured in the 'ON' position. Local means of isolation or switching should not be provided for this equipment.

14.7 OVERCURRENT PROTECTION AND DISCRIMINATION

14.7.1 General

If separate devices are used for fault current and overload protection, each device should be labelled to show its function and the characteristics of the two devices co-ordinated so that the overload protective device and related conductors can withstand the energy let-through of the fault current protective device.

Every fault current protective device and every RCD should have a fault capacity not less than the prospective fault current at the point of installation of the device. Discrimination of operation between series devices is to be ensured for both fault current and overload protection. For RCDs this will involve a time delay in the operation of the supply side device, irrespective of the rated tripping currents.

14.7.2 Pump motors, integral lighting and ancillary circuits

Each circuit should be individually protected against fault current and overload by a suitably rated multi-pole circuit breaker arranged to break all live conductors including the neutral (see 14.6.3 for isolation of dispenser circuits, and 14.7.1 if separate overcurrent and fault protection devices are used). This does not apply to data and signalling circuits which are not liable to overload or fault currents.

14.8 PROTECTION AGAINST ELECTRIC SHOCK

14.8.1 General

Basic protection (direct contact with live parts) and fault protection (indirect contact with parts which may become live in the event of a fault) should be provided by means of earthed equipotential bonding and automatic disconnection of supply, or by use of equipment of Class II construction (see BS 2754 *Memorandum. Construction of electrical equipment for protection against electric shock*) where such equipment is under effective supervision in normal use. To provide fault protection, all circuits supplying equipment on the forecourt are required to disconnect in a time not exceeding 100 ms. Where a single device provides protection against fault current and overload, it has to break all live conductors (line and neutral), (i.e. multipole circuit breakers (CBs) or residual current circuit breakers with overcurrent protection (RCBOs) are necessary). Fuses are not permitted.

For data and other systems not intrinsically-safe, operating at extra-low voltage (ELV), combined protection comprising basic and fault protection should be provided by the installation of separated extra-low voltage (SELV) circuits, supplied via a EN 61558-2-6 *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1100 V. Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers* safety isolating transformer or equivalent safety source. Neither the live parts, nor the exposed metalwork of the SELV circuit should be earthed. If such parts are connected to earth, protection is no longer SELV and means of automatic disconnection of supply has to be employed.

Where a filling station installation forms part of a TT system, or otherwise where earthing arrangements will not ensure the operation of overcurrent protective devices within permitted maximum disconnection times, RCDs will be required to provide automatic disconnection of the supply under earth fault conditions.

In order to ensure security of supply (discrimination), it is preferable that each final circuit is protected by a single RCD which should take the form of a multipole residual current circuit breaker with overcurrent protection (RCBO).

Site operational requirements will usually necessitate disconnection of individual circuits, without interruption of supply to other final circuits, if excessive earth leakage currents or earth faults occur.

Where site operations do not require such security of supply for individual circuits, a group of circuits may be protected by a single RCD. All RCDs incorporated in final circuits serving a hazardous area should be independent of the operation of RCDs protecting non-hazardous area circuits.

For each RCD the leakage current of the protected circuit should not exceed 25% of the rated residual current of the RCD.

Because of the undesirability of an earth fault causing disconnection of supply to the site as a whole, it is inappropriate to provide a single 'front end' RCD at the main switch position as the sole means of earth fault protection for the installation.

If RCDs are to be connected in series, the supply side (front end) device has to be time delayed (within the relevant shock protection disconnection time) to ensure discrimination of operation of the load side device(s).

Enclosures of cables and equipment on the supply side of the RCD(s) nearest to an installation origin have to either be of an insulated type or be separated from circuit conductors (live parts) by Class II or equivalent insulation.

If a circuit-breaker complying with EN 60898-2 *Electrical accessories. Circuit-breakers for overcurrent protection for household and similar installations. Circuit breakers for a.c. and d.c. operation,* having a nominal rating of 32 A or less, is installed for automatic disconnection of supply for shock protection purposes, and the protected circuit is wired with mineral insulated copper sheathed cable having circuit conductors of 1 mm^2, 1,5 mm^2 or 2,5 mm^2, the requirements for shock protection will be met, provided that the following conditions are satisfied:

a. The earthing and bonding requirements of 14.8.2 to 14.8.11 are met.
b. The cable is installed in accordance with requirements of 14.9.
c. The cable length does not exceed 50 m.
d. The continuity of the cable sheath and its terminations has been verified in accordance with the requirements of 14.10.2.1.

14.8.2 Earthing

The earthing arrangements for the installation should include the connection of the main earthing terminal to:

a. the distributor's earthing facility separate from the neutral (TN-S system); or
b. an electrode arrangement independent of the incoming supply (TT system); or
c. the star point of an isolating transformer secondary winding, which is also connected to the transformer casing, core and screen and to an independent earthing electrode (thus forming a local TN-S system).

Prior to the installation of any earth electrode, a prospecting test should be carried out in accordance with the recommendations in BS 7430 *Code of practice for earthing*, to determine the location and type of electrode arrangement to be employed.

The electrode arrangement should be provided by suitably driven earth rods, earth mats, tapes etc, located outside the hazardous area. Individual electrodes of the electrode arrangement should be located to provide a common electrode resistance area for the filling station site.

Provision should be made for the testing of individual electrodes, by separate radial connections to the main earthing bar. It may be necessary to install one or more independent electrodes for test purposes, depending on the electrode arrangement. For general earthing requirements reference should be made to BS 7430.

14.8.3 Main earthing bar or terminal

A main earthing bar or terminal for the installation should be provided at the junction of the earthing arrangements and main bonding conductors connected to main extraneous conductive parts, including metallic service pipes, structural metalwork etc. The bar or terminal should be in an accessible position located near to the point of supply to enable disconnection of the earthing conductor from the main bonding conductors and protective conductor(s) of the installation to facilitate testing of the earthing arrangements. This joint should be in the form of a mechanically strong and electrically reliable link which can only be disconnected by means of a tool (see Figure 14.1). A label worded as follows should be permanently fixed adjacent to the main earthing bar: 'Site safety electrical earth-Do not remove link other than for testing after isolation of the installation. Replace link after testing and before re-energising the installation'.

14.8.4 Earthing of equipment located in hazardous areas

The protective conductor for every circuit supplying LV equipment (e.g. 230 V power) should be provided by means of an integral cable core connected to the earthing bar at the distribution board and the earthing facility provided in the equipment.

14.8.5 Earthing bars or terminals in equipment enclosures

An earthing bar or terminal should be provided in every enclosure of electrical equipment, other than equipment specified as having Class II construction (see BS 2754). Nevertheless, a suitably terminated circuit protective conductor should be provided where an item of Class II equipment may be replaced by an item of Class I equipment. Protective conductors of related incoming and outgoing circuits should be terminated at the earthing bar or terminal in the enclosure. When more than two protective conductors are involved, an earthing bar having an appropriate number of terminal ways is necessary.

14.8.6 Conduit, ducting, pipes and trunking

Electrical trunking and similar enclosures are not to pass through or beneath a hazardous area.

Conduit entering or passing through a hazardous area should be solid drawn. A suitable stopper box has to be installed to terminate a conduit at its point of entry to an explosion-protected enclosure and where a conduit passes from one zone to another zone or a non-hazardous area. A separate protective conductor having a cross-sectional area of not less than 2,5 mm^2 should be provided within the conduit. Where the protective conductor is common to several circuits its cross-sectional area should correspond to that of the largest line conductor.

Where ducting, pipes, trunking, access chambers or similar enclosures are used to accommodate cables, precautions should be taken to prevent the passage of flammable vapour or liquid from one hazardous zone to another zone, or to a non-hazardous area, and to prevent the collection of flammable vapour or liquid in such enclosures. Such precautions may involve sealing the enclosures with mechanical seals, suitable compound or other material resistant to VOCs in liquid and vapour forms and may involve mechanical ventilation (see 14.9.5).

14.8.7 Earthing of cable screening and armouring

Care should be taken to ensure that the earthing arrangements for data cable screening and armouring do not introduce potentially dangerous levels of energy into a hazardous area. The screening or armouring may not be capable of carrying fault or other currents from the electricity supply system or the electrical installation which might pass to earth through it via the electrical installation earthing terminal. In order to avoid such an occurrence, it is common practice to insulate and isolate data cable screening or armouring from contact with earth at its hazardous area end, and to earth it only in the non-hazardous area. Where the operation of data equipment depends on functional earthing, a separate conductor should be provided for that purpose. Reference should be made to the equipment manufacturer's instructions regarding functional earthing of data cable screening or armouring. The cable screen or armour should not be used for functional earthing purposes.

Care should be taken to ensure that metallic screening or sheaths of intrinsically-safe circuit cables are earthed at one point only and do not constitute a path for electrical fault current. Where the intrinsically-safe circuit contained within the screen or sheath is earthed, the screen or sheath should be earthed at the same point of the circuit.

Care should also be taken to ensure that metallic screening or sheaths of data cables either do not constitute an earth path for electrical fault current or are otherwise rated to carry such current where it is not likely to adversely affect transmitted data.

All such cables should be sheathed overall and the screen/armour should not be exposed anywhere along its length.

14.8.8 Bonding for electric shock and explosion protection

Electrical bonding of extraneous conductive parts and other metallic parts such as pipes, rails, steel framework etc, which do not form part of the electrical installation, should, where a hazard is foreseeable, be installed to provide:

a. Protection against the potential explosion hazard from sparks caused by contact between metal parts having different potentials.
b. Protection against electric shock by avoiding the presence of potentially dangerous voltages between simultaneously accessible conductive parts under fault conditions.

Such supplementary bonding should be provided locally across the gap between the conductive parts regardless of any main bonding connections elsewhere. There is no requirement to provide a direct connection to the installation earthing system. Care should be taken to ensure that both aspects of bonding are taken into account and that incompatibilities between the two forms of protection do not arise. The bonding provided should be capable of carrying safely the largest foreseeable current.

14.8.9 Continuity of bonding conductors

In general, an electrical bond between two metallic parts may be achieved by a permanent and reliable metal-to-metal joint of negligible resistance. Bonded metalwork should have an electrical resistance of 0,01 Ω per m or less at 20 °C.

Where sound metal-to-metal joints cannot be achieved, flanged joints in pipework should be fitted with corrosion-resistant metal bridges to ensure good electrical continuity. Connection should be by means of a conductor having a cross-sectional area of not less than 4 mm^2 copper equivalence.

14.8.10 Interconnection of earthing systems

Apart from local supplementary bonding (see 14.8.8), the electrical installation main earthing terminal and lightning protection, together with the metalwork of autogas or other non-electrical installations, should be connected together.

The connection of the bonding conductor to the lightning protection system should be as short and direct as practicable and should be made immediately above the lightning conductor test clamp and to the down conductor side thereof (i.e. to the side of the clamp opposite the earth electrode connection). The conductor should not pass through the hazardous area.

Underground petroleum tanks/pipework having CP and/or static electricity earth bonding should be connected to the foregoing common earthing arrangements only as set out in 14.4.7 and 14.4.8. This does not preclude the vent pipes of such an installation being connected to a separate earth electrode, local to them, where required for lightning protection.

14.8.11 Autogas installations

Provision should be made for the electrical connection of autogas road tankers to the metalwork of the autogas system. The terminal or other provision, which should never be located in any access chamber, should be suitable for making a bond to the tanker prior to the commencement of, and until completion of, the final transfer operation. Where the autogas vessel and metal pipework are cathodically protected, care should be taken to ensure that provision of the tanker bonding point, when in use, does not bridge the CP arrangements.

Where provisions for storage and dispensing of autogas are to be added to a site dispensing other vehicle fuels and the existing earthing system is connected to a PME terminal, a risk assessment should be carried out to determine any possible adverse effects on the autogas installation. Where the metalwork of the autogas installation is cathodically protected and employs insulating inserts, the effects of diverted neutral currents are likely to be obviated in that metalwork.

14.9 WIRING SYSTEMS

This guidance applies to the electrical installation within the curtilage of the site and not to the manufacturer's internal wiring of factory assembled units. Within hazardous areas attention should be given to the requirements of the EN 60079 *Explosive atmospheres* suite of standards, especially to the concepts of explosion protection. For areas other than hazardous areas, the relevant parts of this document and BS 7671 should be followed.

14.9.1 Conductor material

All conductors (except metal bonding bridges described in 14.8.9) having a cross-sectional area of 16 mm^2 or less should be of copper. Every protective conductor not forming part of a cable or cable enclosure should be identified throughout by green/yellow insulating covering.

14.9.2 Cables for intrinsically-safe circuits

Adequate precautions should be taken to prevent contact between the conductors of intrinsically-safe circuits and those of non-intrinsically-safe systems. In order to maintain long-term integrity of intrinsically-safe circuits, these cables should preferably be run in a duct or pipe reserved solely for that purpose. More than one intrinsically-safe circuit may be run in a multicore cable provided that the requirements of the EN 60079 standards are met.

Intrinsically-safe conductors are not to be run in the same multicore cable with conductors of non-intrinsically-safe circuits. The cables of intrinsically-safe circuits should not be run in the same enclosure or duct with non-intrinsically-safe circuits unless segregated by an earthed metal screen or shield. Cables of intrinsically-safe circuits should be of such construction as not to be damaged by the installation of other cables sharing a common duct.

14.9.3 Cables for extra-low voltage systems

Where circuits of ELV and other voltages are contained in a common trunking, duct etc, or a multicore cable is used, the higher voltage system has to be provided with an earthed metallic screen or sheath of equivalent current carrying capacity to that of the cores.

Alternatively, the conductors of ELV systems should be insulated individually or collectively for the highest voltage present on other conductors in the same enclosure.

14.9.4 Cables installed underground

All cables installed underground or in site-formed ducts or ducting etc. should be laid at a depth of not less than 500 mm or be otherwise protected against mechanical damage.

Cables laid directly in the ground should be protected against damage from rocks or stones (e.g. by surrounding with sand), and be protected by cable covers or identified by suitable marking tape.

The route of such cables should be accurately shown, with measurements, in the Site Records.

14.9.5 Underground cable duct systems

Duct systems for underground cables in hazardous areas have to be designed and constructed to minimise the possibility of fuel or vapour entering other areas, while at the same time preventing fuel and vapour from accumulating within the system. The designer of the electrical installation should advise the site architect, designer and/or builder of the requirements for underground cable duct systems.

Duct systems have to be designed to positively prevent petroleum products or other VOCs entering any building. An example of this may be to bring the ducting to above ground level adjacent to the building with sealed cable entry into the building above ground level. Protection against mechanical damage should be provided around the cables rising from the duct system. Such protection has to allow natural ventilation. Wherever possible ducts should be laid with a fall away from occupied buildings. Consideration should be given to installing spare ducts for future services when constructing or modifying a site.

Force ventilated ducts or ducting for autogas installations should be segregated from all other ducts or ducting.

Ducting and fittings should always be impervious to water, petroleum products, or other VOCs (i.e. vitrified clay to EN 295-1 *Vitrified clay pipes and fittings and pipe joints for drains and sewers* and BS 65 *Specification for vitrified clay pipes, fittings and ducts, also flexible mechanical joints for use solely with surface water pipes and fitting*, or unplasticised polyvinylchloride (PVC-U) drain pipe to BS 4660 *Thermoplastics ancillary fittings of nominal sizes 110 and 160 for below ground gravity drainage and sewerage)*. Ducting which is not impervious to VOCs (e.g. pitch-fibre) should not be used. All sealing rings should be nitrile rubber or be equally resistant to degradation by petroleum products or other VOCs. The ducting and fittings on a system should be of the same make, and installed in full compliance with the manufacturer's recommendations as regards off-loading, storage, laying, jointing, trenching and reinstatement.

Ducting should preferably be laid straight between cable chambers or drawpits, but if deviation is necessary, then formed bends of large radius should be used. Ducting should not be deviated by 'pulling-over' at the joints, which impairs their water-tightness. Where ducting is not level, laying should be commenced at the lowest point to ensure full engagement of all joints. Ducting should enter chambers at the corners, to allow maximum cable bending radii, and should be 150 mm above the base of the chamber. Where possible, a suitably sized cylindrical mandrel should be pulled through each duct before final backfilling. Non-degrading draw-ropes should be left in position for future use.

Cable chambers and drawboxes should be water-tight and fuel-tight, constructed of GRP, polyethylene or engineering brick, of adequate thickness for the depth and loading involved, and of sufficient size to accommodate properly the required cabling. Unless the ducting is short and easily accessible, the base should incorporate anchor irons or eyelets, and the walls, if sufficiently deep, should have cable chamber steps where they will least intrude upon the cable space. GRP and polyethylene chambers should be assembled and installed in full compliance with the manufacturer's recommendations, and ducting should enter such chambers via the manufacturer's nitrile rubber bellows seals with stainless steel flange rings and bolts, the seal being secured to the ducting with a corrosion-resistant worm drive clip.

Where it is necessary to fix items to the walls of GRP/polyethylene chambers, watertightness has to be preserved, and adequate strength ensured. Cable fixings, steps etc, which can be installed before backfilling takes place round the chamber, should be secured with corrosion-resistant bolts and nuts; steel and plastic washers should be fitted and a suitable sealant used. For heavy loadings, metal back-plates should be used in place of the external washers. Fixings made after reinstatement of the ground should be by self-tapping screws and a suitable sealant should be applied.

Brickwork cable chambers should be built on 100 mm thick reinforced concrete bases, and should be externally waterproof rendered before backfilling is commenced. Gaps around ducting entries should be sealed with mortar for the full thickness of the wall. There should be no rough or jagged edges where ducting has been cut to length.

Cable chamber covers and frames in vehicle circulation spaces and paved areas should be to a minimum standard of EN 124 *Gully tops and manhole tops for vehicular and pedestrian areas. Design requirements, type testing, marking, quality control*, Class C250. If watertight they should be set level with the surrounding ground; if not, the concrete bedding and surround of the cover should slope downwards so that surface water drains away from the cover.

Care should be taken to ensure that the cable chamber cover frame is adequately sealed to the chamber and to the surrounding concrete slab.

14.9.6 Cabling in underground cable duct systems

Cabling should be routed round the walls of access chambers, preferably on suitable supports (e.g. cable tray or 'J' hooks), between the various ducts. If these supports are metal, they should be corrosion-resistant. It should be noted that underground cable chambers, with the exception of chambers containing a fill point or points, in hazardous areas are classed as Zone 1, and if, exceptionally, cable connection or termination boxes are installed in them, the boxes and any associated accessories (e.g. cable glands) have to be suitable for this classification and also be ingress protected to at least IP67 rating. Where an underground chamber contains fill points it is classed as Zone 0 and no electrical equipment, other than that certified intrinsically-safe for Zone 0, should be installed in the chamber. It is an aid to maintenance if permanent labels (e.g. of engraved 'sandwich' plastic material) are fixed to all cables entering and leaving access chambers, these details being noted on the record drawings held on site.

14.9.7 Sealing of underground cable ducts

Other than for force ventilated duct systems, it is of the utmost importance that after cables have been installed and tested, and before any vehicle fuel is brought on site, all ducting terminations are adequately sealed in underground chambers, at dispensers and particularly where ducting passes from hazardous to non-hazardous areas, for example, where entering buildings. Suppliers of mechanical seals, foams and fillers intended for this application should be asked to demonstrate their compatibility with petroleum products or other VOCs in liquid or vapour form. Sealing should be achieved preferably with mechanical seals. Alternatively, sealing may be achieved with suitable compound or other material resistant to petroleum products, or other VOCs in liquid and vapour form. Conventional builders' foams or filler are not suitable for this purpose. Suppliers of foams or fillers intended for this application should be asked to demonstrate their compatibility with petroleum products or other VOCs and the intended hazardous materials used on the premises. Where sealing compound is used to seal a duct, the inner wall of the duct and the cable sheath(s) should first be cleaned to ensure that the sealant adheres to the surfaces. Suitable spacers should then be inserted to space the cables apart to ensure that the compound is able to completely fill the spaces around the cables and also to minimise penetration of compound further into the duct. All spare and unused ducts should be fitted with blind mechanical seals.

Where it is established that a VOC has been present in a duct or chamber an inspection should always be carried out to determine the continued integrity of any duct sealing.

Cable chambers and pre-formed cable trenches should not be sand filled and/or screeded, since this simply conceals any leakage and accumulation of fuel, and adds considerable difficulty to any future access for repairs or maintenance. Outdoors, access chamber covers should be fitted as described above; for indoor situations in non-hazardous areas adequate fixed covers should be provided to exclude dirt, vermin etc. Where cables emerge above floor level, protection against mechanical damage has to be provided where the cables are not otherwise protected.

14.9.8 Force ventilated ducts and cable chambers for autogas installations

Where a force ventilated system is employed to avoid a build-up of vapour in ducts and access chambers associated with an autogas system, the following points should be noted:

a. The ventilation unit should **not** be controlled by the emergency switching arrangements for the dispenser systems.
b. The ventilation unit has to be explosion-protected for Zone 1.
c. Ventilated ducts and cable chambers have to be totally segregated and sealed from all other ducts and access chambers, also to prevent leakage of potentially flammable vapour into a non-hazardous area.
d. The ventilated ducts are not to be sealed or obstructed throughout their length in any way.
e. Where the ventilation system incorporates a vent pipe, the pipe should be treated as a petrol vent pipe without vapour recovery for the purposes of zoning.
f. Equipment, including cable, should never be mounted on the vent pipe.
g. Cables for forced ventilated systems are not permitted to be run in the ventilated ducts and have to be contained within their own electrical ducts or ducting.

A forced ventilation system should incorporate means for monitoring the flow of air at the points of ingestion and exhaust of ducts and be able to continuously compare these two flow rates so as to maintain the integrity of the system. The system has to incorporate a means of monitoring the percentage of any vapour present to ensure that it is not greater than the recommended lower explosive limit (LEL). The air intake has to also be monitored to ensure that other hazardous products that could increase the hazard are not ingested.

A simple displacement flap system is considered to be inadequate because it will not have the ability to compare input and exhaust flow rates and may not be 'fail-safe'.

14.9.9 Protection against mechanical damage

In any location available for vehicular access, cables, trunking or other enclosures should be positioned or protected to a height of at least 1,5 m so that they are unlikely to be damaged by moving vehicles.

Cables drawn or laid in ducts should be of such construction that they are not liable to be damaged by the drawing in or withdrawal of other cables.

14.9.10 Types of cable

Generally, types of cable and the methods of their installation should comply with BS 7671. Within and under Zone 1 and Zone 2 hazardous areas, the following types are acceptable, with mineral insulated cable being preferred due to its superior resistance to degradation from contact with vehicle fuels:

a. Mineral insulated copper sheathed cable. Cables should be terminated into accessories or enclosures with approved glands, appropriate to a Zone 1 or Zone 2 location, employing earth tail pots. The cable should comply with EN 60702-1 *Mineral insulated cables and their terminations with a rated voltage not exceeding 750V. Cables* with a thermoplastic outer covering; glands being protected by suitable shrouds. This type of cable may be damaged by transient voltages. Particular care should be taken to ensure that associated equipment complies with the cable manufacturer's requirements for voltage surge suppression. Where surge suppression devices are located in hazardous areas, they are to be suitably explosion-protected. Earth tail pots should be used to provide a reliable earthing connection to the sheath of mineral insulated cable. This is in addition to the protective conductor core within the cable.

b. Armoured cable (i.e. with PVC, cross-linked polyethylene (XLPE) or equivalent insulated conductors, insulated, steel wire armoured and PVC or equivalent sheathed cable). The cable should comply with:
   - BS 6346 *Electric cables. PVC insulated, armoured cables for voltages 600/1 000 V and 1 900/3 300 V*;
   - BS 5467 *Electric cables. Thermosetting insulated, armoured cables for voltages 600/1 000 V and 1 900/3 300 V*;
   - BS 6724 *Electric cables. Thermosetting insulated armoured cables for voltages of 600/1 000 V and 1 900/3 300 V, having low emission of smoke and corrosive gases when affected by fire*; or
   - BS 7211 *Electric cables. Thermosetting insulated, non-armoured cables for voltages up to and including 450/750V, for electric power, lighting and internal wiring, and having low emission of smoke and corrosive gases when affected by fire* and be terminated in glands suited to the zoning of the hazardous area to maintain the integrity of the explosion-protection concept used. Where a cable feeding equipment in a hazardous area is supplied from a thin wall enclosure in a non-hazardous area, an earth tag washer is to be fitted between the cable gland and the outside of the enclosure to provide a means of connecting a separate protective conductor to the earthing bar or terminal within the enclosure (i.e. in addition to the protective conductor core within the cable). A corrosion-resistant nut and bolt arrangement should be provided for the thin wall enclosure to facilitate a connection from the external earth tag washer to a lugged cable connected to the earthing bar or terminal inside the enclosure. The internal cable to the earthing bar or terminal should be of the same cross-sectional area as the related phase conductor, subject to a minimum cross-sectional area of 2,5 mm^2.

c. Steel wire braided cable having a hydrocarbon-resistant outer covering. The cable should be terminated in shrouded glands which provide a mechanically and electrically sound anchorage for the steel wire braid and which are suited to the zoning of the hazardous area to maintain the integrity of the explosion-protection concept.

d. Other cables are only acceptable if:
   - The cable forms an integral part of an intrinsically-safe circuit.
   - The cable, if multicore, contains only intrinsically-safe circuits and is not run in common duct with other circuits unless the other circuits are separated from the intrinsically-safe circuits by a suitable earthed metallic screen or barrier.

Within Zone 0 hazardous areas the cables referred to in (a), (b), (c) and (d) are acceptable providing they form part of a system certified intrinsically-safe for Zone 0, or pass unbroken through the zone.

14.9.11 Labels and warning notices applicable to electrical installations

The electrical installer will provide and install the labels and warning notices as detailed below. They should be of a permanent nature (e.g. 'sandwich' plastics material) so that filling of engraved characters is not required.

Use should be made of contrasting colours (e.g. black on a white background, white on a red background) where this is appropriate. Labels and their lettering should be sized in proportion to the equipment on which they are mounted, and should be securely fixed.

Where equipment is not to be drilled (e.g. explosion-proof or watertight apparatus) a suitable adhesive should be used, the manufacturer's recommendations on preparation of surfaces etc. being fully observed. Where adjacent equipment has interchangeable removable covers, labels should not be fitted to the covers but should be in fixed positions.

If any of the labels are provided to warn of a significant risk to health and safety, or are required under any other relevant law, then they have to comply with the Health and Safety (Safety Signs and Signals) Regulations 1996. Guidance on these requirements is contained in HSE *Safety signs and signals: The health and safety (safety signs and signals). guidance on regulations*, L64.

A conspicuous, durable and legible notice has to be fitted adjacent to the main isolating switch for the filling station electrical installation and at any equipment at which cathodically protected metalwork is simultaneously accessible with other earthing arrangements, bearing the words:

ALL OR PART OF THE TANKS AND PIPEWORK AT THIS SITE HAS CATHODIC PROTECTION

At a filling station not storing and dispensing autogas, a conspicuous, durable and legible notice has to be fitted adjacent to the operating means of each emergency switching bearing the words:

PETROL PUMPS SWITCH OFF HERE

Where autogas is stored and dispensed at a filling station, the following apply:

A conspicuous, durable and legible notice has to be fitted adjacent to the operating means of each emergency switching device at the autogas storage compound, bearing the words:

EMERGENCY AUTOGAS PUMP SWITCH OFF HERE

Every emergency switch accessible to staff and the general public has to have fitted adjacent to it a conspicuous, durable and legible notice bearing the words:

AUTOGAS AND PETROL PUMPS SWITCH OFF HERE

A conspicuous, durable and legible notice has to be fitted adjacent to the terminal or other provision for earth bonding of road tankers during fuel transfer, bearing the words:

TANKER EARTH BONDING POINT

14.10 INSPECTION AND TESTING

14.10.1 Verification of the installation

14.10.1.1 General

Whilst this publication gives guidance on requirements for construction and major refurbishment of electrical installations at filling stations in accordance with current safety standards and technology, the following recommendations for inspection and testing include aspects applicable to the verification of older installations pre-dating the first edition of this publication (November 1999).

The site operator (the duty holder) has to rely on the effective monitoring of the electrical installation and equipment in order to comply with the EWR and DSEAR. These recommendations are not addressed to the site operator but provide technical guidance for electrically competent persons appointed to verify the safety and effectiveness of the electrical installation and equipment on behalf of the duty-holder.

The HSE/Local Authority Enforcement Liaison Committee (HELA) *Standard conditions of licence for filling stations* states that "The Licensee (Duty Holder) shall maintain and produce to an Inspector on demand, documentary evidence that all electrical equipment and parts of the electrical installation on the Licensed Premises relevant to; the delivery, storage and dispensing of petroleum spirit; and to those areas of the Licensed Premises where an flammable atmosphere may occur; comply with existing legislative requirements. Note: The 'Licensee' is the Duty Holder under statutory legislation."

In order to provide the maintenance of safety required by the above statutory legislation the verification of the electrical installation and equipment at a filling station is prescribed in the remainder of section 14.

14.10.1.2 Certification of electrical installation and equipment in hazardous areas

To satisfy maintenance requirements under Regulations 6(4) and 6(8) and related Schedule 1 of DSEAR and Regulation 4(2) of the EWR with regard to the prevention of fire or explosion due to ignition of a dangerous substance or flammable atmosphere, inspection and testing should be carried out annually in respect of the following:

a. Electrical equipment in, and associated with, hazardous areas.
b. Electrical earthing arrangements, including measurement of PME diverted neutral currents and other earthing currents.

A model certificate for certifying compliance with the above statutory requirements is provided in Annex 14.5A.

14.10.1.3 Verification of electrical installation and equipment in non-hazardous areas

To satisfy maintenance requirements under Regulation 4(2) of EWR with regard to electrical equipment not in a hazardous area, but which is considered to have an increased level of risk of electric shock because of its duty of use, inspection and testing should be carried out annually in respect of the following:

a. Circuits feeding car washes and other external equipment used by the public.
b. Portable equipment and other equipment connected to the supply via a flexible cord and/or plug and socket.

The remainder of the electrical installation and equipment on site should be inspected, tested and maintained at a frequency which enables the site operator to satisfy their statutory duties under Regulation 4(2) of EWR. Model records for recording compliance with the statutory requirements are provided in Annex 14.5.

14.10.1.4 Verification - general

The verification, including inspection and testing, will depend on the form of construction and inspection and testing facilities incorporated at the time of installation. In particular, the presence or absence of relevant circuit diagrams, charts and previous inspection and testing records will be a major factor in determining the overall amount of verification work to be undertaken. Where such records are not present on site for verification purposes, it will be the responsibility of the person(s) undertaking the current work to create the necessary documentation to form the basis of on-going site electrical records. The simplicity or complexity of this essential task will be reflected in the amount of time required overall for the verification work.

Inspection and testing should relate to the status of the installation, which might be a site under construction where pre-commissioning inspection and testing could be carried out, followed by initial inspection and testing at completion. Alternatively, the installation might be on an 'elderly' site with older dispensers.

Dispensers for vehicle fuels, including refurbished units, should be certified by an accredited testing and certifying body as complying with the relevant harmonised European or International Standard or ATEX, see section 9.

The standards for the certification of metering pump/dispensers do not contain requirements for other aspects of filling station installations.

Typically, electrical requirements in standards for metering pumps/dispensers include:

– Zoning for electrical apparatus within a dispenser, dependent on the presence of prescribed vapour barriers.
– ELV circuits (ELV = not more than 50 V a.c. or 120 V ripple-free direct current (d.c.)) have to be terminated in an explosion-protected terminal enclosure separate from that for the input supply cables.
– All internal metal enclosures of electrical apparatus have to be connected to a main earth connecting facility in or on the metering pump or dispenser.
– A bonding terminal (for testing) has to be provided within the housing.
– All cables and cable terminations have to be labelled and easily identified from manufacturers' drawings.
– Labels warning to isolate equipment electrically before removing electrical enclosure covers have to be mounted within a pump housing and be clearly visible when the inside of the housing is exposed.
– Instructions should always be provided for the safe installation and operation of the dispensers.

Particular items to be inspected or tested at autogas installations include:

– The condition and continuity of the earth bonding terminal or other provision for bonding a tanker during fuel transfer.
– The condition and continuity of flange joints or other couplings in accessible fuel lines and metal bridges where provided.
– The conditions and adequacy of insulation materials around and adjacent to insulating inserts separating cathodically protected parts from other metalwork.

Appropriate documentation relating to electrical equipment on site should be retained. The records should include the following:

– Pre-commissioning test record (see model in Annex 14.6).
– Inventory checklist for equipment associated with the electrical installation (see model in Annex 14.7).
– Filling station electrical installation certificate (see model in Annex 14.8).
– Reports detailing the results of inspection and testing of portable appliances and other current-using equipment.

Further guidance may be obtained from the EN 60079 standards, BS 7671 and IEE Guidance Note 3 *Inspection and testing*.

Inspection and testing applicable to a particular site are determined by selecting the relevant verification programme, shown in Table 14.1, against the installation status. All defects identified following verification in accordance with 14.10.1.2, that require rectification either immediately or within 12 months, should be identified on a defect report (Annex 14.5B) accompanying the Certificate of Electrical Inspection and Testing (Annex 14.5A) and handed to the site operator or their agent for action. The contractor should obtain the signature of the site operator or their agent for receipt of the defect report. The contractor should retain a copy. All defects identified following verification in accordance with 14.10.1.2 and 14.10.1.3 should be recorded on the Electrical Periodic Inspection Report (Annex 14.9).

WARNING: Protection against electric shock and sparking: Before commencing any electrical work, including inspection and testing, at a filling station, it should be determined whether or not CP is employed on site. Work on a CP system should be carried out only by personnel having the requisite competence. The presence of cathodically protected metalwork in tank lid access chambers, or elsewhere, in the proximity of other earthed metalwork including the head of a submersible pump from which it is electrically isolated (e.g. by insulating flanges), presents a possible shock hazard, or an ignition hazard should a metal tool or other object bridge the isolating gap. Work on cathodically protected metalwork or any non-CP electrical equipment in a location where CP is present, should be carried out only after the CP system has been de-engerised in accordance with the recommendations in section 6.2.6 of EI *Guidance on external cathodic protection of underground steel storage tanks and steel pipework at petrol filling stations.*

Table 14.1 Installation status

INSTALLATION STATUS			
Type of site	**Type of verification**	**Availability of records**	**Verification programme**
New site or major refurbishment	Pre-commissioning	Certification of design and construction, design drawings and circuit diagrams available	1
	Initial verification		2
Existing site	Periodic verification	Site electrical records available	3
		Site electrical records not available	4

14.10.2 New site or major refurbishment

14.10.2.1 Pre-commissioning verification - Programme 1

During erection and prior to commissioning, whilst the area (which may be the entire site) is still gas-free, the installation is to be inspected and tested by a competent person to verify that the relevant requirements have been met.

For an extension or modification of an existing installation, pre-commissioning testing should be undertaken only if the area in which testing is required has been certified gas-free by a person competent to make such certification and the site operator or their competent representative has authorised work to start.

During erection of the installation, each mineral insulated cable or steel wire armoured cable should, after assembly of its terminations and before connection to equipment terminals, be tested to verify the continuity of conductors including the metallic sheath/armouring and the adequacy of insulation between each conductor and each other conductor including the metallic sheath/armouring.

Testing procedures should be carried out in the following sequence:

a. After terminating the ends of each mineral insulated or steel wire armoured cable, and before an enclosed core, to be used as the circuit protective conductor, is connected in parallel with the outer metallic sheath or armour, the resistance of the line conductor (R_1) and each other conductor separately, including the sheath/armour, is measured. The value of R_1 should be recorded. (Annex 14.2 gives some expected values).

Note: If a high current test instrument is being used (i.e. between 10 A and 25 A), the test current should be applied for not less than one minute, during which time any noticeable fluctuations in the reading will usually indicate the presence of one or more inadequate connections, which have to be investigated and remedied (see IEE Guidance Note 3).

b. Before connection of the cable conductors to equipment terminals, the insulation resistance is to be measured. The insulation resistance between any conductor and any other conductor or metallic sheath/armouring should not be less than 10 MΩ when tested with a 500 V d.c. insulation test instrument.

c. Where earthing of the installation is provided by a local earth electrode arrangement (see 14.8.2), the earth resistance of each earth rod, plate or tape has to be separately tested. The measurements are to be recorded for future comparison, together with a means of identifying the individual items. This test of earth electrode resistance is a pre-commissioning test which should be carried out using an earth electrode resistance test instrument prior to the installation being energised. An earth fault loop impedance test instrument, which requires a source of supply to be available to the installation, is not appropriate for this test.

The earth electrode resistance of an individual earth rod, plate or tape at a filling station in the UK should normally not exceed 100 Ω. If the value does exceed 100 Ω it may be unstable. The cause of the high reading should be investigated and rectified (e.g. a better electrode may be required). In any event the product (multiple):

R_A x RCD rated residual (tripping) current, ($I_{\Delta n}$), in amperes should not in any circumstances exceed 25, where R_A is the aggregate earth electrode arrangement resistance.

R_A should not exceed 20 Ω. (Note: Where lightning protection is installed, the value should not exceed 10 Ω). A lower value may be required, depending on the rated residual (tripping) current of the RCD selected. For example:

i. An RCD having 2A (2 000 mA) rated residual (tripping) current would require a maximum R_A of 12,5 Ω (25 divided by 2);

ii. An RCD having a 5A (5 000 mA) rated residual (tripping) current would require a maximum R_A of 5 Ω (25 divided by 5).

The maximum rated residual (tripping) current for an R_A of 20 Ω is 1,25A (1 250 mA, i.e. 25 divided by 20).

The determination of R_A provides for selection of an RCD having an appropriate rated residual (tripping) current suited to limiting the potentially dangerous effects of earth faults which might otherwise occur in a filling station hazardous area environment.

d. Where the prospecting test carried out in accordance with 14.8.2 precludes the achievement of an appropriate value, a risk assessment should be carried out by a competent person and the results passed to the site operator for retention.

e. Results of pre-commissioning tests should be recorded on a pre-commissioning test record (see Annex 14.6).

14.10.2.2 Initial verification - Programme 2

On completion of the electrical installation a comprehensive inspection should be undertaken and the inventory checklist (see Annex 14.7) should be completed for retention with the site electrical records. The results of the inspection should be recorded in the checklist in the Filling Station Electrical Installation Certificate (see Model in Annex 14.8). The following tests should be carried out and the results recorded on a suitable schedule of test results:

a. After all the protective conductors are connected to equipment terminals, low current intrinsically-safe continuity tests are to be made to measure the resistance of the earth fault path (R_2) between the main earthing terminal and exposed conductive parts of each dispenser or other item of equipment.

   The resistance (R_2) of the combined path formed by the designated cable core and parallel sheath/armour between the main earthing terminal and a dispenser should always be less than the resistance of the sheath/armour determined from 14.10.2.1, (see Annex 14.2). Test positions and resistance readings should be recorded for comparison with future periodic tests.

b. The polarity and identification of circuit conductors should be verified at all relevant points of the installation.

c. The insulation resistance of each circuit should be tested in accordance with A14.1.8 in Annex 14.1.

d. Earth fault loop impedance measurements should only be made at the origin of the filling station installation (using the test link and test socket provided under 14.4.5), with all installation protective conductors and main bonding conductors disconnected by temporarily opening the test link (see 14.8.3). This procedure is carried out only with the main isolating switch for the site secured in the 'open' position.

   The external fault loop impedance (Z_e) should be measured at the origin of the filling station installation to determine its actual 'in-service' value, using a proprietary earth fault loop impedance test instrument. This should confirm any calculated value used for design purposes. Values obtained by 'enquiry' to energy distributors should not be used in any event. The maximum permitted measured value is: 25 Ω for a TT system; 0,8 Ω for a TN-S system; 0,35 Ω for a TN-C-S system (only at an existing site not converted to TT or TN-S). Further guidance on measuring earth fault loop impedance is given in Annex 14.4.

   The measured value of external earth fault loop impedance (Z_e) at the origin should be added to the measured value of ($R_1 + R_2$) for the cables connected to each item of earthed equipment to provide an overall value of system earth fault loop impedance (Z_S) for that equipment. The measured value of Z_e and determined values of Z_S should be recorded for future reference.

WARNING: It is essential that the earth testing link is securely reconnected before re-energising the installation.

Note: Where the loop incorporates a distribution circuit (sub-main) the relevant resistances should be taken into account.

e. The prospective fault current at the origin of the filling station installation should be determined by calculation or measurement (at the test socket provided under 14.4.5), not by 'enquiry' to the supply distributor. The larger of prospective earth fault or prospective short circuit current (PSCC) should be recorded.

Further guidance on determining prospective fault current is given in Annex 14.4.

f. The operation of RCDs should be tested using a proprietary test instrument as detailed in EN 61557-6 *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. Equipment for testing, measuring or monitoring of protective measures. Effectiveness of residual current devices (RCD) in TT, TN and IT systems.*

For the operation of RCDs and testing of earth electrodes, all tests should be carried out from non-hazardous areas and in accordance with Part 6 of BS 7671.

The test button incorporated in each RCD should also be used to check its mechanical operation.

All readings and measurements should be recorded (see Annex 14.1) in the filling station electrical installation certificate (see Model in Annex 14.8).

Note: RCD tests do not verify the integrity of earthing arrangements.

14.10.3 Existing sites

14.10.3.1 Periodic verification

All electrical equipment on the site should be subject to an inspection and test programme to establish that it is in accordance with the relevant aspects of EWR and particular requirements relating to the storage and dispensing of petrol (see 14.10.1).

The amount of work and the time required to verify the electrical installation at an existing filling station will, with other factors such as the size of the site, depend on the presence of site electrical records, including drawings, schedules of previous test results, etc, and the type of dispensers installed.

The site has to be closed during the inspection and testing of both its main switchgear and earthing systems and may require to be closed during testing of the electrical equipment in hazardous areas.

Prior arrangements should be made for closure of the site and where necessary all computer systems have to be properly logged off and shut down.

An initial survey of the electrical installation and electrical equipment at the filling station should first be carried out and the results recorded on an inventory checklist and initial assessment forms. This will lead to a determination of the installation status.

Testing and recording of results should then be carried out in accordance with the appropriate programme, 3 or 4.

Inspection and testing procedures are detailed in Annex 14.1.

Where the inspection and/or testing reveals a dangerous or potentially dangerous situation on an item of electrical equipment which requires immediate attention, the details should be identified in writing and handed to the site operator or their agent for action (see Model in Annex 14.10). The contractor should obtain the signature of the site operator or their agent for receipt of the notice which should be retained with other site electrical records. The contractor should retain a copy of the notice.

14.10.3.2 Check for PME diverted neutral current

Where the installation is earthed via a public supply earthing facility, the measurement for any diverted neutral current prescribed in 14.3.5 should be made on the earthing conductor. Where the current in the earthing conductor exceeds 100 mA, additional tests should be made on main bonding conductors connected directly to the earthing facility.

Where the current in the main bonding conductors exceeds 100 mA, additional tests should be made on individual circuit protective conductors and on other bonding conductors.

If the value of 100 mA is exceeded on a final circuit protective conductor or a bonding conductor, a detailed risk analysis should be carried out which may conclude that connection to the public supply earthing should be removed and alternative means of earthing provided (further guidance is given in Annex 14.3).

Where the installation is earthed other than via a public supply earthing facility, similar tests should be carried out to ascertain the presence of current exceeding 100 mA. In the event of the current exceeding 100 mA, a detailed investigation of the cause of the current should be undertaken and any necessary remedial work carried out.

14.10.3.3 Minimum inspection and testing requirements for the installation in, and associated with, the hazardous area

This relates to satisfying the requirements of DSEAR and EWR with regard to the risk of fire and explosion existing in hazardous areas (see 14.10.1.2). For the purposes of (i): periodic inspection and testing and (ii): verification of site modifications carried out since the previous electrical certificate was issued, which may affect the safety or operation of the electrical installation, the following equipment, as a minimum, should be subject to an inspection:

a. All equipment in the hazardous and non-hazardous areas associated with the storage and dispensing of fuel.
b. All non-hazardous area equipment which could encroach on the hazardous area (e.g. canopy lighting, signs and portable equipment) and cause danger.
c. All other circuits, the cables of which pass through, or under, hazardous areas or which share the hazardous area ducts. Unless it has been established that cables to other equipment do not pass through the hazardous areas or use common ducts or access chambers, then this equipment should also be tested.

Additionally, items (a) and (c) should be subject to electrical testing.

A certificate of electrical inspection and testing at filling stations with a defect report (if any defects are not corrected) should be completed for statutory enforcement purposes (see models in Annex 14.5A and 14.5B). Additionally, a filling station electrical periodic inspection report (see model in Annex 14.9) detailing test results, defects and observations should be produced for retention with site electrical records. If it is not possible to carry out any of the required tests then this, the reason for it and supporting recommendations, should be stated in the applicable section provided on the inspection and testing report.

For each programme, inspection should be carried out in accordance with Annex 14.1. Testing should be carried out in accordance with one of the following programmes:

i. Programme 3 - when site electrical records available, check:
   – PME diverted neutral current (see 14.10.3.2).
   – Earth continuity - as Programme 2(a).
   – Polarity - appropriate sampling tests.
   – Insulation resistance - see Annex 14.1.
   – Earth electrode resistance - for existing TT installations, using the test socket and test link.
   – Earth fault loop impedance and prospective fault current-if test socket and earth test link present, as Programme 2(d), otherwise calculate prospective fault current.
   – RCD operation - where present, as Programme 2(f).
   – Miniature circuit breaker (MCB) operation-manual operation of circuit-breaker.

Test results should be entered in the existing site electrical records.

ii. Programme 4 - when site electrical records **not** available check:
   – As Programme 3.
   – Create site electrical records relevant to the storage and dispensing of vehicle fuels and enter test results.

14.10.3.4 Minimum inspection and testing requirements to satisfy Regulation 4(2) of EWR

Circuits feeding car washes and other external equipment used by the public; and portable equipment and other equipment connected to the supply via a flexible cord and/or plug and socket should be inspected and tested annually. Results should be recorded. (Note: these requirements do not relate to certification of electrical installations and equipment in or associated with hazardous areas.)

14.10.4 Reporting and certification

Verifying the condition of the electrical installation and equipment at a filling station fulfils two main purposes:

a. To show that it satisfies the statutory safety requirements of EWR and DSEAR.
b. To provide site operators with sufficient information to enable them to comply with their statutory duties.

This will apply regardless of the age of the installation and equipment, and the previous codes of practice to which it was designed and constructed. It is the responsibility of the competent person carrying out the verification to identify any defects, deviations or non-compliances which may make the installation and equipment non-compliant with this publication and the relevant requirements of BS 7671, the EN 60079 standards and all other codes of practice and requirements of statutory regulations.

Additionally, the site operator may be advised of items which could be updated to raise the effectiveness and safety standard of the installation and equipment to the level currently applied to new filling stations.

The site operator has to comply with statutory 'employer' duties. Regulation 3 of the Management of Health and Safety at Work Regulations 1999 (MHSWR) requires every employer and self-employed person to carry out a risk assessment of the workplace. This requires the identification of hazards and eliminating or minimising the risks to persons by applying appropriate control measures.

Certain hazards in workplaces are not subject to the discretion of the employer under the risk assessment requirements of MHSWR Regulation 3, as they have been pre-determined as unacceptable hazards by way of specific requirements or prohibitions contained in other statutory regulations.

In particular, EWR contain many specific requirements and prohibitions which are said to be 'absolute' and must be met regardless of cost or other considerations.

Other requirements in EWR permit 'reasonably practicable' action to be taken to prevent danger arising. This allows an assessment of the cost in terms of the physical difficulty, time, trouble and expense of preventive measures to be weighed against the degree of risk.

The purpose of EWR is to require precautions to be taken against danger (i.e. the risk of death or personal injury), from electricity in the workplace.

The existence of EWR and supporting HSE guidance has eliminated much of the need for, or the freedom to make, risk assessment of electrical hazards. The following examples illustrate why there is no room for subjective or risk assessment evaluations with many electrical safety matters:

a. It is illegal to leave a dangerous live part accessible such that it can be touched by a person.
b. Where metalwork is required to be earthed, it is illegal if it is not earthed.
c. On the basis that a fuse is correctly rated to prevent danger, it is illegal to replace it by a fuse of higher rating or incorrect type.
d. It is illegal for electrical equipment to be installed in a potentially flammable

atmosphere (hazardous area) unless suitably explosion-protected.

The safety provisions of this publication relate to specific safety measures aimed at preventing danger. Risk assessment weighting does not apply to individual measures. A measure is, or is not, applicable depending on the presence of the foreseen hazard.

The following criteria for assessing the danger level of a defect, deficiency or non-compliance are recommended:

i. DANGER PRESENT
   – The risk of death or personal injury exists.

ii. DANGER PROBABLE
   – Whilst danger does not exist, it may occur at any time because of the absence of a required safety precaution.

iii. DANGER POSSIBLE
   – Whilst danger does not exist and is not imminent, the absence of a required safety precaution may result in danger.

The urgency and priority of remedial action should relate to the danger level, which may include the need to isolate a circuit or equipment.

The following examples identify typical defects, deficiencies or non-compliances and recommended remedial action:

i. DANGER PRESENT

Example: Dangerous live parts accessible-possible breach of statutory requirements. This should be dealt with before leaving site.

ii. DANGER PROBABLE

Example: Metal enclosures not earthed as required - possible breach of statutory requirements. Recommend immediate attention.

Example: Fuses over-rated for overload or with under-rated breaking capacity-possible breach of statutory requirements. Recommend immediate attention.

Example: Non-explosion-protected joint box in hazardous area-possible breach of statutory requirements. Recommend immediate attention.

Note: Immediate attention in these three examples means that relevant remedial work should be carried out urgently.

In order to protect the site operator in respect of their legal duties, the above examples should all be classified as 'C = UNSATISFACTORY' on the certificate of electrical inspection and testing.

iii. DANGER POSSIBLE

Examples of other defects, deficiencies or non-compliances relating to safety provisions of this publication, BS 7671, EN 60079 standards or other recognised code of practice are:

Example: Measured diverted neutral current at main earth connection (PME) in excess of prescribed limits. Further detailed investigation of earthing arrangements should be made within 14 days.

Example: Electrical trunking lid and conduit box lids missing in storeroom; cables could be damaged; insulation tests satisfactory. Recommend replacement at time of other electrical work-maximum three months.

Example: An old installation (parts probably at least 25 years old); poor standard; brittle insulation; mixture of old cable types with insulation tests just acceptable; sloppy switch mechanisms. Potential for fire and shock risks. Rewiring possibly required. Recommend detailed survey within six months.

Such defects, deviations or non-compliances should be recorded on the certificate as classification 'B = SUITABLE FOR CONTINUED USE BUT', their description, recommended remedial action and urgency/priority being related to their seriousness.

For example, having checked that an installation has a connection to earth, it might not be possible to safely verify the earth loop impedance, because there is no test socket and/or test link. The Inspection and Test Report would indicate that the earth fault loop impedance had not been tested. Whilst there may be other ways of checking that there is a connection to earth, they will not indicate whether the earth fault loop impedance is acceptable for protection against electric shock and fire.

The absence of the test socket and/or test link and consequential non-measurement of earth fault loop impedance would appropriately fit the 'DANGER POSSIBLE' level.

A suitable comment might be, 'Adequacy of earthing cannot be tested-no test socket/link fitted. Recommend installation of test socket/link before next inspection-maximum 12 months'. If the test socket is not installed within 12 months, it is recommended that this omission be re-catergorised as 'C = UNSATISFACATORY' on the certificate of electrical inspection and testing.

Generally, a site operator will not have the electrical competence required by Regulation 16 of EWR and will have to rely on the competence of others in order to fulfil their legal duties. This is particularly important in respect of the site operator's duty to carry out risk assessment.

Whilst the site operator is not making an assessment of the electrical hazards present, they do have to assess and evaluate the 'reasonably practicable' options for remedial action. There may be different ways of taking remedial action and different urgencies/priorities which can be applied to the remedial action.

For example, the site operator could choose between having a defective item repaired immediately or having it temporarily disconnected from the supply to be replaced at a later date, to suit operational needs.

It is therefore imperative that the verifier provides a full and comprehensible statement about the condition of the electrical installation and equipment on site.

The defect report should therefore identify separately for each defect, deficiency or non-compliance, the following:

– the nature of the defect, deficiency or non-compliance;
– its seriousness;
– necessary remedial action, and
– urgency or priority of remedial action.

The model certificate of electrical inspection and testing shown in Annex 14.5A contains three classifications, one of which is to be awarded for the verification of the installation and equipment:

– A = SATISFACTORY as far as could be ascertained.
– B = SUITABLE FOR CONTINUED USE subject to the defect(s) being remedied before the date(s) shown in the defect report attached.
– C = UNSATISFACTORY Defects observed are of a dangerous nature and require immediate attention. The presence of the recorded defects could make the site operator or their agent liable to prosecution.

The classification awarded relates to the classification of the worst defect(s) observed.

For classification 'B' and 'C' the defect report should be attached to the certificate.

Document serial numbers allocated to the inventory checklist, initial assessment and inspection and test report should be recorded on the certificate.

The defects to be recorded on the defect report (Annex 14.5B) are those relating to failure to meet statutory requirements. Non-compliances relating to other items should only be recorded on the filling station periodic inspection report (Annex 14.9) together with the defects shown in the defect report.

Defects presenting a real and immediate danger should be recorded on the electrical danger notification (Annex 14.10). The electrical danger notification should be signed by a person responsible for the site, who should be given a copy.

Whilst it is recognised that the person(s) undertaking the inspection and testing may not be authorised to carry out remedial work necessary to correct observed defects, every effort should be made to ensure that any items having 'C' classification are corrected without undue delay, thus avoiding the issue of a Class C certificate. The issue of a 'Class C' may result in the enforcing authority serving a prohibition notice to prevent the dispensing or sale of fuel.

The competent person carrying out the periodic inspection/testing should be aware that where the installation is awarded a B or C classification, the enforcing authority will use the certificate as a supporting document for any enforcement action taken should the site operator either continue to use the installation when immediate action has been recommended or where there has been a failure to rectify items in need of improvement within the recommended time scale.

For items having classification B, the recommended period of time for completing the remedial work should be realistic and take into account not only the seriousness of a defect, but also matters such as: availability of spare parts, need for specialist skills, necessary down-time, scheduling with other routine works, etc.

NON-SAFETY PROVISIONS (not applicable to certification for statutory purposes)- to assist in providing site operators with effective and reliable, as well as safe, electrical installations and equipment; this publication also contains technical guidance related to functional matters. For example, precautions against electric shock may require provision of sensitive RCD protection. A single device serving a distribution board or small installation could serve the purpose, by cutting off the electricity supply to the distribution board or installation if an earth fault occurred on any individual circuit or item of equipment. This would cut off the power to all other circuits supplied through the RCD, probably resulting in considerable inconvenience and loss of business.

Alternatively, protection against electric shock could be achieved by providing separate RCD protection for each circuit, so that a fault on one circuit resulted in the disconnection of that circuit only, leaving other circuits unaffected. It is therefore a matter of commercial judgement for the site operator to weigh the initial capital cost of individual circuit RCD protection against possible future interruption of business. Such technical provisions in this publication and BS 7671 may not be safety related. Therefore they do not form part of safety verification. It should be made clear when reporting on such matters that they are not safety related and do not contribute to the classification of the certificate.

14.10.5 Reporting documentation

Annexes 14.5 to 14.10 contain model forms to assist certification and creation of site records.

14.10.5.1 Certificate of electrical inspection and testing and defects report

Annexes 14.5A (Model certificate of electrical inspection and testing) and 14.5B (Defect report for statutory enforcement purposes) are intended to be made available to the petroleum enforcing authority following an initial or periodic inspection.

The defect report should be sufficiently comprehensive as to make it unnecessary to submit any other documentation to the petroleum enforcing authority.

14.10.5.2 Other documentation for site records

Annex 14.6 provides a model pre-commissioning test record which is intended to be issued to the site operator for new or rebuilt sites.

Annex 14.7 Provides a model inventory check list which is intended to be prepared for new or rebuilt sites for compliance with EWR.

Annex 14.8 Provides a model filling station electrical installation certificate which is intended to be issued to the site operator for new/rebuilt sites.

Annex 14.9 Provides a model filling station electrical periodic inspection report which is intended to be issued to the site operator for the periodic inspection and testing required under the HELA *Standard conditions of licence for filling stations*.

Annex 14.10 provides a model electrical danger notification which is intended to be issued to the site operator where the inspection and/or testing reveals a dangerous or potentially dangerous situation on an item of electrical equipment which requires immediate attention.

Where a periodic inspection is carried out and an inventory does not exist, an inventory covering equipment in and associated with the hazardous areas and the storage and dispensing of vehicle fuel should be prepared.

15 DECOMMISSIONING

15.1 GENERAL

Where equipment for storing or dispensing vehicle fuels is taken out of use, either permanently or on a temporary basis, employers, including the site operator and any site contractors, have a legal obligation to ensure that the work is carried out safely and that the equipment is left or maintained in a safe state (see paragraph 82 of HSE Approved code of practice and guidance *Design of plant, equipment and workplaces*, L134).

For various reasons operators may need to take equipment out of use permanently or temporarily. This section describes the methods available. The period of time that a filling station or individual tanks can remain temporarily out of service should be the subject of a risk assessment and agreed with the relevant enforcing authorities prior to the commencement of any work on site.

Any work associated with decommissioning the fuel containment system should only be carried out by competent persons (see Annex B) such as contractors specialising in this type of work. As the site operator has duties to ensure that the work is carried out safely, the contractor should provide him with a risk assessment and SMS and discuss and agree the proposed decommissioning procedures before work is started.

Any material (tank, pipework or soils) contaminated with hydrocarbons can only be removed from site by a registered waste carrier.

For the purposes of this section, any reference to a tank is taken to equally mean all the compartments where a compartmented tank is concerned.

In the UK, when decommissioning sites, reference should also be made to (where required):

– DEFRA and Environment Agency *Model procedures for the management of land contamination* (CLR11).
– DETR and Environment Agency *Guidelines for environmental risk assessment and management*.

15.2 PERMANENT DECOMMISSIONING

15.2.1 General

The decommissioning process should take place as soon as is practicable after operation has ceased and should include:

– Carrying out a full risk assessment taking into consideration all matters concerning health and safety and environmental protection.
– Removal from site of the storage tanks and associated pipework or rendering the tanks safe *in situ*.
– Removal of the dispensers.
– Cleaning and, where appropriate, removal of the oil/water separator and connected surface water drainage system.
– Disconnection and, where appropriate, removal of the electrical installation.

It should be noted that Section 73(1) of the Public Health Act 1961 (PHA) (in Scotland, Section 94 of the Civic Government (Scotland) Act 1982 (CG(S)A)) places a statutory duty on the occupier of premises on which there is a fixed tank or other fixed container which has been used for the storage of petrol and is no longer used for that purpose to take all such steps as may be reasonably necessary to prevent danger from that container. The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) also require all redundant plant and equipment that have contained a dangerous substance, including autogas and petrol, to be made safe before being mothballed, dismantled or removed from site. Additionally, redundant petrol tanks are required to be made permanently safe by being filled with an inert material or by being removed from site.

To prevent any future confusion the vent pipe riser(s) and pipework associated with the tank(s) should be dismantled and removed from site; similarly, any notices referring to petrol where storage has ceased.

Specialists familiar with waste regulations and the risks associated with material and equipment that have been in contact with vehicle fuels should be used for the disposal of tanks, pipework and dispensers.

On completion of the decommissioning work the contractor making the tank and pipework safe should issue a certificate stating the capacity of the tank, the method of making safe and the date on which the work was carried out.

15.2.2 Underground tanks to be removed

15.2.2.1 Contaminated material

During the excavation and removal of an underground petrol storage tank it should be assumed that material contaminated with petrol is likely to be encountered in the area immediately surrounding the underground tank, pipework, oil/water separator and pump island. The contractor should remain vigilant throughout the excavation process and arrange for any material that is suspected of being contaminated to be assessed by a competent person as soon as possible. Care should be taken to ensure that any contaminated material is not permitted to become mobile and migrate to other areas. One measure that can be taken to minimise this risk is the prevention of rainwater build-up within the excavation. Any contaminated material present should be dealt with in accordance with the Environmental Protection Act 1990 (EPA) and any relevant planning conditions.

For further guidance see HSE *Cleaning and gas freeing of tanks containing flammable residues*, CS15 and BS 6187 *Code of practice for demolition* (section 7.10 Excavation and removal of redundant petroleum tanks). Reference should also be made to Environment Agency Pollution Prevention Guidelines *Safe operation of refuelling facilities*, PPG 7.

15.2.2.2 Removal of residual product

Before any work is carried out to render a storage tank permanently safe all residual vehicle fuel should, so far as is reasonably practicable, be removed from the tank. This is referred to as 'bottoming'. Pipework carrying fuel should be drained back to the tank before bottoming takes place. It is recommended that the contractor performing the uplift operation should follow the procedures detailed in EI *Guidelines for uplift of product from retail filling stations and customers' tanks*. Alternatively the contractor may follow any other recognised uplift procedure provided an equally suitable SMS is agreed prior to the commencement of the operation.

Only in the most extreme circumstances, and where there is no alternative method of work, should entry into a tank which has contained petrol be permitted and then only after the issue of a permit-to-work (PTW) as described in section 6.4. This has to address the controls detailed within the Confined Spaces Regulations 1997 (CSR) and if the tank has at any time contained leaded petrol, the Control of Lead at Work Regulations 2002 (CLAW). See also EI *Code of practice for entry into underground storage tanks at filling stations.*

15.2.2.3 Methods of making safe-general controls

Before commencing the excavation and uplifting of an underground petrol storage tank it should be inerted to remove the risk of explosion using one of the methods in 15.2.2.4 to 15.2.2.9 or alternatively cleaned and degassed, see Figure 15.1.

All inerting methods will displace heavy flammable vapour mixtures, which will be forced out of any openings in the tank. During the inerting operation hazardous areas will be created, around the vent pipe, any temporary vent and any other openings. It will, therefore, be necessary to determine the extent of these hazardous areas and take precautions against possible ignition sources.

It should be assumed that the surrounding soil has been contaminated to some degree either by leakage from the tank or by spillage. Therefore the following precautions should be taken:

- Appropriate 'Danger' notices should be displayed.
- No smoking, naked lights or other ignition sources should be allowed in the vicinity.
- A supply of water should be available and where necessary used to dampen down the immediate area to lessen the risk from sparking. However, the excessive use of water will cause the contaminated material to migrate, therefore care should be taken to prevent this occurring.
- Exclusion of personnel from the worksite other than those directly involved in the excavation.

Care should be taken to ensure that no vehicle fuel contaminated water is allowed to enter any drainage system or watercourse or to be released into the ground.

When planning the removal of, for instance, a failed tank from a tank farm filled with granular backfill material, the SMS should clearly indicate how the stability of the remaining tanks is to be maintained and how the backfill material is to be prevented from flowing into the resultant excavation.

Inerting methods using an inert gas will require testing of the tank atmosphere to prove that safe conditions have been achieved. This should only be carried out by a competent person who will be able to select the appropriate equipment and understand its limitations. Under certain circumstances oxygen meters and explosimeters can give false readings and may therefore give a false impression of the tank atmosphere. The competent person will also determine how long the tank will remain in a safe condition and what further precautions or testing are required. On completion of the test the competent person should issue a certificate detailing the date and time of the test, the appropriate meter readings and the duration of the 'safe period' and any other relevant information including details of any further test that may be required.

For all inerting methods, except hydrophobic foam, the tank atmosphere will only remain safe for a limited period of time (e.g. 24 hours). This is particularly relevant for methods using water, which on removal for lifting of the tank will allow a flammable atmosphere to re-form.

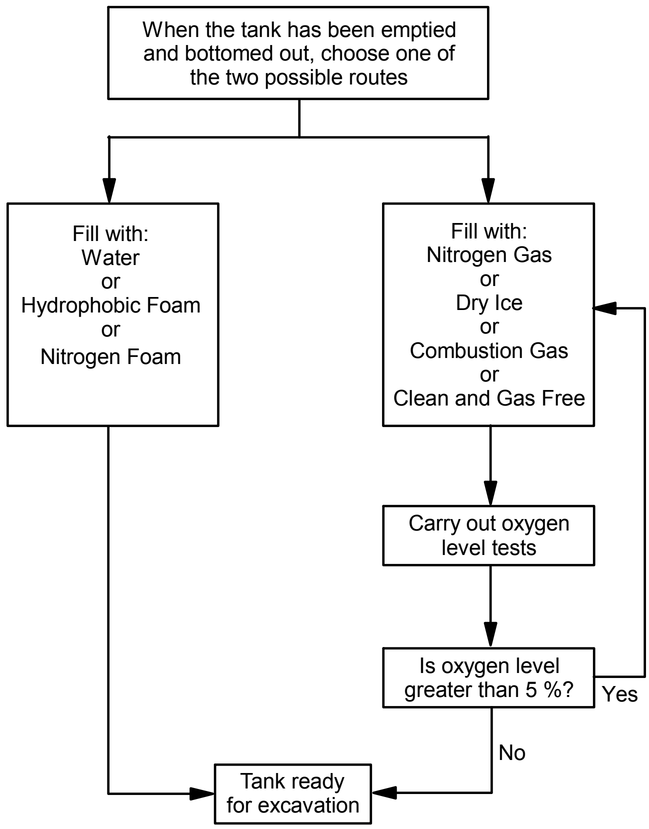


Figure 15.1 Methods for inerting tanks

15.2.2.4 Hydrophobic foam fill

Foam having a designed compressive strength of 8 tonnes/m^2 is generated on site and pumped directly into the tank(s) via the fill pipe. It should be noted that foam of this density is appropriate for inerting tanks for a period not exceeding **six months**. This procedure should be carried out by a competent specialist contractor in accordance with the manufacturer's or supplier's instructions. See also 15.2.4.2.

15.2.2.5 Nitrogen foam fill

High-expansion foam is produced in a generator using nitrogen, water and a detergent foam compound, which is then introduced into the tank via the fill pipe.

The main benefit of nitrogen foam is that it uses the gas efficiently and provides positive displacement of air without the mixing process inherent with a nitrogen gas. The equipment used is portable and with the use of a mobile liquid nitrogen tank to supply the gas, it is possible to use foam inerting in very large tanks.

Unless the tank has been completely filled with nitrogen foam it will be necessary for a competent person to test the atmosphere inside the tank to ensure that oxygen levels have been reduced below 5 % (see 15.2.2.6). An opening to the tank for testing can be created by disconnecting the vent pipe at the tank top after the theoretical quantity of foam (required to fill the tank) has been added. Non-sparking tools or cold cutting equipment should be used for this operation. Removing the vent pipe in this way will also allow the foam to overflow more readily from the vent opening. Note: the foam may be broken down when passing through long vent systems.

15.2.2.6 Nitrogen gas

Nitrogen is passed continuously into the tank at one point, causing the air and vapour to be purged from another opening, remote from the first, in a safe position. This will usually be the vent pipe flame trap outlet.

To ensure a constant pressure is maintained when carrying out this process it is recommended that the nitrogen gas be introduced directly from an industrial gas supplier's road tanker, which is fitted with the necessary reducing valves and measuring equipment. Note: the use of individual nitrogen cylinders or bottles is not recommended as this could lead to irregularities in gas pressure as each bottle becomes empty.

The tank should be bottomed out and all openings sealed except those required for the inlet of nitrogen and for the exhaust outlet (vent pipe) to atmosphere. The nitrogen should then be introduced and the mixture leaving the tank should be vented to atmosphere so that the tank remains at atmospheric pressure throughout the entire operation. Care should be taken to ensure that the gas is not introduced at a rate faster than it can escape through the vent pipe. The atmosphere in the tank should be tested using an oxygen meter and purging continued until a level of less than 5 % is achieved. As a guideline, if approximately five times the tank volume of nitrogen is used, the final oxygen level will be approximately 1 %. Following completion of the purging, the openings of the tank should be sealed and the tank excavated.

If excavation of the tank takes place immediately after purging, a small vent may be left on the tank to allow any small excess pressure to escape. During the excavation and removal any holes found in the tank should be securely plugged. Where holes are found it may be necessary to retest the atmosphere to check the level of inerting.

15.2.2.7 Water fill

Following the bottoming of the tank the suction pipe(s) should be disconnected and the tank connecting points sealed. The tank should then be filled completely with water, care being taken to ensure that any water or residual vehicle fuel does not overflow from the fill point. Air and petrol vapour will escape via the tank vent. Surplus water or residual vehicle fuel should, if necessary, be removed from the fill pipe to avoid an outflow when the vent pipe is disconnected from the tank. Any surplus water or residual vehicle fuel should be disposed of safely. Finally, the vent pipe should be disconnected and the tank connection point and fill point sealed.

The effectiveness of the water fill method as an inhibitor is dependent on the tank remaining full of water during the whole of the excavation work. Extreme care has to be taken when using mechanical plant to avoid puncturing the tank and causing an escape of contaminated water. It is therefore important that periodic checks are made to ensure that no water has leaked out of the tank during the course of the excavation work. If it is suspected that the tank is badly holed, the water fill system is not suitable and an alternative method should be used.

When the tank is ready for lifting from the excavation the water should be uplifted and conveyed to a site authorised for the handling and disposal of contaminated waste. Contaminated water from petrol storage tanks is subject to the regulations made under the EPA. Disposal of contaminated water through the site oil/water separators should only take place following consultation with the relevant agency[23].

23 Environment Agency (England and Wales), the Scottish Environmental Protection Agency (SEPA) in Scotland or the Northern Ireland Environment Agency (NIEA) in Northern Ireland.

15.2.2.8 Dry ice (solid carbon dioxide)

Particular care is required if this method of inerting is used and it should only be carried out by a competent specialist contractor. Hazards can occur due to ineffective inerting as a result of stratification of the cold dense carbon dioxide, insufficient charge of dry ice or incomplete conversion to gas. To check for effective inerting it will be necessary to test the atmosphere at various levels in the tank using an oxygen meter.

Following the bottoming of the tank the vent pipes should be removed and all openings sealed except the one required for the insertion of dry ice. At least 2 kg of dry ice for each cubic metre (1 000 litres) of tank volume should be allowed (i.e. 10 000 litre tank = 20 kg of dry ice). The dry ice should be used in pellet form or blocks broken down into pieces no larger than 3 cm in diameter.

Operatives should wear protective gloves and goggles or other suitable eye protection when handling dry ice. If blocks are being broken down, they should be covered to contain any fragments.

The tank should be left for 12 hours after the addition of the dry ice. After this time the atmosphere should be tested by a competent person with an oxygen meter, taking readings at the top, middle and bottom of the tank. On completion of the test (i.e. after oxygen readings of less than 5 % have been ascertained at all levels) the competent person should issue a certificate detailing the date and time of the test, the appropriate meter readings and any other relevant information including details of any further tests that may be required.

Only after oxygen readings of less than 5 % have been ascertained at all levels should the openings be sealed and excavation work commence. If excavation of the tanks takes place immediately after purging, a small vent may be left in the tank to allow any excess pressure to escape. Care should be taken to ensure that the short-term exposure limit to carbon dioxide is not exceeded whilst working in the vicinity of a tank which has been purged with dry ice.

During the excavation and removal process any holes found in the tank should be securely plugged.

15.2.2.9 Combustion gas

An inert gas containing a proportion of carbon dioxide can be produced by the combustion of hydrocarbons under controlled conditions. Special combustion gas generators are available for this purpose and can be used for inerting tanks. The gas is normally treated by washing and/or filtration to remove carbon and other contaminants, and the result is a mixture containing 12-15 % carbon dioxide, 1 % oxygen and the balance nitrogen.

The procedure for inerting tanks with combustion gas should be carried out by a competent specialist contractor following the guidance given in 15.2.2.6.

15.2.2.10 Cleaning

As an alternative to rendering a tank inert, the tank can be cleaned and degassed. This method involves making the tank safe by removing all flammable materials and vapour. All the residual petrol and sludge are first removed and then the tank surfaces cleaned. Finally, forced ventilation is applied until the tank can be certified gas free. The tank should be certified gas free by a competent person. On completion of the test the competent person should issue a certificate detailing the date and time of the test, the appropriate meter readings and the duration of the 'safe period' and any other relevant information including details of any further tests that may be required. Although this removes many of the subsequent risks during handling, transport and demolition of the tank, it is itself a very hazardous operation and should only be carried out by competent contractors who have carried out and prepared documented risk assessments and SMSs.

15.2.2.11 Tank uplift, transportation and disposal

Prior to lifting a tank from an excavation a risk assessment and SMS should be prepared by the specialist contractor responsible for the works. This documentation should address the requirements of the Lifting Operations and Lifting Equipment Regulations 1998 (LOLER).

A tank should not be lifted by chains or wire ropes unless they are protected to prevent contact with the tank (to reduce the risk of any sparks or sources of ignition). Fabric straps with a design strength suitable for the weight of the tank and any adhering material should be used where practicable. A tank should not be lifted by placing chains or ropes around the tank lid, as it is possible to rip the neck from the tank.

After excavation, the words 'PETROL HIGHLY FLAMMABLE' should be painted in clear indelible letters at each end and/or on opposite sides of the tank.

The Carriage of Dangerous Goods and Transportable Pressure Equipment Regulations 2009 do not apply to the carriage of redundant tanks that are nominally empty. These Regulations, therefore, will not apply to tanks that have been properly prepared for up-lifting by the following methods:

– Tank cleaned and certified gas free (see 15.2.2.10).
– Tank bottomed and filled with hydrophobic foam (see 15.2.2.4).
– Tank bottomed and inerted by one of the methods in 15.2.2.5 to 15.2.2.9.

Tanks that have only been bottomed and inerted will also need the following precautionary work to be carried out in preparation for transport from the site:

– All pipework connected to the tank should, as far as is reasonably practicable, be removed.
– All openings to the tank, including any pipework remaining attached to it, should be sealed to prevent the escape of the inerting atmosphere or liquid.
– A suitable pressure relief valve should be fitted to the tank or individual compartments in the case of a compartmented tank.
– Any holes in the tank caused by corrosion or damage during uplifting should, so far as is reasonably practicable, be sealed to prevent the escape of the inerting atmosphere or liquid.

The person responsible for the removal of the tank should ensure that the recipient of the tank is made aware of the tank's previous use, the toxic hazard within the tank and the need to take adequate precautions against fire and explosion when dealing with it.

15.2.2.12 Dismantling redundant tanks on site

Where the site is not currently being used for storing petrol, or where there is sufficient space to carry out the work safely, redundant tanks may be broken up on site prior to disposal. Before undertaking such work it will be necessary for the competent specialist contractor to carry out a risk assessment (including environmental risk) and prepare a SMS to ensure that dismantling can be carried out without endangering workers, the general public or any active part of the filling station. In order to minimise the risk of fire or explosion only cold cutting techniques should be used.

Before any dismantling is carried out the tanks should be filled with water to prevent the build-up of any flammable vapour, or alternatively, be cleaned and certified gas free by a competent person. The first step in dismantling should be to cut a large opening in the top of the tank, or each compartment to provide adequate explosion relief and natural ventilation. Systematic demolition from the top downwards should then follow.

Additional precautions and protective clothing will be necessary when handling any sludge or tank sections if the tank has been used for storing leaded petrol, in order to comply with CLAW. Even when the tank has been cleaned and the sludge and scale removed there may be sufficient lead compounds absorbed onto the tank surfaces to produce toxic vapour on heating. All parties involved in handling the tank sections, including the final recipient, should be made aware of the possibility of lead contamination.

15.2.3 Pipework removal

The removal of pipework should not be carried out until it has been drained and isolated from sources of vehicle fuel and the site earth bonding arrangements.

A flammable atmosphere or residual petrol may be present in pipework and a precautionary measure of flushing with water should precede the removal and dismantling work.

Excavated pipework should be removed from site as soon as possible and disposed of safely. Care should be taken to ensure that no vehicle fuel or water contaminated with petrol is allowed to enter any drainage system or watercourse or to be released into the ground. Water used to flush out the pipework should be collected for safe disposal. It may be possible, with appropriate approval, to discharge this water through the on-site oil/water separator (see 15.2.2.7).

15.2.4 Underground tanks to be left *in situ*

If tanks are not to be excavated and removed from site, but are to be left *in situ* and made safe, the methods in 15.2.4.1 to 15.2.4.3 should be considered early in the decommissioning works and discussed with the environmental regulator.

15.2.4.1 Filling with sand and cement slurry

With this method of decommissioning, the tank is completely filled with a 20:1 sand/cement slurry having a 175 mm slump according to EN 206-1 C*oncrete. Specification, performance, production and conformity.* This mixture will set to form a solid homogeneous mass fill.

The tank, or all compartments of the tank, should be bottomed as detailed in 15.2.2.2 and then inerted using one of the methods in 15.2.2.4 to 15.2.2.10.

The pipework should be disconnected and removed and the tank lid removed in preparation for the sand/cement slurry filling. In the case of large tanks, prior arrangements should be made with the slurry producer to ensure continuity of supplies to complete the infilling during the course of the working day. The slurry should be vibrated during pouring to remove air pockets and ensure complete filling of the tank.

Very old tanks without a tank lid require specialist treatment, as any filling has to be carried out through a restricted opening such as the fill pipe. In these circumstances hydrophobic foam may be the most suitable method. The following points should be considered for the slurry method of decommissioning:

- The lid will have to be removed from the tank to allow unrestricted access for the pouring of the sand/cement slurry. In many cases the walls of the tank access chamber(s) will need to be demolished to facilitate access to the securing bolts on the lid and also removal of the lid.
- Tanks that have been filled with sand/cement slurry may cause problems with any subsequent redevelopment of the site.
- Removing the tank lid requires a permit-to-work (PTW) system as detailed in section 6.

15.2.4.2 Filling with hydrophobic foam

Urea amino plastic foam is a hydrophobic substance that has the ability to absorb hydrocarbons and it is therefore not necessary to degas the tank before infilling. With this method of decommissioning there is no need to remove the tank lid as the foam is pumped into the tank through the fill pipe (either direct or offset). This work should be carried out by a specialist contractor who is familiar with the product and the foam manufacturer's instructions.

The tank should be bottomed as detailed in 15.2.2.2. In addition it may be necessary to treat the bottom of the tank with a proprietary emulsifier to ensure, so far as is practicable, all residual petrol is removed.

The suction pipe(s) should be disconnected and the tank orifice(s) sealed. The vent pipe should be disconnected (in the tank lid access chamber) and a temporary ventilation outlet fitted by the contractor applying the foam.

The foam, which is generated on site, should be pumped into the tank through a hose connected to the fill pipe. Filling should continue until foam discharges through the temporary vent pipe. The temporary vent pipe should then be removed and the vent connection on the tank securely capped and additional pressure, typically 0,5 bar, applied to the foam to ensure that the tank is completely filled. Decommissioning is completed by replacing the tank fill cap securely and then filling the access chamber with foam, sand or concrete.

Where it is impractical to remove redundant pipework (e.g. a suction line that runs under a building), the pipework can also be permanently inerted by filling with the foam. In many cases this operation can be carried out simultaneously with the filling of the tank to which the pipework is connected.

When using this method the contractor carrying out the foam fill should be advised of:

- The location of the tank lid in relation to the tank length. Filling points in excess of 5 m from either end of the tank require special treatment.
- The total capacity of the tank.
- The strength of the foam to be provided. For permanent decommissioning the compressive strength of the foam is recommended to be 22 tonnes/m^2.

15.2.4.3 Filling with foamed concrete

Foamed concrete is a sand and cement slurry with added foam to give a mixture with a final density not exceeding 1 200 kg/m^3. It is normally made on site by specialist contractors who will need to follow similar procedures to those detailed in 15.2.4.1 for sand and cement slurry. Foamed concrete flows readily but sets to form a solid mass with a density similar to that of the surrounding ground. It is easier to break out than ordinary sand and cement concrete should this be required during any subsequent development of the site.

Foamed concrete is normally added through the open tank lid following bottoming and inerting the tank with water. If water is used as the inerting system it should only be removed immediately prior to the addition of the foamed concrete to prevent the build-up of flammable concentrations of vapour from any residual petrol. As, prior to setting, the foam can be degraded by petrol it will be necessary to remove as much residual petrol as possible and to include a topping up stage in the filling procedure. Where necessary foamed concrete can be pumped through pipework systems but in these cases particular care will be required to ensure the tank is completely filled.

15.2.5 Conversion from petrol to another hydrocarbon liquid (excluding autogas)

A sound petrol tank may be changed over to the storage of other hydrocarbon products (i.e. diesel, kerosene, heating or waste oil etc.) subject to the precautionary measures in 15.2.5.1 to 15.2.5.6.

15.2.5.1 Testing

The tank, or in the case of a multi-compartmented tank all compartments, and all associated pipework should first be tested by one of the methods detailed in section 8 to establish its suitability for continued use as a storage vessel. If the tank has been in continuous use for petrol storage and is known not to be leaking, the environmental precaution of testing is not necessary.

15.2.5.2 Removal of product

Any residual product should be removed as detailed in 15.2.2.2.

15.2.5.3 Conversion to diesel

Where a petrol storage tank is to be converted to diesel it is not necessary to clean the tank prior to refilling with diesel as long as the tank is completely filled and the entire system flushed through (see 15.2.5.5). The following procedure may be adopted:

a. Empty and bottom out the tank.
b. Check to ensure that the internal fill pipe is intact to prevent the possibility of splash loading.
c. Check to ensure electrical continuity between the tank and the tanker.
d. Restrict initial flow of diesel to less than 1 m/s until the bottom of the internal fill pipe has been covered.
e. Fill the tank to its maximum capacity.
f. Flush through pipework to each dispenser connected to the tank, drawing at least 100 litres through each one. The flushings may be returned to the converted tank where its capacity is > 4 000 litres. For smaller tanks, subject to the approval of the regulator (the sewerage undertaker, the relevant agency[24]), the flushings should be dispensed into suitable containers and removed from site for disposal marked clearly as Class 1 petrol or waste petrol for disposal. In any case the material returned to the tank should not reduce the flashpoint below the specified minimum.
g. Clearly re-label the tank and, if applicable, its offset fill pipe termination in accordance with section 4.4.14.
h. Amend site records to reflect the change of storage.
i. Disconnect any Stage 1b or Stage 2 vapour recovery pipework from the tank and blank off.
j. Change or remove any signs associated with vapour recovery as appropriate.

15.2.5.4 Conversion to another hydrocarbon product

Subject to a satisfactory test report for a change to hydrocarbon products other than diesel, the tank should be cleaned. The objective of cleaning is to ensure that residues from the previous use will not contaminate the new product to be stored in the tank. Underground tanks can usually be conveniently cleaned by the water flushing method with equipment operated from outside the tank. Note: Only in the most extreme circumstances, and where there is no alternative method of work, should entry into a tank which has contained petrol be permitted and then only after the issue of a PTW as described in section 6.4. This should address the controls detailed within the CSR and if the tank has at any time contained leaded petrol, see CLAW. See also EI *Code of practice for entry into underground storage tanks at filling stations.*

24 Environment Agency (England and Wales), the Scottish Environmental Protection Agency (SEPA) in Scotland or the Northern Ireland Environment Agency (NIEA) in Northern Ireland.

Any water used for cleaning should be pumped out and disposed of by either removal from site by a hazardous waste specialist or by passing the water through an oil/water separator (see 15.2.2.7). If the oil/water separator route is followed it is important to ensure that:

– The capacity of the separator is adequate for the purpose.
– The oil/water separator is cleared of any vehicle fuels by a waste disposal specialist before the contaminated water is discharged into it.
– The pumping rate of the contaminated water from the tank to the oil/water separator is monitored and controlled to ensure that undue turbulence does not occur.
– On completion, any vehicle fuel in the oil/water separator is removed by the hazardous waste disposal specialist.

When converting to kerosene or gas oils to be used for heating purposes the fill pipe connection should be changed to a different size from that used for petrol deliveries. This is to prevent dangerous crossovers during delivery. Note: compartmental tanks should not be converted for the use of heating oils if any one compartment is to retain petrol.

15.2.5.5 Flushing and filling with the alternative liquid

Residual vehicle fuel should be drained from the suction line(s) and dispenser(s) and sufficient new liquid added to the tank to enable the suction line(s) and dispenser(s) to be flushed. The contents of two lines are usually sufficient for this purpose. The product used for flushing should be pumped into suitable, clearly marked containers and removed from the site for disposal as detailed previously. The tank should be filled to capacity with the alternative product for which it is to be used. Where it is intended to use the tank for the storage of waste engine oil, it is not necessary to fill the tank to capacity but a liquid (fill pipe) seal should be provided. As water flushing does not render the tank gas-free the associated hazardous areas should be maintained and all due precautions taken until the tank has been filled to capacity.

15.2.5.6 Requirements for all product conversions

The following general points are applicable to all conversions:

– In order to avoid any future confusion, all notices and labels referring to petrol should be removed.
– The fill pipe should be labelled to identify the alternative hydrocarbon product together with its safe working capacity expressed in litres.
– Tanks used for the storage of waste products such as engine oil may be subject to 'duty of care' provisions of the EPA
– Tanks that have contained petrol at some time in the past and have since been used for other hydrocarbon products, even for some years, may still contain toxic residues and give off flammable vapour. Accidents have occurred where persons have worked on such tanks without adequate protection. See 15.2.1 for relevance of the PHA and the CG(S)A.
– There are regulations that govern the entry into tanks which have at some time contained leaded petrol. The following notice should, therefore, be permanently fixed adjacent to all access chambers of the tank: 'This tank has contained leaded petrol. Not to be entered without complying with the prescribed regulations'.

15.2.6 Oil/water separator and drainage

Where the oil/water separator will serve no useful purpose in connection with any intended future use of the site, it should, wherever practicable, be uplifted and removed from site for safe disposal. Alternatively the chamber(s) should be filled, *in situ*, with concrete slurry, sand or other similar inert material.

Before removing or infilling the oil/water separator it will first be necessary to carry out the following preparatory work:

– Arrangement should be made for a hazardous waste disposal contractor to remove any liquid or sludge contained in the chambers.
– All inlets to any associated redundant drainage system should be sealed off.
– The outlet pipe from the redundant oil/water separator should be sealed and capped off at the site boundary or at the point where it connects to any remaining live drainage system within the site. Where the surface drainage is to remain operational the inlet and outlet pipes to the separator should be linked.

15.2.7 Electrical installation

Where the site is to be totally decommissioned and demolished the electricity supply company should be requested to disconnect the supply to the site prior to the commencement of the decommissioning work. In other cases a competent electrical contractor should apply the appropriate degree of disconnection and isolation.

15.2.8 Dispensers

Dispensers may be removed from the site and the following precautions should be taken to ensure that the site is maintained in a safe condition:

– Isolate electrically, drain all suction pipework and disconnect the flexible connectors.
– Drain dispensers of residual petrol and purge with nitrogen. The suction entries should be plugged off before the dispenser is placed in storage or despatched for scrap.
– Cap off the suction pipework and any vapour pipework in the under-pump cavity.
– Infill the under-pump cavity with suitable backfill material.

15.3 TEMPORARY DECOMMISSIONING

15.3.1 General

When reviewing facilities that may be taken out of use temporarily, a risk assessment should be carried out which takes into consideration the possible future reinstatement of the facility and whether adequate safety controls can be maintained. Where the whole or part of the fuel containment system is taken out of service for a temporary period of time, it should be temporarily decommissioned so as to render it safe from the risks of fire or explosion, or environmental contamination. In deciding on the most appropriate method of temporary decommissioning, security at the site should be taken into account. Sites that are unoccupied, or liable to become unoccupied, (during the period of time that the installation is decommissioned) need to be secured so as to prevent unauthorised access.

15.3.2 Making tanks safe

15.3.2.1 to 15.3.2.3 provide details of recognised methods of making tanks temporarily safe. The advantages and disadvantages for each method are summarised in Table 15.1.

15.3.2.1 Filling completely with water

The procedure detailed in (a) to (f) below should be followed to ensure that the tank is completely filled with water. It is applicable to a tank fitted with a direct fill pipe and atmospheric venting. For a tank that is fitted with an offset fill and/or connected to a vapour recovery system, modifications will be necessary to allow for the periodic checking of the water level (contents gauges will not be reliable for a tank that is completely full of water) and/or atmospheric venting.

a. All pipework, except the vent pipe(s), connected to the tank should be drained and then disconnected in the access chamber to the tank. The vent pipe should remain connected so that displaced vapour is dissipated safely when the tank is filled with water.
b. The disconnected pipework should be sealed in the access chamber and the pipework apertures on the tank lid should be sealed with a blanking plug.
c. Residual petrol should be removed from the tank.
d. The tank should be filled with water to a level in the fill pipe that is marginally higher than the top of the tank. Procedures should be adopted to prevent water that may be heavily contaminated with petrol from being ejected from the top of the vent pipe.
e. The fill pipe cap should be replaced and securely locked.
f. The water content of the tank should be inspected at intervals of not less than once every three months. Any reduction in the level should be investigated, notified to the enforcing authority and appropriate corrective action should be taken.

15.3.2.2 Filling with hydrophobic foam

The suction pipework should be drained and disconnected and the tank orifice(s) sealed. The vent pipe should be disconnected (in the tank lid access chamber) and a temporary ventilation outlet fitted by the contractor applying the foam. The tank should be bottomed as detailed in 15.2.2.2 and flushed out with a proprietary emulsifier to ensure, as far as is practicable, all residual petrol is removed.

The decision as to what compressive strength of foam to use should be based on the time that the tank will remain in a dormant condition. If it is proposed that the tank will be reinstated within six months, hydrophobic foam with a compressive strength of 8 tonnes/m^2 should be generated on site and pumped directly into the tank. For periods greater than six months hydrophobic foam with a compressive strength of 22 tonnes/m^2 should be used.

The hydrophobic foam can be removed in order to reinstate the tank by cutting into manageable sized blocks and extracting it via the tank opening. This will require the removal of the tank lid and entry into the tank. Appropriate procedures associated with entry into confined spaces will need to be adopted taking into account the potential for oxygen depletion and/or flammable atmospheres. Precautions will also need to be taken to avoid contact with the foam that may be contaminated with vehicle fuels or uncured resin components.

15.3.2.3. Water (internal fill pipe) seal

In exceptional circumstances a small quantity of water can be introduced into a tank, after the residual petrol has been removed, to form a liquid seal at the fill pipe. This method will leave a flammable atmosphere in the ullage space of the tank and should, therefore, only be utilised in instances where sufficient quantities of water are not available for the water fill method to be used, or where there will be an undue delay in a contractor being available to fill the tank with hydrophobic foam. It can also be used to isolate sections of pipework from the storage tank whilst maintenance or repair work is carried out on that section of pipework. Where the site is to be left unoccupied this method will require an additional safeguard (over and above locking the fill pipe cap and replacing the access chamber cover) to prevent any unauthorised access to the fill pipe after the water has been introduced. Filling the access chamber with sand and sealing with a cement screed will provide a level of security; this can be supplemented by placing a large steel plate or other heavy object over the access chamber. The suction pipework should be disconnected from the tank and should be sealed in the access chamber; the pipework apertures on the tank lid should be sealed with a blanking plug. The vent pipe should remain intact to allow the tank to breathe.

Table 15.1 Advantages and disadvantages of methods of temporary decommissioning

Method	Advantage	Disadvantage
Filling completely with water	– Tank totally inerted. – Water level (continued safety) can be easily checked without the need of specialist equipment. – Can be easily reinstated. – The tank is partly prepared for full decommissioning works.	– Wasteful use of water. – Sufficient quantity of water may not be available in drought conditions. – Water has to be treated as a 'special waste' and is expensive to dispose of. – The tank may suffer from internal corrosion.
Filling with hydrophobic foam	– Tank totally inerted. – Shrinkage of the foam should not occur. – The tank is partly prepared for full decommissioning works.	– Reinstatement requires specialist procedures.
Water (internal fill pipe) seal	– Requires only a small quantity of water. – Reinstatement is quick and simple. – Can be easily 'filled with water' should circumstances dictate this course of action.	– Does not inert the tank. – Requires additional security measures.

15.3.3 Tanks left unused but still containing vehicle fuel

Where any tank or compartment at an operating site is dormant due to a surplus storage capacity or similar reason the precautions detailed in 15.3.2 are unnecessary provided:

- A liquid seal is maintained between the bottom of the internal fill pipe and the vapour space in the tank.
- The tank is subject to the same maintenance and security scheme as the remaining active petrol tanks on site.

15.3.4 Dispensers

15.3.4.1 Dispensers left on site

Dispensers should be made temporarily safe if being left *in situ* for a short period of time. If the period of disuse is longer term, or vandalism is likely to occur, then the dispensers should be removed from site. The following precautions should be taken:

– The dispensers should be electrically isolated, all suction lines drained and flexible connectors disconnected.
– The dispenser suction entries should be plugged off and the suction and any vapour pipework capped off in the under-pump cavity.
– The dispenser should be protected from vandalism by a sturdy encasement of suitable material.

15.3.4.2 Dispensers removed from site

Where dispensers are to be removed from site the following measures should be undertaken:

– Isolate electrically, drain all suction lines and disconnect the flexible connectors.
– Drain dispensers of residual vehicle fuel and purge with nitrogen. The suction entries should be plugged off before the dispenser is placed in storage or despatched for scrap.
– Cap off the suction line and any vapour pipework in the under-pump cavity.
– Infill the under-pump cavity with a suitable backfill material.

15.3.5 Oil/water separator and drainage

In the case of sites decommissioned on a temporary basis, the oil/water separator chambers should be emptied of all liquid and sludge contents by a hazardous waste disposal contractor. The chambers should then be replenished with clean water.

15.3.6 Electrical installation

Where a site is to be temporarily vacated or decommissioned, the electrical installation should be disconnected by a competent electrical contractor or supply company who will apply the appropriate degree of disconnection.

15.4 REINSTATEMENT

15.4.1 General

The procedures for reinstatement of a tank or installation will be site-specific and will depend on whether it was out of service for a short period for cleaning or pending modifications or site development (short term decommissioning), or whether it was out of service for a longer period (longer term decommissioning) as agreed with the enforcing authority. In either case, the procedure for reinstatement should be subject to a risk assessment and discussed and agreed with the enforcing authority before any reinstatement work is commenced.

15.4.2 Reinstatement following short term decommissioning

A full visual inspection should be carried out and any defects or omissions rectified or replaced as necessary.

Normally the only testing necessary will be that to prove the integrity of the tank lid gasket and pipework reconnections as appropriate. An assessment of the risks will indicate whether any further testing may be necessary.

15.4.3 Reinstatement following longer term decommissioning

The site should be risk assessed to establish whether or not there are adequate and sufficient safeguards in place to control the risks of fire, explosion or environmental contamination from the storage and handling of vehicle fuels.

The risk assessment may indicate the need for the containment system to be leak tested before being brought back into service. Section 8 gives details of appropriate test procedures.

The electrical installation should be subjected to a full examination and test as detailed in section 14.

15.5 AUTOGAS VESSELS AND ASSOCIATED EQUIPMENT

15.5.1 General

Decommissioning or removal of autogas vessels and associated equipment should be carried out by a competent specialist contractor who has experience in this type of work. Prior to commencing work the contractor should carry out a detailed risk assessment and prepare a SMS for discussion and agreement with the enforcing authority.

15.5.2 Electrical installation

Where the site is to be completely decommissioned and demolished the electricity supply company should be requested to disconnect the supply to the site prior to the commencement of the decommissioning work. In other cases a competent electrical contractor should apply the appropriate degree of disconnection and isolation.

15.5.3 Autogas pumps and dispensers

Prior to disconnecting or removing pumps and dispensers they should be depressurised and purged in accordance with UKLPG Code of practice 17 *Purging LPG vessels and systems.* This should only be carried out by a competent specialist contractor with a knowledge and understanding of this type of work.

15.5.4 Above-ground autogas vessels

Above-ground vessels used for autogas storage should be removed, uplifted and transported from site in accordance with UKLPG Code of practice 26 *Uplifting of static LPG vessels from site and their carriage to and from site by road*. The vessels should be nominally empty. This should only be carried out by a competent specialist contractor with a knowledge and understanding of this type of work.

15.5.5 Below-ground autogas vessels

Guidance for the decommissioning or removal of below-ground autogas vessels is included in UKLPG Code of practice 1 *Bulk LPG storage at fixed installations Part 4: Buried/mounded LPG storage vessels* and UKLPG Code of practice 26. It should only be carried out by a competent specialist contractor with a knowledge and understanding of this type of work.

ANNEXES

Note: the numbering of the following annexes refers to the section to which the information relates.

ANNEX 2.1
HAZARDOUS CHARACTERISTICS OF PETROL

Petrol is a mixture of many organic substances which may include various amounts of ethanol and related materials (i.e. oxygenates). The oxygenates come largely from bio-sources but can also come from chemically manufactured sources. Petrol has properties that can give rise to fire, explosion, health and environmental hazards at filling stations. These hazards can also arise if petrol is misused off site and for this reason it is important that petrol is only dispensed into properly designed and labelled containers. It is also important to deny children access to petrol. This annex is applicable to petrol containing up to 5 % ethanol (E5). The appropriate material safety data sheet (MSDS) should be consulted for the relevant health, safety and environment information of higher blend ethanol fuels and related materials.

A2.1.1 TYPICAL PROPERTIES

The actual properties of petrol can vary widely depending on its source, additives and product specification but typical physical properties are listed in table A2.1.

Table A2.1 Typical properties

Property	Typical values
Boiling range	25-220 °C
Vapour pressure at 37,8 °C	40-100 kPa
Density at 15 °C	0,72-0,79 g/ml
Auto-ignition temperature	greater than 250 °C
Flashpoint	less than -40 °C
Lower explosive limit (LEL)	1,4% v/v
Upper explosive limit (UEL)	7,6% v/v
Vapour density at 40% saturation (air equals 1)	1,7 - 4
Water solubility	Petrol containing no ethanol: water has negligible solubility. Petrol containing ethanol: water is readily soluble.

A2.1.2 FIRE AND EXPLOSION HAZARDS

Petrol is a volatile liquid and gives off vapour even at very low temperatures. The vapour, when mixed with air in certain proportions, can form a flammable atmosphere which burns or explodes when confined if a source of ignition is present. A flammable atmosphere exists when the proportion of vapour in the air is between approximately 1 % (the lower expolosive limit) and 8 % (the upper explosive limit).

Within the flammable range there is a risk of ignition. Outside this range any mixture is either too lean or too rich to propagate a flame. However, over-rich mixtures can become hazardous when diluted with air. If a mixture is in a confined space and is ignited then an explosion may occur.

Petrol vapour is heavier than air and does not disperse easily in still air conditions. It tends to sink to the lowest level of its surroundings and may accumulate in tanks, access chambers, cavities, drains, pits or other depressions. Accumulations of vapour in enclosed spaces or other poorly ventilated areas can persist for long periods even when there is no visible sign of the liquid. Petrol floats on the surface of water; it may therefore be carried long distances by watercourses, sewers, ducts, drains or groundwater and create a hazard remote from its point of release.

Flammable atmospheres may be present in the vapour spaces of tanks containing petrol and in tanks and their associated pipework after petrol has been removed. They may also exist where clothing and other sorbent material or substances are contaminated with petrol.

A2.1.3 HEALTH HAZARDS

Petrol can give rise to health problems following excessive skin contact, aspiration, ingestion or vapour inhalation and these should be considered in the assessment required under the Control of Substances Hazardous to Health Regulations 2002 (COSHH). Exposure to the liquid or vapour should be minimised and where possible this should be taken into account in the planning and design of a filling station. During all work activities or operations where petrol or its vapour may be present, effective controls and handling procedures should be implemented in accordance with the above Regulations.

Petrol is extremely volatile and can give rise to significant amounts of vapour at ambient temperatures. Petrol vapour, even when present in the atmosphere at levels below the lower explosive limit, can have acute and chronic effects if inhaled.

A2.1.3.1 Inhalation

Exposure to petrol vapours with a concentration of between 500 and 1 000 ppm can cause irritation of the respiratory tract and, if continued, will cause a narcotic effect with symptoms including headaches, nausea, dizziness and mental confusion. Prolonged exposure will lead to loss of consciousness. Higher vapour concentrations can rapidly give rise to these effects on the central nervous system and cause sudden loss of consciousness even after only short exposure. Petrol vapour is heavier than air and can accumulate in confined spaces, pits, etc. to cause a health hazard from either the toxic effects or as a result of oxygen deficiency.

There are no reports of adverse health effects arising directly from normal vehicle refuelling and tanker unloading operations where the exposure is only to low concentrations of vapour for short and infrequent periods in well-ventilated areas. Where exposure to petrol vapour is likely to be higher, in situations such as accidents or spills, or where work is being carried out on petrol-containing plant, it will be necessary to consider the potential toxic hazards as well as the fire hazards and to implement appropriate controls.

A2.1.3.2 Ingestion

Ingestion of petrol may irritate the digestive system and cause diarrhoea. Although petrol has only low to moderate oral toxicity for adults, ingestion of small quantities can be dangerous or even fatal to children. Ingestion of petrol is unlikely at a filling station but occurs as a result of siphoning from fuel tanks and, with children in particular, after drinking from incorrectly labelled and/or stored containers.

A2.1.3.3 Aspiration

Aspiration of petrol directly into the lungs may occur following vomiting after the ingestion of petrol. Aspiration of even small amounts of petrol can have serious consequences as it can rapidly lead to breathing difficulties or even potentially fatal chemical pneumonitis.

A2.1.3.4 Skin contact

The components of petrol are degreasing or de-fatting agents and repeated skin contact will result in drying and cracking of the skin and possibly dermatitis. Sensitisation to dyes used in some products has been reported in a few cases. Repeated exposure to petrol may also make the skin more liable to irritation and penetration by other chemicals. Prolonged skin exposure to petrol, as might occur during an accident, has been reported to result in chemical type burns.

A2.1.3.5 Eye contact

Moderate to severe irritation and conjunctivitis may result if liquid petrol comes into contact with the eye. The effect is normally transient and permanent injury is unlikely to occur. Extended exposure to high levels of petrol vapour may also cause irritation of the eye.

A2.1.4 ENVIRONMENTAL HAZARDS

Petrol is a complex mixture of hydrocarbons and oxygenates most of which have varying degrees of toxicity towards living organisms and plants. If released at a filling station by spillage or leaks from tanks and pipework it may, in the absence of adequate controls, either soak into the ground directly or flow into drains or culverts. Its subsequent dispersion and movement will be difficult to predict and will depend on the geology of the area and the physico-chemical properties of the soil. In most cases some of the following types of contamination or pollution will result:

- petrol adsorbed onto soil particles or held in the soil pores;
- petrol floating on groundwater;
- petrol constituents dissolved in groundwater;
- petrol at impervious ground layers such as clay;
- petrol floating on surface water (i.e. rivers and lakes);
- petrol constituents dissolved in water;
- petrol in drains (in use or redundant) or underground voids, and
- petrol vapour released from the above sources into the atmosphere or underground voids etc.

A2.1.4.1 Vapour releases

Vapour released from petrol as a result of spills or leaks, and more significantly during transfer operations, leads to the formation of damaging ozone in the lower atmosphere. A build-up of ozone in the lower atmosphere adversely affects human and animal health, interferes with plant growth and damages building materials. It can also cause photochemical smog which is detrimental to the respiratory system.

A2.1.4.2 Petrol to soil

Petrol adsorbed onto and absorbed into the soil will, because of its toxicity, have a detrimental or fatal effect on the flora and fauna within the contaminated area. Its subsequent dispersion will depend on air movement causing evaporation, the water solubility of the hydrocarbons and oxygenates, water movement, biodegradation and soil absorption. The extent and duration of the pollution will also depend on the quantity and duration of the petrol release and any subsequent action. Small releases may disperse on their own according to the above processes but large or persistent releases may require soil surveys and remedial action. Petrol has been reported to have contaminated drinking water supplies directly by migrating through polyethylene water pipelines in heavily contaminated ground.

A2.1.4.3 Petrol to water

Of particular concern following release of petrol is contamination of groundwater, rivers or lakes, especially in areas where potable water is extracted. Many of the components of petrol have significant solubility in water and once dissolved their rate of biodegradation is much reduced. Component levels are then only significantly reduced by dilution and dispersion. As well as being toxic towards aquatic life, petrol will cause health problems to humans if ingested and because of this any contamination will have to be removed from potable water by the relevant water supply companies.

The discharge of petrol to watercourses is prohibited under the Water Resources Act 1991 which states that it is an offence to discharge poisonous, noxious or polluting material (which includes petrol) into any 'controlled waters' (which includes any watercourse or underground strata) either deliberately or accidentally. The Environment Agency in England and Wales, the Scottish Environmental Protection Agency (SEPA) in Scotland or the Northern Ireland Environment Agency (NIEA) in Northern Ireland is responsible for the protection of controlled waters from pollution. The Environment Agency has issued several relevant Pollution Prevention Guidelines, for example *General guide to the prevention of pollution*, PPG1, and *Safe operation of refuelling facilities*, PPG 7.

A2.1.5 ISSUES PARTICULAR TO PETROL CONTAINING ETHANOL

Petrol containing ethanol and related materials (i.e. oxygenates) is chemically different from petrol containing no ethanol. Common oxygenates in petrol/ ethanol blends are methyl-tertiary-butyl-ether (MTBE), ethyl-tertiary-butyl-ether (ETBE), tertiary-amyl-methyl-ether (TAME), and in petrol/methanol blends are tertiary-butyl-alcohol (TBA).

Ethanol is highly soluble in water. When the water content of a petrol/ethanol blend reaches a critical level the ethanol and any associated water will separate from the blend as an ethanol/water phase. This process is known as phase separation, and will result in the accumulation of the ethanol/water phase at the bottom of a tank. Phase separation of the ethanol from the blend will occur at a water content above approximately 0,15 % (v/v) at 15 °C.

If phase separation occurs, the process is irreversible and the resultant petrol may no longer meet the requirements of EN 228 *Automative fuels. Unleaded petrol. Requirements and test methods*. There is no straightforward means of reblending the ethanol back into the petrol at a filling station. In most cases, both phases will need to be taken off site for appropriate handling as a hazardous waste.

For further guidance on a management of change process, to reduce the likelihood of phase separation occurring, see EI *Guidance for the storage and dispensing of E5 petrol and B5 diesel at filling stations.*

ANNEX 2.2
HAZARDOUS CHARACTERISTICS OF DIESEL

Diesel is a complex and variable mixture of hydrocarbons which may include various amounts of fatty acid methyl ester (FAME), mainly in the range C11 to C25 and containing alkanes, cycloalkanes, aromatic hydrocarbons and aromatic cycloalkanes The final composition of diesel is based on its performance requirements, rather than its compositional parameters, with the exception of sulfur compounds that are limited to 0,001 % by weight of sulfur by EC Council Directive 2009/30/EC. This annex is applicable to diesel containing up to 7 % FAME (B7). The appropriate Material Safety Data Sheet (MSDS) should be consulted for the relevant health, safety and environment information of higher blend FAME fuels.

A2.2.1 TYPICAL PROPERTIES

The actual properties of diesel can vary depending on its source, additives and any seasonal requirements but typical properties are listed in Table A2.2.

Table A2.2 Typical properties

Property	Typical values
Boiling range	160-390 °C
Vapour pressure at 40 °C	0,4 kPa
Density at 15 °C	0,82-0,86 g/ml
Auto-ignition temperature	220°C
Flashpoint	56°C
Viscosity at 40 °C	2-4,5 mm²/s
Pour point (max.)	~5 °C
Water solubility	Negligible

A2.2.2 FIRE AND EXPLOSION HAZARDS

Diesel has a high flashpoint and does not give rise to flammable atmospheres at ambient temperatures unless released as a fine spray under pressure. However, sources of ignition such as naked flames and hot surfaces should be avoided in areas where it is stored or handled. If heated, diesel gives off flammable vapour and will burn fiercely giving off black smoke. Diesel fires are difficult to extinguish but the most effective extinguishing agents are dry powder, foam or carbon dioxide. Small fires may be smothered with sand or earth.

Where diesel tanks are manifolded to petrol tanks via a vent system then the diesel tank, the fill point and any access chambers should be assessed and treated in the same way as those for petrol tanks. Hot work should never be carried out on any tanks or pipework that have contained diesel unless they have been cleaned of all the diesel and its residues or made safe by inerting.

A2.2.3 HEALTH HAZARDS

Diesel should not give rise to health hazards during the normal conditions of storage, dispensing and handling at filling stations provided excessive skin contact is avoided. Work activities, particularly where contact with diesel may arise or where mists may be generated, should be assessed under the Control of Substances Hazardous to Health Regulations 2002 (COSHH).

A2.2.3.1 Inhalation

The vapour pressure of diesel is too low for significant concentrations of vapour to occur during normal conditions of use and storage. Where ventilation is poor and temperatures are high, however, inhalation of diesel vapour in sufficient quantities may occur giving rise to health effects such as central nervous and respiratory system depression that may eventually lead to unconsciousness. If diesel is released as a mist, concentrations above 5 mg/m^3 can irritate the mucous membranes of the upper respiratory tract.

A2.2.3.2 Ingestion

The taste and smell of diesel will normally prevent its ingestion during storage and use at filling stations. Diesel has a low acute oral toxicity but if ingestion does occur it is likely to give rise to spontaneous vomiting and the possibility of aspiration into the lungs. Ingestion may also irritate the mouth, throat and gastrointestinal tract.

A2.2.3.3 Aspiration

Aspiration of diesel directly into the lungs or indirectly as a result of vomiting following ingestion can result in lung tissue damage. This may lead to breathing difficulties followed by potentially fatal chemical pneumonitis.

A2.2.3.4 Skin contact

In common with petrol, and other similar products, diesel is a degreasing agent for the natural fat in the skin and repeated or prolonged contact will lead to drying and cracking of the skin with the possibility of irritation and dermatitis. Some people may be more susceptible to these effects than others. Under conditions of poor personal hygiene, excessive exposure may also give rise to oil acne and folliculitis that may then develop into warty growths and eventually become malignant.

Diesel should never be used as a solvent for cleaning the skin.

A2.2.3.5 Eye contact

Accidental eye contact with diesel may cause mild, transient stinging and/or redness. Exposure to high concentrations of mist or vapour may also cause slight irritation.

A2.2.4 ENVIRONMENTAL HAZARDS

Diesel is a complex mixture of hydrocarbons and fatty acid esters and because of the toxicity of many of its components a release into the environment will have a detrimental impact on the fauna and flora in the contaminated area. On release to the environment the lighter components will generally evaporate but the remainder will become dispersed in groundwater or adsorbed onto soil or sediment. Its subsequent dispersion will depend on migration of fuel, water movement, biodegradation and soil absorption. The extent of the pollution will also depend on the quantity of fuel released and any subsequent action. On release into water, diesel will float on the surface and spread out; the components are generally poorly soluble in water, but the most soluble will dissolve and be dispersed.

Once released into soil or groundwater, diesel will have similar detrimental effects on the environment to petrol. Polluting releases of diesel will also be subject to the Water Resources Act 1991 and the Environmental Permitting (England & Wales) Regulations 2010.

A2.2.5 ISSUES EXACERBATED BY DIESEL CONTAINING FAME

Microbes exist in the water phase of fuels, drawing nutrients from the fuel phase. Diesel containing FAME provides an increased level of nutrients available for microbes compared to diesel containing no FAME. Increased levels of microbial growth can exacerbate localised corrosion, which may result in operational difficulties (e.g. filter blocking).

For further guidance on a management of change process, to reduce the likelihood of increased microbial growth, see EI *Guidance for the storage and dispensing of E5 petrol and B5 Diesel at filling stations* and EI *Guidelines for the investigation of the microbial content of petroleum fuels and for the implementation of avoidance and remedial strategies.*

ANNEX 2.3
CHARACTERISTICS OF AUTOGAS

Autogas in the UK is commercial propane as defined in BS 4250 *Specification for commercial butane and commercial propane* which meets the requirements of EN 589 *Automotive fuels, LPG. Requirements and test methods*. It consists mainly of propane but may contain some propene and small amounts of other hydrocarbons including butane, butene, ethane and ethene. It exists as a gas at normal temperatures and pressures and is liquefied by moderate pressure. If the pressure is subsequently released the hydrocarbons become gaseous again. LPG is naturally colourless and odourless but has added odourants, such as ethyl mercaptan or dimethyl sulphide, so that it is noticeable by smell at concentrations of 20% of its LEL. Typical physical properties of propane are listed in the table below:

A2.3.1 TYPICAL PROPERTIES

Table A2.3 Typical properties

Property		**Commercial propane**
Formula of major component		C_3H_8
Sulphur content % by weight	No greater than 0,02 %	
Boiling point.	°C	-40
Saturation pressure in bar gauge at selected temperatures	-18	2,5
	0	4,5
	15	7
	40	14,5
Density of liquid compared to water		0,50 to 0,51
Litres of liquid per kg of liquid		2
Coefficient of liquid thermal expansion	0 °C	0,26 %/°C
	20 °C	0,30 %/°C
	40 °C	0,38 %/°C
Typical figure for liquid thermal expansion		0,30 %/°C
Density of gas compared to air		1,5
Litres of gas at atmospheric pressure per kg of liquid		540
Litres of gas at atmospheric pressure per litre of liquid		270
m^3 air required to burn 1 m^3 gas		24
Net calorific values (Useful heat given off per unit of gas burnt).	MJ/m^3	86
	Btu/ft^3	2 310
	MJ/kg	46,3
	Btu/lb	19 900

Property		**Commercial propane**
Explosive limits (EL) (i.e. % volume of gas in air which will support combustion)	UEL	10,9
	LEL	1,7
Flash point		-104 °C
Ignition temperature (T class)		470 °C (T1)
Gas subdivision		IIA
Maximum experimental safe gap (MESG) mm		0,92
Notes: – Figures in table are approximate, the actual figures depend on the composition of the LPG. – All properties relate to temperatures of 15 °C unless otherwise stated.		

Table A2.4 Workplace exposure limits

	Long-term exposure limit		**Short-term exposure limit**	
	8-hour TWA reference period		15-minute reference period	
LPG	1 000 ppm	0,10 %	1 250 ppm	0,125 %

A2.3.2 FIRE AND EXPLOSION HAZARDS

Autogas is stored as a liquid under pressure. The liquid is colourless and its density is half that of water and if released on water it may float on the surface before vaporising. The gas is about one and half times as dense as air and does not disperse easily under still conditions or in poorly ventilated areas. It will tend to sink to the lowest level of the surroundings and may accumulate in cellars, pits, drains or other depressions. Autogas forms flammable mixtures with air in concentrations of between approximately 2% and 10% and at these concentrations the gas/air mixture density is approaching that of air and may not be confined to low levels.

Within the flammable range there is a risk of ignition. Outside this range any mixture is either too lean or too rich to propagate a flame. However, over-rich mixtures can become hazardous when diluted with air. If a mixture is in a confined space and is ignited then an explosion may occur. The escape of even a small quantity of liquid will result in significant volume of a flammable gas/air mixture.

A boiling liquid expanding vapour explosion (BLEVE), or an explosive release of boiling liquid and expanding vapour resulting from the failure of a vessel holding a pressurised liquefied gas, may occur if an above-ground vessel is subjected to an uncontrolled fire.

Autogas is always under pressure so any defective joints or components can leak. The odour agent means that detection of gas by smell should be possible at a concentration of 20 % of the LEL (i.e. before the gas concentration is high enough to sustain ignition). The refractive index of autogas differs from air so leaks may be seen as a 'shimmer'. Release of liquid autogas results in chilling so a liquid leak may also be seen as frost at the point of escape and/or condensation of the air around the leak. Leaks can be searched for using a variety of methods including 'soap and water' and the use of a suitably calibrated gas detector. Note: gas detectors are usually calibrated for a single gas so one calibrated on natural gas will give different indications of the concentration of flammables present from one calibrated for LPG.

A naked flame should never be used to search for a suspected leak.

A2.3.3 HEALTH HAZARDS

A2.3.3.1 Inhalation

Autogas is an asphyxiant but is not toxic. At levels of concentration above about 10 000 ppm (1 %) propane becomes a slight narcotic and an asphyxiant. This figure would not be approached in the open air except in the unlikely event of a major vapour cloud. Exposures above 10 000 ppm will result in narcotic effects such as weakness, headache, light-headiness, nausea, confusion, blurring of vision and increased drowsiness. Exposure to very high concentrations may result in loss of consciousness and even asphyxiation as a result of oxygen deficiency.

A2.3.3.2 Skin and eye contact

Autogas is not an irritant to the skin or eyes. However, the rapid vaporisation of liquid in contact with the skin or eyes may produce frost or cold burns. Where this hazard is likely to occur, for example during tanker unloading, personal protective equipment (e.g. hand and eye/face protection) should be worn. Personal protective clothing should not normally be required during vehicle refuelling.

A2.3.4 ENVIRONMENTAL HAZARDS

There are few, if any, ecotoxicological effects from autogas and because of its high volatility autogas is unlikely to cause ground or water pollution. An unignited release of autogas would not pose a serious hazard to the environment, either immediate or delayed, and if an ignition were to occur the fire and/or explosion effects would be limited to the immediate damage.

Within the flammable range there is a risk of ignition. Outside this range any mixture is either too lean or too rich to propagate a flame. However, over-rich mixtures can become hazardous when diluted with air. If a mixture is in a confined space and is ignited then an explosion may occur. The escape of even a small quantity of liquid will result in significant volume of a flammable gas/air mixture.

ANNEX 2.4
BIOFUELS

A biofuel can be defined as a blend of a mineral oil derivative, typically petrol or diesel, and up to 100 % biomass derived component, which is used as a fuel for mobile or fixed engines.

Base mineral components in petrol are supplemented with biomass produced oxygenates, the most common of which is ethanol. EN 228 *Automotive fuels. Unleaded petrol. Requirements and test methods* sets upper limits on the oxygenate content which effectively allows the addition of ethanol up to a specified percentage in petrol, which is currently 5 %[25]. It can be anticipated that the scope of EN 228 will either be extended or new standards introduced allowing further increases in oxygenate content in the future.

Similarly, base mineral components in diesel are blended with fatty acid esters manufactured from biomass sourced materials. EN 590 *Automotive fuels. Diesel. Requirements and test methods* sets upper limits on quantities of these fatty acid esters allowed in diesel. Most commonly fatty acid methyl esters (FAME) are used with a current upper limit of 7 %[26]. It can be anticipated that the scope of EN 590 will either be extended or new standards introduced allowing further increases in fatty acid ester content in the future.

The amount of the biomass derived content in petrol and diesel puts limits on their suitability for use in existing and new vehicles. Manufacturers of some existing vehicles do not warrant the use of fuels with biomass derived content beyond the limits set out in EN 228 and EN 590. Fuels containing higher amounts of biomass derived content will generally require modified or special engines. The changing chemical composition of fuels also requires diligence in ensuring continuing compatibility of the filling station infrastructure.

The technical requirements in the main sections of this publication are applicable to fuels containing biomass derived content up to the limits in EN 228 and EN 590, where the biomass derived component meets the requirements of EN 15376 *Automotive fuels. Ethanol as a blending component for petrol. Requirements and test methods* or EN 14214 *Automotive fuels. Fatty acid methyl esters (FAME) for diesel engines. Requirements and test methods*. For guidance on the actions to be taken as part of the management of change process, for the introduction of these fuels to filling stations, see EI *Guidance for the storage and dispensing of E5 petrol and B5 diesel at filling stations*.

This annex provides information regarding fuels containing biomass derived content above the limits of EN 228 and EN 590.

A2.4.1 FUEL CONTAINING HIGHER PERCENTAGE OF BIOMASS DERIVED CONTENT

In some instances, fuels containing biomass derived content at blend ratios higher than those permitted in EN 228 and EN 590 have been introduced. Fuels with higher blend ratios can only be used in engines specifically designed or modified for use with that fuel. Likewise, the fuel storage and dispensing system at filling stations should be specifically designed or modified to ensure compatibility with the fuel.

25 Petrol containing 5 % ethanol is commonly referred to as E5.
26 Diesel containing 7 % FAME is commonly referred to as B7.

A2.4.1.1 High blend ethanol fuel (HBEF)

A HBEF is usually designated with the prefix 'E' followed by a number representing the percentage, by volume, of ethanol in the fuel. Ethanol used in a HBEF can contain up to 5 % hydrocarbons (either petrol or petrol like additives). Petrol or petroleum spirit is normally added to the ethanol to make up the desired percentage in the fuel. The most common HBEF currently in use is E85, and is typically made up of 85 % ethanol and 15 % petrol. The petrol is normally specifically formulated to meet the vapour pressure requirements of the final HBEF.

A HBEF comprising up to 90 % ethanol falls into gas group IIA; and a HBEF comprising greater than 90% ethanol falls into gas group IIB.

A HBEF can only be used in flexible fuelled vehicles (FFVs) and other vehicles with engines that have been designed and manufactured for alcohol fuels. The conversion of existing vehicles is not generally feasible due to the high cost, requiring changes to e.g. valve seats, injector systems, fuel pipework, fuel pump, engine management system, etc.

Due to the physical characteristics of a HBEF, additional control measures may need to be introduced at a filling station to reduce the risk of fire, explosion and environmental contamination. The characteristics of a HBEF can be summarised under the following categories: material compatibility; electrical conductivity; flammability range, and solubility in water.

A2.4.1.1.1 Material compatibility

A HBEF has different properties to those of petrol conforming to EN 228. Some materials (e.g. aluminium, zinc, brass) in filling stations, together with some plastics and rubbers may be adversely affected by a HBEF.

Consequences of using materials in filling station systems that are incompatible with a HBEF may include:

- fuel leaks that can give rise to increased fire, explosion, and environmental risks, and
- suspended matter (contamination) in the fuel resulting in fuel quality issues.

Tanks

Storage of a HBEF does not impact upon the location of a tank, provided the tank construction, any (internal) lining, seal and gasket materials are compatible. Particular to underground storage tanks, the following should be considered:

- Tanks constructed to EN 12285-1 *Workshop fabricated steel tanks. Horizontal cylindrical single skin and double skin tanks for the underground storage of flammable and non-flammable water polluting liquids*, with leak detection.
- Irrespective of whether a steel tank is double-skin or single-skin, if there is an existing corrosion problem, the conversion to the storage of HBEF may accelerate this.
- If existing single skin steel tanks are to be used then a safety and environmental risk assessment should be carried out to ensure that an appropriate level of protection is applied.
- A HBEF has a higher alcohol and solvent content than petrol, and so can have a detrimental effect on tanks constructed of glass reinforced plastic (GRP), causing the tank to soften and possibly fail. Consequently, a HBEF should not be stored in a GRP tank unless the tank has been specifically constructed and certified for use with HBEF.

Steel tanks that have been lined with polyester or epoxy based coating may not be suitable for storing a HBEF. If there are doubts about the compatibility of materials used to line the tank, the manufacturer of the coating system or the installation contractor should be contacted to confirm that the material has been certified for use with a HBEF.

A risk assessment should be carried out prior to the introduction of a HBEF to above-ground storage tanks.

Tank ancillary equipment
All tank ancillary equipment that may be expected to come into contact with HBEFs should be confirmed as being suitable by the original equipment manufacturer (OEM); on existing sites some items may have to be replaced. Whilst not exhaustive, the following equipment should be assessed to determine its compatability:

– fill, vent and suction pipes;
– pressure and vacuum (P/V) valves;
– flame arresters;
– delivery calming devices;
– overfill prevention devices;
– dipsticks;
– contents gauges;
– high level alarms;
– submersible pumps;
– gaskets and sealants, and
– water detection systems.

Contents gauges
Capacitance probes are not suitable as gauges in HBEFs as they will not work in alcohol.

Where magnetostrictive probes (or other technology) are in use, it should be confirmed with the OEM that it is compatible with HBEFs.

Pipework
Underground pipework that may be expected to come into contact with HBEFs should meet the requirements of EN 14125 *Thermoplastic and flexible metal pipework for underground installation at petrol filling stations* and certification of material compatibility should be sought.

Underground pipework comprising screwed galvanised steel should not be used as any corrosion at internal cut pipe ends may be accelerated; it will also be difficult to confirm that the jointing compounds are compatible with HBEFs.

Dispensers, hoses and nozzles
The OEMs of the component parts of the dispenser system should be contacted to confirm that they are compatible with HBEFs.

Component parts that require adaptation or replacement should be identified.

In-line filters
When first introduced into a system, HBEFs will initially act as a cleaning agent, and dislodge any debris or sludge in the system. A filter maintenance regime should be put in place to avoid filter blockage, slow flow, damage to the dispensing system, etc. The fitting of additional in-line filters, after the initial introduction of HBEFs, may be required.

Fittings and connectors
All fittings and connectors that may be in contact with HBEFs should be compatible for use with the fuel. If in doubt, The OEM should be contacted to confirm compatibility.

A2.4.1.1.2 Electrical conductivity
Ethanol has approximately one third of the conductivity of water, and is at least 10 times more conductive than petrol. Due to this the probability of galvanic corrosion of systems in contact with HBEFs is increased.

An assessment of the specification and approvals of equipment should be undertaken, as the increased conductivity may give rise to the formation of local corrosion cells between dissimilar, adjacent metals.

A2.4.1.1.3 Flammability range

Ethanol and petrol have different flash points and flammability ranges. A HBEF flammable atmosphere will be prevalent across a wider temperature range than a petrol flammable atmosphere. For E85, SAE International Technical Paper 950401 *Flammability Tests of alcohol/gasoline vapours* gives the flammability range as -33 °C to +11 °C.

A2.4.1.1.4 Solubility in water

Ethanol is soluble in water and any free water will be dissolved into solution. EN 228 has an upper limit of 1 % water content, and in the absence of a EN standard for HBEF, it may be reasonable to suggest an equivalent upper limit on water content. Any ingress of water into the system from leakages may result in the fuel specification being compromised.

Solubility is temperature dependent and increases with an increase in temperature.

The high solubility of ethanol and similar oxygenates means that they are not captured by conventional surface oil/water separators. A method of shutting off separators should be put in place to capture larger spillages of fuels containing such materials. For HBEFs with a significant proportion of soluble content alternative drainage and spillage systems may need to be considered. Operators should check where their forecourt and dispensing areas discharge to: if there is a direct discharge to surface waters then the relevant agency[27] should be contacted prior to the introduction of HBEFs. For discharge to sewers the appropriate sewage provider will need to be contacted and discharge consents agreed in advance.

Water courses contaminated with HBEF will have a detrimental effect on animal and plant life, primarily as a result of oxygen depletion.

For further information see EI *Literature review. Biofuels - potential risks to UK water resources.*

Phase separation will occur at a water content above approximately 0,15 % (v/v) at 15 °C. For further information on phase separation see A2.1.5.

A2.4.2 HBEF USED IN DIESEL ENGINES (E95)

The HBEF E95 has been produced for some diesel engines, and is used in the UK in some bus fleets. The fuel composition is 95 % ethanol and 5 % ignition enhancers (polyethylene glycol, methyl-t-butyl ether (MTBE), isobutanol), and is usually red in colour.

E95 is not classified as a petroleum mixture, as no petrol is mixed with the ethanol, and therefore in the UK is not subject to a petroleum-licensing regime. The information provided in this Annex should be reviewed for systems handling E95.

In the UK, the Health & Safety at Work etc Act 1974 (HASAWA) and Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) will be applicable at the filling station. The enforcing authority will be the authority responsible for enforcing the HASAWA at the site (i.e. the Health & Safety Executive (HSE) or the local authority (environmental health department)).

If petrol is also stored at the filling station, the Petroleum Licensing Authority (PLA) will be the enforcing authority for DSEAR.

27 Environment Agency (England and Wales), the Scottish Environmental Protection Agency (SEPA) in Scotland or the Northern Ireland Environment Agency (NIEA) in Northern Ireland

Table A2.5 Typical properties

Property	Typical values
Auto-ignition temperature	360 °C
Flashpoint	9 °C
Lower explosion limit (LEL)	3 % v/v
Upper explosion limit (UEL)	15 % v/v

A2.4.3 HIGH BLEND FAME FUEL (HBFF)

A HBFF is usually designated with the prefix 'B' followed by a number representing the percentage, by volume of FAME, in the fuel. FAME is added to a diesel to make up the desired percentage in the fuel. The most common HBFFs currently used as fuels are B30, B50 and B100. B100 comprises 100 % biomass derived content and contains no mineral diesel. For HBFFs the FAME component can be sourced from a wide range of products with varying properties. Compatibility of the system and materials will need to be confirmed with manufacturers with particular reference to the FAME used. Use of HBFFs in diesel engines may invalidate the vehicle manufacturer's warranty. Compliance with EN 14125 simply defines certain properties to ensure a common basis for use as a blend component and does not imply suitability for use in engines or filling station fuel dispensing systems. It is the responsibility of filling station owners or operators to review and confirm the suitability of their systems for the safe receipt, storage and dispensing of new fuels.

The physical characteristics of a HBFF are different to diesel conforming to EN 590. Some materials (e.g. aluminium, zinc and brass) used in filling stations, together with some plastics and rubbers may be adversely affected by introduction of HBFFs to the filling station, and subsequent storage and dispensing. FAME has solvent properties and will loosen dirt and corrosion products in existing tanks and systems. It may also have an adverse effect on the elasticity, permeability and durability of elastomeric and plastic components.

Prior to the introduction of a HBFF, an assessment of tank, lines, hoses and dispensers should be carried out, to ensure materials compatibility. OEMs guidance should be sought where compatibility with a specific HBFF or material is not identified.

After introduction of a HBFF, a regular tank maintenance regime should be implemented to monitor the condition and performance of the equipment and systems.

FAMEs have varying levels of solubility in water and may not be fully captured by conventional oil/water separators. A method of shutting off separators should be put in place to capture larger spillages. For HBFFs with a significant soluble content alternative drainage and spillage systems may need to be considered. Owners or operators should check where their forecourt and dispensing areas discharge to: if there is a direct discharge to surface waters then the relevant agency[28] should be contacted. For discharge to sewers the appropriate effluent handling company will need to be contacted and discharge consents agreed.

Certain components in FAMEs degrade over time through oxidation and other natural chemical processes. The oxidation of certain B100[29] fuels is exothermic and care must be taken with the storage and disposal of minor spills and wipe rags to avoid the risk of fire through auto-ignition.

28 Environment Agency (England and Wales), the Scottish Environmental Protection Agency (SEPA) in Scotland or the Northern Ireland Environment Agency (NIEA) in Northern Ireland

29 Fuel comprising 100 % FAME.

ANNEX 2.5
AUS 32 (DIESEL EXHAUST FLUID)[30]

In 1999, the EU adopted EC Council Directive 99/96/EC[31], identifying the acceptable limits for exhaust emissions of new vehicles sold in the EU. As of October 2006, heavy duty (commercial) vehicles are required to not emit nitrous oxides (NO_x) beyond a maximum level (referred to as Euro IV). More stringent maximum allowable levels of NO_x emissions will be implemented in the EU, referred to as Euro V and Euro VI. These will be implemented in 2012, and will supersede the limits for exhaust emissions in Euro IV.

In order to meet the required NO_x limits, selective catalytic reduction (SCR) systems have been developed. AUS 32 (Diesel exhaust fluid) is the active ingredient in enabling this process. Typically, the consumption of diesel exhaust fluid is between 2 % and 7 % of diesel consumption, with vehicle tanks of 60 litres capacity.

A2.5.1 CHARACTERISTICS OF AUS 32

AUS 32 is an aqueous urea solution that is 32,5 % synthetically produced pure urea and 67,5 % demineralised water. It is manufactured, stored and distributed within strict quality tolerances in accordance with ISO 22241 Parts 1-4 *Diesel engines. NO_x reduction agent AUS 32*. For specific details on the product specification, reference should be made to the manufacturers' MSDS.

Under the classification system in EC Council Directive 99/45/EC[32] and its amendments (implemented in the UK via the Chemicals (Hazard Information and Packaging for Supply) Regulations 2009), AUS 32 is not classified as dangerous. AUS 32 may be classified as a hazardous waste; for further information, see Environment Agency *What is a hazardous waste? A guide to the Hazardous Waste Regulations and the list of waste regulations in England and Wales.*

In the water environment, in large quantities, AUS 32 is a polluting substance. Environment Agency *Pollution prevention technical information note - information on storing and using Ad Blue*, and the recommendations contained in Environment Agency Pollution Prevention Guidelines (PPG) should be followed in order to meet environmental requirements. Good design and operational practices should be followed in order to reduce the likelihood of leaks and spillages.

AUS 32 is miscible in water, and therefore conventional oil/water separators will not contain it; it will flow through the separator and potentially contaminate the water environment.

30 See glossary for further definition.

31 Directive 1999/96/EC of the European Parliament and of the Council of 13 December 1999 on the approximation of the laws of the Member States relating to measures to be taken against the emission of gaseous and particulate pollutants from compression ignition engines for use in vehicles, and the emission of gaseous pollutants from positive ignition engines fuelled with natural gas or liquefied petroleum gas for use in vehicles and amending Council Directive 88/77/EEC.

32 EC Council Directive 1999/45/EC of the European Parliament and of the Council of 31 May 1999 concerning the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations.

Table A2.6 Typical properties of AUS 32

Property	**Typical values**
Colour	Colourless
Physical state	Liquid, with a slight ammoniacal odour
Freezing point	-11,5 °C
Specific gravity	1,09 g/cm^3
Note: for further information, see ISO 22241-1 *Diesel engines. NO$_x$ reduction agent AUS 32. Quality requirements* and manufacturers' guidelines.	

A2.5.2 STORAGE AND HANDLING OF AUS 32

AUS 32 is a very pure product that is easily contaminated. Contamination can result in failure of SCR components on the vehicle. Materials made of plastics may contain various kinds of additives which may migrate into the AUS 32 in storage.

All tanks, pipework and wetted components should be manufactured from compatible materials, as detailed in European Chemical Industry Council (CEFIC) *AUS 32 According to DIN 70070 quality assurance guidance document* (see also Table A2.7) Existing dispensing and handling equipment is unlikely to be suitable for AUS 32 dispensing and handling.

Table A2.7 Materials for use in direct contact with AUS 32*

Material
Highly alloyed austenitic Cr-Ni-steels and Cr-Ni-Mo-steels acc. to DIN EN 10088-1 to 3, worked according to industrial standard (high grade stainless steel)
HD-Polyethylene
HD-Polypropylene
Polyfluoroethylene
Polyvinylidenedifluoride
Poly(perfluoroalkoxy) PFA
Polyisobutylene
Titanium
Viton
Note: any other material not cited should be tested regarding corrosion resistance and possible influences on the product specification. Materials made of plastics may contain various kinds of additives which possibly migrate into the AUS 32 solution. For this reason special care has to be taken for testing the contamination of AUS 32 by additives from plastic materials used in contact with AUS 32.

*Data taken from ISO 22241-3 *Diesel engines. NOx reduction agent AUS 32. Handling, transportation and storage.*

AUS 32 systems on filling stations are operated under pressure; therefore during the design process consideration should be given to:

Location of equipment

- Above-ground storage tanks should be located away from open drains and nearby water courses. See also section 8.
- Tank and dispensing equipment should be located in non-hazardous areas unless certified for use in hazardous areas.

Selection of materials/equipment (See also Table A2.7)

- Above-ground tanks can be plastic, stainless steel or mild steel with appropriate lining, and should be constructed to a recognised standard. Intermediate bulk containers (IBCs) should not be used.
- Double-skin underground tanks should be used and should conform to a recognised standard. See also section 8.
- Dispensing hoses should conform to a recognised standard (e.g. EN 1360 *Rubber and plastic hoses and hose assemblies for measured fuel dispensing systems. Specification*, EN 1762 *Rubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase), and natural gas up to 25 bar. (2,5MPa). Specification*, EN 12115 *Rubber and thermoplastics hoses and hose assemblies for liquid or gaseous chemicals. Specification*) and be confirmed as suitable for dispensing of AUS 32.
- Selection of leak containment and detection systems for tanks storing AUS 32 should have appropriate bund alarms, sensors and interstitial monitoring.

Risk assessment

The risk assessment should cover:

- environmental risk;
- use of breakaway couplings;
- use of shear valves;
- overfill protection;
- dry disconnect couplings (for delivery hose connections);
- use of compatible hoses;
- use of automatic nozzle with or without nozzle safe break coupling, and
- use of heating units within dispenser or pumping unit.

Emergency plan

- Consideration should be given to the requirement for an emergency response plan and provision of training to site personnel in the event of a spillage of AUS 32. For further infomation see Environment Agency Pollution Prevention Guidelines *Pollution incident response planning,* PPG21.

Maintenance

- Ease of future maintenance (tanks, pipework and associated equipment should be cleaned with demineralised water or AUS 32 and subsequently disposed of in accordance with hazardous waste legislation).

ANNEX 6.1
MODEL SAFETY METHOD STATEMENT FORMAT

<table>
<tr><td colspan="2">SAFETY METHOD STATEMENT</td></tr>
<tr><td colspan="2">Contractor company: ……………………………………………………………….…………
Site/location: ………………………………………………………………………………</td></tr>
<tr><td colspan="2">Task: description of the task
Risk level high/medium/low
Permit(s)-to-work needed? Yes/no</td></tr>
<tr><td colspan="2">Location: where the task is to be carried out</td></tr>
<tr><td>Possible hazards: e.g. underground services, hazardous zones, contaminated ground, overhead power lines, adjacent work.</td><td>Precaution to reduce hazard</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Sequence/method of work: order in which tasks will be carried out and how the tasks will be performed.</td></tr>
<tr><td colspan="2">Details of any isolation: e.g. pumps, dispensers, tanks, suction/offset fill lines, electrical works, working areas from public.</td></tr>
<tr><td colspan="2">Disposal of surplus or contaminated materials: disposal details, where to, when, how etc.</td></tr>
<tr><td colspan="2">Outside authorities to be advised: e.g. Petroleum Enforcing Authority, HSE, EHO, EA, utility services, etc.</td></tr>
<tr><td colspan="2">Tools/equipment: list of tools and equipment to be used for the task.</td></tr>
<tr><td colspan="2">Protective clothing: protective clothing to be worn during task.</td></tr>
<tr><td colspan="2">Signature: ……………………………………… Date: …………………..…………………......
Name: ………………………………………….. Position: ....
Copies to: ………………………………..……………………..……………………………..</td></tr>
</table>

ANNEX 6.2
MODEL PERMIT-TO-WORK FORMAT

PERMIT-TO-WORK	
1. Permit title	2. Permit number *Reference to other relevant permits or isolation certificates.*
3. Job location	
4. Plant identification	
5. Description of work to be done and its limitations	
6. Hazard identification *To include residual hazards and hazards introduced by the work.*	
7. Precautions necessary *Persons who carry out precautions e.g. isolations, should sign that precautions have been taken.*	
8. Protective equipment required	
9. Authorisation *Signature confirming that isolations have been made and precautions taken, except where these can only be taken during the work. Date and time duration of permit.*	
10. Acceptance *Signature confirming understanding of work to be done, hazards involved and precautions required. Also confirming permit information has been explained to all workers involved.*	
11. Extension/shift handover procedures *Signatures confirming checks made that plant remains safe to be worked upon, and new acceptor/workers made fully aware of hazards/ precautions. New time expiry given.*	
12. Hand-back *Signed by acceptor certifying work completed. Signed by issuer certifying work complete and plant ready for testing and recommisioning.*	
13. Cancellation *Certifying work tested and plant satisfactorily recommissioned.*	

ANNEX 6.3
MODEL HOT WORK PERMIT FORMAT

HOT WORK PERMIT		
Date issued: ....Valid for: date & times (max 24 hr)......................... Contractor name, address & telephone no.: .... Contract reference: .... Site address:		
Hot work required: Location on site: .... Within hazardous area? YES/ NO		
List hazards and hazardous area: *e.g.tank farm*		
List likely sources of ignition: *e.g. welding, metal cutting, grinding*		
Standard precautions to be taken:		
Precaution	Management requirement (√)	Contractor to confirm (√)
Equipment in good working order		
All flammable product removed		
Area gas free		
Monitoring of area for flammable atmospheres in place		
Fire extinguishers available		
Welding curtains provided		
Fire blanket provided		
Ventilation (if required) provided		
Area fenced off		
Warning notices in place		

HOT WORK PERMIT (CONT.)		
Additional precaution	Management requirement (√)	Contractor to confirm (√)

Regulatory authority:
- have given approval in writing? YES / NO
- have set conditions? YES / NO

If so, conditions set:

Have all conditions been met? YES / NO

BEFORE WORK COMMENCES
I verify that the information contained in this permit is correct; specifically the work area has been examined and the stated precautions are in place:

Retailer (or their on-site representative):	Contractor/person(s) carrying out the hot work:
Signed:	Signed: ....
Print Name:	Print Name: ....
Position:	Position: ....
Company:	Company: ....
Date and time of handover:	Date and time: ....
....	....

ON COMPLETION OF HOT WORK

I verify that the hot work has been completed in accordance with the above and that the location of the work has been inspected 30 minutes after the task was completed.

Contractor/person(s) carrying out the hot work:
Signed: ....
Print Name: ....
Position: ....
Company: ....
Date and time: ....

ANNEX 8.1
CONTAINMENT SYSTEMS FIGURES

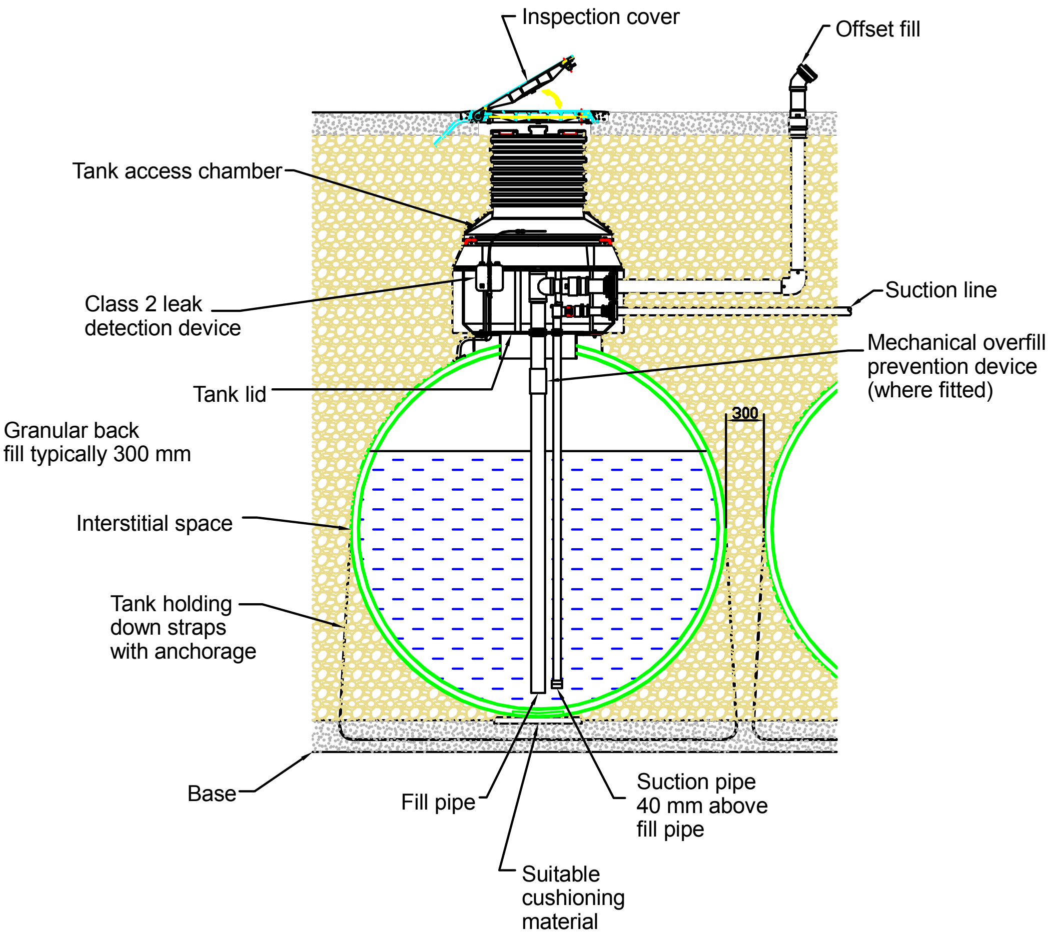


Figure A8.1.1 Typical installation of double-skin steel tank with suction lines and offset fill (vent pipe and gauges omitted for clarity)

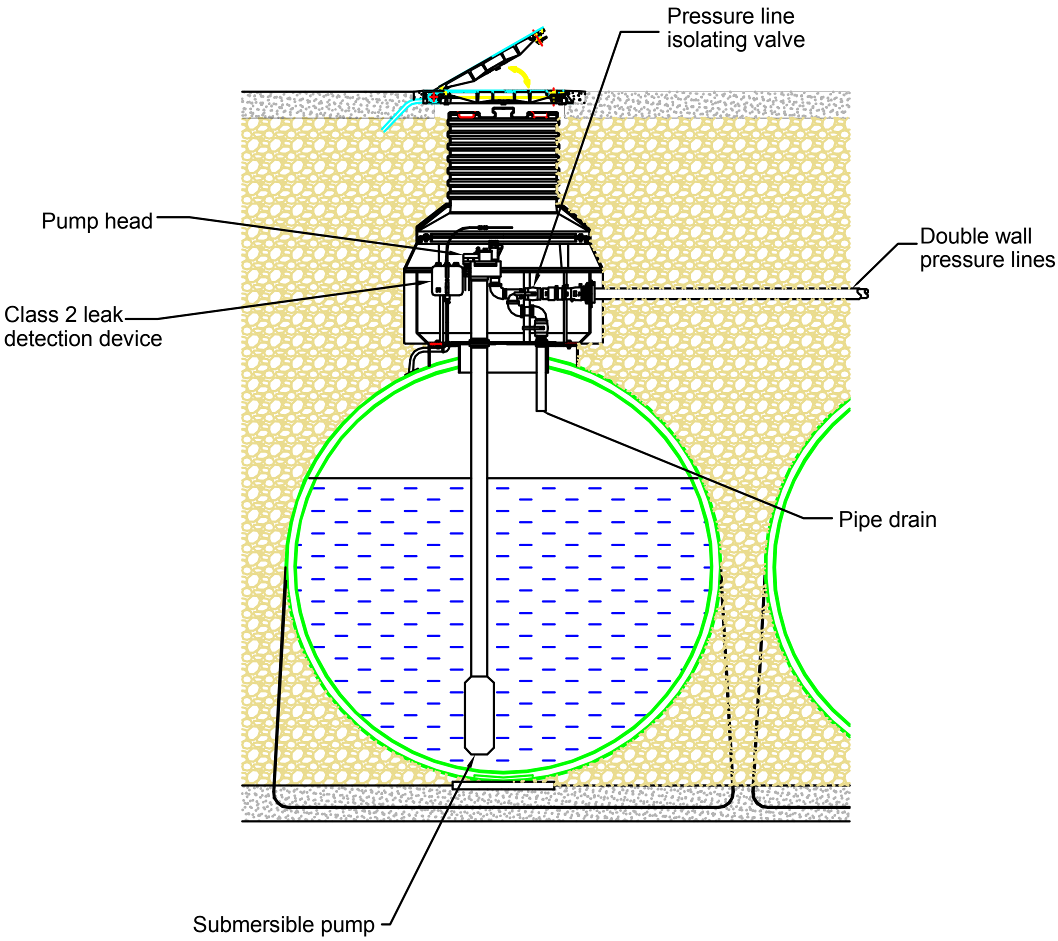


Figure A8.1.2 Typical chamber housing submersible pump

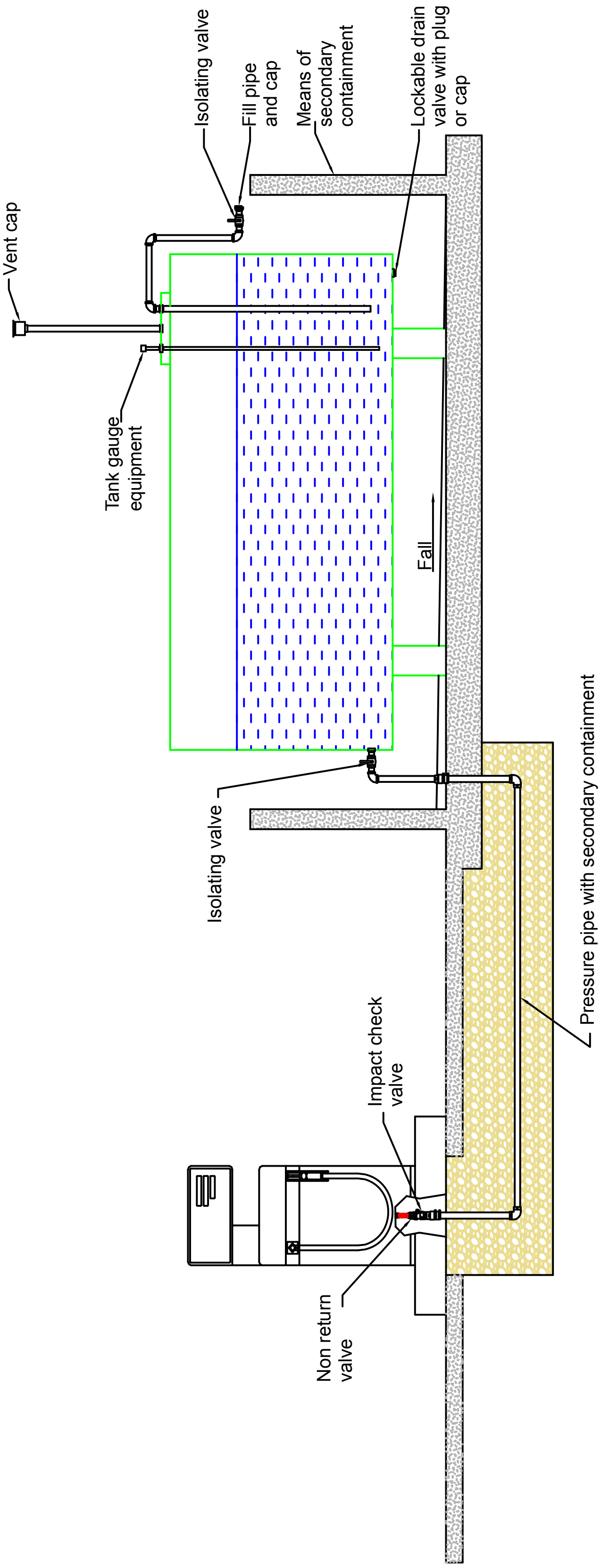


Figure A8.1.3 Typical above-ground diesel tank installation

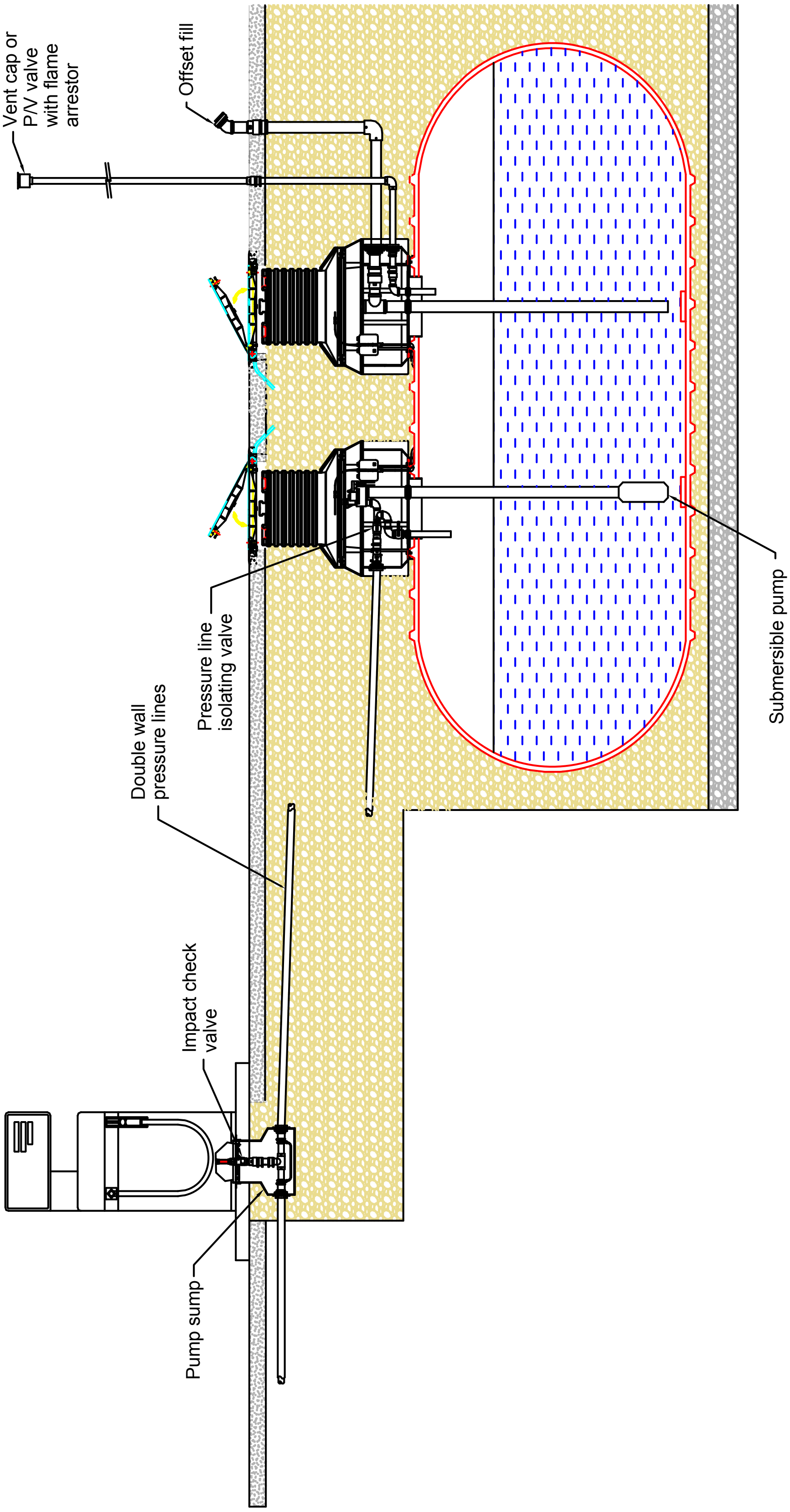


Figure A8.1.4 Typical pressure line installation and double-skin GRP tank

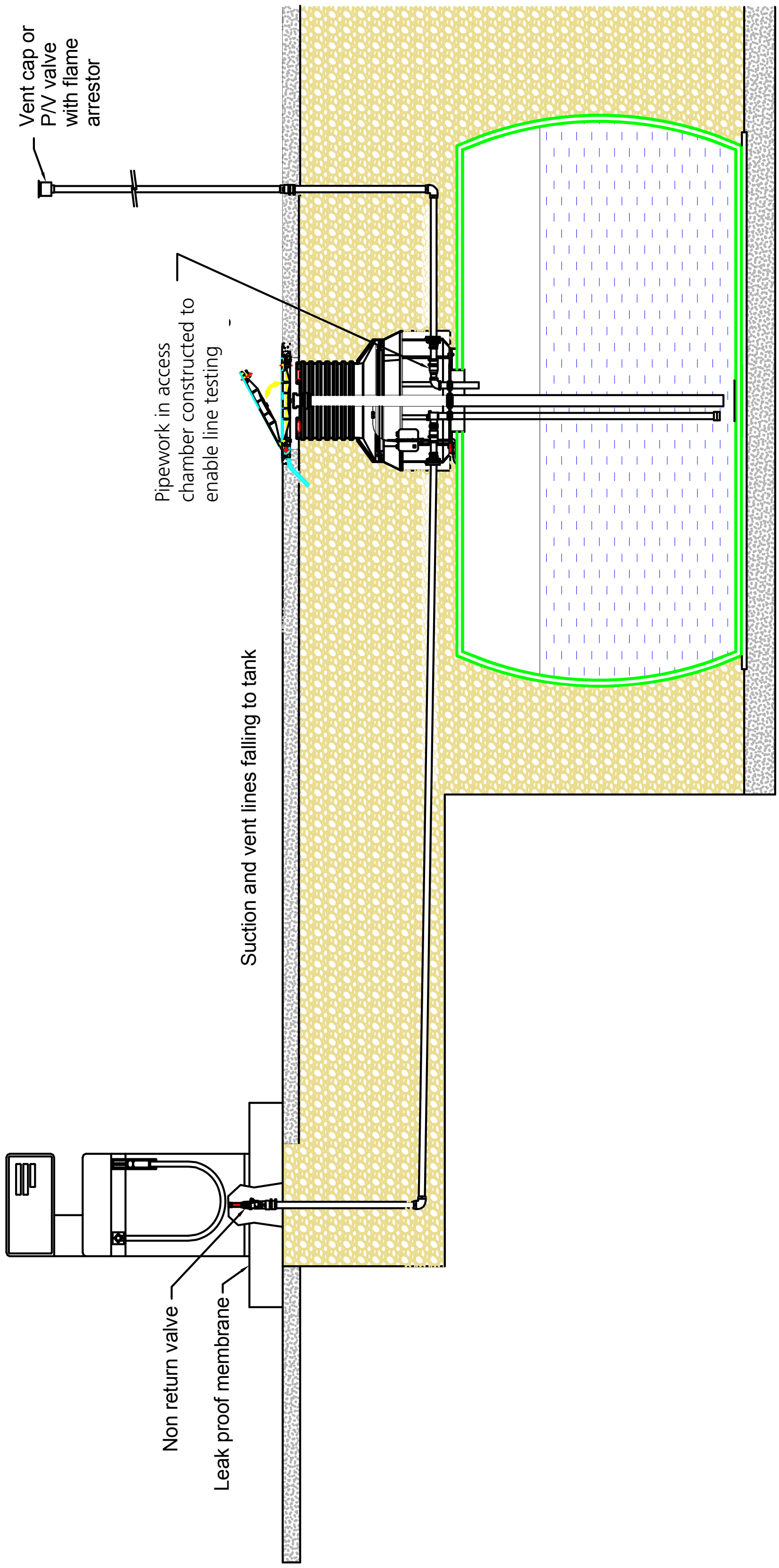


Figure A8.1.5 Typical suction line installation with double-skin tank

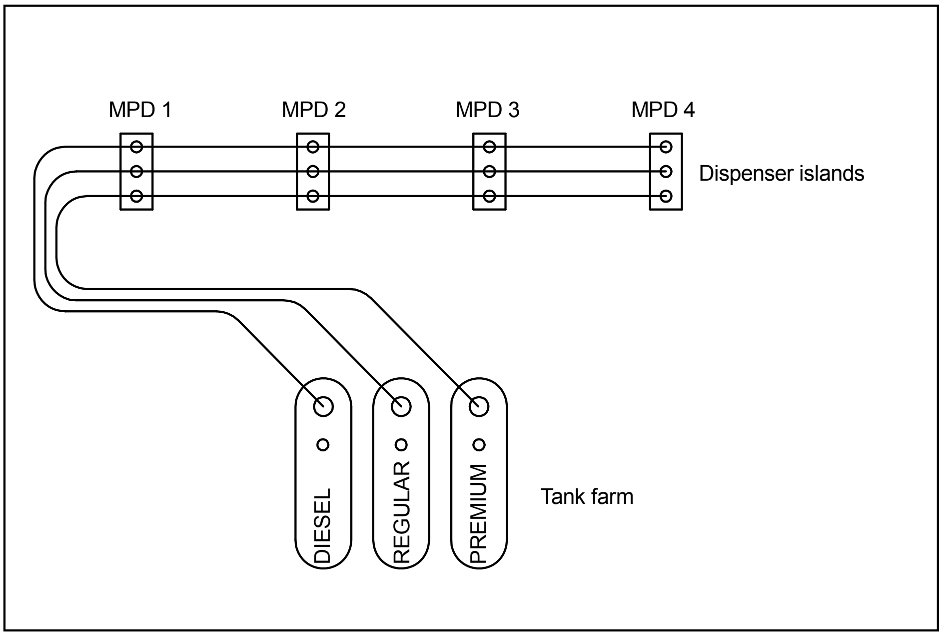


Figure A8.1.6 Example of pressure line layout

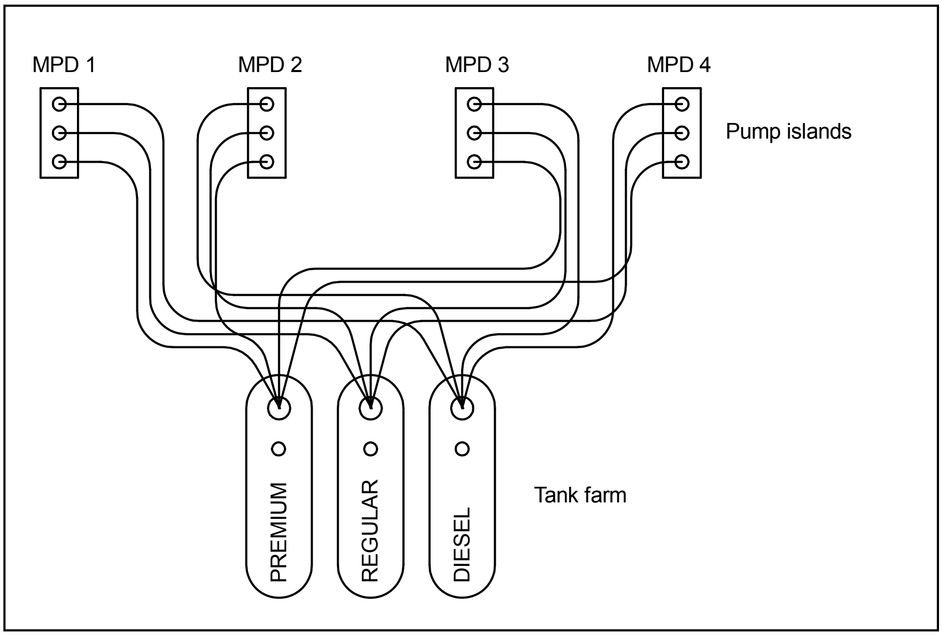


Figure A8.1.7 Example of suction line layout

ANNEX 8.2
SMALL (MOVABLE) REFUELLING UNITS

Small (movable) refuelling units are now commonly used by some businesses and recreational clubs where the nature of the businesses or club activity necessitates the use of petrol in small quantities; typically for the refuelling of horticultural machinery.

These units comprise an integral storage tank and pump/dispenser; the pump can be manually operated or electrically driven. In order to receive gravity fed deliveries from road tankers, the units are designed with a low profile storage tank with the top of the tank and the delivery hose connection point being at a level lower than the road tanker discharge adaptor. The capacity of the storage tank on the unit may range from 900 to 2 500 litres.

Whilst the guidance given in section 8.4 will, in general, apply to these units, their usage and location (i.e. not on a filling station) and varying storage capacities will allow for some leeway in determining separation distancing, positioning and hazardous areas.

A8.2.1 DESIGN AND CONSTRUCTION

The design and materials from which the unit is fabricated should be of a standard such that it will provide an effective containment system throughout its intended design life. All materials which may come into contact with petrol or its vapours should be compatible and should not degrade or prematurely fail.

The unit should not be constructed from plastic as this will give rise to problems with effective earth bonding when petrol or other low flash point liquids are to be stored.

A8.2.2 SEPARATION DISTANCING

When not in use, the unit should be sited in an adequately ventilated position separated from the site boundary, occupied buildings, sources of ignition and any process areas by a distance determined from a site-specific risk assessment. For further guidance on separation distancing, see sections 4 and 8.4, and HSE HSG 176 *The storage of flammable liquids in tanks*.

Factors to be taken into consideration when determining the appropriate separation distance include:

– The construction materials of any nearby building (i.e. a building constructed of timber walls would attract a greater separation distance than one constructed with masonry walls).
– The flammability or explosive characteristics of the contents of any nearby building.
– The physical status of the occupiers of any nearby building.
– The use of the land on an adjoining boundary (i.e. a public road or footpath would attract a greater separation distance than fields put to purely agricultural use).
– Any physical or thermal protection afforded to the unit (i.e. a 'fire wall' or fire-resisting cladding).

Note: The zones determined through hazardous area classification may exceed the separation distances determined by consideration of the above factors.

A8.2.3 POSITIONING

The unit should not be positioned in an excavation or a depression (natural or man-made) to facilitate gravity fed deliveries. Where it is necessary to install the unit in a vault, reference should be made to the recommendations given in 8.4.3.3.

A8.2.4 HAZARDOUS AREA CLASSIFICATION

When carrying out hazardous area classification for the unit the guidance in section 3 should be followed. The following should be considered:

– the method of unloading into the storage tank i.e. gravity or pumped delivery (see section 3.2.2.3d);
– the venting conditions (see section 3.2.3), and
– the dispensing of the fuel i.e. via electric, mechanical or manual pump (see section 3.2.5).

A8.2.5 ELECTRICAL EQUIPMENT

Any electrical equipment fitted to the unit or in the associated hazardous areas should be certified for use in the zone in which it is situated.

Earth bonding cables should be provided on the bowser to equalise electrical potential between:

– the unit and the road tanker (when filling the unit storage tank), and
– the unit and the equipment or tank being re-fuelled.

The resistance between the termination and the unit or road tanker chassis should not exceed 10 Ω.

A8.2.6 SPILLAGE CONTROL

The on-site location of the unit and the capacity of the storage tank, together with environmental sensitivity, will influence the degree of spillage control measures required.

Where it is necessary to provide a means to safely retain any spillages that may occur when the unit is being filled, or from any possible leakages from the storage tank or ancillary equipment, consideration should be given to locating the unit in a bunded area. Where this is implemented, the capacity of the bunded area should be 110 % of the capacity of the storage tank.

A8.2.7 SECURITY

If the site in which the unit is located is not secured against unauthorised access, the unit should be positioned in a secure compound. The compound should be designed and constructed so that it does not impede natural ventilation; robust (metallic) palisade fencing should achieve this.

Gates to any secure compound should be outward opening and should be easily opened from the inside when any personnel are working in the compound. Where only one entrance/exit is provided, the maximum travel distance (from the furthest point in the compound to the exit) should not exceed 12 m. In determining the location and number of entrance/exit gates, consideration should be given to the position of the road tanker when the unit storage tank is being refilled.

A8.2.8 INSPECTION AND MAINTENANCE

The unit and all its ancillary equipment should be maintained in a safe condition. This may be achieved by employing or training personnel who are suitably qualified and understand the hazards associated with the storage and dispensing of petroleum products.

An inspection and maintenance regime should be in place for the unit and its associated equipment and fittings, including the earth bonding arrangements. A record of the inspection and electrical testing should be maintained in a site register.

ANNEX 10.1
CONVERSION TO STAGE 1b AND STAGE 2 VAPOUR RECOVERY

A10.1.1 CONVERSION TO STAGE 1B OPERATION

When a filling station is converted to Stage 1b operation, the most significant change required is the connection of the tank vent pipework to the tanker. Unless it is to be replaced, the type of vent pipework installed will govern the choice of system. Above- or below- ground manifolding can be adopted.

An assessment should be made of the maximum number of tanker compartments which may be discharged simultaneously, in order to maintain the integrity of the vapour recovery system.

The introduction of a vapour recovery system will cause variations in tank pressure and this may affect the operation of some automatic tank gauging systems. Those gauges which are likely to be affected are hydrostatic and pneumatic types, where tank contents are indicated by measuring the pressure of a column of liquid and comparing it to atmospheric pressure. Such gauges may be analogue systems, with a manual pressure pump, or electronic systems operating with a small compressor.

Where the correct functioning of gauges is in doubt, the gauge manufacturers should be consulted for guidance. For some types of gauge it may be possible to upgrade them to meet the vapour recovery requirement (see section 11 for further information on tank gauging).

Any problems which are present in the storage system may have an impact on the Stage 1b system unless they are rectified. In practice some of the problems may not have been noticed previously, such as:

- Restricted fill pipes and restricted venting capacity resulting in slow deliveries. Internal fill pipes not completely sealed (in the tanks).
- Leaking fill pipe caps.
- Leaking joints and connections.

An assessment is required to identify those areas which may prevent the conversion to Stage 1b being effective. Annex 10.2 provides a series of recommended checks that should be carried out in a systematic manner prior to conversion. The results of the checks will provide the basis for the design of the system and a reference against which future checks can be compared.

Annex 10.3 provides recommendations for part of the commissioning procedure following the conversion of a site to Stage 1b vapour recovery.

A10.1.2 CONVERSION TO STAGE 2 OPERATION

The introduction of a Stage 2 system currently requires the following major changes to be made to an existing installation:

- Use of a special refuelling nozzle and ancillary fittings.
- Introduction of a vapour return hose on the dispenser connecting the nozzle to the vapour piping.
- Additional pipework to return vapour from the dispenser to the storage tank.

- Additional equipment installed within the dispenser. This will be influenced by the method adopted for achieving vapour flow back to the storage tank.
- A Stage 1b system unless already fitted.

Where a filling station is adapted to Stage 2 vapour recovery and the vapour return pipework from the dispensers is connected into the storage tank vent pipework then, irrespective of whether manifolding is above ground at high or low level, the overfill prevention device installed has to maintain a vapour space in the storage tank and an open vapour path from the tank vapour space to the vent pipework to allow for a potential overfill. This is necessary to permit normal operation of the Stage 2 dispensers, which would otherwise cut out, if the vapour return pipework was blocked.

It is important to ensure that retrofitting a vapour recovery system into an existing dispenser does not compromise the relevant certification of that dispenser.

A10.1.3 REVISED RISK ASSESSMENT

The introduction of a vapour recovery system will require a revised risk assessment to be undertaken, (see section 2).

ANNEX 10.2
ASSESSMENT CHECKS PRIOR TO CONVERSION OF EXISTING SITES

A10.2.1 ASSESSMENT CHECKS

The following checks should be undertaken prior to designing or installing a conversion to Stage 1b vapour recovery. Checks 1-7 can be done at any time whereas checks 8 and 9 need to be done during a typical delivery.

A10.2.1.1 Check 1

Measure the respective lengths of internal fill pipes and suction lines in each tank to check that the fill pipes all have a liquid seal at the bottom under all conditions. The height of the fill pipe off the floor of the tank should also be checked to ensure that it is at least one quarter of the fill pipe diameter (e.g. 25 mm for a 100 mm diameter pipe) to allow fuel to flow into the tank without undue restriction.

A liquid seal is also important for safety on conversion to Stage 1b. If the tank vapour spaces become pressurised, which can occur when delivering fuel to a system with manifolded vent pipes, then the pressure is also applied to any fill pipes without a liquid seal. This is potentially dangerous; when the fill pipe caps are removed they can come off with considerable force and may become projectiles unless tethered. Also, flammable vapour is released at ground level.

A10.2.1.2 Check 2

Fill pipes may leak vapour through poorly made or damaged seals at the tank lid, or through an overfill prevention device that has not been correctly sealed. It is also possible that the overfill device itself may leak. Vapour leaks at these points can give rise to the same hazards as the lack of liquid seal discussed above and in addition can lead to vapour locks and additional vapour generation. The vapour lock can slow down or even stop liquid flow into the tank. It is important therefore to check the integrity of the fill pipe system. This can be done using a test method, which applies a small pressure against the petrol in the internal fill pipe and monitors the decay rate of the pressure with time.

In addition the fill pipe caps should be checked to ensure that the seals are fitted correctly and have not been damaged or have not hardened with age.

A10.2.1.3 Check 3

For each tank, record the diameter of the fill pipes and whether or not overfill prevention devices are fitted. The presence of such devices (especially those fitted in the fill pipe) could be a source of possible vapour leaks as noted above.

A10.2.1.4 Check 4

Check the depth of the tank below the connection on the top of the fill pipe.

The conversion to Stage 1b requires that a 35 millibar (mbar) pressure/vacuum (P/V) valve be fitted to the tank vents. This is to ensure that vapour actually flows to the tanker and does not find its way out of the filling station vent during the filling operation.

If the vapour is free flowing, most of the time the tanks will only be pressurised to a few millibar. However, if there is any significant restriction the pressure can increase and the effect is to cause petrol to rise up the fill pipes of other tanks on the same manifold once the caps are removed. The 35 mbar set pressure on the P/V valve will support a column of petrol approximately 460 mm high. In some situations where the tanks are nearly full, not buried very deeply and have direct fills, the petrol from the tank could flow back out of the fill pipe.

This is clearly a potentially dangerous situation, as, if the depth is found to be 460 mm or less then the problem could arise. A solution is to fit a direct vent connection to that tank (i.e. not manifolded) to reduce the possibility of generating significant pressure in the tank.

A10.2.1.5 Check 5

For each tank, record the diameter of the vent pipes and their approximate length. It is likely to be difficult to assess the length underground since they seldom seem to run as expected. The purpose is to be able to assess whether any restrictions are likely to be due to blockages or simply the fact that the vent pipework is lengthy.

A10.2.1.6 Check 6

Some filling stations have been fitted with tank gauging and it is important that a check is made with the manufacturer to ensure it will be suitable for use with Stage 1b.

Tank gauges come in several forms. Some work on the basis of measuring the pressure generated in a tube by the head of liquid in the tank. To do this they need the pressure above the liquid as a reference pressure. In non-Stage 1b sites the pressure in the tanks is effectively always equal to atmospheric pressure, but conversion to Stage 1b means that the tank pressure could be anywhere between about -2 mbar vacuum and 35 mbar pressure. Unless they are specially modified the gauges will give a false reading which could lead to tank overfills or inaccurate accounting or both.

It should be noted that using a dipstick when the tank is pressurised or under vacuum can also give false readings.

A10.2.1.7 Check 7

It is recommended that vent pipework be blown through to atmosphere with an inert gas to ensure that they are clear. It has been found that on filling stations where the vent systems have been in place for some years, they can become partially blocked with debris, rust, or in some cases condensed product or water. The vapour recovery system requires free flowing vapour to work correctly and to avoid excessive pressures being developed in the tanks.

Checks 8 and 9 need to be done during a fuel delivery.

A10.2.1.8 Checks 8 and 9

These checks determine if the conversion to Stage 1b is likely to work efficiently. Check 8 is to measure the average unloading rates from a tanker and to assess whether there is any blockage in the vent or fill systems. This is done by unloading a compartment into an underground tank, measuring the time taken from start of liquid flowing to when it has stopped and from the volume of liquid delivered calculating the average rate of flow in litres per minute (l/m).

For Check 9, if a simple flow measuring device is fitted in, or on, the relevant tank vent it is possible to see if there is any significant delay between liquid starting to flow and vapour flow starting. Also, it is possible to see if vapour continues to flow after liquid flow has stopped.

If the vent is blocked or restricted in any way, vapour will not start to flow quickly and due to build-up of pressure in the underground tank may continue to flow for a short time after filling has stopped.

Checks 1-9, should be undertaken on each tank and the results entered on a summary sheet, to allow easy comparison of data and help highlight any problems or anomalies. It is worth including diesel tanks in the checks since they may be converted to petrol at a later date.

A10.2.2 ASSESSMENT OF RESULTS

The main purpose of the assessment is to decide if it is necessary to make any changes before the conversion to Stage 1b. The criteria for change should be 'are there any safety problems to be resolved?' and for other changes 'would the efficiency of operation of the vapour recovery system be affected if they were not done before conversion?'

Any defects identified in Checks 1 and 2 could give rise to hazardous situations before and after conversion to Stage 1b and should be rectified as soon as possible. Check 4 also identifies a potential safety problem and should be taken into consideration in the design of the Stage 1b system.

Checks 8 and 9 will identify whether there are any significant restrictions in the vapour flow during unloading and how they might affect the efficiency of Stage 1b operation after conversion. They will give an indication of how the vapour recovery system should be designed.

If there were no restrictions, the average unloading rates would probably be in the range of 700 to 900 l/m. It would then be quite suitable to manifold together the tank vents into a single off take line for connection back to the tanker.

However, if the flow rates are less than 700 l/m the problem may be small diameter fill pipes or small diameter/long vent pipework. Depending on the recorded data a choice has to be made on whether to convert to a Stage 1b system.

Fill or vent pipework could be replaced, preferably with larger pipework, or it may be possible to select a direct vent connection. In this alternative the tank retains its current fill pipe but a vapour return connection is made directly into the vent pipework of each individual tank. The tanker can only unload one compartment at a time with this system.

The direct connection alternative may also be used if the tank is close to the surface as mentioned in Check 4 above.

The final assessment should be recorded and used as a basis for the design of the Stage 1b system conversion.

ANNEX 10.3
COMMISSIONING AND PERIODIC TESTING/MAINTENANCE OF STAGE 1B SYSTEM

A10.3.1 COMMISSIONING

In order for a manifolded vapour recovery system to operate correctly and safely, there has to be a liquid (petrol) seal between the bottom of the internal fill pipe and the ullage space of each of the (manifolded) tanks. Clearly this situation is not possible with a new installation or where tanks have been temporarily decommissioned for maintenance purposes etc. It is, therefore, important that the first delivery of fuel is carried out with great care so as to avoid the release of large volumes of vapour through the fill pipe openings of the tanks. A safe method of introducing petrol into the tanks is to unload 1 000 litres of petrol into one tank at a time until all the tanks are charged with sufficient petrol to provide a liquid seal at the fill pipe. The vapour transfer hose should be connected at this initial commissioning stage of the delivery and the fill pipe caps of the tanks not being filled should be in the closed position. After this stage of the commissioning procedure has been completed, the remainder of the fuel on the tanker can then be unloaded in the normal manner.

A10.3.2 PERIODIC TESTING

The following testing is required:

a. Confirm that any vapour leak rate from internal fill pipes is less than 2 litres per minute (l/m). For a leak rate between 2 and 5 l/m measures should be taken to reduce the leak rate to below 2 l/m. If a leak rate is found to be greater than 5 l/m it should be rectified immediately since serious safety issues may arise.
   – Any suitable dynamic or static method can be used to test for leaks in the internal fill pipe system provided the results can be interpreted in terms of leak rate at a pressure of 30 mbar or compared to the performance requirements of EN 13616 *Overfill prevention devices for static tanks for liquid petroleum fuels.* Test methods to determine the leak rate should be capable of measuring a directional flow rate of petrol vapour (or a test medium gas/vapour) from the tank ullage space into the fill pipe.
   – In order to determine the integrity of the internal fill pipe connection to the tank lid or the offset fill pipe, the internal fill pipe and any fittings should be tested *in situ*.

b. Confirm that the P/V valves on storage tank vents are not worn, damaged, blocked or leaking, and ensure their continued correct operation.

c. Confirm that the average liquid fill rates are consistent (i.e. all in the same range) and in the indicated 'normal' range when the tanker is producing a suitable vacuum.

d. Confirm that the number of compartments which can be unloaded simultaneously remains appropriate. If there are restrictions at the higher flow rate it may be possible to modify the manifold or alternatively reduce the number of compartments which can be unloaded simultaneously.

Any problems that are identified should be investigated, rectified and the system re-tested.

ANNEX 14.1
GUIDANCE FOR PERIODIC INSPECTION AND TESTING OF ELECTRICAL INSTALLATIONS

A periodic inspection and testing programme should be carried out to determine whether or not the condition of the electrical installation and equipment at the filling station, and in particular within hazardous areas, is satisfactory.

The following scheduled items should, as a minimum, be inspected and tested to assist in the completion of the certificate. The test results, categorised defects and observations should be recorded for retention with the site electrical records for a period of not less than five years.

Test instruments used have to be suitable for the areas tested. On no account should earth fault loop impedance or prospective short circuit current (PSCC) test instruments be used other than as described in sections 14.10.2.2 (d) and 14.10.2.2 (e).

A14.1.1 INSPECTION

A general inspection of the site should be made prior to testing, including verification of the electrical equipment inventory checklist (Annex 14.7). The results of this inspection should be recorded in the filling station electrical periodic inspection report (Annex 14.9). If the inventory checklist is unavailable or changes have occurred, a new inventory checklist should be prepared, covering equipment in and associated with the hazardous areas and the storage and dispensing of vehicle fuel.

Inspection should verify that all relevant items of equipment are recorded on the inventory checklist. Equipment should be constructed to relevant British Standards or equivalent standards, and should not damaged in a way that would impair safety or proper operation.

A14.1.2 FUNCTIONAL CHECKS

An operational check should be made of:

- Every publicly accessible emergency switch, which should also be checked to ensure it cannot re-energise the supply.
- Every operator controlled emergency stop button.
- Every firefighter's switch (for HV discharge lighting).
- The public address (PA)/speaker systems; (including operation after the emergency switch has been operated).
- Tanker stand lighting, also check location of luminaires with respect to tanker position (see section 14.5.6).
- Vent pipes, to ensure no electrical equipment is mounted on them.

A14.1.3 MAIN DISTRIBUTION

Where applicable, secure isolation/restoration should be made as necessary for testing earth fault loop impedance, main polarity, earth electrode resistance, insulation resistance, residual current device (RCD) tripping, current leakage and isolation of systems. An internal visual inspection of the switch and the distribution equipment can be made at the same time.

Note: dispenser internal computer battery back-up systems, if provided, may remain energised unless the manufacturer's instructions specifically state otherwise.

A14.1.4 HAZARDOUS AREAS

Dispenser pump hydraulic housing covers, or other relevant covers as necessary, should be removed to expose earth terminals so that earth continuity can be measured with respect to the main earth terminal after allowing time for any fuel vapour to disperse. Before replacing external covers an inspection should be carried out without the need to remove or disturb components, in particular checking the following points:

a. Name plate details: Accredited Certification Mark, Certificate Standard number (e.g. EN 13617-1, BS 7117-1, SFA 3002[33]);
   Note: uncertified equipment (i.e. with no certifying authority approval for use in hazardous areas) should be reported to the site operator and noted in the site electrical records with a recommendation that the enforcing authority be informed immediately.
b. Explosion protection suitable for zone of installation.
c. Damage or other defects which might impair safety.
d. Equipment clear of dirt, dust and rubbish (leaves etc.).
e. Evidence of fuel leakage.
f. Incoming cables are of suitable type and accessible duct/pipe seals appear satisfactory.
g. Visible gaskets and seals appear satisfactory.
h. Condition of enclosures and fastenings.
i. Lamps of correct types and ratings and in working order.
j. Evidence of unauthorised or undocumented repairs or modifications including 'add ons'.
k. Maintenance appears to be adequate and properly documented.
l. Earthing and bonding arrangements and tightness of terminations.
m. All cables and their glanding appear in order.
n. Cables and other fixtures clear of moving parts.
o. Explosion-protected equipment integrity (i.e. for Ex'p' equipment, check that the air mover is operational, that the static pressure is correct and the air outlet unobstructed and for Ex'd' equipment only, test tightness of flame paths with feeler gauge).
p. Wear or undue running noise of pump motor bearings (e.g. lateral movement of shaft or signs of overheating).
q. Where applicable, excessive mechanical running noise.
r. After refitting covers, checking they are properly located and gasket seals are adequate, re-energise.
s. Where applicable, suitability of the electrical installation and equipment within any structure sited within or opening onto the hazardous area.

33 EN 13617-1 *Petrol filling stations. Safety requirements for construction and performance of metering pumps, dispensers and remote pumping units*, BS 7117-1 *Metering pumps and dispensers to be installed at filling stations and used to dispense liquid fuel. Specification for construction*, BASEFFA Schedule of Accreditation SFA 3002 *Metering pumps and dispensers*.

A14.1.5 GENERAL ELECTRICAL INSTALLATION (ITEMS NOT COVERED ABOVE)

The results of the inspection should be recorded on a suitable inspection checklist which should be retained with the site electrical records. All deviations noted should be recorded on the filling station electrical periodic inspection report (see Annex 14.9).

A14.1.6 GUIDANCE ON PERIODIC TESTING PROCEDURES

All electrical equipment at the filling station should be subject to periodic inspection and testing to establish that it is in accordance with the requirements of this publication (see also section 14.10.1).

Where the inspection and/or testing reveals a dangerous situation the site owner or operator should immediately be informed, in writing, of the action to be taken to remove the danger. Where this situation relates to the storage and dispensing of vehicle fuels, it should also be noted in the site electrical records with a recommendation to the site owner or operator that the enforcing authority be informed immediately.

Where site modifications, which may affect safety or operation of the electrical installation, are carried out subsequently to the issue of a test certificate, the installation, as a whole, should be checked in accordance with the relevant verification programme. For modifications not affecting the installation as a whole, only the items concerned in the modification require verification and recording as an 'interim inspection'.

If it is not possible to carry out any of the recommended tests this should be stated in the test schedule.

A14.1.7 EARTH FAULT LOOP IMPEDANCE/EARTH ELECTRODE RESISTANCE TESTING

Test equipment which injects high levels of current to earth other than at a test point specifically provided for that purpose (see Figure 14.1) is not to be used. This includes instruments for testing earth fault loop impedance, high current continuity and prospective fault current testers and some portable appliance testers.

A14.1.8 INSULATION RESISTANCE TESTING OF ELECTRICAL CIRCUITS

A14.1.8.1 Warning

Insulation resistance tests should never be conducted on any circuit where there is risk of damaging equipment, unless a suitable means of disconnection is provided to prevent such damage.

A14.1.8.2 General description

Insulation resistance tests are to be carried out with an insulation resistance test instrument sited in the non-hazardous area. The purpose is not only to check the integrity of the insulation but also to monitor its condition. Deterioration may be evident if resistance readings are noticeably lower than those taken previously. For this reason reference should be made to the site electrical records and to the data recorded on the last test schedule.

For each circuit cable a test of 500 volts direct current (V d.c.) shall be applied between bunched live (line and neutral) conductors together and earth, including the metallic sheath/armouring. The resultant reading should be greater than 10 MΩ for the insulation to be considered adequate. After making measurements all readings should be compared with previous test records.

Readings below 10 MΩ, and any reading showing a noticeable reduction since the last test, should be treated as suspect and appropriate action taken. For example, a cable showing less than 11 MΩ, which on its last test certificate was in excess of 15 MΩ, is deteriorating and may well become unsafe within a year.

The important factors are firstly that readings should exceed 10 MΩ and secondly that no noticeable change has occurred since the last recorded test.

Subject to proper safety procedures being employed, as an alternative to insulation resistance testing, the 50 hertz alternating current (Hz a.c.) leakage current in a circuit when energised at supply voltage, may be measured using a suitable clamp meter and the value recorded on a test schedule for future comparison. The value of leakage current should be appropriate for the type and length of cable and the type of equipment being tested. Any excessive value should be treated as suspect and should be investigated.

A14.1.8.3 Working procedures

The equipment to be tested should be made safe by isolation of electrical energy at the origin of the circuit and proved dead. This includes all forms of remote secondary supply (e.g. from inverted d.c. battery power). The means of isolation should be secured in the 'off' position (i.e. all live conductors, including neutral, being isolated).

A14.1.8.4 Testing from the non-hazardous area

a. It should be ensured that any data isolation switches relative to the equipment are in the 'off' position (isolated). Failure to do this may damage the control point equipment connected to dispensers.
b. Checks should be carried out, particularly with dispensers, to ensure that no other circuits have been added to the dispensers since the initial installation. It is possible that peripherals may not be listed in the manufacturer's instructions (e.g. auxiliary battery back-up, additional data cables for credit card readers).
   If additional circuitry exists which is not listed in the manufacturer's instructions then the manufacturer of the additional equipment should be contacted to ensure that means of disconnection have been provided via the original means of disconnection in the dispensers, or otherwise. Full details should be entered in the site electrical records if not previously recorded.
c. In any event, all electrical conductors should be securely isolated and proved dead before the tests are carried out.
d. The tests, as previously described, should be carried out directly on the load side of the circuit breaker/datalink isolators, within the non-hazardous area.
   If gaining access to the test terminals does not expose live terminals, only the circuit subject to testing needs to be isolated.
   The results are to be noted with special reference made to any reading which is either below 10 MΩ, or significantly low when compared with the last recorded test. This information should be entered on the electrical test schedule and retained with the site electrical records. Unacceptable readings should be identified and a recommendation made for appropriate remedial work.

e. When testing forecourt equipment sited outside of the hazardous area, for example:
   - canopy lighting;
   - forecourt audio system;
   - pole sign;
   - car wash/jet wash equipment;
   - vacuum cleaning equipment;
   - coin or token operated airline;
   - diesel or kerosene dispensers;
   - close circuit television (CCTV), and
   - driver controlled delivery (DCD) delivery unit;

   it is necessary to ensure that the area in which the equipment on test is sited does not temporarily become a hazardous area, for example by the position of a road tanker during delivery.

   The areas of hazard as defined in this publication should be correctly identified before equipment is isolated and subjected to an insulation resistance test.

A14.1.8.5 Tank gauge systems

Insulation tests on the cables connected to an underground tank gauge should only be carried out in accordance with the manufacturer's instructions. The method indicated by the manufacturer will include a means of disconnection at the probe (automatic or manual).

If a safety barrier is incorporated within 'Ex' equipment in the hazardous area, an approved means of disconnection has been incorporated to allow the test to be carried out. It will sometimes not be possible to carry out the insulation resistance test. If so, this should be noted on the Test Certificate and in the site electrical records (see intrinsically-safe systems in A14.1.8.6).

A14.1.8.6 Intrinsically-safe systems (typically used for tank gauge and leak detection systems)

The safety barrier should normally be located in the non-hazardous area. Cables feeding systems which are certified intrinsically-safe and other equipment should be tested up to the input connections to the safety barrier.

If the safety barrier is within a hazardous area or the system is not certified intrinsically-safe, the insulation resistance tests should not be carried out unless a certified means of disconnection is incorporated. It will sometimes not be possible to carry out the insulation resistance test. If so, this should be noted on the Test Certificate and in the site electrical records.

A14.1.8.7 Selection and use of test instruments

If test instruments are to be used in the hazardous area, they should be certified as intrinsically-safe for use in areas where petrol vapour is present. When an insulation resistance tester applies 500 V d.c. to conductors a charge will be stored within the cable due to capacitance. This charge could remain after the tester has been disconnected, or it could prove incendive if the charged cable discharges via a fault. Most modern insulation resistance test instruments have a built-in discharge facility which is always operational except when the test button is depressed. Where this facility is not available, the cable should be discharged from within the non-hazardous area.

Note: The intrinsically-safe certification of test instruments applies only to the test instrument itself.

When used on any circuit which could store electrical energy the act of testing is not intrinsically-safe.

It is important to note that the method of testing depends on which type of test instrument is used (see A14.1.9.1).

A14.1.8.8 Modifications and uncertified equipment

If modifications have been carried out, the manufacturer's revised instructions have to replace the original and should be noted in the site electrical records.

Uncertified equipment with no certifying authority approval for use in hazardous areas should be reported to the site owner or operator and noted in the site electrical records with a recommendation that the enforcing authority be informed immediately.

A14.1.9 EARTH CONTINUITY TESTING

A14.1.9.1 General

All tests should be directly referenced to the site main earth terminal in the non-hazardous area.

Because of the nature of the test, vehicular access in the vicinity of the equipment being tested should be prohibited and the wander lead itself safeguarded.

a. With a certified intrinsically-safe test instrument.
   The wander lead of known resistance is connected to the site earth terminal in the non-hazardous area. The other lead is then connected to the earth bonding terminal of the equipment subject to test. With the connection made, the test instrument may be activated and the resistance reading obtained. Before removing the test lead the instrument has to be de-activated.
b. With a non-intrinsically-safe test instrument.
   The wander lead of known resistance is reliably connected to the earth bonding terminal or a reliable earth point of the equipment subject to test. The test is carried out in the non-hazardous area by connecting the other end of the wander lead to the site earth terminal via the test instrument. The resistance reading is obtained. Before removing the test lead the instrument has to be de-activated.

This procedure is necessary to prevent the possibility of sparking whilst making or breaking test connections.

A14.1.9.2 Test results

Test results should be compared with those previously recorded on the test schedule. In any event, the resistance obtained should generally be less than 1Ω (after the known resistance of the wander lead has been deducted).

Reference should be made to Annex 14.2, noting that the measured value may be the combined path formed by the designated cable core and the parallel sheath/armour of the cable.

Readings which are above the expected figure or have increased noticeably since last being tested should be identified and if necessary investigated.

ANNEX 14.2
CONDUCTOR RESISTANCES

The resistance of conductors measured at 20°C should, within practical tolerances, not exceed the values detailed below.

CONDUCTOR	**CopperCores csa (mm²)**	**Resistance (mΩ)**					
		Cable Length (m)					
		5	**10**	**15**	**20**	**25**	**30**
Cable cores	1	90	181	271	362	452	543
	1,5	60	121	181	242	302	363
	2,5	37	74	111	148	185	222
	4	23	46	69	92	115	138
	6	15	31	46	62	77	92
	10	9	18	27	37	46	55
2-Core MICS cable							
Cu sheath with earth tail pots	1	15	30	45	60	75	90
	1,5	13	25	38	51	64	77
	2,5	10	19	29	38	48	58
3-Core MICS cable							
Cu sheath with earth tail pots	1	12	24	36	48	60	72
	1,5	10	20	30	40	50	60
	2,5	9	17	26	34	43	51
4-Core MICS cable							
Cu sheath with earth tail pots	1	10	21	31	41	52	62
	1,5	9	18	27	35	44	53
	2,5	6	13	19	26	32	38
2-Core SWA cable							
Steel wire armour	1,5	54	107	161	214	268	321
	2,5	46	91	137	182	228	273
	4	38	75	113	150	188	225
	6	34	68	102	136	170	204
	10	20	39	59	78	98	117
3-Core SWA cable							
Steel wire armour	1,5	49	98	147	196	245	294
	2,5	42	84	126	168	210	252
	4	35	70	105	140	175	210
	6	23	46	69	92	115	138
	10	19	37	56	74	93	111
4-Core SWA cable							

CONDUCTOR	**CopperCores csa (mm^2)**	**Resistance (mΩ)**					
		Cable Length (m)					
		5	**10**	**15**	**20**	**25**	**30**
Steel wire armour	1,5	45	91	136	182	227	273
	2,5	38	76	114	152	190	228
	4	23	46	69	92	115	138
	6	21	41	62	82	103	123
	10	17	34	51	68	85	102

ANNEX 14.3
EXPLANATORY NOTES ON PME SUPPLIES AT FILLING STATIONS

a. The reason for not recommending protective multiple earth (PME) supplies in hazardous areas is that with this system of supply, unavoidable currents flow to earth via underground tanks and pipework, and there is a possible danger of incendive sparking at joints and connections. The currents in question do not arise from faults and insulation failures; they are 'diverted neutral currents' (DNC). Current in the neutral conductor of distribution systems is caused by out-of-balance single phase loadings, and the cumulative effect of harmonics, particularly third harmonics. With TN-S systems, neutral currents return to the transformer star point via the neutral core of distribution cables; they do not flow via the earth itself unless the neutral insulation fails. With TN-C-S (PME) systems however, the situation is different because the neutral is connected to each installation's main earth terminal by the distributor (this is the new name for the regional electricity company (REC) in the Electricity Safety, Quality and Continuity Regulations 2002). All the extraneous-conductive-parts of the installation (e.g. piped services, structural steel, etc.) as listed in Reg. 411.3.1.1 of BS 7671 *Requirements for electrical installations. IEE Wiring Regulations* are also connected to the main earthing terminal.

If, for example, the resistance of the metallic path, (cable neutral core/ sheath/armour), from the transformer neutral terminal to a consumer's neutral/earth terminal is 0,1Ω and the parallel earth path, (transformer earth electrode, the earth itself, and the extraneous-conductive-parts), is say 10Ω, then 1% of the out-of-balance, harmonic and capacitive currents will 'divert' and flow via the parallel path.

This is, of course, an over-simplification of the situation, since each consumer on a PME network has extraneous-conductive-parts, all providing parallel paths to earth. Nevertheless, it is clear that some neutral current will flow to earth from any installation where underground pipes, structural steel columns etc. are connected to the installation earthing terminal (as they have to be). It will also be clear that the current which may flow does not arise particularly from the installation under consideration, although it will contribute towards it. Even when an installation has been isolated, DNCs from the system in general will find a parallel path via buried metalwork which remains connected at all times. It follows that since DNCs depend on the overall loading of the system, they will vary continuously and while at times of light load may not be measurable, at other times may be considerable. Therefore, a current checking has to be carried out at various times and on different days of the week; even then the checks may not provide the highest figures which actually occur.

Note: where a filling station forms part of a larger site, care should be taken to ensure that the earthing system of the filling station is not connected to the earthing system of the remainder of the site via the armouring or sheathing of the supply cable, the fire alarm communications and security cables or any other cables which may link the filling station to the remainder of the site.

b. While removal of PME supplies from all filling stations is desirable, it is not reasonably practicable. New installations do not present many problems, and with complete refurbishment it is not so difficult, but for existing filling stations of perhaps indeterminate age, which have been added to and altered, probably in a built-up area, there are very considerable problems.

c. New installations should be carried out in accordance with the requirements of BS 7671 for TT installations, and in particular, no connection is to be made to a PME earthing terminal provided by the distributor. If there are exposed-conductive-parts on any of the distributor's apparatus (e.g. metering panel, cutout, cable sealing chamber) these will be connected by the distributor to their earthing terminals. However, if any such apparatus is adjacent to, or within 'arm's reach' of any of the consumer's equipment which has exposed-conductive-parts (e.g. metalclad switchgear, steel conduit or trunking, bare mineral insulated copper sheath (MICS) cable etc.) then a non-conducting barrier has to be provided to prevent the simultaneous contact of anyone with the two sets of equipment. Equally, there has to be no opportunity for extraneous-conductive-parts (e.g. structural metalwork, making contact with both). If all the distributor's apparatus has non-conducting casings, with only their earth terminal exposed, then this should either be disconnected from the neutral by the distributor or it should be securely insulated and a permanent notice fixed alongside warning against making any connection to that terminal.

d. In the same way that the neutral/earth terminal of a TN-C-S supply has to be completely separated from a local TT supply, all extraneous-conductive-parts which could form a connection between the two have to be identified and appropriate action taken. It is of no use if the 'earths' are separated at the intake position, but each is bonded to metallic water, gas or other service pipes somewhere else. It is necessary to have 'insulating inserts' on any such pipes and this will require close co-operation with the appropriate supply authorities (see later recommendations on the precautions to be taken at the position of any such inserts). If a new filling station is to be made suitable for TT earthing and it is entirely separate from any associated workshops, showrooms, etc, then there should be no problem with structural steelwork forming an earth connection between the local TT and the general TN-C-S systems. However, if a filling station canopy extends from another building where TN-C-S is in use, then the steelwork will almost certainly be electrically continuous and difficult, if not impossible, to separate. The TN-C-S neutral/earth enters what is intended to be a TT area, and is almost bound to connect with the hazardous area installation via lighting conduits, etc. Supporting stanchions on the pump island will be within arm's reach of dispensers connected to the TT earth, and thus a source of danger should a fault arise. In such situations, there is little alternative to making the whole premises into a TT installation. Compressed air lines, water supplies and metallic drainage can also provide unwanted earth paths between installations, but this can be dealt with by the provision of insulated inserts in the pipework. It would however, be necessary to insulate, or enclose the pipe on one side or the other of such an insert for a distance exceeding arm's length, and it would be advisable to fix a warning notice drawing attention to the presence of the insert and the need to avoid short-circuiting it.

e. If a TT system is established in accordance with the requirements of BS 7671, the installation will include residual circuit devices (RCDs) and it is essential that these be checked regularly by using the 'Test' button. The BS 7671 requirement is for quarterly testing but for hazardous areas more frequent operation is desirable; monthly would be a realistic interval between tests, all results and actions being noted in the test records maintained at the filling station.

f. The provision and maintenance of earth electrodes has been dealt with earlier in this publication, and these recommendations should be strictly observed.

g. As stated above, it may not be reasonably practicable to convert an installation from PME to TT, especially in existing filling stations in built-up areas. In such circumstances there has to be regular measurement of the current flowing in the installation earthing conductor. Two tests should be made on each occasion, first with the filling station in normal operation and second with the supply to the licensed premises switched off. The first test will establish the 'overall' earth current (i.e. that due to the filling station itself, together with the DNC from the distribution system in general). The second test will give the earth current which is not due to the filling station installation and is the distribution system DNC. The difference between the readings indicates the earth current from the filling station. This may be made up of DNC, leakage current from live conductors, capacitance current flowing from phase conductors to earth and perhaps, capacitance currents, (so-called 'earth leakage') from radio frequency filters on data transmission equipment etc. As explained earlier, current flow in earth conductors varies all the time, from the minute to the season, so several well spaced tests are needed to establish a reasonably true value.

h. As an alternative to converting a PME supply to a local TT system, an isolation transformer can be used to provide a local TN-S supply. This does not solve many problems. There is still an absolute need to separate the isolation transformer star point, the 'local neutral', from the PME earth connection and to ensure that no 'bridging' takes place. There is still a need to provide and maintain an independent earth electrode, and although it is not essential to install RCDs on the installation, one is still needed on the supply to the isolation transformer. Without this protection, (refer to Figure 14.2), if an inter-winding insulation failure occurs in the transformer, or a winding-to-core fault, current will circulate from the primary, via the secondary star point and the earth electrode back to the PME earth. If the insulation failure is not sufficiently near to a phase terminal on the primary, the current may be so limited by winding impedances and earth electrode resistance that the overcurrent protection will not operate, although a dangerous situation exists. It is also necessary to ensure that the impedance, particularly with relatively small transformers, is low enough to pass sufficient current to allow correct operation of protective devices in the event of a fault.

i. Considerable care is required when deciding whether a supply is TN-C-S (i.e. PME, or if it is TN-S). While electricity distributors used to fix labels beside their meters so that PME supplies would be readily recognisable, this is not now necessarily done. New consumers are notified at the time of application if their supply is to be PME. However, because of distribution system alterations and additions, it can no longer be assumed that supplies installed as TN-S do not now have PME neutral/earth connections, and that DNCs will not flow in their bonding conductors and earthed metalwork.

If, as indicated in Figure 14.2, an installation is supplied from the consumer's own transformer (e.g. when a filling station is part of a supermarket site) and the transformer low voltage (LV) neutral is earthed only at the substation, then this is truly a TN-S supply. When a remotely situated filling station is the only consumer connected to a distributor's transformer, where the neutral and earth are entirely separate except at the source neutral, then this is also a TN-S supply. It could however, become a TN-C-S (PME) supply if other connections are required in the area. It is not safe to assume that an apparently TN-S supply really is, and that it will remain so. If there is any cause for doubt, enquiry should be made of the distributor and, if written reassurance cannot be obtained, the actions already recommended should be taken.

ANNEX 14.4
NOTES ON MEASURING EARTH ELECTRODE RESISTANCE, EARTH FAULT LOOP IMPEDANCE AND PROSPECTIVE FAULT CURRENT AND TEST SOCKET OUTLET PROVISIONS

A14.4.1 TEST SOCKET OUTLET

A test socket outlet should be provided to allow testing of the earth electrode arrangement, measurement of the line-earth fault loop impedance and prospective fault current at the origin of the electrical installation (see section 14.4.5). The test circuit should be arranged to avoid injection of test current into exposed and extraneous conductive parts of the filling station installation. The arrangement shown in Figure 14.1 allows line to earth and line to neutral tests on the incoming supply, and earth electrode resistance tests, to be carried out with the remaining installation and bonding system completely isolated.

Note 2 to Figure 14.1 identifies the line conductor 'tail' connecting the test socket outlet to the incoming supply as having a resistance R_1. Note 3 to Figure 14.1 identifies the protective conductor connecting the test socket outlet earth contract to the linked earth bar as having resistance R_2. Where these are copper conductors of not less than 6 mm^2 cross sectional area (csa) and of length not exceeding 3 m, the resistances can be ignored.

A14.4.2 COMMENTS ON DETERMINING R_A, Z_e AND PROSPECTIVE FAULT CURRENT

When measuring earth loop impedance (Z_e) for a TT system (assuming the 'tails' to the test socket outlet can be ignored) the value obtained is the sum of:

- the resistance of the earth electrode arrangement local to the installation (R_A);
- the resistance of the electrode for the supply transformer (which could be greater than R_A);
- the resistance of the ground between the two electrode areas (which should be lower than either of the electrode resistances);
- the impedance of the transformer winding, and
- the impedance of the supply phase conductor.

An earth loop impedance test therefore cannot provide a value of R_A for the electrode local to the filling station, it simply provides a loop value to confirm that the related protective device operates in the relevant disconnection time. Additionally, most proprietary earth loop impedance test instruments allow only a very small amount of energy to pass during the test. This can be sufficient to obtain a satisfactory reading through poor conductive paths which would otherwise not be able to carry a significant fault current for a longer period of time. Continuity of protective conductors and their connections should preferably be tested by applying a substantial current for a reasonable period of time. Earth electrode resistance (R_A) should be measured using a proprietary earth electrode resistance test instrument.

The external earth fault loop impedance (Z_e) for the filling station installation is determined by using the test socket and test link (see Figure 14.1). The value obtained should relate reasonably to the design value achieved by calculation. Values which can be obtained by 'enquiry' to an energy supply distributor are not to be used. Such values from a supply distributor may cause confusion. For example a typical 'enquiry' response is 0,35 Ω for Z_e and 16 kA for prospective fault current. Using these declared values, a loop impedance of 0,35 Ω would correlate with a prospective fault current of only 680 A. On the other hand, for a fault current of 16 kA to flow, the loop impedance would have to be of the order of 0,015 Ω.

In order to verify that protective devices have sufficient fault breaking capacities and that conductors can withstand the heating effects of fault currents, it is necessary to determine the prospective fault current at the origin of the filling station installation. This applies to both the load (live) conductor loop and earth fault loop, since the fault withstand must relate to the higher of the two possible fault currents. The values may be determined by measurement or by calculation. Values obtained by 'enquiry' to an energy supply distributor are not to be used. Where the length and csa of a service cable from a supply transformer can be obtained, then by using conductor resistance tables it is possible to calculate the resistance of the cable loop (i.e. two cable cores in series). By dividing this value into the transformer output voltage, the maximum possible prospective fault current is obtained. This may be considerably less than an 'enquiry' value. The 'real' value will be even lower if the transformer winding impedance, etc, is taken into account.

A14.4.3 TESTING PROCEDURES UTILISING TEST SOCKET OUTLET

a. The main isolating switch should be locked or interlocked in the ‘open’ position.
b. The main earthing terminal link should be secured in the ‘open’ position. The test socket isolating switch should be unlocked and closed. Figure 14.1 shows the test circuit.
c. With the main isolating switch thus ‘open’ and bonding isolated, tests should be made of earth electrode resistance, earth loop impedance and if appropriate prospective fault current.
d. The aggregate resistance (R_A) of the electrode arrangement should be measured using a proprietary earth electrode resistance test instrument, which should be connected between the earth contact of the test socket outlet and an independent test electrode previously installed for this purpose (see 14.8.2) or other test electrode sited outside the zone of the electrode(s) under test. The earth resistance zone of the independent electrode must not overlap the zone of any electrode under test. If the measured R_A exceeds the requisite value, tests of individual electrodes should be made by temporarily disconnecting their earth conductors at the linked earth bar and applying the test instrument between each of them in turn and the independent test electrode. The earth resistance of an individual electrode should not exceed 100 Ω.
e. The earth loop impedance test instrument should be plugged into the test socket outlet, ensuring that the polarity neons are correctly lit before pressing the test button to obtain the earth loop impedance value in Ohms. The earth fault loop impedance (Z_e) at the origin of the installation should be calculated from the instrument reading minus ($R_1 + R_2$) if relevant (see A14.4.1).
f. If the earth loop impedance test instrument incorporates a facility for measuring prospective fault current, its value should also be obtained.
g. The instrument should be disconnected from the socket outlet and the test socket isolating switch locked in the ‘open’ position.
h. The main earth terminal link should be reconnected.
i. The main isolating switch should be unlocked and closed.

ANNEX 14.5A
MODEL CERTIFICATE OF ELECTRICAL INSPECTION AND TESTING FOR STATUTORY ENFORCEMENT PURPOSES

CERTIFICATE OF ELECTRICAL INSPECTION AND TESTING AT FILLING STATIONS FOR NEW INSTALLATIONS AND PERIODIC INSPECTIONS OF EXISTING INSTALLATIONS IN AND ASSOCIATED WITH POTENTIALLY FLAMMABLE ATMOSPHERES
HEALTH AND SAFETY AT WORK ETC. ACT 1974,
ELECTRICITY AT WORK REGULATIONS 1989,
DANGEROUS SUBSTANCES AND EXPLOSIVE ATMOSPHERES REGULATIONS 2002

DETAILS OF THE SITE OPERATOR

Name of site operator

Business name

Address of filling station

Postcode

DETAILS OF THE INSPECTION AND TESTING

Date of the inspection and test

Age of electrical installation years (approximate if relevant records are not available)

INSTALLATION STATUS

Type of site	Type of verification	Availability of records	Verification programme
New site or major refurbishment	Pre-commissioning	Certification of design and construction, design drawings and circuit diagrams available	1
	Initial verification		2
Existing site	Periodic verification	Site electrical records available	3
		Site electrical records not available	4

CERTIFICATION STATEMENT

I declare I am competent to sign this certificate and I hereby certify that the electrical installation in the above premises operated for the storage, use and dispensing of petroleum spirit and autogas has been inspected and tested in accordance with verification programme(s) of APEA/EI *Design, construction, modification, maintenance and decommissioning of filling stations* .

The classification awarded is:

*Delete as appropriate

*A SATISFACTORY as far as could be ascertained.

*B SUITABLE FOR CONTINUED USE subject to defects being remedied before the date(s) shown on the accompanying Inspection and Test Report.

*C UNSATISFACTORY, defects observed are of a dangerous nature and require immediate attention. The presence of the recorded defects could make the site operator or their agent liable to prosecution.

The Classification awarded relates to the classification of the worst defect observed.

For Classification B and C the Defect Report should be completed.

This certificate relates to:

Inventory checklist no Dated Inspection and test report no Dated

Initial assessment no Dated

Signature of person carrying out the inspection (Note 1) Full name (CAPITALS) Dated

Position Qualifications

Company name and address

NOTES
1. It is an offence under Section 33 of the Health and Safety at Work etc. Act 1974 for any person to make a false entry on this certificate.
2. The person carrying out the inspection and testing must be competent, be fully conversant with BS 7671 - *Requirements for electrical installations* and the particular requirements for hazardous area zones in filling stations and have practical experience with the relevant parts of EN 60079 *Explosive atmospheres*

All persons completing and signing the certificate are reminded of the legal requirements for competence contained in Regulation 16 of the statutory Electricity at Work Regulations.

The defects to be recorded on the Defect Report (Annex 14.5B) are those relating to failure to meet Statutory requirements. Non-compliances relating to other items should only be recorded on the Filling Station Electrical Periodic Inspection Report (Annex 14.9) together with the defects shown in the Defect Report.

ANNEX 14.5B
MODEL DEFECT REPORT FOR AN ELECTRICAL INSTALLATION AT A FILLING STATION FOR STATUTORY ENFORCEMENT PURPOSES

This report must accompany a certificate of electrical inspection and testing where defects relate to statutory requirements

Item	Description of defect	Classification*	Remedial action	Remedial action required by (date)

* Guidance on classifications of defects is given in 14.10.4 of APEA/EI *Design, construction, modification, maintenance and decommissioning of filling stations*

ANNEX 14.6
PRE-COMMISSIONING TEST RECORD

Space for company information and logos

Name of site operator ....

Business Name ....

Address of Premises ....

....

PRE-COMMISSIONING TEST RECORD

* The area was certified gas-free by

....

Date .... Signed ....

Qualifications .... Company ....

Certificate no./date

Tests of circuits in the future prospective hazardous areas

Circuit number description	Test current + (amperes)	Test voltage + (volts)	Test duration + (minutes)	R (ohms) Annex14.2	R_2 (ohms)	Insulation resistance		
						L-E	N-E	L-N

Insulation resistance of cables prior to connection (see 14.10.2.1)

Earth electrode resistance tested separately (see 14.10.2.1) electrode type ....

Position	Position	R (ohms)	Position	R (ohms)	Position	R (ohms)	Position	R (ohms)
Issued by .... Signed .... Date................								
Qualifications .... Company								

* Only required if, exceptionally, fuel is or has been on site.
\+ Where high current tests are applied.

ANNEX 14.7
INVENTORY CHECKLIST

Premises .... Date ....

This inventory identifies items of electrical equipment which may be associated with the electrical installation at these premises.

The items present at a particular filling station should be identified on the check list.

Any electrical equipment not shown in the inventory should be added at the time of the inspection by the verifier.

Enter number of items present in the appropriate column. Enter N/A (not applicable) if item is not present.

Fixed equipment	Zone 0	Zone 1	Zone 2	Non-hazardous	Remarks
Dispensers - petrol					
Dispensers - diesel					
Dispensers - autogas					
Dispensers - kerosene					
Submersible pumps					
Remote pumping equipment					
Tank gauge sensors					
Underground leak detection					
Under forecourt vehicle detection					
Overfill prevention devices					
Oil/water separator sensors					
Under pump leak detection					
Monitoring well detectors					
Card readers					
Note acceptor units					
Tanker control terminals					
Security card readers					
Firefighter's switch					
Pump emergency switch					
Fixed air line equipment					
Fixed vacuum cleaning equipment					
Fixed oil change suction unit					
Drinks can dispensers					

Fixed equipment	Zone 0	Zone 1	Zone 2	Non-hazardous	Remarks
Pole signs					
Canopy lighting					
Forecourt lighting					
Fixed advertising module					
High sided vehicle detectors					
CCTV cameras					
Video cameras					
Security sensors					
Security alarm units					
Exit gate mechanisms					
Vehicle lane detection					
Fixed vending machines					
Help point (disabled drivers)					
Car wash-Roll over					
Fixed jet wash					
Security lighting					
Emergency lighting					
Low level forecourt lighting					
Illuminated signs					
Audio speakers					
Automatic door sensors					
Fixed children's ride equipment					
Emergency cabinet					
Tanker delivery lighting					
Hand dryers					
Hot water heaters					
Light switches					
Shaving sockets					
Kiosk console					
Cash register					
Console card readers					

Fixed equipment	**Zone 0**	**Zone 1**	**Zone 2**	**Non-hazardous**	**Remarks**
Forecourt audio unit					
Kiosk customer display					
Kiosk receipt printer					
Microwave ovens					
Refrigeration units & chillers					
Game machines					
Electric radiators					
Telephone					
Hot food preparation equipment					
CCTV monitors					
Video recorders					
Television receivers					
Insect control units					
Air conditioning units					
Cooling fans					
Music systems					
Air sanitisers					
Automatic door mechanisms					
Tank gauge terminals					
Leak detection terminals					
Distribution panel					
Emergency switches (public)					
Emergency switches (DCD)					
Emergency cabinet microswitch					
Kiosk lighting					
Emergency lighting					
Air line compressors					
Lathes					
Drilling machines					
Tyre balancing machines					
Vehicle tuning equipment					
Inspection pit lighting					

Fixed equipment	**Zone 0**	**Zone 1**	**Zone 2**	**Non-hazardous**	**Remarks**
Rolling road equipment					
Vehicle lifts or jacks					
Lottery machines					
Auto cash machines					
Other					

PORTABLE APPLIANCES OR EQUIPMENT	**Quantity**	**Date inspected**	**Zone 2**	**Non-hazardous**	**Remarks**
Vacuum cleaners					
Oil change suction units					
Radio transmitters					
Radio receivers					
Advertising modules					
Vending machines					
Jet wash					
Heaters					
Kettles					
Floor cleaning equipment					
Grass cutting equipment					
Hedge cutting equipment					
Welding equipment					
Power drills					
Power grinders					
Extension lead lamps and battery hand lamps					
Extension leads					
Other					

ANNEX 14.8
MODEL FILLING STATION ELECTRICAL INSTALLATION CERTIFICATE
(not for statutory enforcement purposes)

FILLING STATION ELECTRICAL INSTALLATION CERTIFICATE

A DETAILS OF THE SITE OPERATOR

Name of site operator

Address of filling station

Telephone no

Postcode

Extent of installation work

The installation work is

New

An addition

An alteration

B DESIGN

I/We, being the person(s) responsible for the DESIGN of the electrical installation (as indicated by my/our signature(s) below), particulars of which are described above, having exercised reasonable skill and care when carrying out the design, hereby CERTIFY that the design work for which I/we have been responsible is, to the best of my/our knowledge and belief, in accordance with EN 60079 and BS 7671 amended to (date) and the recommendations given in the APEA/EI guidance except for the departures, if any, detailed as follows:

The extent of liability of the signatory/signatories is limited to the work described above as the subject of this certificate.

For the **DESIGN** of the installation: **(*Where there is divided responsibility for the design*)

Signature Date Name (CAPITALS) Designer 1

Signature Date Name (CAPITALS) ** Designer 2

C CONSTRUCTION

I/We, being the person(s) responsible for the CONSTRUCTION of the electrical installation (as indicated by my/our signature below), particulars of which are described above, having exercised reasonable skill and care when carrying out the construction, hereby CERTIFY that the construction work for which I/we have been responsible is, to the best of my/our knowledge and belief, in accordance with EN 60079 and BS 7671 amended to (date) and the recommendations given in the APEA/EI guidance except for the departures, if any, detailed as follows:

The extent of liability of the signatory is limited to the work described above as the subject of this certificate.

For the **CONSTRUCTION** of the installation:

Signature Date Name (CAPITALS) Constructor

D INSPECTION AND TESTING

I/We, being the person(s) responsible for the INSPECTION AND TESTING of the electrical installation (as indicated by my/our signatures below), particulars of which are described above, having exercised reasonable skill and care when carrying out the inspection and testing, hereby CERTIFY that the work for which I/we have been responsible is to the best of my/our knowledge and belief in accordance with EN 60079 and BS 7671, amended to (date) and the recommendations given in the APEA/EI guidance except for the departures, if any, detailed as follows:

The extent of liability of the signatory/signatories is limited to the work described above as the subject of this certificate.

For the **INSPECTION AND TESTING** of the installation:

Signature Date Name (CAPITALS) Inspector

reviewed by

Signature Date Name (CAPITALS) Supervisor

E DESIGN, CONSTRUCTION, INSPECTION AND TESTING *

* *This box to be completed only where the design, construction, inspection and testing have been the responsibility of one person.*

I, being the person responsible for the DESIGN, CONSTRUCTION, INSPECTION AND TESTING of the electrical installation (as indicated by my signature below), particulars of which are described above, having exercised reasonable skill and care when carrying out the design, construction, inspection and testing, hereby CERTIFY that the said work for which I have been responsible is to the best of my knowledge and belief in accordance with EN 60079 and BS 7671, amended to (date) and the recommendations in the APEA/EI guidance except for the departures, if any, detailed as follows:

The extent of liability of the signatory is limited to the work described above as the subject of this certificate.

For the **DESIGN**, the **CONSTRUCTION** and the **INSPECTION AND TESTING** of the installation.

Signature Date Name (CAPITALS) Inspector

reviewed by

Signature Date Name (CAPITALS) Qualified Supervisor

F COMMENTS ON EXISTING INSTALLATION

Enter 'NONE' or, where appropriate, the page number(s) of additional page(s) of comments on the existing installation.

FILLING STATION ELECTRICAL INSTALLATION CERTIFICATE

G PARTICULARS OF THE ORGANISATION(S) RESPONSIBLE FOR THE ELECTRICAL INSTALLATION

DESIGN (1)	Organisation	**CONSTRUCTION**	Organisation
Address	Postcode	Address	Postcode
DESIGN (2)	Organisation	**INSPECTION AND TESTING**	Organisation
Address	Postcode	Address	Postcode

H NEXT INSPECTION

§ *Enter interval in terms of years, months or weeks, as appropriate*

I/We, the designer(s), RECOMMEND that this installation is further inspected and tested after an interval of not more than §

I SUPPLY CHARACTERISTICS AND MAIN SWITCH

Tick boxes and enter details, as appropriate

System type	TT		TN-S		Local TN-S		TN-C-S	
Number and type of live conductors	1-phase, 2 wire		3-phase, 4 wire		Other		(please state)	
Nature of supply parameters	Nominal voltage U(1)	V	Nominal frequency(1)	Hz	Prospective fault current(2)(3)	kA	External Z_e(2)(3)	Ω
	U_0(1)	V					No of supplies	
Characteristics of primary supply overcurrent protective device(s)	BS EN		Type		Nominal current rating	A	Short-circuit capacity	kA
Main switch or circuit-breaker	BS EN		No of poles		Supply conductor material		Supply conductor csa	mm^2
	Voltage rating	V	Current rating	A	Rated residual RCD operating current	mA	RCD operating time at residual operating current	ms
Rated fault current of forecourt switchgear		kA						

(1) by enquiry (2) by measurement (3) where more than one supply, record highest value

FILLING STATION ELECTRICAL INSTALLATION CERTIFICATE

J RELATED REFERENCE DOCUMENTS

The inspector is required to confirm that all applicable related reference documents have been recorded.

		Date issued
Inventory of Electrical Equipment No		
Design Drawing No		
Method of Work No		
Risk Assessment No		
Hazardous Area Classification Doc. No		
Site Plan No		
Other (please state)		
Other (please state)		

L EARTHING ARRANGEMENTS

Tick boxes and enter details, as appropriate

Means of earthing Distributor's facility ☐ Installation earth electrode ☐

Main Earthing Terminal Can be disconnected by a link ☐ Accessible ☐ Labelled ☐

Main earthing conductor Material ☐ Csa ☐ Continuity check ☐

Reference	Earth electrode type	Material	Location of electrode	Resistance to earth

Ground conditions ☐ Combined earth electrode resistance, all electrodes connected in parallel R_A ☐

K TEST INSTRUMENTS USED

Test instrument:	Manufacturer	Model	Serial No.
Earth fault loop impedance			
Insulation resistance			
Earth electrode resistance			
Earth leakage clamp ammeter			
RCD			
Continuity			
Other			

M MAIN BONDING CONDUCTORS AND CIRCUIT PROTECTIVE CONDUCTORS

	Csa	Resistance (Ω)		Csa	Resistance (Ω)		Csa	Resistance (Ω)
Canopy			Compressor			Lightning protection		
Other structural metal work			Water service			Other		
Pole sign			Gas service			Other		
Above ground tank			Oil service			Other		

FILLING STATION ELECTRICAL INSTALLATION CERTIFICATE

N CHECKLIST FOR INSPECTION OF AN ELECTRICAL INSTALLATION

† *See note below*

1 Presence of records, diagrams and schedule information

2 Electrical characteristics at the origin

3 Earthing connections and bonding

4 Presence of test earth fault loop impedance socket-outlet adjacent to supply intake (non-hazardous area)

5 Presence of lightning protection

6 Methods of protection against direct and indirect contact

7 Main switchboard and distribution boards - circuit identification

8 Labelling of circuits, protective devices, switches and terminals

9 Presence of appropriate devices for secure isolation and switching

10 Isolating devices capable of being locked in the 'off' position

11 Choice and setting of protective and monitoring devices

12 Correct connection of socket-outlets, lamp holders and other accessories

13 Single pole devices for protection or switching in phase conductors only

14 All live conductors (including neutral) are switched and isolated for hazardous area circuits, including emergency switching

15 Ancillary equipment - luminaires, socket-outlets, portable and transportable equipment

16 Selection of equipment and protective measures appropriate to external influences

17 Identification and connection of conductors

18 Selection of wiring systems and conductors for current-carrying capacity and voltage drop

19 Cables routed correctly

20 Presence of fire barriers and protection against thermal effects

21 Integrity of ducts, ducting, trenches, piping, access chambers etc. for fuel in both liquid and gaseous forms

22 Presence of signs, labels and other warning notices

23 Lighting (e.g. enclosures and seals)

24 Serviceable lamps of correct types and ratings

25 Apparatus is suitable for environment and correctly labelled

26 Damage to apparatus or wiring systems which might impair safety

27 No unauthorised or unrecorded modifications/repairs or 'add-ons'

28 No overhead lines (e.g. HV and LV power and telephone lines) over or encroaching on hazardous areas

29 No part of the hazardous area extends beyond the forecourt perimeter (including the zone around vent pipes)

30 No building opening extends into the hazardous area (including the zone around vent pipes)

31 The zone around the vent pipes is free from electrical equipment including cables

32 Suitability of residual current device (RCD) protection

33 There is no equipment which may influence the hazardous area by, for example, displacing and /or ingesting air out of, or into, the hazardous area

34 RCD protection has been provided for dispensers

35 The location and adequacy of the tanker stand lighting is correct

36 Additional checks for all hazardous area equipment and components (this does not refer only to dispensers):

- a nameplate details - accredited certification mark, certificate standard number
- b explosion protection suitable for zone of installation
- c correct temperature classification
- d appropriate apparatus group or subgroup
- e correct circuit identification
- f maintenance of integrity of enclosures
- g cable glands, entries and stoppers etc. complete and appropriate to the enclosure
- h integrity of electrical connections
- i satisfactory earthing, bonding etc.
- j correct rating of apparatus and components
- k adequate environmental protection, e.g. against weather, mechanical damage

37 Details of other items of non-compliance

38 No indication of fuel, oil or compound leakage

39 Accessible and impervious seals in ducts / ducting / pipes

O FUNCTIONAL CHECKS

† *See note below*

Publicly-accessible emergency switching devices (where fitted) function correctly and are installed at the correct height

Operator-controlled emergency switching devices function correctly

The emergency switch circuit cannot be re-energized other than by an authorized person

All emergency switches are correctly labelled

All emergency switches have red operators on yellow background

An emergency stop switch is provided at every operator position

An emergency stop switch is provided at each exit of the autogas compound

The autogas emergency stop switch(es) functions correctly

The Driver Controlled Delivery emergency stop switch functions correctly

Firefighter's switch is at the correct height and functions correctly

The public address (PA) system is operating correctly and is not disabled by the emergency stop system

The tanker stand lighting is functioning correctly

All RCDs and circuit-breakers operate correctly

† ***All boxes must be completed.*** *'✔' indicates that an inspection or test was carried out and the result was* ***satisfactory****.* ***'N/A'*** *indicates that an inspection or test was '****Not Applicable****' to the particular installation.*

FILLING STATION ELECTRICAL INSTALLATION CERTIFICATE

P TESTS PERFORMED AT INTAKE POSITION

	p-n	p-e	Measured value	Acceptable Max\ min values
Earth fault loop impedance at test socket-outlet				
Prospective fault current *(tick one)*			kA	
Current measured in earthing conductor under normal conditions			A	A

Q DISTRIBUTION BOARD DETAILS

TO BE COMPLETED IN EVERY CASE

Location of distribution board: ______ Distribution board designation: ______

TO BE COMPLETED ONLY IF THE DISTRIBUTION BOARD IS NOT CONNECTED DIRECTLY TO THE ORIGIN OF THE INSTALLATION ⭐ *See note below*

Supply to distribution board is from: ______ No of phases: ______ Nominal voltage: ______ V Conductor csa: ______ mm^2

Overcurrent protective device for the distribution circuit: Associated RCD (if any): BS(EN) ______

Type: BS(EN) ______ Rating: ______ A RCD No of poles: ______ $I_{\Delta n}$ ______ mA

Characteristics at this distribution board

Z_s ⭐ ______ Ω

I_{pf} ⭐ ______ kA

Operating times of associated RCD (if any) At $I_{\Delta n}$ ______ ms

At $5I_{\Delta n}$ (if applicable) ______ ms

R CIRCUIT DETAILS

S TEST RESULTS

Circuit number and phase or reference no.	Circuit designation	Type of wiring ↑ (see code below)	Reference method	Number of points served	Circuit conductors: csa Live (mm²)	Circuit conductors: csa cpc (mm²)	Max. disconnection time permitted (s)	Overcurrent protective devices BS (EN)	Overcurrent protective devices Type No	Overcurrent protective devices Rating (A)	Overcurrent protective devices Short-circuit capacity (kA)	RCD Rated operating current, $I_{\Delta n}$ (mA)	Maximum Z_s permitted by BS 7671 (Ω)	Circuit impedances (Ω) All circuits (At least one column to be completed) $R_1 + R_2$	Circuit impedances (Ω) R_2	Insulation resistance † Record lower or lowest value Line/Line † (MΩ)	Line/Neutral † (MΩ)	Line/Earth † (MΩ)	Neutral/Earth (MΩ)	Polarity (✓)	Maximum measured earth fault loop impedance, Z_S ⭐ See note below (Ω)	RCD operating times at $I_{\Delta n}$ (ms)	RCD operating times at $5I_{\Delta n}$ (if applicable) (ms)

⭐ *Note: Where the installation can be supplied by more than one source, such as a primary source (e.g. public supply) and a secondary source (e.g. standby generator), the higher or highest values must be recorded*

CODES FOR TYPE OF WIRING			
F	G	H	O (Other - please state)
PVC/SWA cables	XLPE/SWA cables	Mineral-insulated cables	

ANNEX 14.9
MODEL FILLING STATION ELECTRICAL PERIODIC INSPECTION REPORT (not for statutory enforcement purposes)

FILLING STATION ELECTRICAL PERIODIC INSPECTION REPORT

A DETAILS OF THE SITE OPERATOR

Name of site operator

Trading title

Address of filling station

Telephone no

Postcode

B CLASSIFICATION AND CERTIFICATION OF SITE

I/We being the person(s) responsible for the inspection and testing of the electrical installation (as indicated by my/our signatures below) particulars of which are described above (see A) having exercised reasonable skill and care when carrying out the inspection and testing, hereby declare that the information in this report, including the observations (see G) and the attached schedules provide an accurate assessment of the condition of the electrical installation taking into account the stated extent of the installation (see D) and the limitations of the inspection and testing (see E). The inspection and testing has been performed in accordance with EN 60079 and BS 7671, amended to ....(date) and the recommendations given in the APEA/EI guidance.

I/We further declare that in my/our judgement the said installation was overall in * **condition (see G) at the time the inspection was carried out, and that it should be further inspected as recommended (see F).**

* *(Insert **'a satisfactory'** or **'an unsatisfactory'**, as appropriate)*

Inspection, testing and assessment by

Signature

Name (CAPITALS)

Inspector

Position

Date

Reviewed by

Signature

Name (CAPITALS)

Supervisor

Date

Contractor responsible for the work which is the subject of this certificate (trading title)

Trading address

Telephone no.

C PURPOSE OF THE REPORT

Purpose for which this report is required

D EXTENT OF THE INSTALLATION

Extent of the electrical installation covered by this report

E LIMITATIONS OF INSPECTION AND TESTING

Agreed limitations, if any, on the inspection and testing

F NEXT INSPECTION

I/We recommend that this installation is further inspected and tested after an interval of not more than

(Enter interval in terms of years or months, as appropriate)

FILLING STATION ELECTRICAL PERIODIC INSPECTION REPORT

G OBSERVATIONS AND RECOMMENDATIONS FOR ACTIONS TO BE TAKEN

Item No		Code (A, B or C)	Remedial action required by (date)
1			

Urgent remedial work recommended for Items ______ **Corrective action(s) recommended for Items** ______

Note: Items coded 'B' and 'C' are also recorded on the defect report

H SITE DOCUMENTS

The inspector is required to confirm that all applicable related reference documents have been recorded.

		Serial No.	Date
	Electrical Installation Completion Certificate		
	Previous Filling Station Electrical Periodic Reports		
	Site plan		
	Earth rod layout drawing		
	Inventory of electrical equipment		
	Hazardous area classification document		

I TEST INSTRUMENTS USED

Test instrument :	Manufacturer	Model	Serial No.
Earth fault loop impedance			
Insulation resistance			
Earth electrode resistance test instrument			
Earthing leakage clamp ammeter			
RCD			
Continuity			
Other			

FILLING STATION ELECTRICAL PERIODIC INSPECTION REPORT

J SUPPLY CHARACTERISTICS AND MAIN SWITCH

Tick boxes and enter details, as appropriate

System type	TT		TN-S		Local TN-S		TN-C-S	
Number and type of live conductors	1-phase, 2 wire		3-phase, 4 wire		Other		(please state)	
Nature of supply parameters	Nominal voltage U(1)	V	Nominal frequency(1)	Hz	Prospective fault current(2)(3)	kA	External Z_e(2)(3)	Ω
	U_0(1)	V					No of supplies	
Characteristics of primary supply overcurrent protective device(s)	BS EN		Type		Nominal current rating	A	Short-circuit capacity	kA
Main switch or circuit-breaker	BS EN		No of poles		Supply conductor material		Supply conductor csa	mm²
	Voltage rating	V	Current rating	A	RCD rated residual operating current	mA	RCD operating time at residual operating current	ms
Rated fault current of forecourt switchgear		kA						

(1) *by enquiry* (2) *by measurement* (3) *where more than one supply, record highest value*

K TEST PERFORMED AT INTAKE POSITION

† *See note below*

					Measured value	Acceptable Max\min values
Earth fault loop impedance (phase to earth) measured at *(tick one)*	test socket-outlet		or at origin (no test socket)			
Prospective fault current *(tick one)*	p-n		p-e		kA	
Current measured in earthing conductor under normal conditions					A	A
Combined resistance of earth electrode arrangement (where measured)				R_A	Ω	Ω
Operating times of residual current device (RCD) at $I_{\Delta n}$ and at 5 $I_{\Delta n}$ (if applicable)				$I_{\Delta n}$	ms	ms
				5 $I_{\Delta n}$	ms	ms

	The test socket-outlet is adjacent to the origin of the filling station installation (located in a non-hazardous area)
	The test socket-outlet has the correct isolation and protection
	Main Earthing Terminal test link is labelled
	Main equipotential bonding checked
Ground conditions	

L FUNCTIONAL CHECKS

† *See note below*

	Publicly-accessible emergency switching devices (where fitted) function correctly and are installed at the correct height
	Operator-controlled emergency switching devices function correctly
	The emergency switch circuit cannot be re-energized other than by an authorized person
	All emergency stop switches are correctly labelled and have red operators on yellow background
	An emergency stop switch is provided at every operating position
	An emergency stop switch is provided at each exit of the autogas compound
	The autogas emergency stop switch(es) functions correctly
	Driver Controlled Delivery emergency stop switch functions correctly
	Firefighter's switch is at the correct height and functions correctly
	The public address (PA) system is operating correctly and is not disabled by the pump emergency stop system
	The tanker stand lighting is functioning correctly

All boxes must be completed. *'✓' indicates that an inspection or a test was carried out and that the result was* ***satisfactory****. 'X' indicates that an inspection or a test was carried out and that the result was* **unsatisfactory**.
'N/A' *indicates that an inspection or a test was* ***not applicable*** *to the particular installation.* ***'LIM'*** *indicates that, exceptionally, a* ***limitation*** *agreed with the person ordering the work (as recorded in Section E)* ***prevented*** *the inspection or test being carried out.*

FILLING STATION ELECTRICAL PERIODIC INSPECTION REPORT

M CHECKLIST FOR INSPECTION OF AN ELECTRICAL INSTALLATION

† *See note below*

	1 Presence of records, diagrams and schedule information
	2 Electrical characteristics at the origin
	3 Earthing connections and bonding
	4 Presence of test earth fault loop impedance socket-outlet adjacent to supply intake (non-hazardous area)
	5 Presence of lightning protection
	6 Methods of protection against direct and indirect contact
	7 Main switchboard and distribution boards - circuit identification
	8 Labelling of circuits, protective devices, switches and terminals
	9 Presence of appropriate devices for secure isolation and switching
	10 Isolating devices capable of being locked in the 'off' position
	11 Choice and setting of protective and monitoring devices
	12 Correct connection of socket-outlets, lamp holders and other accessories
	13 Single pole devices for protection or switching in phase conductors only
	14 All live conductors (including neutral) are switched and isolated for hazardous area circuits, including emergency switching
	15 Ancillary equipment - luminaires, socket-outlets, portable and transportable equipment
	16 Selection of equipment and protective measures appropriate to external influences
	17 Identification and connection of conductors
	18 Selection of wiring systems and conductors for current-carrying capacity and voltage drop
	19 Cables routed correctly
	20 Presence of fire barriers and protection against thermal effects
	21 Integrity of ducts, ducting, trenches, piping, access chambers etc. for fuel in both liquid and gaseous forms
	22 Presence of signs, labels and other warning notices
	23 Lighting (e.g. enclosures and seals)
	24 Serviceable lamps of correct types and ratings
	25 Apparatus is suitable for environment and correctly labelled
	26 Damage to apparatus or wiring systems which might impair safety
	27 No unauthorised or unrecorded modifications/repairs including 'add-ons'
	28 No overhead lines (e.g. HV and LV power and telephone lines) over or encroaching on hazardous areas
	29 No part of the hazardous area extends beyond the forecourt perimeter (including the zone around vent pipes)
	30 No building opening extends into the hazardous area (including the zone around vent pipes)
	31 The zone around the vent pipes is free from electrical equipment including cables
	32 Suitability of residual current device (RCD) protection
	33 There is no equipment which may influence the hazardous area by, for example, displacing and /or ingesting air out of, or into, the hazardous area
	34 RCD protection has been provided for dispensers
	35 The location and adequacy of the tanker stand lighting is correct
	36 Additional checks for all hazardous area equipment and components (this does not refer only to dispensers):
	a nameplate details - accredited certification mark, certificate standard number
	b explosion protection suitable for zone of installation
	c correct temperature classification
	d appropriate apparatus group or subgroup
	e correct circuit identification
	f maintenance of integrity of enclosures
	g cable glands, entries and stoppers etc. complete and appropriate to the enclosure
	h integrity of electrical connections
	i satisfactory earthing, bonding etc.
	j correct rating of apparatus and components
	k adequate environmental protection, e.g. against weather, mechanical damage
	37 Details of other items of non-compliance
	38 No indication of fuel, oil or compound leakage
	39 No corrosion of enclosures, fixings, cable entries etc.
	40 No undue accumulation of dust, dirt or rubbish (leaves, paper etc.)
	41 No loose electrical connections, including those for earthing, bonding etc.
	42 No loose fixings, glands, conduit, stoppers etc.
	43 No wear or undue running noise of pump motor bearings (external check only, e.g. lateral movement of shaft or signs of overheating)
	44 No inadvertent contact between moving and fixed parts
	45 Integrity of guards
	46 Maintenance appears adequate (as per manufacturer's recommendations) and properly documented
	47 Accessible and impervious seals in ducts / ducting / pipes

† ***All boxes must be completed.*** *'✔' indicates that an inspection or test was carried out and the result was* ***satisfactory****. 'X' indicates that an inspection or a test was carried out and that the result was* **unsatisfactory**.
'N/A' *indicates that an inspection or test was '****Not Applicable****' to the particular installation. '****LIM****' indicates that, exceptionally, a* ***limitation*** *agreed with the person ordering the work (as recorded in Section E)* ***prevented*** *the inspection or test being carried out.*

FILLING STATION ELECTRICAL PERIODIC INSPECTION REPORT

N HAZARDOUS AREA CIRCUIT DETAILS

Tick boxes and enter details, as appropriate

Circuit description (Such as dispenser or submersible pump)	1φ or 3φ	Wiring type	Circuit conductors: csa		Overcurrent protective devices				RCD		Lowest insulation resistance			Equipment serial number	Fuel type (petrol, autogas)	No of nozzles	Certification (i) EN 13617, (ii) BS 7117, (iii) SFA 3002	Type of Ex Protection of junction box e.g. Exd, Exe	Type of Ex Protection of cable gland e.g. Exd, Exe	Suitability of apparatus for zone (✓ or ✗)	Visual condition of enclosure (✓ or ✗)	Condition of gaskets, stoppers, fastenings (✓ or ✗)	Integrity of connections (✓ or ✗)	IP ratings of enclosures (✓ or ✗)	No contact between fixed and moving parts (✓ or ✗)	No undue noise/vibration from motor/bearings (✓ or ✗)	Low Ω continuity (wander lead method) (Ω)	No visible damage or unauthorized modifications	Classification (A, B,or C)
			Live (mm^2)	cpc or sheath (mm^2)	BS (EN)	Type	Rating (A)	Short-circuit capacity (kA)	Operating current, $I_{\Delta n}$ (mA)	Operating time at $I_{\Delta n}$ (ms)	Line/Earth (MΩ)	Neutral/Earth (MΩ)	Leakage current (mA)																

All boxes must be completed. *'✓' indicates that an inspection or a test was carried out and that the result was* ***satisfactory****. 'X' indicates that an inspection or a test was carried out and that the result was* ***unsatisfactory****.*
'N/A' *indicates that an inspection or a test was* ***not applicable*** *to the particular installation.* ***'LIM'*** *indicates that, exceptionally, a* ***limitation*** *agreed with the person ordering the work (as recorded in Section E)* ***prevented*** *the inspection or test being carried out.*

CODES FOR TYPE OF WIRING			
F	G	H	O (Other - please state)
PVC/SWA cables	XLPE/SWA cables	Mineral-insulated cables	

ANNEX 14.10
MODEL ELECTRICAL DANGER NOTIFICATION

DETAILS OF THE DANGEROUS CONDITION

While at the premises/location indicated below, an electrical condition has been observed which, in the opinion of the competent person issuing this Notification, constitutes a real and immediate danger to persons, property or livestock. **The person(s) having responsibility for the safety of the electrical installation or equipment concerned have a duty to ensure that appropriate action is taken without delay to remove the danger.** The competent person issuing this Notification will be able to provide further specific advice.

Dangerous condition

The dangerous condition detailed above may result in risk of injury or loss from

Electric shock ☐ Fire ☐ Burns from hot surfaces ☐ Burns from the passage of electric current ☐ Mechanical movement of electrically-actuated equipment ☐ Explosion ☐

ORGANISATION AND/OR PERSON RESPONSIBLE

Organisation and/or person responsible

Address

Postcode

ADDRESS AND SPECIFIC LOCATION OF DANGEROUS CONDITION

Address and specific location

Postcode

DETAILS OF THE ORGANISATION AND/OR CONTRACTOR NOTIFYING THE DANGEROUS CONDITION

Trading title

Trading address

Postcode

Telephone no.

Signature | Position

Name (CAPITALS) | Date | Time

IMMEDIATE ACTION TAKEN

Time

FURTHER URGENT ACTION RECOMMENDED

RECEIPT

I acknowledge receipt of this dangerous condition notification.

Signature | Position

Name (CAPITALS) | Date

IF YOU ARE NOT A PERSON HAVING RESPONSIBILITY FOR THE SAFETY OF THE ELECTRICAL INSTALLATION/EQUIPMENT CONCERNED, IT IS IMPORTANT THAT YOU PASS THE NOTIFICATION TO SUCH A PERSON WITHOUT DELAY

This form is intended to be used to notify the existence of a dangerous electrical condition. It is not a detailed or comprehensive report on the condition of the installation /equipment concerned.

ANNEX 14.11
EXPLANATORY NOTES ON EQUIPMENT PROTECTION LEVELS

There are several types of explosion protection and it is acknowledged that they do not all provide the same level of protection, and hence are considered to be suitable for different zones. In the past there has been a direct link between the type of protection and the zone, without taking any account of the operational requirements; thus, at present, EN 60079-14 *Explosive atmospheres. Electrical installations design, selection and erection* allocates specific types of protection to specific zones, though it also has the concept of 'equipment protection levels' (EPLs). EPLs can apply to electrical equipment, and introduce a degree of flexibility to allow equipment of a higher or lower category than that normally required for the zone in question to be used e.g. where:

– Equipment is temporarily taken into a zoned area and alternative effective precautions are provided to control the risk. An example might be arrangements to isolate or shut down equipment to prevent the release of a flammable substance.
– Workers can be excluded from the hazardous area, and will not be at risk from any ignition of a flammable atmosphere.
– Equipment of the required category is simply not available, but a lower category can be used in combination with other protective measures to achieve effective precautions.

Three EPLs - Ga, Gb, and Gc (for gas group II) are defined. Category Gc equipment is defined as not containing sources of ignition which occur continuously or frequently in normal operation. In addition for category Gb equipment, even sources of ignition which can occur in rare situations such as malfunctions of the equipment are to be avoided. In addition for category Ga equipment, even sources of ignition which can occur in very rare situations such as rare malfunctions of the equipment are to be avoided. These are matters which are determined by the manufacturer of the equipment, and will be detailed on the Declaration of Conformity which accompanies the product. For typical consequences from an accidental ignition, these EPLs would correspond to zone 2, 1 and 0 equipment respectively, and this would be the norm where no additional risk assessment has been performed. However, it may be possible to adjust the zone rating of apparatus subject to a risk assessment such as that required by Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR). For a step-by-step approach to equipment selection, see Annex D in EI Model code of safe practice Part 1 *The selection, installation, inspection, and maintenance of electrical and non electrical apparatus in hazardous areas.*

ANNEX 14.12
SAFETY SIGNS AND SAFETY INFORMATION NOTICES

A14.12.1 WORKPLACE SAFETY SIGN REQUIREMENTS

The Health & Safety (Safety Signs and Signals) Regulations 1996 (Safety Signs Regulations) require employers to use a safety sign where there is a significant risk to health and safety that has not been avoided or controlled by methods required under other relevant law, provided the use of a sign can help reduce the risk. Safety signs are not a substitute for other methods of controlling risks such as engineering controls and safe systems of work.

These regulations apply to workplaces and to all activities where people are employed, but exclude signs used in connection with transport or the supply and marketing of dangerous substances, products and equipment.

These regulations do not place any duty on employers to provide signs to warn other people (e.g. filling station customers) of risks to their health and safety; they do not apply to the self-employed. However, in both cases employers or the self-employed will still have duties under the Health and Safety at Work etc Act 1974 (HASWA) and the Workplace (Health, Safety and Welfare) Regulations 1992 regarding the health and safety of non-employees. For further information see HSE *Safety signs and signals: The health and safety (safety signs and signals) guidance on regulations*, L64.

In these regulations signs incorporating certain colours have specific meanings. Those for safety signs are as follows:

Colour	**Meaning**
Red	Prohibition
Yellow or amber	Warning
Blue	Mandatory
Green	First-aid

The purpose of these regulations is to encourage the standardisation of safety signs (including fire safety signs) throughout the member states of the European Union. The intrinsic feature of all safety (and fire safety) signs is a pictogram. Such signs complying with BS 5499-1 *Graphical symbols and signs. Safety signs, including fire safety signs. Specification for geometric shapes, colours and layout* and previously BS 5378-1 *Safety signs and colours. Specification for colour and design* Parts 1 and 3[34] meet the requirements of these regulations.

A14.12.2 DANGEROUS SUBSTANCES AND EXPLOSIVE ATMOSPHERES REGULATIONS 2002 (DSEAR)

Under regulation 7(3) of DSEAR employers are required to place signs, if necessary, at entry points of places that have been classified as hazardous areas. This is in addition to the requirements of the Health and Safety (Safety Signs & Signals) Regulations 1996. The sign to be used is as follows:

34 Now replaced by BS 5449-5 *Graphical symbols and signs. Safety signs, including fire safety signs. Signs with specific meanings.*

Areas of the forecourt to which the general public have access should already be provided with sufficient warning notices to make customers aware of the hazards and the 'EX' symbol need not be displayed at the entry points to those areas.

For example, the provision of the standard signage 'Petroleum spirit - highly flammable' (together with the stated prohibitions on ignition sources) will serve as one of the control measures to comply with the employer's duties under HASWA.

Regulation 10 of DSEAR requires employers (which includes the duty-holder in control of the premises, whether or not they are employers) to identify the hazardous contents of containers and pipes, not otherwise subject to the Safety Signs Regulations.

A14.12.3 FIRE SAFETY SIGNS

Duties on employers to provide signage (including acoustic signals) that:

– provide information on escape routes and emergency exits in case of fire;
– provide information on the identification or location of firefighting equipment, and
– give warning in case of fire

will arise from the 'general fire precautions' requirements of the Regulatory Reform (Fire Safety Order 2005 (for England and Wales) and for Scotland and Northern Ireland respectively, the Fire (Scotland) Act 2005 and the Fire & Rescue Services (Northern Ireland) Order 2006. The purpose of the Safety Signs Regulations is essentially to describe the type of sign that may be used.

Under the Safety Signs Regulations, the colours used in fire safety signs have specific meanings, namely:

Colour	Meaning
Red	Fire alarm/warning Firefighting equipment
Green	Emergency escape routes Emergency exits

A14.12.4 SAFETY INFORMATION NOTICES:

The use of conspicuous and easily understood signs and notices can help the safety of operations at filling stations and the effective action necessary in the event of fire or other emergency.

Safety information notices (SINs) are distinct from the signs required under the legislation identified in A14.12.1 to A14.12.3. Where signs in accordance with A14.12.1 to A14.12.3 are provided, there is potential benefit in supplementing these with appropriate text to help meet the requirements for the SINs detailed in this section. Where this is done, the text should match the safety sign category (e.g. for a 'Prohibition' sign, suitable text would be 'No smoking'). The background colour of the text should also be the same as that of the safety sign.

The signs and notices that are displayed at filling stations can be put into the five broad categories of:

i. *Prohibition notices*
These notices identify the nature of the hazard and the prohibitions on activities and the use of equipment that could ignite petrol vapours (and where applicable,

autogas vapours). Such notices will be displayed in a prominent position in all the designated hazardous areas.
The age-related restrictions on the supply of petrol and the restrictions on the types of portable containers that can be filled will also fall into this category.

ii. *Warning notices*
These notices identify the nature of the hazard (e.g. 'Petroleum Spirit - Highly Flammable' displayed in a prominent position in the vicinity of the hazard, typically the road tanker unloading position, the vent stack and the dispensing position).

iii. *Instructional notices*
These notices are to be followed by tanker drivers before and during the unloading process and by maintenance engineers when working on the installation.
Notices on dispensers directing customers in the method of operation will also fall into this category.

iv. *Informative notices*
These notices advise tanker drivers and maintenance engineers of the purpose, location and operation of equipment. Labels identifying tank, capacity/grade etc. and pipework designation will fall into this category. Labelling may also be required under the legislation identified in A14.12.1 to A14.12.3.

v. *Emergency instructions*
These notices will mainly apply to customers using unmanned sites and sites when operating in unattended self service mode.
The layout and size of a filling station will dictate to location and, where necessary, the repetition of certain warning signs. For example, if the road tanker unloading position is located between the dispensers, there may only be a need to display one sign prohibiting naked lights, smoking and the use of certain electrical equipment etc. Whereas, at large or dispersed sites like a motorway services, such prohibitive signs will need to be displayed at the unloading position and at the dispensing points.

Prohibition notices

– *Road tanker unloading and dispensing areas*
The prohibition notices to be displayed in the hazardous areas where petrol vapours may be present, typically at the road tanker unloading position, the vent stack and the dispensing positions are:
  – 'No smoking - no naked lights';
  – 'Switch off mobile telephones', and/or
  – 'Switch off engine'.

At sites where there is an autogas facility, the following prohibition notice should be displayed on the autogas storage vessels or on the compound perimeter:
  – 'No smoking - no naked lights';

and at the dispensers:
  – 'No smoking - no naked lights';
  – 'Switch off mobile telephones', and/or
  – 'Switch off engine'.

Similarly at sites retailing LPG in cylinders the following prohibition notices should be displayed on the cylinder storage cage:
  – 'No smoking - no naked lights'.

– *Dispensing restrictions*
A notice warning customers of the restrictions on the types/capacities of portable containers that can be filled should be displayed at or near each dispenser.
A notice warning customers of the prohibition on the supply of petrol to children under 16 years of age should be displayed at or near each dispenser.

Warning notices

– *Road tanker unloading, storage and dispensing*
The warning notices to be displayed at the road tanker unloading position, tank connections (tank compound as appropriate), the vent stack and the dispensing positions are:
  – 'Petroleum spirit - highly flammable'.

– *Dropped lines*
Where a vertical drop has been incorporated into a suction line to achieve a fall back from dispenser to tank, the termination points of the suction line in the dispenser and tank access chamber should be labelled:
  – 'Beware - dropped line'.

– *Autogas*
At sites where there is an autogas facility, the following notice should be displayed on the autogas storage vessels or on the compound:
  – 'Autogas - highly flammable'.

– *LPG*
At sites retailing LPG in cylinders the following warning notice should be displayed on the cylinder storage cage:
  – 'LPG - highly flammable'
together with the appropriate HazChem sign.

Instructional notices

– *Vapour recovery*
The instructions for the tanker driver when unloading at a site with Stage 1b vapour recovery in operation are:
  – 'Connect vapour transfer hose before unloading (tanker end first)'; and
  – 'The maximum number of tanker compartments to be unloaded simultaneously is X'.

To alert maintenance engineers to the possible consequences of working on a petrol tank that is connected to a Stage 1b system, the following notice should be displayed on the tank lid:
  – 'Warning: This tank is manifolded. Isolate tank vent pipe before commencing any work'.

This notice should be displayed on all petrol tank (and diesel tank, if applicable) lids that are manifolded to system.

– *Earth bonding*
  At sites where there is an earth bonding system for road tankers to connect to for the unloading process, the earth bonding point should be identified with the following notice:
  – 'Tanker earth bonding point'.

– *Dispensing:*
  At the dispensers, a notice setting out the directions for customers to operate the dispenser should be displayed at the dispenser.

Informative notices

– *Storage tank details*
  Each storage tank and storage tank fill point should bear a label stating the tank's identifying number/letter, grade of product and safe working capacity.
  Each vent pipe rise should be labelled/tagged with the corresponding number/letter of the storage tank to which it is connected.
  Each suction or pressure line should be labelled/tagged as follows:
  – in the storage tank chamber, with the number of the dispenser it is feeding, and
  – in the dispenser sump, with the number/letter of the storage tank it is connected to.

– *Vapour recovery*
  In the tank access chamber of each tank equipped with vapour recovery the following notice should be displayed:
  – 'Tank equipped for vapour recovery'.

  In the tank access chamber of all manifolded tanks and adjacent to vapour pipework, the following notice should be displayed:
  – 'Tank vents manifolded, isolate vent pipe before commencing any work'.

  Where a tank is fitted with an overfill prevention device, a notice should be displayed at the fill point to alert tanker drivers and maintenance engineers that such a device is fitted and functional.
  At sites where a diesel tank is manifolded to the Stage 1b vapour recovery system, the following notice should be displayed in the (diesel tank) access chamber:
  – 'Diesel and petrol tank vents manifolded. For diesel tank, take safety precautions as for petrol tank'.

– *Cathodic protection*
  At sites where the tanks and pipework are cathodically protected the following notice should be displayed at the filling station's main isolating switch and at any equipment at which cathodically protected metalwork is simultaneously accessible with other earthing arrangements:
  – 'All or part of the tanks and pipework at this site has cathodic protection'.

Emergency notices and instructions

– *Electrical isolation switches*
At filling stations without autogas facilities, the emergency isolation switches should be labelled:
   – 'Petrol pumps switch off here'

At filling stations with an autogas facility, the emergency isolation switch in the storage tank compound should be labelled:
   – 'Emergency autogas pump switch off here'.

At filling stations with petrol and autogas facilities, the emergency isolation switch, available to staff and the general public, should be labelled:
   – 'Autogas and petrol pumps switch off here'.

– *High voltage (HV) discharge lighting*[35]
At sites where there is apparatus consisting of luminous tube signs designed to work at a voltage normally exceeding:
   – 1 000 volts a.c. or 1 500 d.c. if measured between any two conductors, or
   – 600 volts a.c. or 900 volts d.c. if measured between a conductor and earth

an external isolation switch should be provided for use by the Fire and Rescue Service.

The switch must be coloured red and have a label in lettering at least 13 mm high 'FIREFIGHTER'S SWITCH'. The ON and OFF positions should be clearly marked, and the OFF position should be at the top. A lock or catch should be provided to prevent accidental reclosure.

– *Unmanned sites and sites operating in unattended self service mode:*
A notice outlining the actions to be taken in case of emergency should be displayed in the customer emergency cabinet, which itself should be clearly signed.

35 Article 37 of the Regulatory Reform (Fire Safety) Order 2005.

ANNEX A
ABBREVIATIONS

The following abbreviations have been used in this publication:

a.c.	alternating current
AD	Approved Document (Building control)
APEA	Association for Petroleum and Explosives Administration
AS	attended service
ASS	attended self service
ATEX	(from the French '*ATmosphere EXplosible*') and referring to EC Council Directive 94/9/EC The approximation of the laws of Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres
ATG	automatic tank gauge
BASEEFA	British Approvals Service for Electrical Equipment in Flammable Atmospheres (former HSE National Certification Authority)
BLEVE	boiling liquid expanding vapour explosion
BS	British Standard
BSI	British Standards Institute
BSI PAS	British Standards Institute - Publically Available Specification
CB	circuit breaker
CCTV	closed-circuit television
CDM	Construction (Design and Management) Regulations 2007
CE	The initials do not stand for any specific (marking) words but are a declaration by the manufacturer that his product meets the essential requirements of the applicable EC Council Directive(s)
CEFIC	European Chemical Industry Council
CEN	Comité Européen de Normalisation (European Committee for Standardization)
CFOA	The Chief Fire Officers Association
CIRIA	Construction Industry Research and Information Association
CNG	compressed natural gas
CONCAWE	The oil companies' European association for environment, health and safety in refining and distribution
CoP	code of practice
COSHH	Control of Substances Hazardous to Health Regulations 2002
CP	cathodic protection
csa	cross-sectional area
Cu	copper
d.c.	direct current
DCD	driver controlled delivery
DCLG	Department for Communities and Local Government.
DEFRA	Department for Environment Food and Rural Affairs
DFA	Downstream Fuels Association (formerly AUKOI - Association of UK Oil Independents)
DNC	diverted neutral current
DSEAR	Dangerous Substances and Explosive Atmospheres Regulations 2002
EA	Environment Agency
EC	European Communities
ECA	Electrical Contractors Association
EHO	Environmental Health Officer

EI	Energy Institute (formerly Institute of Petroleum)
EI 15	EI Model code of safe practice Part 15 *Area classification code for installations handling flammable fluids*
EL	explosive limits
ELLD	electronic pressure line leak detection
ELV	extra-low voltage
EN	European Standard
EN ISO	European Standard International Standards Organisation
EPA	US Environment Protection Agency
EPL	equipment protection level
EPR	Environmental Permitting (England and Wales) Regulations 2010
EPS	Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996
ETBE	ethyl-tertiary-butyl-ether
EU	European Union
EWR	Electricity at Work Regulations 1989
FAME	fatty acid methyl ester
FEF	Forecourt Equipment Federation
FFV	flexible fuelled vehicle
FL	flammable limits
GRP	glass reinforced plastic
HASWA	Health and Safety at Work etc Act 1971
HBEF	high blend ethanol fuel
HBFF	high blend fame fuel
HM	hydrocarbon management (when used in title of IP publication)
HSE	Health & Safety Executive
HSG	Health and Safety Guidance
HV	high voltage
IBC	intermediate bulk container
IEE	Institution of Electrical Engineers
IP	Index of Protection
ISO	International Standards Association
IT	Coding for electrical systems earthing arrangements (for definition see BS 7671)
L-E	line-earth
L-N	line-neutral
LED	light emitting diode
LEL	lower explosive limit
LFL	lower flammable limit
LOLER	Lifting Operations and Lifting Equipment Regulations 1998
LPG	liquefied petroleum gas
LV	low voltage
MCB	miniature circuit breaker
MESG	maximum experimental safe gap
MHSWR	Management of Health and Safety at Work Regulations 1999
MICC	mineral insulated copper clad (cable) (also referred to as MICS)
MICS	mineral insulated copper sheathed (cable) (also referred to as MICC)
MID	Measuring Instrument Directive
MLLD	mechanical pressure line leak detection
MPD	multi-pump dispenser

MSDS	material safety data sheet
MTBE	methyl-tertiary-butyl-ether
N/A	not applicable
N-E	neutral-earth
NFPA	National Fire Protection Association
NICEIC	National Inspection Council for Electrical Installation Contracting
NIEA	Northern Ireland Environment Agency
NS	nominal size
ODPM	Office of the Deputy Prime Minister (now Department for Communities and Local government)
OEM	original equipment manufacturer
OIML	Organisation Internationale de Métrologie Légale (International Organisation of Legal Metrology)
OVD	orifice vent device
p-e	phase-earth
p-n	phase-neutral
P/V	pressure/vacuum valve (or breather vent)
PA	public address
PCP	polychloroprene
PEI RP	Petroleum Equipment Institute Recommended Practices
PEIMF	Petroleum Equipment Installers and Maintenance Federation
PER	Pressure Equipment Regulations 1999
PME	protective multiple earthing
PPG	Pollution Prevention Guidelines
PPS	Planning Policy Statement
PRA	Petrol Retailers Association
PSCC	prospective short circuit current
PSSR	Pressure Systems Safety Regulations 2000
PTW	Permit-to-Work
PUWER	Provision and Use of Work Equipment Regulations 1998
PVC	polyvinylchloride
PVC-U	unplasticised polyvinylchloride
RCBO	residual current circuit breaker with overcurrent protection
RCD	residual current device
REC	regional electricity company
RMIP	Retail Motor Industry Petrol (Petrol Retailers Association)
ROSOV	remotely operated shut-off valve
RTM	remedial target methodology
SAC	Special Areas of Conservation
SCR	selective catalytic reduction
SELECT	The Electrical Contractors Association of Scotland
SELV	separated extra-low voltage
SEPA	Scottish Environmental Protection Agency
SIR	statistical inventory reconciliation
SMS	safety method statement
SOX	lower pressure sodium (lamp)
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SPZ	source protection zone
STP	submersible turbine pump
SWA	steel wire armour
SWC	safe working capacity

TAME	tertiary-amyl-methyl-ether
TBA	tertiary-butyl-alcohol
TN-C-S	coding for electrical system earthing arrangements. (For definition see BS 7671)
TN-S	coding for electrical system earthing arrangements. (For definition see BS 7671)
TS	Technical Standards
TSO	Trading Standards Officer
TT	coding for electrical system earthing arrangements. (For definition see BS 7671)
TWA	time weighted average
UEL	upper explosive limit
UFL	upper flammable limit
UK	United Kingdom (of Great Britain and Northern Ireland)
UKLPG	LP Gas Association
UKPIA	UK Petroleum Industry Association
UL	underwriter laboratory
UM	unmanned site
US	United States (of America)
USS	unattended self service
VOC	volatile organic compound
WFD	Water Framework Directive
WSE	written scheme of examination
XLPE	cross-linked polyethylene (cable insulation)

The following abbreviations for units have been used in this publication:

°C	degree Celsius
% (v/v)	the volume fraction of a material
Ω	ohm
A	ampere
bar(a)	bar absolute
bar(g)	bar gauge
Btu/ft^3	British Thermal Units per cubic foot
Btu/lb	British Thermal Units per pound
cm^3	cubic centimetre
g/cm^3	grams per cubic centimetre
g/ml	grams per millilitre
h	hour
Hz	hertz
$I_{\Delta n}$	rated residual (tripping) current in amperes
I_{pf}	prospective fault current
kA	kiloampere
kΩ	kiloohm
kg	kilogram
kg/s	kilogram per second
kPa	kilopascal
kV	kilovolt
l(m)	length in metres
l/d	litres per day (day defined as a 24 h period)
l/h	litres per hour
l/m	litres per minute
l/s	litres per second
lux	SI unit of illuminance equal to one lumen per square metre

m	metre
m^2	square metres
m/s	metres per second
MΩ	megohm
mΩ	milliohm
mA	milliamp
mbar	millibar
mg/l	milligram per litre
MJ/m^3	megajoules per cubic metre
MJ/kg	megajoules per kilogram
ml	millilitre
mm	millimetre
mm^2	square millimetres
mm^2/s	square millimeters per second
mm/h	millimetre per hour
MPa	megapascal
ms	millisecond
Φ	phase
P(d)	probability of detecting a leak
P(fa)	probability of false alarm
ppm	parts per million
R	resistance
R(m)	radius in metres
R_1	resistance of the phase conductor within an electrical installation
R_2	resistance of the earth fault path within an electrical installation
R_A	aggregate earth electrode arrangement resistance
$tonnes/m^2$	tonnes per square metre
U	voltage between phases
U_o	nominal phase voltage (to earth for TN systems)
V	volt
W	watt
Z_e	external earth fault loop impedance
Z_S	system earth fault loop impedance

ANNEX B
GLOSSARY OF TERMS

adaptor: a self-sealing male component on tank or pipework end to which hose couplings are attached. Located on the road tanker and at the filling station vapour connection. Features a valve which, when not activated by a spigot on the mating connector, seals off the vapour path.

agreed procedures and safety method statement: a work procedure acknowledged as sufficiently proven to be a safe way of carrying out a specific task, so much so that if agreed precautions and a safety method statement are relevant to impending work, and the issuing authority undertakes to ensure that they will be followed, then it is not necessary for the issuing authority to draft further procedures and a safety method statement for the work.

attended service: a filling station where an attendant directly operates and controls the dispenser and the discharge nozzle on behalf of the customer.

attended self service: a filling station where customers operate the dispenser which is activated, supervised and may be shut off in an emergency by an attendant at a control point.

AUS 32: An aqueous urea solution comprising 32,5 % synthetically produced pure urea and 67,5 % demineralised water, used to reduce emissions of NO_x from the exhaust of diesel engine motor vehicles. Also known as AdBlue™.[36]

authority: an individual or a corporate body, according to the circumstances, e.g. a corporate body is an artificial legal person in law just as an individual, with legal rights and obligations.

autogas: in the UK at present, propane complying with BS 4250 sold for automotive propulsion purposes. Also commonly referred to as liquefied petroleum gas or LPG. In other countries, it may be different mixtures of propane and butane.

back-up power supplies: alternative arrangements providing a maintained supply to all or part of the electrical installation, in the event of failure of the mains supply, e.g. standby generator, uninterruptible power supply, battery back-up.

bar: metric unit of atmospheric pressure equal to 14,7 pounds per square inch or 1,02 kilograms per square centimetre.

bar(a) or bara: unit of absolute pressure. Absolute pressures are zero referenced to a complete vacuum and when expressed in bar are often referred to as bar(a) or bara. Thus, the absolute pressure of any system is the gauge pressure of the system plus atmospheric pressure).

bar(g) or barg: used to indicate that the pressure is read from a gauge which measures the difference between the fluid's pressure and the atmospheric pressure

36 AdBlue™ is a term owned by the German Association of Automotive Industry (VDA).

biofuel: a blend of mineral oil derivative, typically petrol or diesel, and up to 100% biomass derived component used as a fuel for mobile or fixed engines.

biomass derived component: a component manufactured to a recognised standard, subsequently blended in a mineral oil derivative (e.g. petrol or diesel) and used as fuel for combustion engines. For petrol, an established component is ethanol specified to EN 15376, and for diesel, an established component is FAME specified to EN 14214.

bottom loading: the filling of a mobile container at or near its lowest point by means of a connection at low level.

breakaway coupling: see *safebreak*.

breathing: emissions from, or intake of air into, a tank due to ambient temperature/pressure effects, or due to vaporisation/condensation of product and to compensate for product dispensed by forecourt pumps.

bund: an area surrounding an above-ground storage tank that is designed and constructed so as to retain leaks or spills.

cathodic protection: prevention of corrosion rate by shifting the corrosion potential of the electrode toward a less oxidising potential by applying an external electro-motive force.

checklist: a secondary document which the performing authority is required to complete prior to, or in the course of, carrying out the work, by way of evidence that specific safety precautions have been taken.

Class I and Class II electrical equipment: equipment constructed in particular ways to protect against electric shock (see BS 2754).

clearance certificate: written authority given to a contractor while on site to perform specified work in a given work area and declares that the area is safe, under the stated conditions, to carry out the given work. However the contractor is required to perform that work in a safe and competent manner and meet all legislation required for the work. It should contain, or make reference to, a risk assessment of the tasks to be undertaken. It is a form of a permit-to-work system.

closed system: a product handling and transfer system designed to minimise vapour emissions to atmosphere.

co-axial hose: a flexible petrol dispensing hose of annular construction in which vapour and flow are independent of one another.

combined sewer: a sewer discharging to a sewage treatment works conveying both foul and surface water.

competent person: a person with enough practical and theoretical knowledge, training and actual experience to carry out a particular task safely and effectively. The person should have the necessary ability in the particular operation of the type of plant and equipment with which they are concerned, an understanding of relevant statutory requirements and an appreciation of the hazards involved. That person should also be able to recognise the need for specialist advice or assistance when necessary and to assess the importance of the results of examinations and tests. A 'person' can be taken to mean more than one, or a body corporate or incorporate. It is therefore possible to appoint appropriate organisations (e.g. insurance companies or inspection bodies) to carry out tasks designated for competent persons.

competent person (electrical): for electrical work a person has to satisfy the competence requirements of Regulation 16 of the Electricity at Work Regulations 1989, which will necessarily involve being fully conversant with BS 7671 and EN 60079 as applicable.

condensate: liquid formed due to the change of state from vapour to liquid.

containment system: the combination of storage tank, delivery, fill and vent pipework including associated valves and fittings which together provide vehicle fuel containment.

contractor: any person or company contracted by a site owner or operator to carry out work on a filling station.

control point: a position in a kiosk or other building at an attended self-service filling station from which an attendant can view and supervise activities at the dispenser, activate the equipment and shut it off in an emergency.

controlled waters: rivers, streams, ditches, other surface water bodies such as canals, estuaries, coastal waters and ground waters.

coupling: a device to permit the connection of a pipe or a hose to an adaptor.

dipping: measurement of the height of fuel in a tank by means of a graduated tape or rod.

direct fill point: a vehicle fuel entry point, e.g. on an underground tank at a filling station, positioned directly on top of the tank.

dispenser (or metering pump): a measuring system designed to draw fuel from a supply tank which may or may not incorporate its own pumping system installed at filling stations and used to dispense liquid fuel.

distributor: the term used for the electricity supplier in the Electricity Safety, Quality and Continuity Regulations 2002 (formerly referred to as the Regional Electricity Company).

diverted neutral currents: see Annex 14.3.

drainage system: a system for transporting foul and/or surface water to a point of disposal, normally subterranean.

driver controlled delivery: a delivery where the complete operation of delivering vehicle fuel to the filling station is under the control of the delivery tanker driver without any assistance from the filling station personnel.

dropped suction line: the arrangement used where it is not possible to arrange a continuous fall from dispenser to tank utilising a vertical leg with a draw-off pit.

dry break coupling: a coupling designed to minimise the leakage of product when disconnected.

duty-holder: site operator, owner, licensee or any person holding a legal duty, in particular those relating to health & safety legislation.

electrical installation: all electrical/electronic and telecommunications equipment located within the boundaries of the filling station. (This includes cables feeding apparatus located outside the curtilage of the filling station).

emission: a release of vapour to the atmosphere.

enforcing authority: the organisation charged with day to day responsibility for ensuring compliance with statutory regulations.

evaporation: conversion of a liquid to a vapour, without necessarily reaching the boiling point.

explosive atmosphere: a mixture of dangerous substances with air, under atmospheric conditions, in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture.

filling station: a facility for the storage and dispensing to the public of petroleum products used as fuels for motor vehicles, including petrol, diesel and autogas.

fire-resistant: a term used to denote a defined standard of resistance to fire exposure (e.g. see BS 476 series).

firewall: a barrier to protect autogas vessel(s) from thermal radiation from a fire nearby and to ensure an adequate dispersion distance to boundaries, buildings and sources of ignition for autogas leaking from the vessel or its fittings where normal separation distances cannot be achieved.

flame arrester: a device to prevent the passage of a flame.

flammable: a substance which is easily ignitable and capable of burning rapidly.

footvalve: a valve at the base of a mobile container leading to the discharge pipework.

foul sewer: a sewer discharging to a sewage treatment works.

fully documented procedures: safety method statements and procedural statements to describe an activity (such as tank testing). The documentation should explain any equipment operation, the principles of operation and technician activity, making clear description of safe working practices.

gauging device: a device for the measurement of the level of liquid in a tank.

hazardous area and zone: a three-dimensional space in which a flammable atmosphere is, or may be expected to be, present in such frequencies as to require special precautions for the construction and use of electrical, and some non-electrical, apparatus. All other areas are referred to as non-hazardous in this context. In a hazardous area three types of zone are recognised.

hazardous waste: In England and Wales, a waste possessing one or more of the hazardous properties set out in Annex III of the Hazardous Waste Directive[37]. In Scotland referred to as special waste.

high blend ethanol fuel (HBEF): a fuel used in petrol combustion engines where the ethanol component is greater than the allowable biomass derived content in EN 228.

high blend FAME fuel (HBFF): a fuel used in diesel combustion engines where the FAME component is greater than the allowable biomass derived content in EN 590.

inerting: the filling of a fuel tank with an inert gas to reduce the risk of explosion.

interlock: a safety system that ensures that two or more actions can only take place in a pre-determined sequence.

internal fill pipe: a pipe fitted vertically inside a tank and reaching nearly to the bottom of the tank, designed to reduce splashing during tank filling and to maintain a liquid seal, so isolating the vapour space.

issuing authority: the authority responsible for raising requests for access to filling stations to commence work, and subsequently raising and authorising any additional documentation as a condition of approval to proceed. The issuing authority will invariably be a competent person nominated by the contractor.

leak detection system: an automated system for detecting product leaks from storage tanks and pipework.

leak prevention: generic term for a secondary containment system that will prevent any leaking vehicle fuel from being released into the environment, e.g. class 1 and 2 leak detection systems, liquid-tight vaults and membranes and impervious clay layers.

liquefied petroleum gas (LPG): see *autogas*.

manifold: a large diameter pipe into which the vent (spur) pipework from several tanks or compartments are connected.

material safety data sheets: a formal document containing important information about the characteristics and actual or potential hazards of a substance. It defines the manufacturer of the material and usually includes chemical identity, hazardous ingredients, physical and chemical properties, fire and explosion data, reactivity data, health hazard data, exposure limits data, precautions for safe storage and handling, PPE, spill control, clean-up and disposal procedures.

37 Council Directive 91/689/EEC 12/12/91.

metering pump: see *dispenser*.

monitoring system: a system as used in double-skinned containment systems (tanks and pipework) to identify failure of either of the containment walls. Alternatively a system of hydrocarbon sensing devices located in wells, placed so as to detect leakage of vehicle fuels.

multi-point (off-loading system): a facility at which more than one hose can be discharged simultaneously from a road tanker into storage tanks.

non-precision test: any test process not having certification as for a precision test.

Notified body: an organisation that has been accredited by a Member State to assess whether a product meets a certain preordained standard.

nozzle: a device for controlling the flow of fuel during a dispensing operation.

offset fill pipe: a filling pipe for a tank or tank compartment which leads from a tank to a connection point for a delivery vehicle hose remote from the tank.

offset fill point: a filling point, e.g. on a filling station tank, in which connection for the hose of the delivery vehicle is at some distance from the tank.

oil/water separator: part of the forecourt drainage system, which separates light liquid from waste water and retains the light liquid.

overfill prevention device: a device designed to shut off automatically and prevent a delivery of fuel overfilling a tank (or compartment of a tank) beyond its maximum working capacity (97 %).

performing authority: the individual who will physically supervise or carry out the work on the filling station. The performing authority is usually an employee of the contractor.

Permit-to-work: a documented procedure that authorises certain personnel to carry out potentially hazardous tasks within a specified time frame. It sets out the precautions necessary to complete the work safely.

petrol (or petroleum-spirit): petroleum which, when tested in accordance with the Petroleum (Consolidation) Act 1928, has a flash point of less than 21 °C.

pipework: all pipes, lines and fittings (including joints) designed to carry vehicle fuels as liquids or vapour.

poppet valve: a valve mounted in half a coupling that is opened by a protruding member on the other mating half of the coupling.

precision test: is defined as any tank tightness test which has the capability of detecting a leak rate of 0,38 l/h with a probability of at least 95 % whilst operating at a false alarm rate of 5 % or less. Precision tests take into account such variables as the thermal expansion of the stored fuel, evaporative losses, the compressibility and thermal expansion of any other medium being used and the effects of other variables including groundwater levels and properties of the medium surrounding the tank.

pressure/vacuum valve (P/V valve): a dual purpose valve which automatically prevents excessive positive or negative pressure in the tank or pipe to which it is connected.

protected above-ground tank: a tank designed and constructed in accordance with UL 2085 or equivalent, that consists of a primary tank provided with protection from physical damage and fire-resisting protection from exposure to a high-intensity liquid pool fire.

radiation wall: see *firewall*.

regional electricity company: see *distributor*.

requirements for electrical installations: this document otherwise known as BS 7671 *Requirements for electrical installations*, *the IEE wiring regulations, seventeenth edition*, while not statutory is widely recognised as a code of practice likely to achieve compliance with relevant aspects of the Electricity at Work Regulations 1989. BS 7671 does not deal with fire and explosion hazards for which reference should be made to the various parts of EN 60079.

risk assessment: a process of recognising a hazard, estimating its likelihood of occurring and the possible consequences.

road tanker: a mobile road vehicle equipped with a tank containing two or more compartments for transporting and delivering fuel to a filling station.

safebreak: a coupling designed to shear at a pre-determined load, in which the two halves, when parted, are sealed by internal valves.

safety method statement: a written document prepared by a company that wants to carry out work on a filling station. It should outline the work, people and equipment to be used, the known hazards involved in the work and the safeguards to be put in place in carrying out the work to protect the work area, personnel involved and any others who may be affected by the work.

secondary closure valve: a valve at the outlet of the tank-vehicle bottom pipe that may be used for loading, unloading, or both. Usually referred to as an API Adaptor, adaptor for bottom loading or faucet valve.

secondary containment: a means to prevent loss of liquid fuel in the event of a leak or spill.

separation distance: the horizontal distance between the nearest part of an above-ground storage tank and any specified feature (e.g. occupied buildings, facilities, process areas, site boundary). The purpose of a separation distance is to protect the vessel from heat radiation should there be a fire involving nearby properties or facilities and to protect nearby properties etc. from the effects of a fire involving the storage vessel. The latter is also intended to provide sufficient time for emergency evacuation and the mobilisation of additional firefighting equipment. Note: The term separation distance should not be confused with the distances involved in hazardous area classification.

separator: see *oil/water separator*.

silt trap: a containment facility for settleable waterborne particles.

single (off-loading) point: a facility at which only one mobile container can be off loaded at once.

site operator: person (or company) in charge of (with day to day control) a filling station, i.e. the petroleum spirit licence holder. In some cases this will be the owner.

site records: permanent records, retained at the filling station, including such details as the equipment installed, repairs, modifications and replacements carried out, and the results of all inspection and testing of the electrical installation.

slide valve: a valve positioned in a manifold pipe system which slides shut when the vapour hose to the delivery vehicle is connected, thus closing off the line to the P/V valve on the filling station. Removing the vapour transfer hose opens the slide valve.

split delivery: a delivery of vehicle fuel to a filling station in which the delivery vehicle compartment is only partially emptied.

Stage 1a: the control of vapour emission during petrol storage and when loading a delivery vehicle at a refinery or terminal.

Stage 1b: the control of vapour emission during the filling of a storage tank at a filling station.

Stage 2: the control of vapour emission during the filling of a customer's vehicle fuel tank with petrol at a filling station.

statutory authorities:
- Environment Agency
- River Purification Board
- Northern Ireland Environment Agency
- Regional water companies
- Local Authorities (as agents for water companies)
- Scottish Regional Councils
- Scottish Environment Protection Agency
- Department for Environment Food and Rural Affairs

submersible pump: an electrically driven pump immersed in a liquid fuel storage tank.

surface water sewer: a sewer discharging to a river or stream.

tanker stand: position on a forecourt where a delivery tanker is located during the unloading process.

topping off: the act of filling a car fuel tank up to the top of the filler neck beyond the normal nozzle cut-off point, by lifting out the nozzle slightly and re-operating the fill valve.

unattended self service: a filling station where the dispenser is activated and operated by a customer without supervision by an attendant.

unmanned site: a filling station designed and constructed to function without the day-to-day presence of trained staff.

ullage: the free space above the liquid fuel in a tank.

vapour generation: the production of hydrocarbon vapour by evaporation of a volatile product. This can occur during filling of the tank or when the tank is undisturbed during periods where dispensing has stopped.

vapour recovery: the process by which vapour displaced during the filling of a container by fuel is fed back to the ullage of the container from which the fuel was discharged.

vapour recovery system: the pipework and associated equipment used to connect vapour emission sources and feed them to a central recovery point for eventual disposal or recovery.

vehicle wash separator: part of the vehicle wash system, comprising at least two chambers, which separates the settleable solids from the waste water and retains the settled solids.

verification: the confirmation that all measures (including fixed equipment/plant and operational procedures) to prevent the ignition of flammable vapour in designated hazardous places are suitable and adequate. The verification process can be carried out by a competent person or organisation.

verifying authority: the authority for approving requests for access to filling stations to commence work. This may be the developer's engineer or the nominated person employed by the contractor.

volatile organic compound (VOC): compound containing at least one carbon atom and which in liquid form readily evaporates at ambient temperature. Not all VOCs are hydrocarbons, e.g. ethers are not hydrocarbons as they also contain oxygen atoms.

wetstock reconciliation: system for checking and keeping records of the petrol stored and dispensed, and comparing the two to identify any discrepancies which might indicate a leak.

work control procedures: a system designed to ensure that installation and maintenance work on filling stations is carried out safely and without risks to health.

zone 0: that part of a hazardous area in which a flammable atmosphere is continuously present or present for long periods.

zone 1: that part of a hazardous area in which a flammable atmosphere is likely to occur in normal operation.

zone 2: that part of a hazardous area in which a flammable atmosphere is not likely to occur in normal operation, and if it occurs, will exist only for a short period.

ANNEX C
REFERENCES

The following references have been included in the text, or are offered for further information. Although dated standards are included below to identify which were applicable at the time of drafting and publication, users of this publication are encouraged to refer to the latest available edition. The first time a reference is included in the text the title is given in full; thereafter it may be abbreviated or the publication number given only.

SECTION 2 RISK ASSESSMENT

Included in the text:

Anti-Pollution Works Regulations 1999, (SI 1999/1006)

CFOA *Petrol filling stations guidance on managing the risks of fire and explosion*

CONCAWE product dossier 92/102 *Liquefied petroleum gas*

CONCAWE product dossier 92/103 *Gasolines*

CONCAWE product dossier 95/107 *Gas oils (diesel fuels/heating oils)*

Control of Substances Hazardous to Health Regulations 2002, (SI 2002/2677) (As amended by SI 2003/978)

Dangerous Substances and Explosive Atmospheres Regulations 2002, (SI 2002/2776)

DCLG *Fire safety risk assessment - offices and shops*

DCLG *Fire safety risk assessment - factories and warehouses*

DEFRA Groundwater protection code: *Petrol stations and other fuel dispensing facilities involving underground storage tanks*

EC Council Directive 98/24/EC The protection of the health and safety of workers from the risks related to chemical agents at work. Official Journal L131, 05/05/1998

EC Council Directive 99/92/EC Minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres. Official Journal L023, 28/01/2000

EI *Guidance document on risk assessment for the water environment at operational fuel storage and dispensing facilities*

EI *Guidelines for soil, groundwater and surface water protection and vapour emission control at petrol filling stations*

Environment Agency *Groundwater protection policy and practice* (GP3)

Environment Agency *Petroleum hydrocarbons in groundwater: supplementary guidance for hydrogeological risk assessment*

Environment Agency Pollution Prevention Guidelines series

Environmental Permitting (England and Wales) Regulations 2010, (SI 2010/675)

Environmental Protection Act 1990

Environmental Protection Act 1990 (Part II A)

Fire (Scotland) Act 2005 (2005 asp5)

Fire and Rescue Services (Northern Ireland) Order 2006, (SI 2006/1254)

Health and Safety at Work etc. Act 1974

HSE Approved code of practice and guidance *Control of substances hazardous to health*, L5

HSE Approved code of practice and guidance *Dangerous substances and explosive atmospheres*, L138

HSE *Five steps to risk assessment* INDG163 (rev2)

Management of Health and Safety at Work Regulations 1999, (SI 1999/3242)

ODPM Planning Policy Statement (PPS) 23: *Planning and Pollution Control*

Regulatory Reform (Fire Safety) Order 2005, (SI 2005/1541)

Remedial Targets Methodology

Water Resources Act 1991, (SI 1991/57)

For further information:

HSE Approved code of practice and guidance *Unloading petrol from road tankers*, L133

HSE Approved code of practice and guidance *Design of plant, equipment and workplaces*, L134

HSE Approved code of practice and guidance *Storage of dangerous substances*, L135

HSE Approved code of practice and guidance *Control and mitigation measures*, L136

HSE Approved code of practice and guidance *Safe maintenance, repair and cleaning procedures*, L137

SECTION 3 HAZARDOUS AREA CLASSIFICATION

Dangerous Substances and Explosives Atmospheres Regulations 2002, (SI 2002/2776)

EC Council Directive 94/9/EC The approximation of the laws of Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. Official Journal L100, 19/04/1994

EC Council Directive 98/24/EC The protection of the health and safety of workers from the risks related to chemical agents at work. Official Journal L131, 07/04/1998

EC Council Directive 99/92/EC Minimum requirements for improving the safety and health of workers potentially at risk from explosive atmospheres. Official Journal L23, 28/01/2000

EN 60079-10-1 *Explosive atmospheres. Classification of areas. Explosive gas atmospheres*

Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996, (SI 1996/192) (As amended SI 2001/3766)

EI Model code of safe practice Part 15 *Area classification code for installations handling flammable fluids*

HSE Approved code of practice and guidance *Unloading petrol from road tankers*, L133

UKLPG Code of Practice 1: Part 1 *Bulk LPG storage at fixed installations: design, installation and operation of vessels located above ground*

UKLPG Code of Practice 20 *Automotive LPG refuelling facilities*

SECTION 4 PLANNING AND DESIGN

Included in the text:

BS 5306-3 *Fire extinguishing installations and equipment on premises. Commissioning and maintenance of portable fire extinguishers. Code of practice*

Centre for Accessible Environments/UKPIA *Making goods and services accessible to disabled customers*

Construction (Design and Management) Regulations 2007, (SI 2007/320)

Control of Pollution (Oil Storage) (England) Regulations 2001, (SI 2001/2954)

DCLG *Fire safety risk assessment - offices and shops*

DCLG *Fire safety risk assessment - factories and warehouses*

DEFRA and Environment Agency: *Model procedures for the management of land contamination* (CLR 11)

Disability Discrimination Act 1995, 2005 and 2010

EI *Guidelines for investigation and remediation of petroleum retail sites*

EN ISO 16852 *Flame arresters. Performance requirements, test methods and limits for use*

Environment Agency: *Groundwater protection policy and practice* (GP3)

Fire (Scotland) Act 2005 (2005 asp 5)

Fire and Rescue Services (Northern Ireland) Order 2006, (SI 12006/1254)

ODPM Planning Policy Statement (PPS) 23: *Planning and pollution control*

Pressure Systems Safety Regulations 2000, (SI 2000/128)

Regulatory Reform (Fire Safety) Order 2005, (SI 2005/1541)

For further information:

BS 5930 *Code of practice for site investigations*

EI *Guidance document on risk assessment for the water environment at operational fuel storage and dispensing facilities*

EI *Guidelines for soil, groundwater and surface water protection and vapour emission control at petrol filling stations*

Environment Agency R&D publication 20 *Methodology for the derivation of remedial targets for soil and groundwater to protect water resources*

Health and Safety (Safety Signs and Signals) Regulations 1996, (SI 1996/341)

HSE HSG 176 *The storage of flammable liquids in tanks*

HSE *Safety signs and signals: The health and safety (safety signs and signals) guidance on regulations*, L64

SECTION 5 ACCEPTANCE AND VERIFICATION/COMMISSIONING

Dangerous Substances and Explosive Atmospheres Regulations 2002, (SI 2002/2776)

Pressure Systems Safety Regulations 2000, (SI 2000/128)

UKLPG Code of Practice 1: Part 3 *Bulk LPG storage at fixed installations: Examination and inspection*

SECTION 6 CONSTRUCTION AND CONSTRUCTION SAFETY

Included in the text:

BS 7375: *Distribution of electricity on construction and demolition sites. Code of practice*
Confined Spaces Regulations 1997, (SI 1997/1713)
Construction (Design and Management) Regulations 2007, (SI 2007/320)
Construction (Health, Safety and Welfare) Regulations 1996, (SI 1996/1592)
Control of Substances Hazardous to Health Regulations 2002, (SI 2002/2677) (As amended by SI 2003/978)
Dangerous Substances and Explosive Atmospheres Regulations 2002, (SI 2002/2776)
EI *Code of safe practice for contractors and retailers managing contractors working on filling stations*
EI *Code of practice for entry into underground storage tanks at filling stations*
Electricity at Work Regulations 1989, (SI 1989/635)
Environment Agency Pollution Prevention Guidelines *Working at construction and demolition sites,* PPG 6
Health and Safety at Work etc. Act 1974
HSE Approved code of practice *Managing health and safety in construction*, L144
HSE Approved code of practice and guidance *Safe Maintenance, repair and cleaning procedures*, L137
HSE HSG141 *Electrical safety on construction sites*
HSE HSG 250 *Guidance on permit-to-work systems - A guide for the petroleum, chemical and allied industries*
Management of Health and Safety at Work Regulations 1999, (SI 1999/3242)

For further information:

APEA *Manhole entry procedures*
BS 6187 *Code of practice for demolition*
Construction (Head Protection) Regulations 1989, (SI 1989/2209)
HSE 159 *Managing contractors. A guide for employers*
HSE Approved code of practice and guidance *Safe use of work equipment,* L22
HSE Approved code of practice and guidance *Safe work in confined spaces*, L101
HSE *Cleaning and gas freeing of tanks containing flammable residues*, CS15
HSE HSG 33 *Health and safety in roof work*
HSE HSG 47 *Avoiding danger from underground services*
HSE HSG 85 *Electricity at work: safe working practices*
HSE HSG 150 *Health and safety in construction*
HSE HSG 151 *Protecting the public: your next move*
HSE HSG 168 *Fire safety in construction*
HSE HSG 253 *The safe isolation of plant and equipment*

SECTION 7 STORAGE AND DISPENSING OF AUTOGAS

BS 1387 *Specification for screwed and socketed steel tubes and tubulars and for plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads*

BS 4250 *Specification for commercial butane and commercial propane*

Dangerous Substances and Explosive Atmospheres Regulations 2002, (SI 2002/2776)

EC Council Directive 94/9/EC The approximation of the laws of Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. Official Journal L100, 19/04/1994

EC Council Directive 2004/22/EC Measuring Instrument Directive. Official Journal L135, 30/04/2004

EN 3-7 *Portable fire extinguishers. Characteristics, performance requirements and test methods*

EN 1762 *Rubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase), and natural gas up to 25 bar (2,5 MPa). Specification*

EN 10255 *Non-alloy steel tubes suitable for welding and threading. Technical delivery conditions*

EN ISO 9001 *Quality management systems. Requirements*

HSE *The health and safety (safety signs and signals) guidance on regulations Safety signs and signals*, L64

Pressure Equipment Regulations 2000, (SI 2000/128)

Pressure Systems Safety Regulations 2000, (SI 2000/128)

Provision and Use of Work Equipment Regulations 1998, (SI 1998/2306)

UKLPG Code of Practice 1 *Bulk LPG storage at fixed installations Part 1: Design, installation and operation of vessels located above ground*

UKLPG Code of Practice 1 *Bulk LPG storage at fixed installations Part 3: Examination and inspection*

UKLPG Code of Practice 1 *Bulk LPG storage at fixed installations Part 4: Buried/mounded LPG storage vessels*

UKLPG Code of Practice 3 *Prevention or control of fire involving LPG*

UKLPG Code of Practice 7 S*torage of full and empty LPG cylinders and cartridges*

UKLPG Code of Practice 17 *Purging LPG vessels and systems*

UKLPG Code of Practice 19 *Part 1: Liquid measuring systems for LPG. Flow rates up to 80 litres per minute in installations dispensing road vehicle fuel*

UKLPG Code of Practice 20 *Automotive LPG refuelling facilities*

UKLPG Code of Practice 22 *LPG piping system design and installation*

UKLPG *User information sheet 024* (which replaced Code of practice Part 14)

SECTION 8 CONTAINMENT SYSTEMS

Included in the text:

BS 799-5: *Oil burning equipment. Carbon steel oil storage tanks. Specification*

CFOA Information note *Petrol filling stations - siphon systems*

CIRIA C535 *Above-ground proprietary prefabricated oil storage tank systems*

Control of Pollution (Oil Storage) (England) Regulations, (SI 2001/2954)

EI *Code of practice for entry into underground storage tanks at filling stations*

EI *Code of safe practice for contractors and retailers managing contractors working on filling stations*

EI *Guidelines for the investigation of the microbial content of petroleum fuels and for the implementation of avoidance and remedial strategies*

EI *Guidance on external cathodic protection of underground steel storage tanks and steel pipework at petrol filling stations*

EI Model code of safe practice Part 21 *Guidelines for the control of hazards arising from static electricity*

EI *Performance specification for undergound pipework systems at petrol filling stations*

EN 124 *Gully tops and manhole tops for vehicular and pedestrian areas. Design requirements, type testing, marking, quality control*

EN 228 *Automotive fuels. Unleaded petrol. Requirements and test methods*

EN 590 *Automotive fuels. Diesel. Requirements and test methods*

EN 976-1 *Underground tanks of glass-reinforced plastics (GRP). Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels. Requirements and test methods for single wall tanks*

EN 976-2 *Underground tanks of glass-reinforced plastics (GRP). Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels. Transport, handling, storage and installation of single wall tanks*

EN 12285-1 *Workshop fabricated steel tanks. Horizontal cylindrical single skin and double skin tanks for the underground storage of flammable and non-flammable water polluting liquids*

EN 12285-2 *Workshop fabricated steel tanks. Horizontal cylindrical single skin and double skin tanks for the aboveground storage of flammable and non flammable water polluting liquids*

EN 13160-3 *Leak detection systems. Liquid systems for tanks*

EN 13160-7 *Leak detection systems. General requirements and test methods for interstitial spaces, leak protecting linings and leak protecting jackets*

EN 13616 *Overfill prevention devices for static tanks for liquid petroleum fuels*

EN 14125 *Thermoplastic and flexible metal pipework for underground installation at petrol filling stations*

EN ISO 9001 *Quality management systems. Requirements*

EN ISO 16852: *Flame arresters. Performance requirements, test methods and limits for use*

Environment Agency Pollution Prevention Guidelines. *Above ground oil storage tanks*: PPG 2

Environment Agency Pollution Prevention Guidelines. *Incident response planning*: PPG 21

EPA *Standard test procedure for evaluating various leak detection methods*

HSE Approved code of practice and guidance *Safe maintenance, repair and cleaning procedures*, L137

HSE *Cleaning and gas freeing of tanks containing flammable residues*, Guidance Note CS15

HSE HSG 150 *Health and safety in construction*

HSE HSG 176 *The storage of flammable liquids in tanks*

NFPA 30 *Flammable and combustible liquids code*

NFPA 30A *Code for motor fuel dispensing facilities and repair garages*

PEI RP 200: *Recommended practices for installation of aboveground storage systems for motor-vehicle fuelling*

STI *Keeping water out of your storage system*

UL 971 *Standard for safety nonmetallic underground piping for flammable liquids* may also be used

UL 1316 *Standard for safety glass-fiber-reinforced plastic underground storage tanks for petroleum products, alcohols, and alcohol-gasoline mixtures - second edition; reprint with revisions through and including May 12, 2006*

UL 2085: *Standard for safety protected aboveground tanks for flammable and combustible liquids*

For further information:

Confined Spaces Regulations 1997, (SI 1997/1713)

Construction Products Regulations 1991, (SI 1991/1620)

DEFRA and Environment Agency, Process Guidance Note PG1/14 (06) *Unloading of petrol into storage at petrol stations*

EN 13160-1 *Leak detection systems - General principles*

EN 13160-2 *Leak detection systems - Pressure and vacuum systems*

EN 13160-3 *Leak detection systems - Liquid systems for tanks*

EN 13160-4 *Leak detection systems - Liquid and/or vapour sensor systems for use in leakage containments or interstitial spaces*

EN 13160-5 *Leak detection systems - Tank gauge leak detection systems*

EN 13160-6 *Leak detection systems - Sensors in monitoring wells*

EN 13160-7 *Leak detection systems - General requirements and test methods for interstitial spaces, leak protecting linings and leak protecting jackets*

HSE Approved code of practice and guidance, *Regulations and guidance Safe work in confined spaces*, L101

SECTION 9 DISPENSERS AND CONTROL SYSTEMS

Included in the text:

BS 7117-1 *Metering pumps and dispensers to be installed at filling stations and used to dispense liquid fuel. Specification for construction*[38]

BSI PAS 022 *Specification for construction of vapour recovery systems installed in petrol metering pumps and dispensers*[39]

38 Standard superseded and withdrawn by BSI.

39 Standard withdrawn by BSI.

EC Council Directive 94/9/EC The approximation of the laws of Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. Official Journal L100, 19/04/1994

EC *Guidelines on the application of Directive 94/9/EC of 23 March 1994 on the approximation of the laws of Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres*

EN 228 *Automotive fuels. Unleaded petrol. Requirements and test methods*

EN 590 *Automotive fuels. Diesel. Requirements and test methods*

EN 1360 *Rubber and plastic hoses and hose assemblies for measured fuel dispensing systems. Specification*

EN:1762 *Rubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase), and natural gas up to 25 bar. (2,5MPa). Specification*

EN 5979 *Remote centres receiving signals from fire and security systems. Code of practice*

EN 13012 *Petrol filling stations. Construction and performance of automatic nozzles for use on fuel dispensers*

EN 13483 *Rubber and plastic hoses and hose assemblies with internal vapour recovery for measured fuel dispensing systems. Specification*

EN 13617-1 *Petrol filling stations. Safety requirements for construction and performance of metering pumps, dispensers and remote pumping units*

EN 13617-2 *Petrol filling stations. Safety requirements for construction and performance of safe breaks for use on metering pumps and dispensers*

EN 13617-3 *Petrol filling stations. Safety requirements for construction and performance of shear valves*

EN 13760 *Automotive LPG filling system for light and heavy duty vehicles. Nozzle, test requirements and dimensions*

EN 14678-1 *LPG equipment and accessories. Construction and performance of LPG equipment for automotive filling stations. Dispensers*

Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996, (SI 1996/192) (As amended SI 2001/3766)

For further information:

BS 7117-2 *Metering pumps and dispensers to be installed at filling stations and used to dispense liquid fuel. Guide to installation* (Standard withdrawn by BSI.)

BS 7117-3 *Metering pumps and dispensers to be installed at filling stations and used to dispense liquid fuel. Guide to maintenance after installation* (Standard withdrawn by BSI.)

SECTION 10 VAPOUR RECOVERY SYSTEMS

Included in the text:

BS 7244 1990 *Specification for flame arresters for general use* (Current, Obsolescent)

DEFRA AQ05(08) *Petrol vapour recovery at service stations: explanatory notes on the use of orifice vent devices, pressure vacuum relief valves and applications for Stage II*

DEFRA Process Guidance Note 1/14 (06) *Unloading of petrol into storage at petrol stations*

EI *Petroleum road tanker design and construction*

EN 1360 *Rubber and plastic hoses and hose assemblies for measured fuel dispensing systems. Specification*

EN 13012 *Petrol filling stations. Construction and performance of automatic nozzles for use on fuel dispensers*

EN 13483 *Rubber and plastic hoses and hose assemblies with internal vapour recovery for measured fuel dispensing systems. Specification*

EN 13616 *Overfill prevention devices for static tanks for liquid petroleum fuels*

EN 13617-1 *Petrol filling stations. Safety requirements for construction and performance of metering pumps, dispensers and remote pumping units*

EN 13617-2 *Petrol filling stations. Safety requirements for construction and performance of safe breaks for use on metering pumps and dispensers*

EN ISO 16852 *Flame arresters. Performance requirements, test methods and limits for use*

Environmental Permitting (England and Wales) Regulations 2010, (SI 2010/675)

FEF Code of Practice. *Design, installation, commissioning, operation and maintenance of Stage II vapour recovery systems*

Pollution Prevention and Control Act 1999 (1999c.24)

For further information:

EC Council Directive 94/63/EC On the control of volatile organic compound (VOC) emissions resulting from the storage of petrol and its distribution from terminals to service stations. Official Journal L365, 31/12/1994

EI *Guidelines for the design and operation of gasoline vapour emission controls at distribution terminals* 3rd edition

Environmental Protection Act 1990

SECTION 11 LEAK CONTAINMENT AND LEAK DETECTION SYSTEMS

Included in the text:

CFOA *Petrol filling stations guidance on managing the risks of fire and explosion (the red guide)*

Dangerous Substances and Explosive Atmospheres Regulations 2002, (SI 2002/2776)

DEFRA and Environment Agency: *Model procedures for the management of land contamination* (CLR11)

DEFRA Groundwater protection code: *Petrol stations and other fuel dispensing facilities involving underground storage tanks*

EC Council Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy. (The EU Water Framework Directive (WFD)) Official Journal, L327, 22/12/2000

EI *Guidance document on risk assessment for the water environment at operational fuel storage and dispensing facilities*

EI *Guidance on external cathodic protection of underground steel storage tanks and steel pipework at petrol filling stations*

EI *Guidelines for soil, groundwater and surface water protection and vapour emission control at petrol filling stations*

EI *HM 3. Tank calibration. Section 7: Calibration of underground tanks at service stations*

EN 13160 Parts 1-7 *Leak detection systems*

EN 13160-1 *Leak detection systems. General principles*

EN 13160-2 *Leak detection systems. Pressure and vacuum systems*

EN 13160-3 *Leak detection systems. Liquid systems for tanks*

EN 13160-4 *Leak detection systems. Liquid and/or vapour sensor systems for use in leakage containment or interstitial spaces*

EN 13160-5 *Leak detection systems. Tank gauge leak detection systems*

EN 13160-6 *Leak detection systems. Sensors in monitoring wells*

EN 13160-7 *Leak detection systems. General requirements and test methods for interstitial spaces, leak protecting linings and leak protecting jackets*

EN 13352 *Specification for the performance of automatic tank contents gauges*

EN 15268 *Petrol filling stations. Safety requirements for the construction of submersible pump assemblies*

Environment Agency *Wetstock reconciliation at fuel storage facilities. An operator's guide*

Environment Agency *Groundwater protection: Policy and practice (GP3) Part 3 - tools*

Environment Agency Pollution Prevention Guidelines *Safe operation of refuelling facilities*, PPG7

Environmental Damage (Prevention and Remediation) Regulations 2009, (SI 2009/153)

Environmental Permitting (England and Wales) Regulations 2010, (SI 2010/675)

EPA/530/UST-90/005 *Standard test procedures for evaluating leak detection methods: Non volumetric tank tightness testing methods*

EPA/530/UST-90/007 *Standard test procedures for evaluating leak detection methods: statistical inventory reconciliation methods*, (SIR) 1990

OIML R 85-3:2008 *Automatic level gauges for measuring the level of liquid in stationary storage tanks*

The Petroleum (Consolidation) Act 1928 (PCA) (as amended by DSEAR)

Water Resources Act 1991

For further information:

EPA 510-B-00-008 *Operating and maintaining underground storage tank systems*, 2000

EPA/530/UST-90/004 *Standard test procedures for evaluating leak detection methods: volumetric tank tightness testing methods*, 1990

EPA/530/UST-90/010 *Standard test procedures for evaluating leak detection methods: pipeline leak detection systems*, 1990

EPA/530/UST-90/012 *Standard test procedures for evaluating leak detection methods: straight-talk on tanks*, 1990

SECTION 12 CANOPIES AND BUILDINGS

Included in the text:

Building Regulations 2000. Volume 2. Buildings other than dwellinghouses. Approved Document B

BS 559 *Specification for the design and construction of signs for publicity, decorative and general purposes*

BS 7671 *Requirements for electrical installations. IEE Wiring Regulations. Seventeenth edition*

EI Model code of safe practice Part 15 *Area classification code for installations handling flammable fluids*

EN 13501-1 *Fire classification of construction products and building elements. Classification using test data from reaction to fire tests*

EN 50107-1 *Signs and luminous-discharge-tube installations operating from a no-load rated output voltage exceeding 1 kV but not exceeding 10 kV. General requirements*

EN 50143 *Cables for signs and luminous-discharge-tube installations operating from a no-load rated output voltage exceeding 1 000 V but not exceeding 10 000 V*

EN 60598-1 *Luminaires. General requirements and tests*. (EN 60598-1:2004 remains current but work in hand)

EN 60598-2-1 *Luminaires. Particular requirements. Specification for fixed general purpose luminaires*. (Standard also refers to BS 4533-102-1:1990 *Luminaires. Particular requirements. Specification for fixed general purpose luminaires*.)

EN 61050 *Specification for transformers for tubular discharge lamps having a no-load output voltage exceeding 1 000V (generally called neon-transformers). General safety requirements*

For further information:

BS 9999 *Code of practice for fire safety in the design, management and use of buildings*

HSE Approved code of practice and guidance *Unloading petrol from road tankers*, L133

HSE Approved code of practice and guidance *Design of plant, equipment and workplaces*, L134

HSE Approved code of practice and guidance *Storage of dangerous substances*, L135

HSE Approved code of practice and guidance *Control and mitigation measures*, L136

HSE Approved code of practice and guidance *Safe maintenance, repair and cleaning procedures*, L137

SECTION 13 DRAINAGE SYSTEMS

Included in the text:

BS 7533-1 *Pavements constructed with clay, natural stone or concrete pavers. Guide for the structural design of heavy duty pavements constructed of clay pavers or precast concrete paving blocks*

BS 8500-1 *Concrete*, Complementary British Standard to BS EN 206-1. *Method of specifying and guidance for the specifier*

BS 594987 *Asphalt for roads and other paved areas. Specification for transport, laying, compaction and type testing protocols*

Building Regulations 2000, (SI 2000/2531)

Building Regulations 2000 Drainage and waste disposal. Approved Document H

Dangerous Substances and Explosive Atmospheres Regulations 2002, (SI 2002/2776)

EN 124 *Gully tops and manhole tops for vehicular and pedestrian areas. Design requirements, type testing, marking, quality control*

EN 206-1 *Concrete. Specification, performance, production and conformity*

EN 752 *Drain and sewer systems outside buildings*

EN 858-1 *Separator systems for light liquids (e.g. oil and petrol). Principles of product design, performance and testing, marking and quality control*

EN 858-2 *Separator systems for light liquids (e.g. oil and petrol). Selection of nominal size, installation, operation and maintenance*

EN 1338 *Concrete paving blocks. Requirements and test methods*

EN 1339 *Concrete paving flags. Requirements and test methods*

EN 1610 *Construction and testing of drains and sewers*

EN 13108-1 *Bituminous mixtures. Material specifications. Asphalt concrete*

EN 13108-4 *Bituminous mixtures. Material specifications. Hot rolled asphalt*

Environment Agency Pollution Prevention Guidelines *Use and design of oil separators in surface water drainage systems*, PPG 3

Environmental Permitting (England and Wales) Regulations 2010, (SI 2010/675)

HSE Approved code of practice and guidance *Dangerous substances and explosive atmospheres,* L138

For further information:

CIRIA/Environment Agencies Joint Guidelines *Masonry bunds for oil storage tanks*

CIRIA/Environment Agencies Joint Guidelines *Concrete bunds for oil storage tanks*

DEFRA Groundwater protection code: *Petrol stations and other fuel dispensing facilities involving underground storage tanks*

EN 12056-3 *Gravity drainage systems inside buildings. Roof drainage, layout and calculations*

Environment Act 1995, (SI 1995/25)

Environment Agency Pollution Prevention Guidelines series:

- *General guide to the prevention of pollution,* PPG 1
- *Above ground oil storage tanks,* PPG 2
- *Safe operation of refuelling facilities,* PPG 7
- *Safe storage and disposal of used oils,* PPG 8
- *High pressure water and steam cleaners,* PPG 13
- *Managing fire water and major spillages,* PPG 18
- *Dewatering underground ducts and chambers,* PPG 20
- *Pollution incident response planning,* PPG 21
- *Installation, decommissioning and removal of underground storage tanks,* PPG 27

Environment Agency Ground water vulnerability maps (See also Environment Agency: *Groundwater protection policy and practice* (GP3))

Groundwater Regulations 1998, (SI 1998/2746)

Special Waste Regulations 1996, (SI 1996/972)

Trade Effluent Agreement (Section 118 of the Water Industry Act 1991)

Water Industry Act 1991, (SI 1991/56)

Water Resources Act 1991 (Section 85), (SI 1991/57)

SECTION 14 ELECTRICAL INSTALLATIONS

Included in the text:

BASEEFA Schedule of accreditation SFA 3002:1971 *Metering pumps and fuel dispensers*

BS 65 *Specification for vitrified clay pipes, fittings and ducts, also flexible mechanical joints for use solely with surface water pipes and fitting*

BS 559: *Specification for the design and construction of signs for publicity, decorative and general purposes*

BS 2754 *Memorandum. Construction of electrical equipment for protection against electric shock*

BS 4444 *Guide to electrical earth monitoring and protective conductor proving*

BS 4660 *Thermoplastics ancillary fittings of nominal sizes 110 and 160 for below ground gravity drainage and sewerage*

BS 5467 *Electric cables. Thermosetting insulated, armoured cables for voltages 600/1 000 V and 1 900/3 300 V*

BS 6346 E*lectric cables. PVC insulated, armoured cables for voltages 600/1 000 V and 1 900/3 300 V*

BS 6656 *Assessment of inadvertent ignition of flammable atmospheres by radio-frequency radiation. Guide*

BS 6724 *Electric cables. Thermosetting insulated armoured cables for voltages of 600/1 000 V and 1 900/3 300 V, having low emission of smoke and corrosive gases when affected by fire*

BS 7117-1 *Metering pumps and dispensers to be installed at filling stations and used to dispense liquid fuel. Specification for construction*. (Standard superseded and withdrawn by BSI)

BS 7211 *Electric cables. Thermosetting insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring, and having low emission of smoke and corrosive gases when affected by fire*

BS 7430 *Code of practice for earthing*

BS 7671 *Requirements for electrical installations. IEE Wiring Regulations. Seventeenth edition*

Dangerous Substances and Explosive Atmospheres Regulations 2002, (SI 2002/2776)

EC Council Directive 94/9/EC The approximation of the laws of Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. Official Journal L100, 19/04/1994

EI *Guidance on external cathodic protection of underground steel storage tanks and steel pipework at petrol filling stations*

EI Model code of safe practice Part 21 *Guidelines for the control of hazards arising from static electricity*

Electromagnetic Compatibility Regulations 2005, (SI 2005/281)

Electricity at Work Regulations 1989, (SI 1989/635)

EN 124 *Gully tops and manhole tops for vehicular and pedestrian areas. Design requirements, type testing, marking, quality control*

EN 295-1 *Vitrified clay pipes and fittings and pipe joints for drain and sewers*

EN 13617-1 *Petrol filling stations. Safety requirements for construction and performance of metering pumps, dispensers and remote pumping units*

EN 60079 *Explosive atmospheres*. Note: EN 60079 consists of Parts 0 to 31, issued between 2007 and 2010

EN 60079-14 *Explosive atmospheres. Electrical installations design, selection and erection*

EN 60529 *Specification for degrees of protection provided by enclosures (IP code)*

EN 60702-1 *Mineral insulated cables and their terminations with a rated voltage not exceeding 750V. Cables*

EN 60898-2 *Electrical accessories. Circuit-breakers for overcurrent protection for household and similar installations. Circuit breakers for a.c. and d.c. operation*

EN 61557-6 *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. Equipment for testing, measuring or monitoring of protective measures. Effectiveness of residual current devices (RCD) in TT, TN and IT systems*

EN 61558-2-6 *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V. Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers*

EN 62305-1 *Protection against lightning. General principles*

Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996, (SI 1996/192) (As amended SI 2001/3766)

Health and Safety (Safety Signs and Signals) Regulations 1996, (SI 1996/341)

HELA *Standard conditions of licence for filling stations*

HSE *Guidance on regulations memorandum of guidance on the Electricity at Work Regulations 1989*, HSR25

HSE *Safety signs and signals: the health and safety (safety signs and signals). guidance on regulations*, L64

HSE HSG 38 *Lighting at work*

HSE HSG 107 *Maintaining portable and transportable electrical equipment*

IEE Guidance Note 3 *Inspection and testing*

Management of Health and Safety at Work Regulations 1999, (SI 1999/3242)

For further information:

EC Council Directive 79/196/EC The approximation of the laws of the Member States concerning electrical equipment for use in potentially explosive atmospheres employing certain types of protection

EN 14678-1 *LPG equipment and accessories. Construction and performance of LPG equipment for automotive filling stations. Dispensers*

SECTION 15 DECOMMISSIONING

Included in the text:

BS 6187 *Code of practice for demolition*

Carriage of Dangerous Goods and Transportable Pressure Equipment Regulations 2009. (SI 2009/1348)

Civic Government (Scotland) Act 1982, (1982 c.45)

Confined Spaces Regulations 1997, (SI 1997/1713)

Control of Lead at Work Regulations 2002, (SI 2002/2676)

Dangerous Substances and Explosive Atmospheres Regulations 2002, (SI 2002/2776)

DEFRA and Environment Agency. *Model procedures for the management of land contamination* (CLR11)

DETR and Environment Agency. *Guidelines for environmental risk assessment and management*. (Only available through DEFRA.)

EI *Code of practice for entry into underground storage tanks at filling stations*

EI *Guidelines for uplift of product from retail filling stations and customers' tanks*

EN 206-1 *Concrete. Specification, performance, production and conformity*

Environment Agency Pollution Prevention Guidelines *Safe operation of refuelling facilities*, PPG 7

Environmental Protection Act 1990

HSE Approved code of practice and guidance *Design of plant, equipment and workplaces*, L134

HSE *Cleaning and gas freeing of tanks containing flammable residues*, CS15

Lifting Operations and Lifting Equipment Regulations 1998, (SI 1998/2307)

UKLPG Code of Practice 1 *Bulk LPG Storage at fixed installations Part 4: Buried/mounded LPG storage vessels*

UKLPG Code of Practice 17 *Purging LPG vessels and systems*

UKLPG Code of Practice 26 *Uplifting of static LPG vessels from site and their carriage to and from site by road*

Public Health Act 1961, (1961 c.64)

For further information:

Electricity at Work Act 1989, (SI 1989/635)

HSE Approved code of practice and guidance *Safe maintenance, repair and cleaning procedures*, L137

ANNEXES 2.1 - 2.5

BS 4250 *Specification for commercial butane and commercial propane*

CEFIC *AUS 32 According to DIN 70070 Quality Assurance Guidance Document*

Chemicals (Hazard Information and Packaging for Supply) Regulations 2009, (SI 2009/716)

Control of Substances Hazardous to Health Regulations 2002, (SI 2002/2677) (As amended by SI 2003/978)

Dangerous Substances and Explosive Atmospheres Regulations 2002, (SI 2002/2776)

EC Council Directive 1999/45/EC of the European Parliament and of the Council of 31st May 1999 concerning the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations

EC Council Directive 1999/96/EC of the European Parliament and of the Council of 13 December 1999 on the approximation of the laws of the Member States relating to measures to be taken against the emission of gaseous and particulate pollutants from compression ignition engines for use in vehicles, and the emission of gaseous pollutants from positive ignition engines fuelled with natural gas or liquefied petroleum gas for use in vehicles and amending Council Directive 88/77/EEC

EC Council Directive 2009/30/EC of the European Parliament and of the council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as vessels and repealing Directive 93/12/EC

EI *Guidance for the storage and dispensing of E5 petrol and B5 diesel at filling stations*

EI *Guidelines for the investigation of the microbial content of petroleum fuels and for the implementation of avoidance and remedial strategies*

EI *Literature review. Biofuels - potential risks to UK water resources*

EN 228 *Automotive fuels. Unleaded petrol. Requirements and test methods*

EN 589 *Automotive fuels, LPG. Requirements and test methods*

EN 590 *Automotive fuels. Diesel. Requirements and test methods*

EN 1360 *Rubber and plastic hoses and hose assemblies for measured fuel dispensing systems. Specification*

EN 10088-1 *Stainless steels. List of stainless steels*

EN 10088-2 *Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purpose*

EN 10088-3 *Stainless steels. Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes*

EN 12115 *Rubber and thermoplastics hoses and hose assemblies for liquid or gaseous chemicals. Specification*

EN 12285-1 *Workshop fabricated steel tanks. Horizontal cylindrical single skin and double skin tanks for the underground storage of flammable and non-flammable water polluting liquids*

EN 14125 *Thermoplastic and flexible metal pipework for underground installation at petrol filling stations*

EN 14214 *Automotive fuels. Fatty acid methyl esters (FAME) for diesel engines. Requirements and test methods*

EN 15376 *Automotive fuels. Ethanol as a blending component for petrol. Requirements and test methods*

EN 1762 *Rubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase), and natural gas up to 25 bar. (2,5 MPa). Specification*

Environment Agency. Pollution Prevention Guidelines series:

General guide to the prevention of pollution, PPG 1

Above ground oil storage tanks, PPG 2

Safe operation of refuelling facilities, PPG 7

Pollution incident response planning, PPG 21

Environment Agency *Pollution prevention technical information note - information on storing and using Adblue*

Environment Agency *What is a hazardous waste? A guide to the Hazardous Waste Regulations and the list of waste regulations in England and Wales.*

Groundwater Regulations 1998, (SI 1998/2746)

Health & Safety at Work etc Act 1974

ISO 22241 Parts 1-4 *Diesel engines. NOx reduction agent AUS 32.*

ISO 22241-1 *Diesel engines. NOx reduction agent AUS 32. Quality requirements*

ISO 22241-2 *Diesel engines. NOx reduction agent AUS 32. Test methods*

ISO 22241-3 *Diesel engines. NOx reduction agent AUS 32. Handling, transportation and storage*

ISO 22241-4 *Diesel engines. NOx reduction agent AUS 32. Refilling interface*

SAE International Technical Paper 950401:1995 *Flammability Tests of Alcohol/Gasoline Vapours*

Water Resources Act 1991, (SI 1991/57)

ANNEXES 8.1 - 8.2

HSE HSG 176 *The storage of flammable liquids in tanks*

ANNEX 10

EN 13616 *Overfill prevention devices for static tanks for liquid petroleum fuels*

ANNEXES 14.1 - 14.12

BASEFFA Schedule of Accreditation SFA 3002:1971 *Metering pumps and dispensers*

BS 5378-1 *Safety signs and colours. Specification for colour and design* (withdrawn by BSI)

BS 5378-3 *Safety signs and colours. Specification for additional signs to those given in BS 5378: Part 1*[40]

BS 5499-1 *Graphical symbols and signs. Safety signs, including fire safety signs. Specification for geometric shapes, colours and layout*

BS 5449-5 *Graphical symbols and signs. Safety signs, including fire safety signs. Signs with specific meanings*

BS 7117-1 *Metering pumps and dispensers to be installed at filling stations and used to*

40 Withdrawn by BSI.

dispense liquid fuel. Specification for construction. (Standard superseded and withdrawn by BSI) *corrosion resisting steels for general purpose*

BS 7671 *Requirements for electrical installers. IEE Wiring Regulations. Seventeenth edition*

Dangerous Substances and Explosive Atmospheres Regulations 2002, (SI 2002/2776)

EI Model code of safe practice Part 1 *The selection, installation, inspection, and maintenance of electrical and non electrical apparatus in hazardous areas*

Electricity Safety, Quality and Continuity Regulations 2002, (SI 2002/2665)

EN 13617-1 *Petrol filling stations. Safety requirements for construction and performance of metering pumps, dispensers and remote pumping units*

EN 60079-14 *Explosive atmospheres. Electrical installations design, selection and erection*

Fire & Rescue Services (Northern Ireland) Order 2006, (SI 2006/1254)

Fire (Scotland) Act 2005, (2005asp5)

Health and Safety at Work etc Act 1974

Health and Safety (Safety Signs & Signals) Regulations 1996, (SI 1996/341)

HSE *Safety signs and signals: The health and safety (safety signs and signals) guidance on regulations*, L64

Regulatory Reform (Fire Safety) Order 2005, (SI 2005/1541)

Workplace (Health, Safety and Welfare) Regulations 1992, (SI 1992/3004)

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The APEA is a UK based organisation, drawing membership from all quarters of the petroleum industry worldwide, including regulators from national and local government authorities, oil companies, equipment manufacturers and suppliers, service and installation organisations, training establishments and many others. It is seen to be unique in representing all sides of the industry and in providing a forum for debate and the generation of technical guidance for the petrol filling station.

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