BS 5410-3:2016

BSI Standards Publication

Code of practice for oil firing

Part 3: Installations for furnaces, kilns, ovens, oil-fuelled standby generators and other industrial purposes

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Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 May 2016. It was prepared by Technical Committee RHE/13, *Oil burning equipment*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 5410-3:1976, which is withdrawn.

Information about this document

This is a full revision of the standard and introduces the following principal changes:

- the use of bio-fuel is now included;
- the use of coal tar fuels has been deleted; and
- the installation of standby generators is covered.

It is desirable that there should be minimum recommendations for the oil firing installation aspects of furnaces, kilns, ovens, oil-fuelled stand-by generators and other industrial plants so that equipment manufacturers, suppliers, installers and users may have a common basis on which to work.

This part of BS 5410 gives recommendations on the design as well as installation, commissioning and maintenance aspects of oil-using equipment within its scope. Designers should give careful consideration to products having an environmental impact and seek to use the best available technologies that have the potential for improvement through design where practical.

In following the recommendations given in this British Standard, other authorities might need to be consulted.

Hazard warnings

WARNING. Decommissioning and disposal of oil storage tanks
The decommissioning and disposal of oil storage tanks can become necessary as part of the maintenance cycle of an oil fired system. This is not covered in this British Standard. It is a very hazardous procedure, and it is imperative that it is only undertaken by specialist operatives who have the right equipment and expertize. Building owners are never to attempt to cut up old oil storage tanks themselves.

NOTE 1 Attention is drawn to the Contruction (Design and Management) Regulations 2007 [1], which class such work as a "demolition project".

NOTE 2 Guidance on decommissioning and disposal of oil storage tanks is given in OFTEC Technical Book 3 [N1].

NOTE 3 Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

Use of this document

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Relationship with other publications

BS 5410 is published in three parts, as follows:

- Part 1 – Installations up to 45kW output capacity for space heating and hot water supply services;
- Part 2 – Installations of over 45 kW output capacity for space heating, hot water and steam supply purposes; and
- Part 3 – Installations for furnaces, kilns, ovens, oil-fuelled standby generators and other industrial purposes.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

In particular, attention is drawn to the following specific regulations:

- Contruction (Design and Management) Regulations 2007 [1];
- The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2];
- The Building Regulations 2010 [3];
- The Environmental Protection Act 1990 [4];
- The Control of Pollution (Special Waste) (Amendment) Regulations 1988 [5];
- The Control of Pollution (Oil Storage) (England) Regulations 2001 [6];
- The Water Resources (Control of Pollution) (Oil Storage) (Wales) Regulations 2016 [7];
- The Control of Pollution (Oil Storage) (Amendment) Regulations (Northern Ireland) 2011 [8];
- The Water Environment (Oil Storage) (Scotland) Regulations 2006 [9];
- The Hazardous Waste (England and Wales) Regulations 2005 (as amended) [10];
- The Hazardous Waste Regulations (Northern Ireland) 2005 [11];
- The Special Waste (Amendment) (England and Wales) Regulations 2001 [12];
- The Special Waste Amendment (Scotland) Amendment Regulations 2004 [13];
- The Building (Approved Inspectors etc.) Regulations 2010 [14]; and
- The Building (Forms) (Scotland) Regulations 2005 (as amended) [15].

1 Scope

This part of BS 5410 gives recommendations and guidance on the design, installation, commissioning and maintenance of oil burning equipment used in conjunction with industrial installations such as furnaces, kilns, ovens and standby generators. Recommendations and guidance are given for the selection, application and installation of burners, storage tanks, piping systems, accommodation, chimneys, electrical and control equipment.

This part of BS 5410 is applicable to installations burning liquid fuel conforming to BS 2869, including bio-fuels, e.g. those containing fatty acid methyl esters (FAME) conforming to BS EN 14214, and blends thereof, and prEN 15940 [1)].

This British Standard covers the provision of new installations and also gives guidance on the modernizing of existing installations. Recommendations and guidance are given on the selection and installation of oil storage tanks associated with these installations.

This British Standard is primarily intended for use by designers, specifiers, installers and building owners.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standards publications

BS 159, *Specification for high-voltage busbars and busbar connections*

BS 799-3, *Specification for oil burning equipment – Part 3: Automatic and semi-automatic atomizing burners up to 36 litres per hour*

BS 799-4:1991, *Oil burning equipment – Part 4: Specification for atomizing burners (other than monobloc type) together with associated equipment for single burner and multi burner installations*

BS 799-5:2010, *Oil burning equipment – Part 5: Carbon steel oil storage tanks – Specification*

BS 845-1, *Methods for assessing thermal performance of boilers for steam, hot water and high temperature heat transfer fluids – Part 1: Concise procedure*

BS 845-2, *Methods for assessing thermal performance of boilers for steam, hot water and high temperature heat transfer fluids – Part 2: Comprehensive procedure*

BS 1710, *Specification for identification of pipelines and services*

BS 2869:2010+A1:2011, *Fuel oils for agricultural, domestic and industrial engines and boilers – Specification*

BS 5306 (all parts), *Fire extinguishing installations and equipment on premises*

BS 5410-1, *Code of practice for oil firing – Part 1: Installations up to 45 kW output capacity for space heating and hot water supply purposes*

BS 5970, *Thermal insulation of pipework, ductwork, associated equipment and other industrial installations in the temperature range of –100 °C to +870 °C – Code of practice*

BS 7430, *Code of practice for protective earthing of electrical installations*

[1)] It is anticipated that this will be published in 2016.

BS 7445 (all parts), *Description and measurement of environmental noise*

BS 7671, *Requirements for electrical installations – IET wiring regulations*

BS 7698 (all parts), *Reciprocating internal combustion engine driven alternating current generating sets*

BS EN 590, *Automotive fuels – Diesel – Requirements and test methods*

BS EN 1457 (all parts), *Chimneys – Clay/ceramic flue liners*

BS EN 1856 (all parts), *Chimneys – Requirements for metal chimneys*

BS EN 1857, *Chimneys – Components – Concrete flue liners*

BS EN 1859, *Chimneys – Metal chimneys – Test methods*

BS EN 12446, *Chimneys – Components – Concrete outer wall elements*

BS EN 12285-1, *Workshop fabricated steel tanks – Part 1: Horizontal cylindrical single skin and double skin tanks for the underground storage of flammable and non-flammable water polluting liquids*

BS EN 12285-2, *Workshop fabricated steel tanks – Part 2: Horizontal cylindrical single skin and double skin tanks for the aboveground storage of flammable and non-flammable water polluting liquids*

BS EN 13063 (all parts), *Chimneys – System chimneys with clay/ceramic flue liners*

BS EN 13069, *Chimneys – Clay/ceramic outer walls for system chimneys – Requirements and test methods*

BS EN 13216-1, *Chimneys – Test methods for system chimneys – Part 1: General test methods*

BS EN 13341, *Static thermoplastic tanks for above ground storage of domestic heating oils, kerosene and diesel fuels – Blow moulded and rotationally moulded polyethylene tanks and rotationally moulded tanks made of anionically polymerized polyamide 6 – Requirements and test methods*

BS EN 14125, *Thermoplastic and flexible metal pipework for underground installation at petrol filling stations*

BS EN 14214:2012+A1:2014, *Liquid petroleum products – Fatty acid methyl esters (FAME) for use in diesel engines and heating applications – Requirements and test methods*

prEN 15940[1)], *Automotive fuels – Paraffinic diesel fuel from synthesis or hydrotreatment – Requirements and test methods*

BS EN 50291 (all parts), *Electrical apparatus for the detection of carbon monoxide in domestic premises*

BS EN 60947-4-1, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

BS EN 62271-106, *High-voltage switchgear and controlgear – Part 106: Alternating current contactors, contactor-based controllers and motor-starters*

BS EN 62305 (all parts), *Protection against lightning*

BS EN ISO 23553 (all parts), *Safety and control devices for oil burners and oil-burning appliances*

BS ISO 1996 (all parts), *Acoustics – Description, measurement and assessment of environmental noise*

BS ISO 8528 (all parts), *Reciprocating internal combustion engine driven alternating current generating sets*

BS ISO 13577 (all parts), *Industrial furnaces and associated processing equipment – Safety*

Other publications

[N1] OIL FIRING TECHNICAL ASSOCIATION. Technical Book 3, *Domestic & Commercial Requirements for Oil Storage & Supply Equipment.* Ipswich: OFTEC.

[N2] OIL FIRING TECHNICAL ASSOCIATION. *Steel oil storage tanks and tank bunds for use with distillate fuels, lubrication oils and waste oils.* Oil Firing Equipment Standard OFS T200. Ipswich: OFTEC.

[N3] OIL FIRING TECHNICAL ASSOCIATION. *Polyethylene Oil Storage Tanks,* Oil Firing Equipment Standard OFS T100. Ipswich: OFTEC.

[N4] CONSTRUCTION INDUSTRY RESEARCH AND INFORMATION ASSOCIATION. *Construction of Bunds.* CIRIA Report 163, 1997.

[N5] SAE INTERNATIONAL. Emulsified Water/Fuel Separation Test Procedure. SAE J1488 2010_10, 2010.

[N6] HEALTH AND SAFETY EXECUTIVE. *The storage of flammable liquids in tanks.* Health and Safety Executive document HSG 176.

[N7] EUROPEAN COMMUNITIES 2000/14/EC. Council Directive 2000/14/EC – Noise Emission of Outdoor Equipment. Luxembourg: Office for Official Publications of the European Communities.

[N8] OIL FIRING TECHNICAL ASSOCIATION. *Filters and Water Separation for use with Oil Supply Systems*. OFS E104.

3 Definitions

For the purposes of this part of BS 5410 the following terms and definitions apply.

3.1 batch (or intermittent) furnace

furnace in which the heating cycle is completed on one batch (or charge) of material

NOTE 1 For example, the material being raised to the required temperature and in some cases allowed to cool before removal from the furnace.

NOTE 2 Heat recovery is not necessarily adopted with this type of furnace.

3.2 bund

containment vessel to hold spillage from a primary tank, or tanks, caused by leakage or overfilling

NOTE 1 A bund provides secondary containment to a primary tank and is sometimes referred to as "secondary containment".

NOTE 2 A bund is designed to contain any leakage from the primary tank or any liquid escaping in an overfill situation and so prevent pollution and the risk of fire.

NOTE 3 A bund can be provided as an integral part of an oil storage tank.

3.3 chimney

construction to carry the products of combustion to the atmosphere having one or more passages

NOTE The passages are known as "flues".

3.4 continuous furnace

furnace in which the heating cycle is simultaneously maintained through the furnace

NOTE 1 For example, a continuous flow of material is heated and in some cases cooled whilst passing through the furnace.

NOTE 2 Heat recovery is usually integral with this type of furnace.

3.5 critical application standby generators

standby generator where their installation and maintenance is a critical operation

NOTE Failure of a critical application standby generator could result in loss of life, high cost or failure of applications such as emergency lighting or other "non critical" applications. Such standby generators are typically used in hospitals, banks, and communication centres.

3.6 direct fired furnace

*COMMENTARY ON **3.6***

*There are two types of direct fired furnace (see **3.6.1** and **3.6.2**).*

3.6.1 open flame furnace

furnace in which there is no barrier interposed between the burning fuel and the material being heated

NOTE The material is subject to direct heat transfer from the flame and from the products of combustion.

3.6.2 semi-muffle furnace

furnace in which the material being heated is not subjected to direct heat transfer from the flame

3.7 fire screen wall

imperforate wall, of fire-rated construction, provided between an oil storage tank and a building or a boundary to act as a heat radiation barrier

3.8 flammable liquids

liquid fuels with a flashpoint of 60 °C or below

NOTE 1 A liquid fuel stored in a location where the maximum ambient temperature is not less than 10 °C lower than the fuel's flashpoint or where a flammable mist or spray might occur.

NOTE 2 Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

3.9 flue duct

connection to carry the products of combustion from a combustion equipment or air-heater outlet to the entry of a chimney

3.10 furnace

enclosed structure in which material can be heated to very high temperatures

NOTE 1 The term furnaces includes ovens, kilns, etc.

NOTE 2 Furnaces are used for smelting metals and other industrial processes.

3.11 high temperature furnace

furnace in which the fuel is burnt in surroundings which have a temperature above the spontaneous ignition temperature of the fuel/air mixture that is produced by the fuel firing equipment

3.12 indirect fired furnace

furnace in which the material being heated is not subject to direct heat transfer from the flame and which is protected from contact with the products of combustion throughout the heating cycle

NOTE This type of furnace is also referred to as muffle furnace or radiant tube furnace.

3.13 low temperature furnace

furnace in which the fuel is burnt in surroundings which have a temperature below the spontaneous ignition temperature of the fuel/air mixture that is produced by the fuel firing equipment

3.14 moving fire furnace

furnace in which the material is heated on a batch basis and the combustion zone is moved in a circular patch around the furnace

NOTE Heat recovery is integral with this type of furnace.

3.15 oil storage system

system for the storage of oil consisting of a manufactured, or site-built, unit comprising a primary tank with its fill, venting, draw off, gauging and alarm equipment and any secondary containment provided

3.16 primary tank

vessel used for the containment of liquid fuel

NOTE This can be located within a bund.

3.17 service tank

tank that isolates the main storage tank or tanks from the burner installation

3.18 standby generator

on site electricity generation equipment to provide an electricity supply in the event of the mains connected electricity supply failing

3.19 tank chamber

enclosure of a tank consisting of structural walls, floor and ceiling or roof

NOTE The main purpose of a tank chamber is to protect the contents of the tank from a fire originating outside the tank chamber.

4 Classification of fuels

For information on flashpoints, auto ignition temperatures, etc. reference should be made to BS 2869, BS EN 590, BS EN 14214 and the manufacturer’s material safety data sheet.

5 Storage and handling temperatures for petroleum oil fuels

NOTE Fuels of class E to class H require storage and handling plant equipped with heating facilities.

The minimum temperatures for all fuels of the given class should be in accordance with Table 1.

Table 1 **Minimum storage, outflow and handling temperatures**

	BS 2869 class					
	C	**D**	**E**	**F**	**G**	**H**
Minimum temperature in tank, °C	Ambient	Ambient	10	25	40	45
Minimum temperature for outflow from tank and for handling, °C	Ambient	Ambient	10	30	50	55

6 Oil tanks and equipment

*COMMENTARY ON CLAUSE **6***

Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

6.1 Oil tank construction

Owners and installers of oil storage equipment should obtain written confirmation that the equipment has a 20-year expected working life when correctly installed, used and maintained. This documentation should be retained by the owner for the lifetime of the installation. Records of installation and maintenance (see Clause **22**) should also be retained by the owner for the lifetime of the installation.

NOTE 1 Attention is drawn to the Control of Pollution (Oil Storage) Regulations [5], [6], [7], [8] and the guidance note for the Control of Pollution (Oil Storage) Regulations relevant to the area in which the installation is located.

Tanks should also conform to the relevant standard listed in Table 2.

Table 2 **Types of oil tank and locations for which they are suitable**

Standard	**Type of tank**	**Location**
BS 799-5	Steel fabricated primary tank	Above ground, internal or external
OFS T200 [N2]	Steel fabricated primary tank or integrally bunded tank	Above ground, internal or external
BS EN 13341	Themoplastics primary tank	Above ground, internal or external up to 10 000 L storage capacity
OFS T100 [N3]	Medium density polyethylene primary tank or integrally bunded tank	Above ground, internal or external up to 10 000 L storage capacity
BS EN 12285-1	Steel fabricated double skinned primary tank	Below ground
BS EN 12285-2	Steel fabricated double skinned primary tank	Above ground

Concrete tanks and bunds should be designed by specialists in consultation with the engineers responsible for the layout of the oil firing and storage system. The application of linings impervious to oil, such as glass or ceramic tiles, steel or special cements, should be carried out by, or under the direct and continuous supervision of, specialists.

For liquid fuels which require heating, metallic tanks should be the preferred option.

Tanks with a riveted construction, e.g. old shell boilers, should never be used as oil tanks due to penetration of oil, and eventual leakage, at the joints.

6.2 Capacity

The minimum net capacity of oil storage tanks for high volume installations should be the greater of:

a) two weeks supply of oil calculated at the maximum rate of consumption; or

b) two weeks supply of oil calculated at the maximum rate of consumption, plus the usual quantity ordered for one delivery.

The oil supplier shoud be consulted before finalizing the minimum net capacity.

The gross capacity of oil storage tanks should be sufficient to allow for:

1) minimum quantity of oil delivered at one time;

2) the additional volume (dead space) below the fuel take-off required to accommodate sludge and water at the bottom of the tank;

3) the additional volume (ullage) required as a safety allowance against overfilling, thermal expansion and dumping from rooftop tanks, see **6.13** and **6.14**;

4) the additional volume required to accommodate heating equipment and any other equipment fitted within the tank.

Where oil containing biofuel is to be used, the sizing and design of the tank should be determined in order to avoid fuel being stored over its life expectancy.

6.3 Selection of tanks

6.3.1 Above ground tanks

The choice of above ground tank configuration should be determined in accordance with the requirements of specific location it is to be installed.

NOTE 1 Attention is drawn to the Control of Pollution (Oil Storage) Regulations [5], [6], [7], [8] and the guidance note for the Control of Pollution (Oil Storage) Regulations relevant to the area in which the installation is located.

NOTE 2 The following types of tanks are available for above ground use:

a) Single skinned tanks. These provide primary containment only.

b) Double skinned tanks. These provide primary containment only.

c) Integrally bunded tanks. These provide both primary and secondary containment in a single unit.

6.3.2 Below ground tanks

Below ground tanks should conform to **8.3**.

6.4 Provision for measurement of contents of oil storage tanks

6.4.1 Tank contents control and gauging

The quantity of oil in a tank should be monitored in order to:

a) ascertain when a new delivery is necessary;

b) determine how much oil can be ordered;

c) determine if the new delivery can be accommodated; and

d) monitor fuel consumption.

Contents measuring equipment of one of the following types should be provided:

1) electronic device for local and/or remote reading;

2) hydrostatic device for local and/or remote reading;

3) pneumatic device for local and/or remote reading;

4) mechanical device for local and/or remote reading; or

5) dip stick or dip tape for local reading.

A calibrated dip stick or calibrated dip tape should be provided in addition to any other form of oil-level indicator in order to check the accuracy of the indicator.

Indicators marked in units of volume should have a litre scale.

The oil contents indicator should be marked "O" or "EMPTY" to show when the oil surface is level with the top of the outflow, or level with the foot valve if one is fitted.

To reduce the likelihood of overfilling, scales should be marked "FULL" at a level equivalent to 95% of brimful/gross capacity for tanks with a capacity up to and including 20 000 L and at a level equivalent to 97.5% of brimful/gross capacity for tanks with a capacity of over 20 000 L.

6.4.2 Tank contents display systems

6.4.2.1 General

A tank contents display system should be provided, for use by the persons responsible for stock control and by personnel responsible for delivering fuel into the tank. The system should always include a means for the level of oil in the tank to be seen at the fill point.

The tank contents display system(s) used should enable the tank contents level to be clearly read.

Tank contents display systems should incorporate the following features, in accordance with **6.4.1**:

a) local display of contents level, i.e. on the tank;

b) remote display of contents level, i.e. at some convenient position away from the tank; or

c) both local and remote display of contents level.

6.4.2.2 Local display

Where the contents display is on the tank it should be visible without the need to use steps or ladders. If this is not possible, permanent secure means should be provided for the required access.

Where local access is used for stock control, the contents display should be monitored.

Where delivery is made directly into the tank, local display of the tank contents level should be visible from the point at which the delivery person stands to control the delivery. If this is not practicable, a remote display should be used.

6.4.2.3 Remote display

Remote display should be either by means of a permanently installed gauge or by the use of a driver-held remote reading device which can sense the tank contents level.

NOTE 1 Many remote gauging systems can accept signals from such devices, which can also provide an overfill warning alarm.

NOTE 2 Remote display has the advantage of enabling the tank contents level to be read at a point which is convenient for the persons involved in stock control. This could be in an office, plant room or other suitable location.

NOTE 3 Remote systems can also permit the tank contents level to be read via a telephone link at the oil distribution depot from which the tank is serviced. This enables an automatic control of stock to be arranged to supplement the duties of site staff or without the need for on-site staff to be involved.

6.5 Environmental precautions

NOTE 1 Attention is drawn to the Control of Pollution (Oil Storage) Regulations [5], [6], [7], [8] and the guidance note for the Control of Pollution (Oil Storage) Regulations relevant to the area in which the installation is located.

All tanks should be labelled at the fill point with the nominal capacity, and the following precautions taken:

a) supervision of all fuel stocks by a responsible person;

b) supervision of all fuel deliveries by a responsible person;

c) precautions against overfilling of tanks including:

   1) contents indicators clearly visible from the filling point;

   2) an overfilling alarm system, or an automatic delivery shut-off device;

   3) a bund alarm;

   4) tank vent clearly visible from the filling point, or installation of an overfill prevention device if the vent from the primary tank is not clearly visible from the filling point.

Where night deliveries are envisaged, illumination of the filling point and contents gauge should be provided.

NOTE 2 Certain commercial applications require high level and overfill alarms in order to meet the requirements of fuel suppliers. Requirements for overfill alarms are specified in OFS E105 [16].

6.6 Fill pipes and connections

Where the filling point is outside the tank bund it should be provided with a separate bund or drip tray capable of holding a minimum of 3 L of oil plus a suitable ullage to allow the tray to be moved without spilling the contents.

Fill point bunds manufactured from concrete or masonry should conform to the constructional requirements of CIRIA Report 163 [N4]. Fill point bunds manufactured from steel or plastics should conform to the constructional requirements of OFS T200 [N2] or OFS T100 [N3], respectively.

Fill pipe connections should conform to BS 799-5.

Where more than one grade of oil is being stored in the same installation or building, there should be a separate filling terminal for each grade and a label indicating the grade.

A separate fill pipe should be provided for each tank.

Each tank and each corresponding fill pipe should be clearly numbered.

If this is not convenient with a multi-tank installation storing the same grade of fuel, a common fill line could be used, and if so, the following conditions should be met:

a) where independent connections fitted with isolating valves are made between each tank and the common fill line, the isolating valves should be readily accessible and should indicate whether they are open or closed; and

b) each tank should be clearly numbered and the same number displayed on or close to the corresponding oil-level indicator and on the corresponding isolating valve.

Each fill pipe should be fitted, at the fill point, with a protective cap.

Fill pipes should be self-draining to the storage tank wherever possible. Where this is not possible, an isolation valve plus a non-return valve should be provided adjacent to the filling point. For classes F and G oils plus some biofuels, fill pipes containing undrained oil should be trace heated and thermally insulated.

The fill point should not be installed at a height exceeding 1 250 mm from ground level or from the level of a secure filling point stand with protective railings. It should be protected from mechanical damage and secured against unauthorized interference.

The filling terminal should be sited to allow easy access by delivery vehicles.

Pipes should be identified in accordance with BS 1710.

6.7 Vent pipes

Vent pipes should conform to BS 799-5, OFS T100 [N3] or OFS T200 [N2], as appropriate. The diameter of the vent pipe should be not less than 50 mm and not less than the diameter of the fill pipe or the outlet, whichever is greater. The vent pipes should discharge into the secondary containment through their open end or through an unloading device.

NOTE 1 Attention is drawn to the Control of Pollution (Oil Storage) Regulations [5], [6], [7], [8] and the guidance note for the Control of Pollution (Oil Storage) Regulations relevant to the area in which the installation is located.

The vent pipe should be free from sharp bends, have a continuous rise and be as short as possible. It should terminate in the open air in a position where it cannot be tampered with. Wherever possible the vent pipe terminal should be visible from the filling point. The end of the vent pipe should be kept away from any zone in which the discharge of air and vapour might be dangerous or offensive.

In the case of multiple tank installations, a separate vent pipe should be provided for each tank.

NOTE 2 Where of necessity the vent pipe rises to a considerable height, excessive internal pressure on the tank might result if overfilling occurs.

To prevent possible tank failure due to overfilling, a vent pipe unloading device should be provided. If an overfill alarm is fitted to the vent pipe, it should not restrict the oil flow should an overfill occur.

6.8 Drainage and de-sludging facility

*COMMENTARY ON **6.8***

The purpose of the drainage and de-sludging facilityis to permit the removal of water and sludge from the tank at regular intervals. It also provides a facility for draining the dead space below the draw-off point when the tank is emptied for cleaning.

Drainage and de-sludging facilities should conform to BS 799-5, OFS T100 [N3] or OFS T200 [N2], as appropriate.

NOTE 1 Drainage and de-sludging facilities can be located at the lowest point of the tank but top mounted suction type arrangements are preferred.

Provision should be made to secure drainage and de-sludging facilities from unauthorized interference.

Low level drainage valves should not be fitted in bunds. Bunds should be emptied by pumping out from above.

NOTE 2 Attention is drawn to the Control of Pollution (Oil Storage) Regulations [5], [6], [7], [8] and the guidance note for the Control of Pollution (Oil Storage) Regulations relevant to the area in which the installation is located.

6.9 Multiple storage tanks with return line connections

Where the oil burning system requires the connection of an oil return line to the storage tanks it is essential that the returned oil should pass back to the bulk storage tank from which it has been drawn unless otherwise specified by the equipment manufacturer.

NOTE If this is not arranged, overflow of the other tanks could occur.

On multi-tank installations that are not under constant operator supervision and control, an interlocking valve system or similar device should be installed to maintain the correct connections when changing over from one tank to another.

Multiple tank installations should only be used when no other option is available.

6.10 Installation of oil storage tanks

Foundations and/or supports should be completed before delivery of the oil storage tanks so that tanks can be installed without delay. The storage tank base or support system should be in accordance with the tank manufacturer's instructions.

NOTE 1 Details of supports for steel tanks, including spacing etc., are given in BS 799-5 and OFS T200 [N2]. For plastic tanks refer to BS EN 13341 or OFS T100 [N3].

NOTE 2 Attention is drawn to the Building Regulations 2010 [3].

The tank base, supports and foundations should be designed to support a load equivalent to that which would occur if the tank were completely filled with water, plus an additional 10%. The bearing capacity of the soil should be assessed to ensure that it is suitable for the proposed loads and the foundation should be designed to ensure correct stability. Where settlement of the foundations is likely to occur, the tank connections used should be sufficiently flexible to allow for the resulting movement.

Where steel tanks are fabricated on site, or where tanks made at a manufacturer's works have been altered on site or subjected to abnormal strain or damage during erection, they should be subjected to a pressure test, at the design pressure of the tank, in accordance with BS 799-5:2010, Annex A. All traces of water, welding debris, scale, and other foreign matter should be removed from inside the tank.

For steel tanks, provision should be made to prevent moisture accumulating between the steel plates of the tank and the supports on which they rest. Where concrete, brick or steel piers are used to support the tank, one of the following methods should be used:

a) those surfaces of the tank that come into contact with the supports should be cleaned and one coat of bituminous mastic solution and one thickness of a bitumen-impregnated damp-proof material applied. The top surface of the supports should be spread thickly with cement mortar in order to allow for any irregularities and the treated tank lowered onto the supports; or

b) those surfaces of the tank that come into contact with the supports should be cleaned. The top surface of the supports should be coated with a thick layer of either bitumen or pitch, and the tank lowered onto the supports.

Where tanks are placed directly on foundations, e.g. vertical cylindrical tanks, the foundation ring of the tank should be sealed to the foundations with a bitumen compound. This compound should be shaped or sloped upwards from the toe of the foundation ring to the side of the tank casing, thus allowing rainwater, etc. to drain off and so prevent lodgement of water that could otherwise lead to corrosion at the base of the tank. With large vertical flat-bottomed tanks, the bottom should rest on a bitumen-impregnated sand layer so arranged as to provide uniform support and avoid tensile stress in the base plate.

Where protective bonding is provided it should incorporate electrical conductivity in accordance with BS 7430.

NOTE 3 Attention is drawn to BS 7671.

The stability of tanks when empty should be taken into account under the following two circumstances:

1) buried tanks might tend to lift under flooded conditions and they should be suitably anchored;

   *NOTE 4 For detailed information regarding buried tanks see **8.3**.*

2) above ground tanks should be secured to their foundations in accordance with the manufacturer's instructions in order to reduce the effects of wind pressure and flotation caused by flooding.

6.11 Painting and cleaning of steel tanks on site

Where the steel tank has not been painted by the manufacturer before delivery in accordance with BS 799-5, on site painting and cleaning of steel tanks should be in accordance with BS 799-5.

The external surfaces of tanks should be thoroughly cleaned and freed from rust, oil or grease and protected with a suitable rust-inhibiting primer.

Painting comprising at least two coats of oil-resistant paint should be carried out as soon as practicable after delivery of the tanks to the site, or after fabrication in the case of the tanks fabricated on site. Any damage to painted surfaces should be made good after erection on site.

Where the painting of the tanks is not the responsibility of the installer, painting requirements should be specified to those responsible for this work.

Internal surfaces should be wire brushed but not painted. The underside of tank roofs of large vertical, cylindrical tanks should be painted with red oxide or provided with equivalent protection against condensation.

Before the tank manholes are secured after painting and cleaning, the tanks should be inspected and any debris removed.

6.12 Heating for oil tanks containing classes E, F, G and H oils and biofuels

6.12.1 General

The tank manufacturer's and fuel supplier's guidance should be sought on the suitability of the storage tank for containing class E, F, G and H oils, including its suitability for the required heating.

Storage and handling equipment for oils of classes E, F, G and H should be equipped with heating facilities to raise the temperature of the oil in order to reduce its viscosity to enable it to flow to the pumps and burners of the oil burning equipment.

NOTE 1 In special cases, heating of class D oil and biofuel blends might be necessary.

The minimum temperatures should be in accordance with Table 3.

NOTE 2 For liquid fuels which require heating, metallic tanks are the preferred option.

Heaters for steel oil storage tanks should conform to BS 799-5.

The heating of the oil should be carried out by one of the following methods:

a) whole-tank heating by means of manually or thermostatically controlled steam or hot water pipe coils or by thermostatically controlled electric immersion heaters inside the tank;

b) outflow heaters provided with thermostatically controlled steam, water or electrically heated elements;

c) method b) together with partial tank heating similar to method a), particularly for classes F, G and H oils; or

d) other types of electric heating, e.g. trace heating.

Table 3 **Minimum tank, outflow and handling temperatures for liquid fuels**

Temperature	**Classes of oil** (BS 2869:2010+A1:2011)				**Biofuels** FAME blends B50D and B75K (BS EN 14214:2012+A1:2014, prEN15940[1)])
	E	F	G	H	
Minimum temperature in tank, °C	10	25	40	45	10
Minimum temperature for outflow from tank and for handling, °C	10	30	50	55	10

6.12.2 Whole-tank heating only

In cases where a residual grade of oil is to be stored in a tank not fitted with an outflow heater, heating equipment of one of the following types should be used:

a) internal (immersion or submersion); or

b) external electric heating (mat or trace heating) or steam/thermal fluid coils.

In this case, the minimum temperature maintained within the tank for each class of oil in accordance with Table 3, line 2, i.e. the outflow and handling temperature. External thermal insulation should be used for any tank where the minimum temperature of the oil is to be maintained.

Liquid fuel should be stored at the temperatures in accordance with Table 3.

NOTE This is particularly important for class E oils.

The following recommendations should be followed for whole-tank heating:

1) the heat supply for heating the tank contents should be calculated on the basis of the maximum volume, the type of fuel, the target fuel temperature (the mid-point of the target temperature range should be used) and the amount of insulation installed on the tank;
2) heating coils and connections within the tank should be constructed of seamless steel tube and all joints should be welded;
3) heating coils should be supported and steam coils arranged to drain freely; and
4) to minimize the risk of leakage and to facilitate renewal, the heating coils at their points of entry to and exit from the tank should pass through oversize flanges or stools attached to the tank, the ends of the coils being welded to counter-flanges that in turn are bolted to the flanges or stools.

6.12.3 Tanks fitted with outflow heaters only

*COMMENTARY ON **6.12.3***

The use of tank outflow heaters only is not recommended for residual oils as heat input to the heater is local to the heater and not distributed to the tank contents.

Outflow heaters should be sized to raise the temperature of the maximum amount of liquid fuel required by the burner equipment, including oil returned from the burner equipment, from the minimum storage temperature to the minimum outflow temperature, as given in Table 3.

NOTE If the bulk contents are at a temperature below the minimum value given in Table 3 there might be difficulty in maintaining fuel flow to the outflow heater when using oils of classes F, G, H and some biofuels.

6.12.4 Tank heating combined with outflow heaters

To reduce heat losses from tanks, the oil should be stored at a temperature lower than that required for handling, provided that it can still flow towards an outflow heater that raises the oil in its vicinity to the recommended minimum handling temperature in accordance with Table 3, line 2.

The minimum storage temperature for the oil should be in accordance with Table 3, line 1.

NOTE 1 This arrangement is the one found to be most satisfactory in practice for classes F, G and H oils.

NOTE 2 In cases where the distance between the outflow heater and the farthest wall of the tank is not excessive, provision of heating over only part of the base of the tank might be adequate for classes F and G oils to ensure flow to the outflow heater at all times.

Tank heating should be so arranged as to also provide heat in the vicinity of the drain valve to facilitate the periodic draining of water and sludge from the tank.

NOTE 3 The suitability of partial tank heating depends on the dimensions of the tank, the conditions of exposure to which it is subjected and whether or not it is thermally insulated.

6.12.5 Other recommendations for heating for oil tanks

Electric heater elements should be in accordance with the maximum loadings given in BS 799-4:1991, **6.6.2**, Note 1.

Where high-pressure hot water is the primary heating medium, a heat exchanger should be used to ensure the tank heater coils or outflow heaters are fed with low-pressure steam or low-temperature hot water. If high-temperature hot water is used as the direct heating medium, the temperature should not exceed 175 °C.

When steam is used, it should be dry saturated and at a pressure not exceeding 3.5 bar.

NOTE 1 The use of steam at higher pressure is not recommended as control is easier at lower pressures and a larger heating surface at a lower temperature is more effective.

When siting oil tanks, account should be taken of the space required for withdrawal of heater coils and outflow heaters.

If the heat supply is by steam or hot water, and is liable to be interrupted for long periods, an electric immersion heater should be fitted in the tank or incorporated in the outflow heater.

NOTE 2 Where several tanks are installed this need only be provided in one tank.

Heating coils, electric immersion heaters and thermostats should be fixed at least 75 mm above the bottom of the tank to reduce the risk of their becoming immersed in sludge. They should be below the level of the outflow to ensure complete immersion at all times.

Such heaters should incorporate a high-temperature safety cut-out, with manual reset, set at approximately (10 ±1) °C above the operating temperature.

The control system should ensure that the heater system cannot be used when the oil level in the tank is below the heater level.

The heater design should be such that the thermostats are located above the heating element so that when fitted correctly, they detect heat rising from the element.

If plastics tanks are used, the manufacturer's advice should be sought.

To avoid fire or explosion hazards due to overheating, heating facilities and their controlling thermostats should not become exposed when in operation.

When a tank is being emptied, the heat supply should be discontinued and disconnected.

Precautions should be taken to prevent any oil contained in condensate or in circulated hot water from oil heating facilities from entering boiler systems.

Any condensate from oil heating coils or heaters should not be returned to the boiler or feed-water system as a heating coil failure could result in contamination of the system.

Condensate should be run to waste and any oil content should be trapped and not discharged to drainage systems or waterways.

NOTE 3 Attention is drawn to the Control of Pollution (Oil Storage) Regulations [5], [6], [7], [8] and the guidance note for the Control of Pollution (Oil Storage) Regulations relevant to the area in which the installation is located.

If the heating medium is steam at a pressure less than the oil pressure in the tank, a non-return valve should be fitted in the steam supply line in order to prevent oil being forced into the line in the event of heater failure.

Where medium- or high-pressure hot water is used as the primary heating medium, an intermediate water/steam or water/water heat exchanger system should be used so that the heating coils or heaters are fed with low-pressure steam or hot water to eliminate any danger of oil entering the circulating mains boiler system in the event of accidental leakage.

If a condensate recovery system is used, this should include means for detecting trace quantities of oil.

NOTE 4 Proprietary devices are available to perform this function.

6.13 Service tanks

6.13.1 General

Service tanks and fittings should be designed and constructed in accordance with BS 799-5 or OFS T200 [N2], as applicable, and should be no greater than 10% of the volume of the bulk tank, not exceeding 1 000 L capacity.

A service tank should be placed to ensure that any escaping oil cannot reach hot surfaces, see Clause **8**.

An overflow pipe should be run from the service tank to the top of the main storage tank.

The vent pipe of a service tank fed by gravity should be carried to a point as high as the top of the tank supplying it. The overflow pipe and vent pipe should conform to BS 799-5 and should be not less than 100% of the diameter of the fill line.

Measures should be taken to ensure that the service tank is not subjected to an excessive pressure head during a dumping operation overfill event.

NOTE Attention is drawn to the Control of Pollution (Oil Storage) Regulations [5], [6], [7], [8] and the guidance note for the Control of Pollution (Oil Storage) Regulations relevant to the area in which the installation is located.

A fire valve should be fitted on the outlet pipe of the service tank serving combustion equipment other than standby generators, see **7.6**.

6.13.2 Heating of service tanks

Where oils listed in **6.12.1** are used, the service tank heating should be in accordance with **6.12**.

The tank manufacturer's and fuel supplier's guidance should be sought on the suitability of the service tank for containing class E, F, G and H oils.

6.14 Rooftop tanks

For rooftop tanks, the advice of the local authority, the Fire and Rescue Service and the insurance company should be sought at the design stage in case planning approval is required.

For rooftop locations, metallic tanks should be used.

Rooftop tanks should be either service tanks in accordance with **6.13**, or storage tanks of total capacity not exceeding 10% of that of the bulk storage tank and not exceeding 3 500 L. They should only be used when there is no alternative.

Rooftop tanks should be replenished by a pumped supply from the ground level storage tank. The tank should be provided with a float control to switch off the pump automatically when the oil reaches a predetermined level. The tank should be fitted with an overflow prevention device and a by-pass pressure relief valve.

NOTE 1 The method of controlling the filling of the tank could be either manual or automatic by float control.

The rooftop tank should be equipped with an overflow pipe leading back to the ground level storage tank. The diameter of the overflow pipe should be at least equal to that of the fill pipe.

Arrangements should be incorporated to permit the automatic dumping of the contents of the rooftop tank back into the bulk storage tank in the event of fire or other emergency.

NOTE 2 Extra capacity is required in the bulk tank to take any oil returned to it in this manner.

The automatic dump valve should be fitted in a pipe run from the base of the rooftop tank into its overflow pipe.

Dumping arrangements should be actuated by the fire valve system (see **7.6**), and should shut down the transfer pump from the main storage tank.

7 Oil handling systems from storage tank to oil-using equipment

*COMMENTARY ON CLAUSE **7***

Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

7.1 General

NOTE 1 For standby generators, the function of a system for handling liquid fuel is to transfer fuel from the outlet of the storage tank to the injector pump of the standby generator under specified conditions of pressure, rate of flow, temperature and therefore viscosity.

The oil handling system should be such that at all times it delivers correctly filtered water-free fuel to the oil-using appliance within the limits of pressure and temperature required for correct functioning of the equipment. Information on the condition of the fuel required at the oil-using appliance should be obtained from the manufacturer.

Distillate grades of fuel, i.e. those specified in BS 2869 should be handled at ambient temperatures. Systems for distillate fuels should be in accordance with **7.2**.

NOTE 2 Correct siting and insulation of tanks, pipework and filters might be required to provide sufficient protection to maintain the necessary flow properties in cold weather.

Where continuity of service is critical, a tank immersion heater capable of maintaining the oil in the tank at between 0 °C and 5 °C and pipeline trace heating capable of maintaining the oil in the pipeline at between 0 °C and 5 °C should be used.

When deciding the route by which fuel is to be transferred from the bulk storage tank to the oil burning equipment day tank or service tank, the likelihood of mechanical damage to the pipeline transferring the oil should be minimized by avoiding points at which vehicular or other damage could occur.

Biofuels or biofuel blends should not be used in a system where the ancillary equipment contains rubber that is not biofuel compatible unless permitted by the equipment manufacturer.

Oil supply systems to oil burning equipment should incorporate a fire protection system to ensure the isolation of oil to the oil burning equipment.

The fire valve system should not isolate the fuel supply to standby generators.

7.2 Fuel supply systems for distillate fuels

7.2.1 Gravity supply systems

NOTE A gravity supply system is one where the oil flows directly from the bulk storage tank to the standby generator(s).

For a gravity supply system to work, the outlet from the bulk tank should be at least 500 mm higher than the injector pump can lift, as per the standby generator manufacturer's instructions.

The oil supply line should fall continuously from the tank. Where this is not possible, air vents should be provided at high points.

A stop valve should be fitted at the bulk tank outlet, followed by a filter in accordance with SAE J1488 2010_10 [N5], to remove all water in the oil supply pipe.

For standby generators an oil cut-off valve, actuated by a sump switch in the standby generator house floor or by another method of leakage detection, should be installed in the standby generator room.

Where the oil supply line supplies more than one item of oil-using equipment it should be of such size that any variation in oil pressure resulting from changes in the friction head loss does not exceed the limits of such pressure variation acceptable to the standby generator equipment at all flow rates.

7.2.2 Pumped supply systems

7.2.2.1 Use of the oil burner pump (a sub-gravity system)

7.2.2.1.1 General

In instances where the relative position or level of service tanks and oil burning equipment do not allow a gravity feed, a day tank (service tank) should be used for transferring the oil from the bulk tank to the standby generator.

7.2.2.1.2 Single pipe system

When a single pipe suction system is connected to the top outlet from the bulk storage tank, an anti-siphon device should be fitted at the tank outlet.

A non-return valve should not be used in the oil supply pipe. Where standby generators require an overfuel return pipe back to the day tank or bulk tank, a non-return valve should be used in the return line.

The flow and return pipes from the fuel tank to the standby generator should be clearly marked.

7.2.2.1.3 Two pipe system

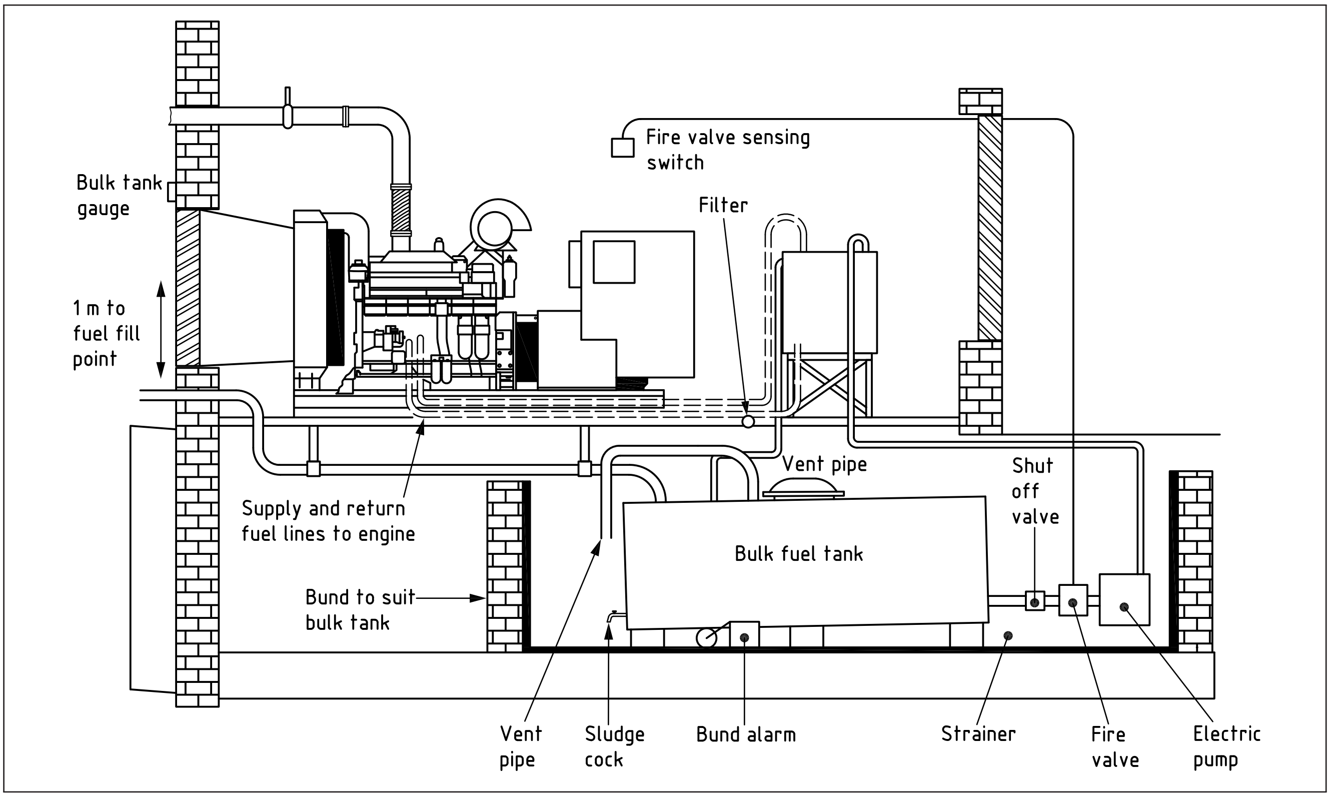
NOTE In this system, the two pipe connection to the oil burning equipment is run directly to and from the bulk storage tank.

A non-return valve should be fitted in the return pipe close to the tank or, if the suction pipe enters through the top, a foot valve should be fitted to the end of the pipe. In the latter case provision for withdrawal should be made for servicing the foot valve. The draw-off level of the suction pipe should allow for a dead space in the bottom of the tank for accumulation of water and sediment.

The return pipe should be valved and able to take the fuel surplus from all the standby generators. Where a standby generator runs solely off a bulk tank, the suction pipe should rise continuously to the standby generator and a suitable priming point should be provided at the high point to facilitate priming, see Figure 1.

A stop valve should be fitted at the bulk tank outlet, followed by a duplex filter/polishing system in the supply pipe.

Figure 1 **Remote fuel transfer system**



7.2.2.2 Use of transfer pump

NOTE A transfer pump controlled by electronic valves can be used to transfer fuel from the bulk tank to the day/service tank.

Where the transfer pump supplies more than one off-take point or day tank, it should be of such size that any variation in fuel pressure resulting from changes in the friction head loss does not exceed the limits of pressure variation acceptable to the oil burning equipment at all flow rates.

A stop valve should be fitted at the bulk tank outlet, followed by a filter/polishing system in the supply pipe.

In view of the dependence of the fuel system on the transfer pump, a duplex pump should be installed to provide emergency back-up.

7.2.2.3 Pumped ring main systems

NOTE 1 In these systems, oil flows by gravity or under suction from a storage or service tank to a pump and then around a circulatory system. This comprises a flow line up to the last outlet served, and a return line to the pump suction or to the oil tank.

The maximum static head when the tank is full should be less than the maximum permitted inlet pressure at the oil equipment. Where the maximum static head is too great, a constant-level control device, a pressure reducing valve or a service tank should be installed between the storage tank and the pump.

The pressure in the ring main should be controlled, within the limits required for the operation of the equipment supplied, at all flow rates and under zero draw-off conditions by either:

a) a pressure control device of suitable size fitted on the downstream side of the last outlet served; or

b) a vertical loop on the return line to the tank where the equipment only requires a low inlet oil pressure.

The flow rate of the pumped oil should be in excess of equipment requirements to ensure that the correct pressure at the inlet to the equipment is maintained by any pressure control device over the range of flow rate required. Spill-type burners have special requirements in this respect and the burner manufacturer should be consulted for advice.

The oil-using equipment manufacturer should be consulted about sizes for the pump and the ring main system.

High points of the ring mains should be fitted with air vents.

Pressure regulating valves should be installed with isolating valves and with a bypass valve incorporating a manual control, so that operation of the plant can continue if failure of the pressure regulating valve occurs.

Pressure gauges should be fitted at the pump outlet and immediately upstream of the pressure regulating valve and bypass valve.

A filter should be incorporated in the pump suction line.

NOTE 2 A non-return valve needs to be fitted in the ring main return line before it enters the pump suction or the tank.

7.2.2.4 Oil suction lines

The total pressure drop in the suction pipe, filters, valves and any other fitting, plus any suction lift where the lowest level of oil in the supply tanks is below the level of the oil burning equipment at the maximum flow rate should be within the maximum suction lift provided by the transfer pump.

The maximum suction acceptable at the pump inlet should not exceed the pump manufacturer's stated maximum vacuum.

Suction lines should be as short as possible, with a minimum number of bends to reduce friction losses. Easy bends should be used.

To avoid air in-leakage problems, the joints in suction pipework should be, where possible, welded or flanged joints. When joints are required that can be disconnected, they should be flanged rather than screwed. Types of valve designed to eliminate air in-leakage should be used at priming points and for isolating the inlet side of the oil pump, e.g. ball valves or lubricated plug cocks.

7.2.2.5 Filters

NOTE 1 Since the introduction of Biofuel (FAME) into fuels the quality and life expectancy of fuels has been adversely affected as FAME is hydroscopic so any water in the fuel goes into suspension. This water can lead to injector pump damage and facilitate the growth of bacteria which blocks conventional filters.

*NOTE 2 Removing as much water as possible preserves the quality of the fuel and for critical standby generators only filters conforming to SAE J1488 2010_10 [N5] are to be used, see **18.10**.*

Filters should be fitted in positions accessible for examination and cleaning.

Filters should be duplicated or be of a type that permits maintenance without shut-down.

Fuels for emergency generators should be tested every six months for quality and suitability.

7.2.3 Electric tracing

7.2.3.1 General

NOTE 1 This method of tracing is relatively simple and low in initial cost.

Electric tracers should be applied externally under thermal insulation and should be of a type suitable for the temperatures and conditions of use. Full particulars of ratings and instructions for fixing should be obtained from the manufacturers.

The type selected should be able to withstand the temperatures reached by the conductors, pipes and any other methods of tracing to be employed on the same pipe.

NOTE 2 Examples of the types of electrical trace heaters available are as follows:

a) twin-conductor cable, plastics- or lead-sheathed for lower temperatures;

b) mineral-insulated metal-sheathed cable either single core, twin core or multicore according to the method of temperature control;

c) heating tapes made up of two single cores with heat-resisting insulation that are sheathed and spaced apart by a covering material selected according to temperature or protection required.

7.2.3.2 Installation recommendations

If single core, the lead and return cables should be laid together to avoid magnetic loop impedance. If more than one cable or pair of cables are used for a complete circuit they should be terminated as far as possible at a common point permitting the supply from one straight feeder.

The heating cable(s) should be held in firm contact with the oil pipe by a continuous heat-insulating tape binder applied in a close spiral round the oil pipe and the steam or hot water pipe, where fitted.

Where two or more heating cables are used, they should be spaced apart by the heat-insulating tape. Sharp bends, damage and undue strain on the cables should be avoided before they are covered by the thermal insulation. The cables should be kept dry under the thermal insulation.

Where cables cross valves, flanges or other fittings, they should be protected from damage by inserting pads of lead strip, or other suitable material, between the cable and any sharp edges. To facilitate removal of valves or fittings or breaking of joints, some slack should be left in the cable at such points.

NOTE 1 Where it is necessary to accommodate additional cable length, i.e. where the watts required per metre run are greater than watts per metre run output from the cable(s), the cable(s) can be spiralled round the oil pipe or laid in a wave formation. Some waving of stiff cable can be used to allow for differential expansion.

The heat input of tracer cables should be balanced with the maximum heat loss of the pipelines and in some cases it might be advisable to zone the tracer system. Where thermostatic control is incorporated, the balance should be maintained.

The siting of the thermostat should be located at a point that ensures that at no portion of the pipeline can the oil fall below the required temperature.

The tracers should be terminated with flexible insulated cold leads. Where these leads are not part of a made-up cable they should be attached to the conductors in accordance with the manufacturer's instructions. The cold leads should be connected to the supply cables in a waterproof junction box.

Pipe joints should have protective bonding comprising copper wire not less than 4 mm^2.

NOTE 2 Attention is drawn to BS 7671 with regard to protective bonding.

The metallic cable sheath should be earthed through the electrical installation. The complete pipeline should have protective bonding through the electrical installation but if the tanks are far from the oil burning equipment and the resistance of the pipeline too high, it might be necessary to use a local earth electrode or to lay a protective bonding conductor along the pipeline.

7.2.4 Thermal insulation of pipelines

Pipelines, including flexible pipes, handling oil should be insulated in accordance with BS 5970. In selecting the type of insulation, account should be taken of the location of the pipeline and exposure to weather and draughts. The insulation should be covered by a suitable material to minimize the absorption of moisture and/or oil and should be protected against mechanical damage. If exposed to the weather the covering should be weatherproofed.

The insulation should be so arranged that flanges or couplings are easily accessible and leakage readily detectable.

All materials should be compatible with the product being stored and passed through the pipelines, including any biofuels. The manufacturer's advice should be sought as necessary.

NOTE 1 BS EN ISO 23553-1 covers the construction and testing of shut off valves. OFS E101 [17] covers non-electrically operated remote acting fire safety valves.

NOTE 2 Further guidance is given in OFTEC Technical Book 3 [N1].

7.3 Materials and construction and erection of oil pipelines

7.3.1 Materials and construction

Materials for piplines and joints should conform to BS 799-4.

Where pipelines are welded or screwed and socketed, occasional flanges or unions should be used to facilitate dismantling. Pipework carrying oil within a building or above ground externally should be constructed of steel or copper or some other material with an equal degree of fire resistance, except where it is inside an appliance casing which is protected by a remote fire valve in accordance with **7.6**.

*NOTE 1 Twinwall plastic pipes can be used externally below ground (see **8.3**).*

Underground plastics oil piplines should conform to BS EN 14125.

Galvanized pipe and fittings should not be used.

If steel pipes and malleable fittings are used these should be inspected and cleaned before use.

Taper threads should always be used.

Running joints, long screws or connectors should not be used.

NOTE 2 Petroleum resisting compounds and polytetrafluoroethylene (PTFE) tapes which remain slightly plastic make the most satisfactory joints.

Jointing material should not enter the fuel system.

All pipework should be rigid, firmly fixed, and protected, where necessary, against damage. Any required flexible pipework should be run and supported in order to avoid strain or damage to the pipework.

7.3.2 Erection of oil pipelines

Oil pipelines should be as short as practicable, with the minimum number of directional changes.

Easy bends or swept tees should be used. The use of elbows or square tees should be avoided.

Pipelines should be laid with a fall to be self-draining and should be supported at intervals that are sufficiently frequent to avoid sagging and damage from any possible imposed loading.

In outside situations a suitable corrosion-resistant and weatherproof treatment should be applied.

Oil pipelines that run underground should conform to *OFTEC Technical Book 3* [N1].

NOTE For underground installations, twin walled plastic pipe can be used, preferably laid in continuous lengths without joints.

Any joints should be made within an inspection chamber. The pipework should be fitted with a continuous leak monitoring system.

7.4 Testing of the pipework installation

7.4.1 General

The complete pipework system should be subject to a leak detection test in accordance with OFTEC Technical Book 3 [N1] after erection and before any paint primer, paint, trace heating or thermal insulation is applied.

Electrical continuity checks should be made on electric trace heating before fitting the thermal insulation.

The final operational test using oil under operating conditions should be applied when all thermal insulation has been completed. This test should cover all the specified conditions of operation required for the installation.

7.4.2 Test method

Metallic pipes should be tested at 1 bar pneumatic pressure for 30 min.

If there is a loss of pressure the pipework should be exposed and repaired or replaced and the test repeated.

If there is no loss of pressure after 30 min the test is considered a pass.

The pressure reading should be taken and recorded.

Plastic pipes should be tested in accordance with their manufacturer's requirements.

7.5 Painting and identification

Oil, air, steam and water piping, and any gas piping in the vicinity, should be painted in colours conforming to BS 1710.

A numbered disc or tag should be affixed to each valve in the system, the numbers corresponding with those indicated in written working instructions on diagrams or on record plans.

7.6 Fire valve systems and their installation

NOTE 1 This subclause does not apply to standby generator sets.

A fire valve system should be fitted so as to cut off the supply of oil remotely from the combustion equipment and burner in the event of an accidental fire occurring in or around the appliance. For appliances installed inside buildings, the oil supply should be shut off externally to the building. For existing installations where oil lines serving internally installed combustion equipment are run so as to be built into the structure internally, the cut off point should be at the point where the line is first exposed internally. This type of layout should not be used for new installations.

Fire valve sensors should typically be positioned inside the appliance casing over the burner or as recommended by the appliance manufacturer. The sensor activating temperature should be selected in consultation with the appliance manufacturer so as to avoid nuisance cut outs.

Where fire valves are incorporated within core heating chambers, special attention should be given to the location of the sensing element. The sensors used should be ones designed to trip at a higher temperature than those for use in other locations to avoid nuisance cut outs.

Where more than one oil burning unit is installed, each appliance should be provided with a sensor controlling a fire valve. Each oil pipe entering the building should be protected by a fire valve.

Fire valve systems should either be in accordance with the following recommendations or take the form of a system as described:

a) it is essential that the system can sense a fire inside or close to an oil burning unit and also shut off the oil supply at a point that enables conformity to this British Standard;

b) in the event of any part of a valve or any other component becoming damaged, it is essential that the supply of oil is closed off;

c) manual operation is necessary in order for oil to be passed through to the burner after the system has been thermally activated; and

d) the system should include a means for testing for satisfactory operation and for manual resetting.

NOTE 2 BS EN ISO 23553-1 covers the construction and testing of shut off valves. OFS E101 [17] covers non-electrically operated remote acting fire safety valves.

The functional features required for a fire valve system can be incorporated in one unit or provided by more than one separate component and should conform to the recommendations in this subclause.

Fire valve systems alternative to that referred to should take one of the following forms:

1) an electrically operated valve coupled to thermal fuses located as described, can be fitted. The valve should be self-closing on open circuiting of the thermal fuses, and installed so that the oil pressure exerted by the head of oil in the tank assists closure. The thermal fuses should be of the type which remains open circuited after operation;

2) a weight- or spring-loaded valve can be used. It should be held open by a flexible cable with fusible links inserted in its length over each firing point. At all changes of direction, the flexible cable should pass over corrosion resistant metal pulleys with a diameter of not less than 40 mm. The flexible cables should be made of corrosion resistant, inextensible multi-strand wire, suitable for use with the pulleys and which does not take a permanent set. This type of fire valve should not be used where the run of the cable would be long or tortuous. Each fusible link should be at a sufficient distance from the pulleys, or other possible obstructions, to ensure that the metal fitting forming part of the fusible link has free movement to permit complete closure of the fire valve when a link fuses; or

3) a spring loaded valve held open by a flexible cable enclosed within a flexible outer sheath, terminating in a fusible link can be fitted. Excessive lengths of this type of cable or sharp bends can result in unreliable operation and should be avoided.

Where the sensing element is positioned external to any appliance casing it should be located at a maximum distance of 1 m directly above the burner.

Electrical circuits for fire valves should be independent of burner or other control circuits.

Where the oil supply system to the appliance involves the installation in an internal location of equipment such as constant level oil controls or oil lifters containing a reservoir of oil, they should be protected by remote acting fire valves positioned in accordance with the appliance manufacturer's instructions.

NOTE 3 Further guidance is given in OFTEC Technical Book 3 [N1].

8 Accommodation for oil storage and service tanks

*COMMENTARY ON CLAUSE **8***

Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

8.1 General

Tanks should be provided with secondary containment, i.e. a bund, and should be situated externally to the building they serve.

NOTE 1 If external location is impracticable, tanks can be sited within the building subject to approval by the local building control department, Fire and Rescue Service and insurers.

Tanks should be so situated that they are as near as practicable to the standby generator they serve. Tanks should also be easily accessible for receiving deliveries, but if this is not possible, an extended fill pipe should be used.

Where an integrally bunded tank is used, the clearance measurements for fire protection should be measured from the outside of the whole oil storage system, i.e. including the bunded part, if that is wider, higher or longer than the primary container.

NOTE 2 Tanks can be situated in any of the three principal ways, i.e.:

a) above ground away from or outside buildings;

b) buried in the ground; or

c) within, on, or over a building.

Wherever possible, above ground installations should be adopted in preference to below ground installations.

8.2 Tanks above ground away from or outside buildings (other than over or upon the roof)

Where tanks are installed externally, they should be installed on or over a non-combustible base that extends out at least 300 mm from all sides of the tank. If the tank is closer than 300 mm to a building wall or fire screen wall which has the degree of fire protection required for the tank, the base should only extend as far as the wall.

A fire-resistant tank chamber or fire screen walls should be installed, except:

a) where the tank is more than 2 m away from any building or similar structure on the same site and from any adjoining site, and the quantity of oil to be stored does not exceed 3 500 L; or

b) where the tank is more than 6 m from such a boundary and adjoining site, where the quantity of oil to be stored exceeds 3 500 L.

In all cases other than the exceptions referred to in a) and b), protection from any building or similar structure on the same site and from any adjoining site should be in accordance with 1) and 2).

Where the quantity of oil to be stored does not exceed 3 500 L, a fire screen wall, as described in 2), should be provided between the tank and any adjoining site within 2 m.

In addition, either:

1) the walls of any building or similar structure on the same site within 1.8 m in any direction from any part of the tank should have at least 1 h fire resistance and should be imperforate; or

2) a fire screen wall should be provided between the tank and the building or similar structure, this wall having at least 1 h fire resistance and extending not less than 900 mm beyond the ends and uppermost parts of the tank.

Where the oil to be stored exceeds 3 500 L, a fire screen wall, as described in 2) above, should be provided between the tank and any adjoining site within 6 m.

In addition, either:

i) the walls of any building or similar structure on the same site within a distance of 6 m in any direction from any part of the tank should have at least 2 h fire resistance and should be imperforate where they are within 1.8 m in any direction of the tank; any openings in the walls between 1.8 m and 6 m away from the tank should be fitted with 1 h fire resisting glazing or 1 h fire-resisting self-closing doors; or

ii) a fire screen wall should be provided between the tank and the building or similar structure; it should have at least 1 h fire resistance and extend not less than 900 mm beyond the ends and uppermost parts of the tank.

NOTE For further guidance, see OFTEC Technical Book 3 [N1].

8.3 Steel tanks buried in the ground

Steel tanks buried directly in the ground should conform to BS EN 12285-1.

These tanks should have at least two skins and should be installed with a leak detection system.

NOTE 1 Single skin tanks are not to be installed underground.

In order to spread the load evenly and reduce the possibility of settlement, the tank should be placed upon a reinforced concrete raft.

In districts where the water table is likely to rise above the bottom of the tank, the tank should be securely anchored by means of steel straps to its concrete raft, which should have sufficient mass to offset the buoyancy of the tank when empty.

Steel tanks should be protected against external corrosion by the application of a protective coating in accordance with BS EN 12285-1. Coatings should be oil resistant paint or a proprietary polyethylene or epoxy material which is applied after shotblasting.

NOTE 2 Protective coatings are a passive method of preventing corrosive attack and if damaged during installation can leave the tank vulnerable to corrosion or degradation.

Coatings should be inspected for signs of damage and areas of damage should be repaired in accordance with the manufacturer's recommendations before the excavation is backfilled.

NOTE 3 Active protection for steel tanks against external corrosion can be achieved by cathodic protection. Other coating systems as detailed in BS EN 12285-1 can be used.

The manufacturer's instructions should be followed when tanks are buried.

In circumstances where the occurrence of an oil leak might have serious consequences, the tank should be enclosed in a tank chamber. The chamber should be impervious to oil and water.

8.4 Tanks within, on or over a building

Metallic tanks should be used inside and above buildings unless the installation is on the ground floor or below.

Tanks within, on, or over a building should be enclosed within a fire-resistant tank chamber constructed of brick, concrete or other suitable material and with the enclosure, doors and windows having the periods of fire resistance in accordance with Table 4 and Table 5.

NOTE 1 Examples of suitable types of construction are set out in Table 4 or Table 5, as appropriate.

NOTE 2 Attention is drawn to the Building Regulations 2010 [3].

A tank having a capacity greater than 3 500 L within a building should, wherever practicable, be situated at the lowest level in the building. When a tank is situated at any level in a building other than the lowest, the whole of the structure supporting the tank chamber should be constructed to a standard of fire resistance not less than that recommended in the manufacturer's instructions for the tank chamber or for the remainder of the building, whichever is the greater.

A tank chamber within a building should, wherever practicable, be situated against an external wall and be accessible from the open air.

Tank chambers should either be provided with internal bunds in accordance with **8.5**, or the chamber itself should be constructed so as to be impervious to oil, or the tanks within them should be of the integrally bunded type conforming to OFS T100 [N3] or T200 [N2].

Table 4 **Construction, and fire resistance of tank chamber and generator enclosures and the doors and openings therein in large buildings and places of public entertainment or assembly**

Location	External walls	Roof	Doors and openings in external walls and roofs	Walls and floors separating chamber from rest of building	Doors in internal walls separating chamber from rest of building
Detached but within 6 m of main building	Non-combustible bricks, blocks or concrete A), B)	Concrete not less than 1 h A), B)	Doors 1 h self-closing A), B)	—	—
External to but adjoining main building	Non-combustible bricks, blocks or concrete A), B), C)	Concrete not less than 1 h A), B), C)	Doors 1 h self-closing A), B)	1 h	Inner and outer 1 h doors or a single 1 h door of a type incorporating an insulating material to limit the transmission of heat D)
Within the main building E)	Non-combustible bricks, blocks or concrete C)	—	Doors 1 h self-closing	1 h E)	Inner and outer 1 h doors or a single 1 h door of a type incorporating an insulating material to limit the transmission of heat D)
On roof or within topmost storey of building F)	Non-combustible bricks, blocks or concrete C)	Concrete not less than 1 h C)	Doors 1 h self-closing	1 h	Inner and outer 1 h doors or a single 1 h door of a type incorporating an insulating material to limit the transmission of heat D)

A) As an alternative, the tank could be in the open if it is possible to provide effective screening from adjacent buildings.

B) Enclosures are to be imperforate except for the necessary access doors and vent openings to prevent stagnation of air, positioned so as to present the least risk to adjacent buildings.

C) A higher standard of construction might be required by the local building control department, Fire and Rescue Service or insurers, who are to be therefore consulted.

D) Where inner and outer 1 h doors are provided, the outer door is to be kept locked shut and be clearly marked on the outside: OIL STORE – THIS DOOR TO BE KEPT LOCKED SHUT and the inner door next to the storage chamber fastened shut and be clearly marked KEEP SHUT.
Where a single 1 h door is provided it is to be kept locked shut and be clearly marked on the outside: OIL STORE – THIS DOOR TO BE KEPT LOCKED SHUT.
A key for emergency use is to be available in an adjacent box with a thin glass front.

E) Where a tank chamber is within a building but projects partly therefrom so that its ceiling is partly the underside of a separating floor and partly the underside of a roof, the floor portion is to have a 1 h standard of fire resistance and the roof portion of reinforced concrete not less than 100 mm thick.

F) Storage should be limited to a daily service tank not exceeding 10% in capacity of the bulk tank (with a maximum of 1 000 L) sited adjacent to and separated from the standby generator room. In addition the supply pipe between the main storage chamber and the service tank is to be within its own non-combustible 1 h duct.

Table 5 **Construction and fire resistance of tank chamber and generator enclosures and the doors and openings therein in all buildings other than large buildings and places of public entertainment or assembly**

Location, and quantity of oil that can be stored	External walls	Roof	Doors and openings in external walls and roofs	Walls and floors separating chamber from rest of building	Doors in internal walls separating chamber from rest of building
Within, on or over a building any storage not exceeding 1 250 L	No special recommendation A), B)	Concrete not less than 1 h B)	No recommendation as to fire resistance B)	1 h C)	1/2 h, kept shut and bolted
Within, on or over a building any storage exceeding 1 250 L but not exceeding 3 500 L	1 h A), B)	Concrete not less than 1 h B)	1/2 h doors kept shut and bolted B)	2 h C)	1 h, kept shut and bolted
Within a building any storage exceeding 3 500 L	2 h A), B)	Not applicable	1 h doors kept shut and bolted and clearly marked on the outside: OIL STORE – THIS DOOR TO BE KEPT SHUT B)	4 h A)	Two 2 h doors kept shut, and bolted, and clearly marked on the outside: OIL STORE – THIS DOOR TO BE KEPT SHUT D)

A) A higher standard of construction than that recommended might be required by insurers, who might requiring consulting.

B) Enclosures need to be imperforate except for the necessary access doors and for vent openings to prevent stagnation of air.

C) Where a tank chamber is within a building but projects partly therefrom so that its ceiling is partly the underside of a separating floor and partly the underside of a roof, the roof portion is to be of reinforced concrete not less than 100 mm thick.

D) In a building or part of a building provided with two or more staircases the protection might be one 2 h door (bolted and marked as described) where the opening is between the tank chamber and an adjoining standby generator room or between the tank chamber and an area of very low fire risk.

8.5 Bunds (secondary containment)

Secondary containment bunds are essential for all above ground tanks covered by this British Standard.

Purpose-made integrally bunded tankontrols conforming to OFS T100 [N3] or OFS T200 [N2] can be used but where this is not possible, concrete or masonry bunds should be constructed so as to conform to CIRIA report 163 [N4].

NOTE 1 Attention is drawn to the Control of Pollution (Oil Storage) Regulations [5], [6], [7], [8] and the guidance note for the Control of Pollution (Oil Storage) Regulations relevant to the area in which the installation is located.

The bund should be able to contain 110% of the contents of the tank under overfill and leakage conditions.

NOTE 2 In some cases additional capacity might be required, see CIRIA report 163 [N4].

Where more than one primary tank is located in a single bund, the bund capacity should be at least 110% of that of the largest tank or 25% of the total storage capacity, whichever is the greater.

The bottom surface of masonry and concrete bunds should be laid to fall to an impervious sump. The sump should be un-drained.

Bunds should never be provided with drainage facilities that involve any form of opening in the bund, whether this is valved or not. It should only be possible to empty the bund by pumping the liquid out of the top of the bund.

Ventilation and pipe ducts, etc. should be arranged so as to maintain the integrity of the bund and the fire resistance period of any enclosures.

8.6 Siting of tank chambers within buildings with reference to means of escape and accessibility

8.6.1 Means of escape

All large tank chambers, i.e. exceeding 6 m in either length or breadth, should be provided with two separate unobstructed means of escape in case of fire.

All doors should open outwards from the chamber and operate from inside the chamber without the aid of a key.

It is essential that any bolts can be operated from the inside.

Where the tank chamber also acts as a bund, any door provided should be located in such a position that opening it would not affect the integrity of the bund.

The tank chamber should be so sited within the building that the presence of smoke in the event of fire would not prejudice the means of escape from the building. The Fire and Rescue Service should be consulted in all cases.

NOTE Depending on the circumstances, imperforate separation from a main staircase might be required. Alternatively, protection of such a staircase might be required by means of fire-resisting approach lobbies or corridors which might be required to be ventilated.

The siting of tank chambers in buildings provided with only one staircase, in dead-end portions of multi-staircase buildings, or where the public have access to the building or part of a building concerned, should be determined.

8.6.2 Accessibility

There should be accessibility within a tank chamber to permit access to all tank mountings and fittings and to all pipe joints and any polishing/filtration systems.

Space should be provided for painting the external surfaces of the tank.

There should be space between the sides of the tank and the walls of the bund for access to valves and fittings, and for withdrawal of any heating elements.

There should be sufficient height between the tank drain valve and the floor.

8.7 Ventilation of tank chambers

A tank chamber should be ventilated to the open air to prevent stagnation, independently of any other portion of the premises and by natural means. Ventilation openings should be so placed as not to render any bund ineffective.

Any ventilation openings serving the tank chamber should not be sited within 3 m of a final exit from any staircase to the street in order to not create a smoke hazard for persons escaping from the rest of the building in the event of a fire.

Any ventilation shaft necessary for the tank chamber should be enclosed and separated from the remainder of the building, including any chimney or smoke shaft, by non-combustible materials having the same period of fire resistance as the enclosures to the chamber or as required for the remainder of the building, whichever is longer.

8.8 Automatic fire-extinguishing installations and foam inlets in tank chambers

If a fixed automatic fire extinguishing installation or foam inlet is required by the Fire and Rescue Service, the local fire and rescue service and insurers should be consulted.

8.9 Lighting and electrical equipment in tank chambers

Permanently installed lighting fittings of totally enclosed pattern, i.e. of the bulkhead or well-glass type, should be provided in tank chambers.

Only transfer pumps and other such electrical equipment required to be installed close to the storage tanks should be within the storage chamber and all such electrical apparatus should be of the totally enclosed type.

When electrical equipment is used in the vicinity of tanks storing kerosene, the guidance given in Health and Safety Executive document HSG 176 [N6] should be followed.

The wiring should be enclosed in screwed metal conduits or consist of armoured or mineral-insulated metal-sheathed cable.

NOTE Attention is drawn to BS 7671 with regard to electrical equipment in tank chambers.

The controls for any electrical equipment or lighting circuit within a tank chamber should be installed outside the tank chamber.

9 Fuel selection considerations

*COMMENTARY ON CLAUSE **9***

Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

The configuration of the space available as the combustion zone could influence the choice of oil, particularly relevant in respect of flame length.

The following should be determined when selecting the correct type of fuel:

a) combustion chamber design;

b) burner;

c) environmental consideration and restrictions;

d) heat input variation (turn-down ratio);

e) supervision and maintenance; and

f) combustion product contact with materials.

10 Selection of burners for furnaces

*COMMENTARY ON CLAUSE **10***

Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

10.1 General

The type of oil burner to be used and the mode of control of the burner should be selected to be suitable for:

a) the type of plant unit, e.g. shell combustion equipment, water-tube combustion equipment, warm air heater;

b) the class of liquid fuel to be used, see Clause **4**;

c) utilization pattern of plant, e.g. constant output, variable output such as variations in heating load.

NOTE Attention is drawn to the Clean Air Act 1993 [18] and the Clean Air (Northern Ireland) Order 1981 [19].

There are a large range of burners available (see Annex A) and guidance on burner selection should be obtained from the burner manufacturer.

10.2 Choosing oil burning equipment

The maximum output of the burner(s) should be sufficient to meet the maximum rating of the combustion equipment or warm air heater. Depending upon the type of burner employed, the method of operation of the burner should be chosen from one of the following types to meet the varying load requirements:

a) on/off;

b) on/off, with transitional low-flame start;

c) high/low/off; or

d) fully modulating over the turn-down range.

The flame size and shape should be such as to be confined within the combustion space of the unit under the conditions specified by the combustion equipment or heater designer.

NOTE 1 It is often difficult to visually judge if a flame is impinging on the surface within the combustion space or if it appears to be impinging, whether it might cause damage. If flame impingement is occurring due to chilling of the flame, carbon builds up on the surface or it becomes impossible to reduce the carbon monoxide level below a level of 0.01%, or the smoke number (Bacharach scale) of the exhaust gases might be higher than for normal operation.

NOTE 2 Attention is drawn to the Clean Air Act 1993 [18] and the Clean Air (Northern Ireland) Order 1981 [19].

Many types of oil burners have been developed commercially to meet individual requirements for heating and steam raising (see Annex A).

11 Selection and application of burner types for furnaces

11.1 General

NOTE Having decided upon the most suitable grade of fuel to be used, the choice of burner type can be made from the groups of burners generally available (see Annex A).

Selection of the burner should be in accordance with **11.2** to **11.9** together with factors such as rate of energy consumption, physical size of equipment and maintenance requirements.

11.2 Maximum and minimum heat input requirements

Assessment should be made of the maximum and minimum heat input requirements to determine the "turn-down" capability required of the combustion equipment.

Where the turn-down required is beyond the capacity of a single burner, the use of multiburners should be considered.

NOTE The minimum firing rate required of a single burner might be the deciding factor in the choice of burner type, e.g. for firing rates less than 30 kW, the medium pressure air atomizing burner is generally preferable.

11.3 Heat release rates (heat release rate per unit volume)

The volume of the space in which combustion is to be effected should be determined, particularly with respect to heat release rates less than 300 kW/m^3, i.e. small flames in large spaces, and heat release rates in excess of 3 500 kW/m^3.

NOTE The rate of heat release depends on the energy used for the combustion system; the larger the heat release rate, the larger the pressure energy supplied by the combustion air has to be.

11.4 Type and shape of flame

*COMMENTARY ON **11.4***

The design of the burner results in flames of widely differing character, and, in considering the application, the most suitable flame is of crucial importance. For example, a slow burning, long, luminous flame might be desirable, or at least acceptable; the burner could then be relatively simple, cheap and use little air energy. At the other extreme, a very short, small flame, or indeed no visible flame, might be required, in which case the burner is more complex, more costly and uses more air energy. Oil burning equipment can be obtained that produces special flames such as flat, fish-tail or saucer shaped; these flames might be more suitable in certain circumstances.The process might require a non-luminous flame or one having a high velocity. These flames might be needed under conditions where either oxidizing or reducing conditions are a process requirement. A burner designed to produce particular flame characteristics at full firing rate might not be capable of continuing to maintain these conditions at the low firing rate.

If preheated combustion air is used, the combustion temperature is higher than with cold air. The nearer to the stoichiometric rate at which the burner operates, the higher the combustion temperature.Generally, and within reasonable limits, the more excess air that is supplied, the shorter the flame.

The method of introducing excess air into the combustion zone when the amount is greater than 50% of the stoichiometric quantity should be determined in the design of the burner. In such cases, the excess air should not be introduced through the burner assembly but at a point away from the burner assembly.

11.5 Configuration of the combustion zone

The size and proportions of the combustion zone relative to the firing rate and the combustion conditions should determine the number of burners to be used and the flame characteristics they produce.

Deep quarls to support combustion at low rates, or baffle walls to help reduce length, are expedients that should be provided in cases where the configuration of the combustion zone requires it.

11.6 Combustion air source

Combustion air should be introduced into the combustion zone by any of the following methods:

a) induction by the natural draught of the chimney;

b) induction by an induced draught fan;

c) induction by draught created by a venture system;

d) blown in by a forced draught fan; and

e) various combinations of a), b), c) or d).

According to the individual arrangements, all or some of the combustion air should be passed through the burner(s).

The size of the flues and waste gas passages should be large enough to enable the burners to work correctly at their maximum rating, with due allowance being made for the accumulation of dirt and other obstructions. The forced or induced draught system should be capable of providing all the combustion air required to burn the oil fuel at the maximum rating of the burner(s) together with any excess air or dilution air necessary for the process.

The oil supply should be shut off if the combustion air supply fails. Any fault condition that results in inadequate air supply should cause an alarm to be activated and/or the oil supply to be shut off.

Where the air is drawn direct from the atmosphere, or where the air has been preheated to a temperature not exceeding 150 °C, it should be passed through the body of the burner, e.g. as with low air pressure atomizing type burners. Where combustion air is preheated to temperatures in excess of 150 °C, it should be introduced in such a way that overheating of the oil fuel does not occur as it passes through the atomizer.

The combustion air flow regulation system should be designed to take into account any specific volume variation that could occur with varying air preheat temperature, particularly for cold starting conditions.

Siting of forced draught combustion air fans should ensure that, as far as possible, the air intakes draw clean fresh air. Provision should be made to ensure that the following should not be entrained into combustion air fan intakes:

1) flash steam from steam traps or drains;

2) waste gases or vented combustible gases from plant;

3) fuel gas control systems;

4) entrained combustibles, e.g. paint spray, timber dust.

In dusty environments, the use of fan air intake filters should be determined.

Account should be taken of the restriction to air flow which progressively increases with use.

Where air filters are fitted, it is essential that the air flow is monitored.

If the combustion air could possibly be dust laden, as might occur, e.g. with stone dryers or calciners, a type of burner should be selected that is not vulnerable to internal dust deposition.

Where combustion air is supplied from a compressor, i.e. for atomizing with medium or high pressure air type atomizers, it should be free from lubricating oil and water.

Facilities should be provided in the air supply system for this purpose, in accordance with the manufacturer’s instructions.

11.7 Pressure in the combustion zone

To ensure efficient combustion of the oil fuel, the pressure within the combustion zone should be determined by the:

a) design of the combustion zone;

b) process requirements; and

c) method used for the disposal of the waste gases.

The design of the the combustion air system should allow for the combustion zone being under positive pressure.

NOTE 1 Local overheating of the burner and the burner quarl due to the discharge of products of combustion at the burner can be caused by the positive pressure in the combustion zone.

If a positive pressure persists after the burner has been shut down, means should be provided to protect the burner assembly against overheating.

NOTE 2 Operation of combustion chambers with relatively high positive pressures in excess of 250 mbar accelerates the mixing rate of the oil fuel and the combustion air compared with that at atmospheric pressure.

The effect of the increase in the intensity of combustion under these conditions should be determined.

The design of the combustion air system should allow for the combustion zone being under negative pressure and the possible effects on burner performance and on the design of the combustion system.

11.8 Positioning of burners

NOTE The location of the burner is governed by the combustion requirements and flame shape needed within the combustion zone.

The positioning of the burner/s should be determined so that each burner should have external access to ensure access for maintenance. In positioning several burners to fire into one combustion zone, mutual interference of their flames should be avoided, unless this is required for heat transfer reasons.

The burner should be securely mounted in its correct firing position with provision for easy removal for cleaning, maintenance and replacement. Connections for oil and air should be simple to disconnect and reconnect when using the appropriate tool.

For control and maintenance, the burner should be located so that it is accessible from floor level. If this is impracticable, then either working platforms should be provided at the proper height or the burner should be capable of being withdrawn to a space where maintenance can be more readily performed.

Where working platforms are provided above normal floor level, their construction should take account of, and provide protection against, any hazard that might arise for persons on the platform or underneath it, e.g. danger from hot gases discharged from furnace doors or openings rising through open mesh platform floors, from spillage of oil or from dropping of tools or other items or materials through open mesh floors.

11.9 Noise level

NOTE 1 It is generally desirable to assess the likely noise level that could result from the proposed burner assembly, including any associated fans, compressors, oil pumps, etc.

NOTE 2 The noise resulting from the combustion process is not readily predictable; generally the greater the energy imparted to the air and the oil, the greater the noise produced by the combustion process.

To achieve a low noise level, the following procedures should be carried out, where appropriate:

a) the furnace should be mounted on a solid foundation. Any oil firing equipment, such as fans, which can cause vibration should be mounted to avoid the transmission of noise and vibration;

b) furnaces with metal casings should have a non-combustible insulating lining in the space between the casing and the inner furnace;

c) all flue connections on the furnace and the chimney should be correctly jointed and sealed;

d) to prevent transmission of vibrations between the furnace and the oil burning equipment, direct contact should be avoided. Where equipment has to pass into the furnace, heat-resistant packing should be fitted to provide a seal. Unit burners directly mounted on the furnace should have heat-resistant gaskets fitted between the burner plate and the furnace casing, and the mounting bolts should be insulated against vibration;

e) to achieve very low noise levels in the vicinity of the furnace sound-absorbent casings around burners and other noise sources such as fans should be provided; and

f) burner equipment incorporating electromagnetic features should be prevented from creating magnetic hum.

12 Accommodation for and installation of furnaces

12.1 General

Furnaces should be selected and installed in accordance with BS ISO 13577 (all parts).

12.2 Fire resistance for furnace accommodation

12.2.1 Building design

Where oil fired furnaces and any associated equipment are installed, account should be taken of fire risk in the design and the materials used in the construction of the building.

12.2.2 Proximities

The proximity of other types of plant and equipment should be determined to ensure that hazards, e.g. fire, do not spread in the event of maloperation or malfunction.

12.2.3 Enclosures

Standards of fire resistance for enclosures surrounding furnaces should be appropriate for the circumstances of the occupancy and the general activities carried out in the same enclosure or immediately adjacent thereto.

12.2.4 Foundations

Building foundations should be protected against excessive heat transfer through the base of furnaces. No part of a structural floor, building foundation or surrounding soil should be at a temperature in excess of 100 °C. For reasons of operator comfort, floor surfaces and walkways should not be at temperatures in excess of 65 °C.

NOTE Where a waterproof membrane (damp-course) is incorporated in the foundations, its protection against excessive downward heat transmission might need assessing.

The materials for supporting furnaces should be capable of taking the load-bearing pressures and high temperatures. Wherever possible air or water cooling should be incorporated into the foundations of high temperature furnaces, especially where the operation is continuous.

12.2.5 Access doorways for buildings

Where an enclosure is provided for furnaces located in a building, access doorways should have non-combustible thresholds raised not less than 75 mm above floor level and should be fitted with a self-closing door having not less than 30 min standard fire resistance.

12.3 Automatic fire extinguishing installations and foam inlets

NOTE In some circumstances the local authority, the insurers or the local fire authorities might require the installation of fixed automatic fire extinguishing facilities or foam inlets into the enclosure or to the area in which the oil storage tanks are situated.

The fire authority and the insurers should be consulted when installing automatic fire extinguishing installations and foam inlets.

12.4 Access to and means of escape from buildings in which furnaces are located

12.4.1 Means of escape

The direct distance to any exit, or place of safety, should not exceed 12 m. If the means of escape is by stairs or ladder the route should be protected by means of a full height enclosure of 30 min fire-resisting construction and 30 min fire-resisting self-closing door. All hinged doors affording means of escape from a furnace enclosure should open in the direction of the escape route and should open from inside the enclosure without the aid of a key. No access door should be locked whilst furnaces are operating or when oil is being pumped into or circulated within a furnace enclosure.

12.4.2 Ventilation

Ventilation of buildings in which furnaces are located should be so disposed that any smoke or fumes arising from the process, either under normal or extraordinary circumstances, does not interfere with personnel escape routes, cause a nuisance or danger on public highways, railways or airports, or result in a discharge into neighbours' premises.

12.4.3 Access and escape routes

There should be provision within all industrial premises to ensure that unauthorized interference with the operation of any equipment associated with the furnace or its oil burners does not occur.

12.5 Smoke outlets

Where oil burning equipment serving furnaces is located below ground level, smoke outlets should be provided by means of pavement or stallboard lights, as might be appropriate for the circumstances of the installation. The smoke outlets should be accessible to the fire services, and be as large as possible.

The covers provided for the smoke outlets should be of breakable construction. Any outlet shafts leading to the smoke outlet should be constructed to the same standard of fire resistance as that required for the enclosure or for the remainder of the building, whichever is the greater. The outlets should be suitably distinguished at ground level by notices, e.g. smoke outlet from basement.

12.6 Lighting

Furnace enclosures should be lit by permanent electric lighting. Where furnaces are required to be entered for inspection or repair, a socket-outlet with a residual current device (RCD) for wandering leads should be provided for an inspection lamp of the extra-low voltage type to minimize the risk of injury to personnel in the event of electrical faults.

12.7 Plant access

There should be access for the installation, removal, repair and overhaul of the relevant plant.

12.8 Ventilation and supply of combustion air

Facilities for ventilation should be provided to ensure a supply of air sufficient for both combustion, the process requirements and general ventilation of the enclosure, when all access doors are closed.

Where the ventilation is by natural means and forced or induced draught fans are not incorporated into the oil burning equipment, the air necessary for combustion should be admitted by permanent openings at low level to the outside air, a total free area of not less than 0.2 m^2 being provided for each 250 kW of heat input.

If the combustion equipment incorporates forced draught or induced draught fans, account should be taken of the air intake facilities and provision made for ventilation.

If a mechanical system of ventilation is necessary or if the air is introduced into the enclosure by fans, the system should be independent of any other ventilation system serving other parts of the premises.

Permanent openings to the outer air having a total free area of not less than 0.1 m^2 per 250 kW of installed heat input (with a minimum of 0.25 m^2) should be provided at high level to effect general ventilation and to remove smoke and fumes.

Where furnaces are located below ground level, special ducts might be necessary to admit the air and such ducts should be enclosed and separate from the rest of the building by non-combustible construction, having the same standard of fire resistance as that required for the enclosure, or for the remainder of the building in the case of Class B buildings.

13 Waste gas handling equipment – Chimneys

Waste gas handling should be carried out using one of the following two methods:

a) a proprietry exhaust system, as designed by the combustion equipment manufacturer; or

b) a purpose-built chimney system.

NOTE 1 Chimneys are passages carrying the waste gases to the atmosphere.

The selection of waste gas handling equipment should depend upon the following factors:

1) the height of the vertical flue or chimney should be determined:
   i. to provide draught for the equipment when operating at its maximum rating with natural draught or a combination of natural and mechanical draught;
   ii. to provide gas dispersion so as to limit the concentration of its pollutant content;
   iii. to ensure that the top of any chimney which forms part of or is in close proximity to a building is carried up well clear of the roof of the building or of any adjacent building to prevent down-draught or the creation of a nuisance to adjacent property;

   NOTE 2 Attention is made to the Clean Air Acts [18], [19] and current related legislation: Memorandum on Chimney Heights under Clean Air Acts, Ministry of Housing and Local Government and Scottish Development Department, 1963 [20].

2) the internal cross-sectional area should be chosen to take into account the pressure drop (resulting from the friction of the gases as they pass up the chimney) under all working and temperature conditions including the dynamic energy loss at the exit;
3) in order to prevent inversion, the internal cross-sectional area of the exit from the chimney should be chosen so that the normal minimum exit velocity is not less than 3 m/s;
4) the internal cross-sectional area of the exit from the chimney should be not less than 50% of the average internal cross-sectional area of the chimney;

   NOTE 3 The fitting of a tapered head to a chimney top has the effect of increasing the velocity of discharge of the flue gases. Although there are no set formulae for nozzle design, as a guide it has been found that good results are obtained with a ratio of depth of nozzle to diameter of discharge of approximately 1.6:1 and with a nozzle angle of 13° to 15° to the vertical.

5) internal surfaces should be as smooth as possible to minimize gas friction. The volume of any pockets (dead spaces) below the flue entry should be as small as possible;
6) when furnaces are operating at high temperatures with a reducing atmosphere, they should have independent flue systems and independent chimney systems. Furnaces using fuels other than oil should not discharge their waste gases into chimneys used by furnaces burning oil fuels or vice versa without special consideration of the circumstances; and
7) to prevent chimney internal surface temperatures being reduced below the dew point temperature of the waste flue gases, insulation should be fitted externally to the chimney to minimize heat losses.

Where the requirements of items c) and d) cannot be met, the use of multi-core chimneys should be used. The design of such chimneys should take account of the differential expansion that occurs when one or more cores are out of use.

Where chimney internal surface temperatures are below the acid dew point (e.g. where wet washing grit arresters are incorporated as with sand and stone dryers) the materials of construction should be corrosion resistant, e.g. mild steel should not be used.

Where high operating temperatures apply, the insulation material should be fitted inside the chimney. Lightweight insulating refractory material, which might be liable to absorb moisture, should not be used for chimney lining where any prolonged condensation could occur.

Where such prolonged condensation occurs, a dense refractory should be used and if necessary back-filled with loose fill insulating material. An insulating lining in a high chimney requires support at intermediate levels of about 10 m so as to avoid any given portion of lining being of excessive weight and also to limit the amount of expansion in the portion of lining nearest the top of the chimney.

Capping should be provided to weatherproof the top rim of the chimney.

Where lightning conductors are fitted they should be in accordance with BS EN 62305.

NOTE 4 Depending on the size of the chimney and conditions of operation, facilities for entry at the bottom of the chimney might be desirable for cleaning purposes. With large chimneys, access through the flue system is normally possible.

14 Means of heat recovery from waste gases

14.1 Regenerators

The refractories used for packings and linings of regenerators should be chosen for their suitability to resist attack by ash resulting from the combustion of the fuel and from any products carried over from the process. A generous allowance for fouling should be made in the spacing of the packing.

14.2 Recuperators

The choice of the materials used for both refractory type and metallic type recuperators should take into account the worst condition that might arise in respect of dew point and depositions of volatilized fuel oil ash or products carried over from the process.

14.3 Waste heat combustion equipment and economizers

The maximum temperature of waste gases that can be passed to the combustion equipment should be in accordance with the manufacturer’s specification but should not exceed 500 °C.

The minimum temperature should be such that the surfaces of the gas passages in the combustion equipment do not fall below the acid dew point temperature for any prolonged periods.

NOTE 1 The acid dew point depends on the grade of fuel from which the waste gases are formed and possibly on the nature of the products that might be carried over from the process.

NOTE 2 In economizers, the waste gas temperature is dependent on the construction and the rate of water flow to effect heat removal. Where steam atomizing burners are used on a furnace etc., the increased moisture content of the resulting waste gases lowers their dew point temperature.

15 Air supply facilities

Any building in which an oil fired furnace is installed should be provided with means of ventilation to ensure a supply of air sufficient for both combustion and general ventilation.

The air necessary for combustion and cooling should be provided by permanent openings in accordance with the specified requirements for the installation of the equipment. High inlet air velocities should be avoided, wherever possible, by provision of openings larger than the minimum recommended sizes and the openings should be positioned, wherever possible, in such a way to avoid draughts affecting operating personnel, the flame, hot oil pipework and control equipment.

NOTE For large installations below ground level, special ducts might be required to admit the required air. Such ducts or tanks are separated from the rest of the building by construction having a standard of fire resistance not less than that required for the enclosure of the room in which the plant is situated.

Any external door installed in such a place that it might reduce the flow of air inlets to the furnace should have permanent openings or louvres equal in area to the minimum size of openings given above.

16 Arrangements of additional ventilation where flammable solvents are evaporated in furnaces (ovens)

*COMMENTARY ON CLAUSE **16***

Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

NOTE 1 Explosions might occur where solvents are evaporated, for example from paint or adhesive films, unless the evaporate solvent vapour is rapidly diluted with sufficient fresh air to prevent the accumulation of an explosive mixture.

In the case of continuous drying ovens, the mechanical ventilation rate should be not less than is sufficient to induce 60 m^3 of fresh air for each litre of solvent evaporated in order to maintain the concentration of solvent vapour below 25% of the lower explosive limit.

NOTE 2 Batch type ovens present a problem since the rate of evaporation varies throughout the drying cycle.

Sufficient fresh air should be induced by mechanical means to maintain the solvent vapour concentration below 25% of the lower explosive limit at all times.

With mechanical ventilation, air flow switches in the exhaust duct or the air inlet should be provided, so interlocked that, if the ventilation rate falls below minimum requirements, fuel is shut off.

17 Explosion relief

*COMMENTARY ON CLAUSE **17***

Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

Low temperature furnaces or low temperature sections of high temperature furnaces, when directly fired or when evaporating solvents, should, where possible, have sufficient permanent openings, e.g. waste gas exit and air entries or explosion relief doors or panels, to prevent damage to the plant or injury to personnel in the event of an explosion.

Relief doors or panels should be sited in such a way that they do not cause flames to be directed towards personnel, and they should be strongly hinged or otherwise secured.

In order to reduce the possible explosion pressure to the lowest level, relief doors or panels should be as large as possible up to the cross-sectional area of the plant where this is not more than six times as long as it is wide. In other cases relief should be provided at intervals along the length.

In all cases the relief doors or panels should weigh less than 50 kg/m^2. In cases where panels are designed to blow out they should do so without tearing and be made from a suitable soft material, unlikely to cause injury.

18 Standby generator sets

*COMMENTARY ON CLAUSE **18***

Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

*Clause **18** covers the fuel supply, fire safety and maintenance recommendations for combustion engine-driven alternating current standby generating sets supplied in accordance with, e.g. BS ISO 8528 (all parts).*

18.1 General

NOTE Due to the application of standby generator sets, e.g. in hospitals, banks, and communication centres which are "critical applications" where failure could result in loss of life or high cost and applications such as emergency lighting or other "non critical" applications, their installation and maintenance is a critical operation.

Before installing a standby generator set, advice of the local authority, Fire and Rescue Service and insurance company should be obtained with regard to design and installation of the following:

a) storage of fuel, lubricating oil, Aqueous Urea Solution 32.5% and coolant;

b) fire protection;

c) noise levels;

d) exhaust and air pollution levels;

e) electrical requirements;

f) commissioning and maintenance; and

g) fuel filtration.

18.2 Accommodation for bulk storage tanks

Storage should be provided for fuel, lubricating oil, Aqueous Urea Solution 32.5% and coolant.

Fuel should be stored in accordance with Clause **8**.

Lubricating oil should be stored in a bunded container or drums on a drip tray. Aqueous Urea Solution 32.5% and coolant should be stored in separate bunded containers either inside or outside the building in a containment area.

Standby generator fuel should be supplied from either:

a) the sub base fuel tank located under the standby generator;

b) an intermediate daily fuel service tank located within the standby generator room which is automatically refilled from a bulk tank;

c) a bulk fuel storage tank, provided that the outlet connection on the tank is at least 500 mm higher than the base on which the standby generator is mounted; or

d) a combination of a), b) and c).

The final selection of the fuel system should be dependent upon the site layout and the relative heights of the standby generator and the bulk fuel storage system.

NOTE See Figure 1 and Figure 2 showing tank systems.

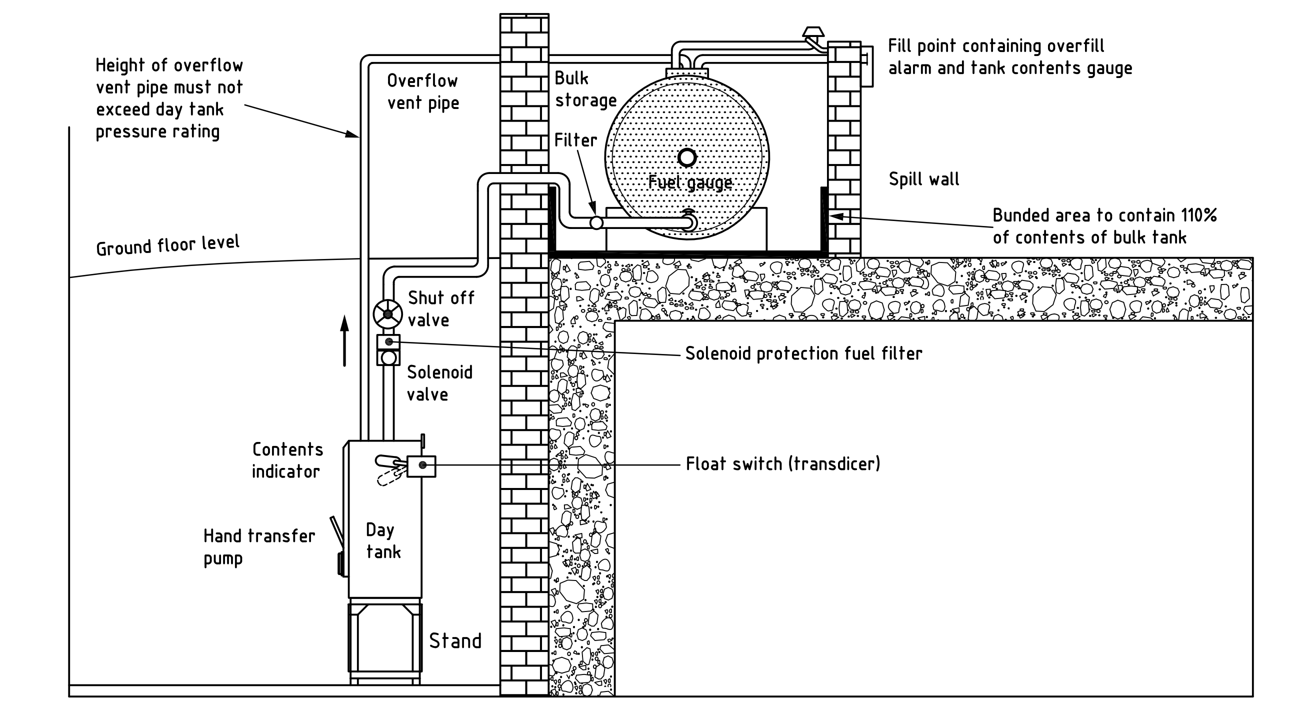
18.3 Fire protection

Standby generators should be housed in fire proof enclosures in accordance with Table 4 and Table 5.

The standby generator room should have good ventilation.

If the bulk storage tank is located in the standby generator room, it should not be refuelled while the standby generator is running.

Figure 2 **Gravity feed fuel transfer supply system**



18.4 Noise levels

Unless otherwise detailed, standby generator sets should be installed in accordance with EEC.2000/14/EC [N7].

Local authority environmental health departments should be consulted with regard to acceptable noise levels.

NOTE 1 Attention is drawn to the Environmental Protection Act 1990 [4].

NOTE 2 The noise levels often relate to the existing background noise levels in the area (e.g. at nearby residences, offices, hospitals etc.).

NOTE 3 It is generally desirable to assess the likely noise level that might result from the proposed standby generator assembly, including any associated fans, compressors, oil pumps, etc.

To achieve a low noise level, one or a combination of a) to f) from the following procedures should be carried out:

a) the standby generator should be mounted on a solid foundation. Any standby generator ancillary equipment, such as fans which can cause vibration, should be mounted to avoid the transmission of noise and vibration;

b) a standby generator with metal casings should have a minimum 50 mm of non-combustible insulating lining in the space between the casing and the standby generator;

c) all exhaust connections on the standby generator and the exhaust should be correctly jointed and sealed;

d) to prevent transmission of vibrations between the standby generator and the exhaust equipment a flexible connector should be used. The mounting bolts should be insulated against vibration;

e) to achieve very low noise levels in the vicinity of the standby generator, sound-absorbent casings should be provided around the standby generator and other noise sources such as fans; and

f) standby generators incorporating electromagnetic features should not create magnetic hum.

18.5 Exhaust emissions

Unless otherwise detailed, standby generator set exhaust systems should be installed in accordance with BS 7445 and BS ISO 1996 (all parts).

Consultation should be sought with local authority environmental health departments before design and installation.

NOTE 1 Attention is drawn to EC Directive 2000/14/EC [N7] for use of standby generator sets installed outside.

NOTE 2 Attention is drawn to the Clean Air Act 1993 [18] and the Clean Air (Northern Ireland) Order 1981 [19].

18.6 Air cooling system

Standby generators require a sufficient supply of fresh air for cooling of the combustion engine which should be provided by one of the following methods:

a) induction by the natural draught into the standby generator room;

b) induction of an induced draught fan;

c) induction of a forced draught fan; or

d) various combinations of a), b), c) or d).

Advice should be sort from the standby generator manufacturer to ensure correct air flow levels are achieved.

18.7 Electrical capacity

The size of the standby generator set required to meet the electrical load capacity should be determined as this has a direct effect on the size of any enclosures and associated services. Advice should be sort from the utility supply company.

An assessment should be made of the maximum and minimum electrical load requirements to maximize standby generator efficiency and minimize exhaust emissions. Where the electrical load variation is beyond the capacity of a single standby generator the use of multiple standby generators should be determined.

Only fully qualified and competent electrical technicians should carry out electrical installation, service and repair.

Due to movement of standby generating sets on their vibration mounts the electrical connection to the set should be made with flexible cable.

The cable should be suitable for the output voltage of the standby generator set and the rated current.

In determining the size of the cable, the ambient temperature, method of installation, proximity to other cables etc. should be determined.

The voltage drop from the standby generator on the load side should be determined when cable cross sections are being selected.

Unless otherwise detailed by the manufacturer of the standby generator, the electrical systems should conform to:

a) BS 7671;

b) BS 7698 (all parts);

c) BS ISO 8528 Parts 1 to 10 and Part 12;

d) BS 159:1992.

Electrical earthing should conform to BS 7430.

The utility supplier should be consulted before the standby generator is connected.

18.8 Control system

Standby generator control systems should be installed in accordance with the manufacturer's instructions.

NOTE A typical arrangement is shown in Figure 3.

18.9 Maintenance

Unless otherwise detailed by the supplier of the standby generator set, maintenance should be in accordance with the maintenance schedule in Annex B.

For reliable performance of standby generators, only clear and bright low sulfur gas oil should be used which has all water removed in accordance with the manufacturer's recommendations.

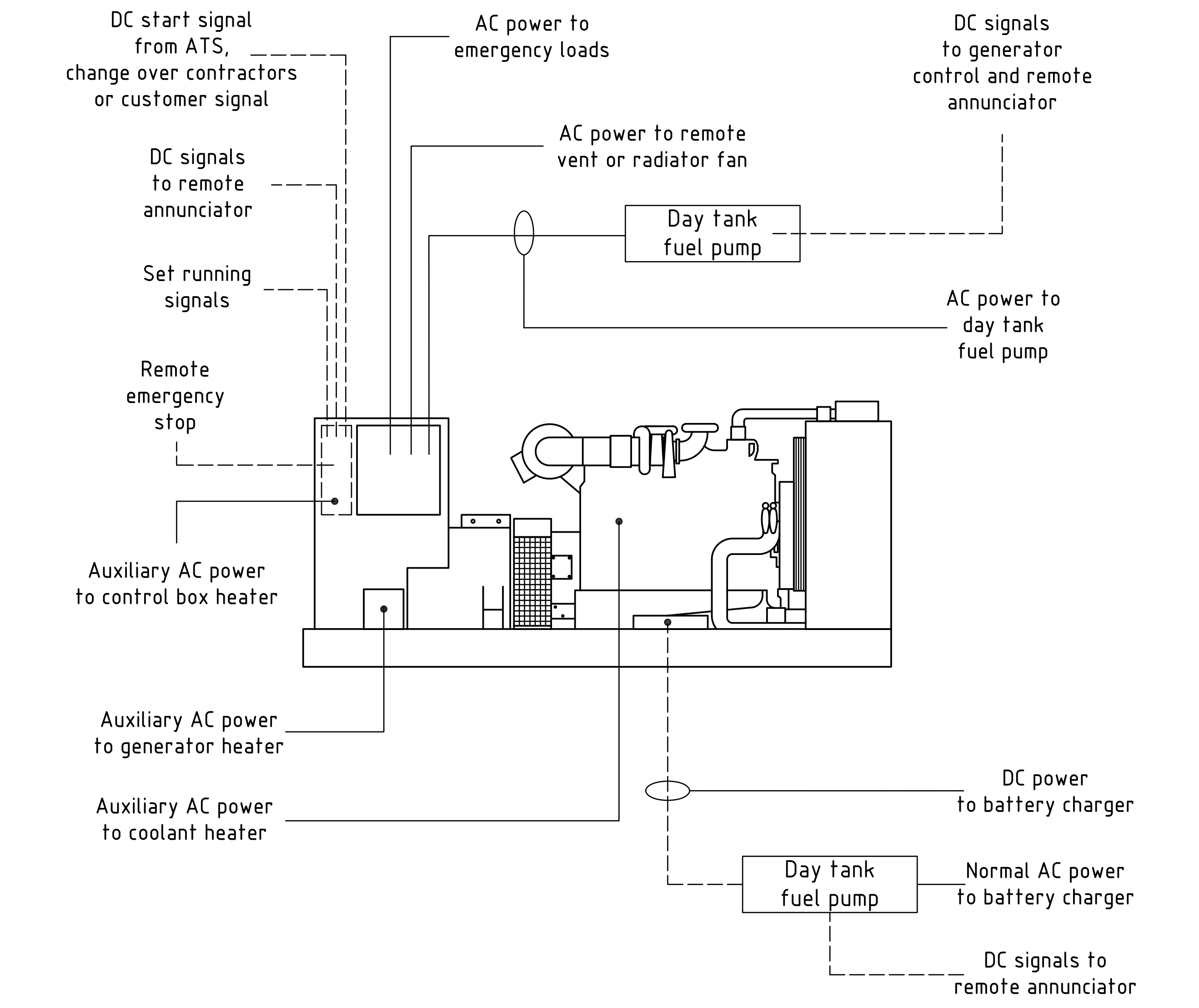
To ensure the correct operation of the standby generator, a schedule of safety checks and plant maintenance should be carried out by competent personnel at regular intervals as recommended by the standby generator manufacturer.

NOTE Responsibility for maintenance rests with the user (see ***22.3****).*

The standby generator manufacturer and fuel polishing supplier should be consulted concerning maintenance requirements.

A minimum of two persons should be trained to receive oil deliveries and deal with local spillages.

Figure 3 **Typical standby generator set control and accessory wiring**



18.10 Fuel filtration – filters

NOTE 1 Since the introduction of Biofuel (FAME) into fuels, the quality and life expectancy of fuels has been adversely affected as FAME is hydroscopic so any water in the fuel goes into suspension. This water can lead to injector pump damage and facilitate the growth of bacteria which blocks conventional filters.

NOTE 2 Removing as much water as possible preserves the quality of the fuel.

"Critical" standby generators should install filters conforming to SAE J1488 2010_10 [N5].

There should be a fuel polishing system to help maintain the fuel quality. If there is no polishing system the fuel should be tested every three months.

Filters should be fitted in positions accessible for examination and cleaning.

Filters should be duplicated or be of a type that permits maintenance without shut-down.

Filters used for "Critical Standby" generator sets should conform to SAE J1488 2010-10 [N5].

Filters for "Non Critical" generators should conform to OFS E104 [N8].

Fuels for emergency generators should be tested every six months for quality and suitability.

19 Control of standby generators

*COMMENTARY ON CLAUSE **19***

Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

The method of control used for starting up and shutting down the standby generator and the need for load monitoring control should be determined by the type of standby generator system installed.

Critical standby generators should be provided with fully automatic controls.

Where a large number of standby generators are running, there should be constant supervision, manual control should not be used and standby generators should be maintained in accordance with the schedule of maintenance (see Annex B).

If air cooling of the standby generator is required under high temperatures, the standby generator manufacturer should be consulted.

19.1 Temperature and pressure control

The design of the electrical sensing devices used to provide the signal for automatic control of the standby generator should be determined through consultation with the designer, electrical engineer and manufacturer, to produce a system which should take into account the following factors:

a) the load range of the standby generator;

b) the type of electrical load sensing;

c) location of the load sensing element;

d) material of sensing device to suit the atmospheric temperature of the standby generator;

e) the requirements of pockets or sheaths in respect of resistance to damage, e.g. from standby generator atmospheres, charge material and temperature conditions;

f) the type of controller most suited to the process, such as high/low, on/off or modulating;

g) the type of signal required, e.g. electrical or pneumatic to suit the valve actuator to be used;

h) the requirement for temperature indicating and/or recording devices to be included in the system; and

i) the requirement for manual override.

20 Exhausts

*COMMENTARY ON CLAUSE **20***

Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

NOTE 1 Exhausts are the passages carrying the waste gases from the standby generator to the atmosphere. Emission levels are critical for clean air and pollution reduction.

NOTE 2 Most new standby generators are either Euro 5 or 6 engines and therefore use a catalytic reduction system (CRS) using, which is a 33.5% urea solution in deminlised water. The urea is normally mixed as one litre urea to 6 L of fuel burnt.

Technicians should consult the standby generator manufacturer to ensure the correct sizing of the bulk tank which should be 110% bunded.

Connections between standby generators and extended exhausts should contain a minimum number of bends.

The risk of expansion within joints should be determined to ensure that air infiltration or discharge of waste gases from expansion joints does not occur.

Where metal exhausts are to be used at waste gas temperatures above 350 °C, they should be internally lined with insulating material.

Exhausts should be supported and arranged to allow movement for expansion without fracture or distortion, jointed with a suitable material to remain gas-tight under all conditions, and insulated only where necessary to reduce unwanted heat emission.

21 Commissioning, performance tests and handover

*COMMENTARY ON CLAUSE **21***

Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

21.1 Commissioning arrangements

*COMMENTARY ON **21.1***

Correct commissioning of the oil storage and handling plant and the oil burning equipment is always of great importance to ensure the successful operation of the plant.

Attention is drawn to the end user directive, ATEX 137 [21], which is enforced by the Dangerous Substances and Explosive Atmosphere Regulations 2002 [2].

The specification of fittings for tanks storing heating fuel with a flashpoint of 60 °C or below at commercial and industrial premises should be determined to eliminate the risk of fire or explosion originating from equipment or processes. Stored fuel should be risk-assessed.

NOTE Attention is drawn to the Dangerous Substances and Explosive Atmosphere Regulations 2002 [2].

Responsibility for this work should be determined before the order for supply and installation of an installation is placed (see **22.3**).

Commisioning work in connection with standby generators should be undertaken by competent technicians subject to supervision by a registration body, if appropriate.

For large schemes a detailed commissioning programme should be agreed between the purchaser and the contractor in consultation with the suppliers of the oil burning equipment.

For small schemes a simpler procedure in accordance with the manufacturer's recommendations for commissioning of the equipment should be agreed between the purchaser and the installation contractor.

Appliances should be commissioned by a competent person using the correct calibration equipment in accordance with the manufacturer's instructions. In the case of new equipment, the equipment manufacturer's instructions should be used. In the case of equipment that has been converted, the burner manufacturer's instructions should be used.

21.2 Precommissioning procedure

Before any part of the plant is energized or filled with oil the main contractor should co-ordinate, with the aid of specialist engineers as necessary, the examination of the whole of the oil burning installation including mechanical and electrical controls to ensure that they are in accordance with the design drawings, specifications and wiring diagrams.

Fuel and electrical services should be made ready for start-up as necessary.

The fill line and vent of the oil storage tank should be checked for accessibility and freedom from obstruction. The contents gauge should be calibrated or checked at the time of filling the tank.

The oil tank should be filled with sufficient oil of the correct specified grade or type for commissioning purposes. This should be enough to provide the heat load required to enable the oil burning equipment to be commissioned over the operational range.

A check sheet and log sheets should be prepared for use during commissioning. These should include the following items.

a) Oil storage system:
   1) tank installation security;
   2) fire protection requirements;
   3) bunding requirements.

   NOTE Environment Agency Oil Care Stickers are available, with a contact number to be used in the event of spillage.

b) Oil handling system:
   1) oil pressures and temperatures over the whole system; running currents of all motors: overload settings, etc.; running currents of electrical tracing;
   2) thermostat settings and operating performance.

c) Combustion system:
   1) oil pressures and temperatures at burner inlet and at the burner head; oil throughput at high flame and low flame;
   2) running current of motors: overload settings;
   3) operation and timing of safety controls: flame failure equipment, etc.; draught conditions;
   4) flue gas – CO_2 content, temperature and Bacharach smoke number or stack solids burden;
   5) O_2 content test;
   6) fire protection system in accordance with BS 5306 (all parts), where required.

21.3 Commissioning procedure

21.3.1 General

Equipment to be commissioned should conform to the installation requirements of this British Standard.

21.3.2 Oil storage system

Oil storage tanks should be installed in accordance with the manufacturer’s instructions.

NOTE Attention is drawn to the Control of Pollution (Oil Storage) Regulations [5], [6], [7], [8] and the guidance note for the Control of Pollution (Oil Storage) Regulations relevant to the area in which the installation is located.

The identification label attached to each tank should verify that the tank conforms to the appropriate construction standard as given in Table 2.

Tank bases and supports should be capable of bearing the weight of the tank when full.

Oil storage tank clearances from adjacent buildings and boundaries and tank chamber construction should be in accordance with Clause **8**.

The tank venting system, if installed on site, should be in accordance with **6.7** and conform to OFS T200 [N2], OFS T100 [N3] or BS 799-5, as appropriate.

The secondary containment system, i.e. the bund, if constructed on site, should be in accordance with CIRIA report 163 [N4].

Gauges and overfill alarms/protection devices should be checked to ensure they are operating correctly.

Any environmental protection notices required by a statutory body should be clearly visible.

21.3.3 Oil handling system

21.3.3.1 General

The oil handling system should be commissioned with the oil burning equipment valved off.

NOTE 1 Attention is drawn to the Control of Pollution (Oil Storage) Regulations [5], [6], [7], [8] and the guidance note for the Control of Pollution (Oil Storage) Regulations relevant to the area in which the installation is located.

For new installations, commissioning engineers should be provided with a certificate from the installer confirming that a pressure test has been undertaken on the pipework in accordance with BS 799-5:2010, Annex A.

NOTE 2 This is especially important for buried pipes.

In the absence of a certificate, the commissioning engineer should complete the pressure test, noting in the report that a certificate had not been made available.

21.3.3.2 Systems for class D fuels and biofuels

The direction of rotation of any ring main pumps or transfer pumps should be checked for correct operation in accordance with the specification. Pumps should not be run dry for more than 1 s or 2 s.

The tank outlet valve should be opened gradually and the oil fed into the supply pipework, bleeding any air from the vents.

When a ring main or transfer pump is fitted without a flooded inlet, the oil pump should be primed before starting.

Air venting should be completed and a check made for any oil leaks.

Oil pressure controllers and pump relief valves should be tested and adjusted in accordance with the design pressure requirements, with the oil pump operating in accordance with the manufacturer's recommendations.

Safety equipment such as fire valves, sump switches, tank overfill devices, and dump valves should be tested.

NOTE The system is then ready to feed into the oil-using equipment.

It should be confirmed and recorded that the equipment installed is suitable for the fuel that is contained in the fuel line.

21.3.3.3 Systems for classes E, F, G and H fuels and biofuels

Storage tank heaters and outflow heaters should be checked for correct operating temperatures, and controls should be adjusted as necessary (see Table 1).

The direction of rotation of any ring main or transfer pumps should be checked for correct operation in accordance with the specification. Pumps should not be run dry for more than 1 s or 2 s.

Line tracing should be put into operation.

The oil flow outlet valve should be opened gradually and the oil fed into the supply piping, bleeding any air from the vents.

When a ring main or transfer pump is fitted, this should be started to circulate warm oil around the system.

When a line heater is fitted, it should be put into operation and checked for correct oil temperature, and the controls adjusted as necessary.

Air venting should be completed and checks made for oil leaks.

Any oil pressure controllers and pump relief valves should be checked and adjusted in accordance with the design pressure requirements, with the oil pump operating in accordance with the manufacturer's recommendations.

Safety equipment such as fire valves, sump switches, tank overfill devices and dump valves should be tested to ensure they are operating correctly.

NOTE The system is then ready to feed oil into the oil burning equipment.

It should be confirmed and recorded that the equipment installed is suitable for the fuel that is contained in the fuel line.

21.3.4 Oil burners

21.3.4.1 General

When commissioning of the oil handling system has been completed, commissioning of the oil burners should be undertaken.

NOTE The detailed commissioning procedure depends upon the particular design and mode of operation of the burner.

It is essential that the oil-using equipment is in a safe operational condition before operation.

The commissioning of oil burners should only be undertaken by individuals who have undertaken generic industry training and have received specific product training from the burner manufacturer.

21.3.4.2 Broad guide to procedure prior to firing

The combustion chamber, flueways and chimney should be free from obstruction.

Manually or automatically operated flue dampers should be checked and confirmed as operating correctly.

The direction of rotation of any forced and induced-draught fans fitted should be checked and confirmed as operating correctly.

A run-through should be made of the burner electrical sequence and all safety interlocks with the fuel supply valved off.

The temperature and pressure of the oil supply should be measured to ensure it is within the correct requirements.

NOTE Further guidance is given in OFTEC Technical Book 7 [22].

21.3.4.3 Broad guide for procedure for firing

The burner should be fired in accordance with the manufacturer's instructions, making sure that there is adequate draught available. A check should be made that the correct flame length is obtained without impingement on heating surfaces whilst obtaining correct combustion conditions.

Flame failure should be simulated to check burner safety devices.

The operation of the control and safety devices on the oil-using equipment should be checked to ensure that they operate as specified.

The oil inputs should be adjusted to suit each firing rate specified. The oil/air ratio should be adjusted to meet specified performance in accordance with the design documentation.

All oil pressures, temperatures and the other items listed in Clause **38**, should be recorded, including the values obtained under conditions of maximum oil consumption.

21.4 Performance tests

It is essential that responsibility for this work and the method of test to be adopted are decided before the order for supply and installation is placed.

Before conducting the tests, the oil-using equipment combustion system should be cleaned so that the tests are conducted with clean heating surfaces.

The performance test should be undertaken with the system in its correct operational configuration, in accordance with BS 845-1 or BS 845-2, as appropriate, and the manufacturer's recommendations.

NOTE 1 The test method used can be either direct or indirect; for the latter an assumption of radiation and other losses has to be made in order to determine thermal efficiency and to infer heat output from measurement of oil input.

Upon completion of all adjustments during commissioning, an agreed period of stable operation should be arranged during which no further adjustments are permitted in accordance with the manufacturer's recommendations.

Performance tests should not be undertaken until all aspects of commissioning have been completed and the plant is operating in a manner which allows performance tests to be completed correctly.

In all cases data should be obtained to determine combustion conditions and thermal efficiency at rated output which should be verified. In the case of high/low flame or modulating burners, tests should be repeated at low flame or over the modulation range as appropriate, and the turn-down ratio verified.

Independent test instrumentation should be used to allow any installed instruments to be cross-checked for accuracy.

Where oil burning equipment is fully automatic, no manual adjustments of oil or combustion air should be permitted during the tests, i.e. between operation at high, or low flame or over the modulation range.

NOTE 2 Attention is drawn to BS 7671 with regard to the inspection and testing of the electrical installation.

21.5 Handover

Following the completion of all aspects of commissioning, performance tests and acceptance of the results, the plant should be handed over to the user.

During the commissioning period, the user should be provided with instruction in operation and maintenance of the equipment to ensure the correct operation at the time of handover.

Comprehensive operation and maintenance instructions incorporating manufacturers' details, wiring diagrams and spares list should be provided by the contractor to the user.

The contractor should notify the user of the periods of guarantee provided by the manufacturers for the plant that has been installed.

The contractor should recommend to the user that an independently mounted carbon monoxide detector with an audible alarm be fitted in the area containing the combustion equipment to give reassurance to the user.

Where a carbon monoxide detector conforming to BS EN 50291 is already fitted, the contractor should recommend that it be replaced with an audible alarm.

The contractor should ensure that the user understands that fitting an alarm is not a substitute for regular servicing and maintenance of the installation by a competent person.

22 Maintenance

*COMMENTARY ON CLAUSE **22***

Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

22.1 General

Maintenance work in connection with oil storage and supply, and standby generator and fuel filtration/polishing performance should be undertaken by competent technicians subject to supervision by a registration body, where applicable to type of work being undertaken.

To ensure the correct operation of the standby generator, a schedule of safety checks and plant maintenance should be carried out by competent personnel at regular intervals, see Annex B.

*NOTE Responsibility for maintenance rests with the user (see **22.3**).*

The standby generator and fuel polishing supplier should be consulted concerning maintenance requirements.

A minimum of two persons should be trained to receive oil deliveries and deal with local spillages.

22.2 Supplier's and/or installer's responsibility

22.2.1 Instructions

Maintenance instructions should be provided by the suppliers and/or the installer to the user.

The instructions should include details of the required frequency of servicing and information on the individual components of the equipment, where applicable. They should also include flow diagrams, wiring diagrams and other relevant data.

Whenever possible, verbal and written instructions should be given by the commissioning engineer to operators, supervisors and management. Where subcontractors are employed, the main contractor should be responsible for correlating the information required from each subcontractor into a comprehensive manual that could also include operating instructions, see, for example, BS 799-4:1991, Clause **9**.

Operating and maintenance instructions should be displayed in a clear and prominent position adjacent to the plant.

All relevant personnel should receive a copy of the operation and maintenance instructions.

22.2.2 Maintenance facilities

The supplier and/or installer of the standby generator and equipment should make provision for routine safety checks and maintenance procedures, see Annex B.

All equipment requiring regular maintenance should be accessible and, where necessary platform and access ladders should be provided.

Permanent means of identification should be provided on storage tanks and pipework, valves, controls, motors and starters, etc., for relating such items to the corresponding flow diagrams and wiring diagrams. All identification should be clearly visible and free of over-painting.

All components driven by electric motors should be permanently marked to indicate direction of rotation.

Lists of essential spare parts and special tools should be provided.

22.3 User's responsibility

The user should ensure that maintenance contracts are arranged.

A maintenance programme should be prepared, in consultation with the supplier or installer of the equipment, and made available to the maintenance personnel concerned.

The programme and maintenance instructions should state the times at which servicing should be carried out, describe the procedure to be followed and list any replacement parts, tools and lubricants that might be needed.

Maintenance staff should be trained and familiarized with the particular equipment to be employed, including the use of a personal carbon monoxide alarm monitor.

Essential spare parts, special tools and correct lubricants should be available on site.

Where underground pipework is installed, the user should ensure pipework is maintained and tested regularly in accordance with **7.4**.

NOTE Attention is drawn to the Control of Pollution (Oil Storage) Regulations [6], [7], [8]. Attention is also drawn to the guidance note for the Control of Pollution (Oil Storage) Regulations relevant to the area in which the installation is located which require underground pipework to be pressure tested a minimum of every five years if there are mechanical joints and every ten years if there are no joints, see ***7.4.2****.*

23 Furnace, kiln and oven operating and maintenance instructions

Operating and maintenance instructions should be formulated and agreed by the furnace builder, the burner manufacturer and the user.

Instructions should be attached to the plant, be visible from the operating position and set out the steps for safely lighting and shutting down the plant. In addition, operating and maintenance instructions should be provided together with a safe method of commissioning the plant.

24 Combustion and safety controls for burners

*COMMENTARY ON CLAUSE **24***

Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

24.1 General

To ensure safety, oil burning equipment should be fitted with protective devices (see Clause **40**) conforming to BS 799-3 and BS 799-4.

24.2 Flame monitoring

NOTE 1 The most suitable form of flame monitoring is generally by some type of photoelectric system. Such systems can be obtained to operate on the visible light band, at the ultraviolet end or at the infra-red end of the spectrum.

Flame sensors should be positioned as to be sensitive only to the main oil burner flame and insensitive to any other condition.

As photoelectric devices are temperature-sensitive, if overheating is possible, air or water cooling should be provided.

Spurious signals should be prevented.

NOTE 2 These could be electrically induced or promoted by vibration.

Where appropriate, as an alternative to monitoring the main oil flame, the pilot flame should be monitored.

Where the pilot flame is provided by gas, flame safeguard devices should be fitted to gas pilots where the release of unignited gas could cause unsafe conditions.

NOTE 3 Slow acting flame safeguard devices i.e. thermoelectric, or fast acting devices, i.e. electronic, can be used.

Where a permanent pilot is used (either gas or oil) it should be solely monitored on the assumption that its continued presence assures the ignition of the main oil flame.

NOTE 4 In some industrial installations it might not be necessary or indeed desirable to have flame failure protection. For instance in the case of a high temperature process operating continuously there is sufficient temperature to ensure the re-ignition of fuel in the event of a momentary stoppage of fuel.

Conditions relevant to a particular installation should be determined before deciding what, if any, flame failure system to employ.

24.3 Failure of ignition

24.3.1 Automatic light-up

With an installation involving a fully automatic burner, it is essential that a starting sequence is monitored by a control device which conforms to BS 799-3 and BS 799-4.

Failure to light should be followed by an automatic purge as defined in BS 799-4:1991, Clause **5**.

The burner should not be reset from lock-out more than three times before the reason for failure to ignite is investigated.

24.3.2 Manual light-up

For installations arranged for hand lighting, instructions on start-up and shut-down should be displayed adjacent to the oil firing equipment. These instructions should emphasize that oil is not to be allowed to accumulate in the combustion zone. If a burner does not successfully light within the specified time, its fuel valve should be closed and time allowed for unburnt gases to disperse naturally.

24.3.3 Oil or vapour present

With all installations, if liquid oil has accumulated in the combustion zone, it should be removed before a light-up is attempted.

With a hot furnace, no source of ignition should be introduced until it is definitely established that the complete furnace is vapour-free or has been allowed to cool to a temperature below the vaporization temperature of the oil.

24.4 Failure of electricity supply and voltage variations

With all systems, including fully automatic systems (see BS 799-4:1991, **5.4**), provision should be made to ensure that, in the event of any electricity supply failure or an excessive voltage drop which interferes with the safe operation of the plant, the fuel supply is shut off. The conditions under which the burner could then restart should be determined at the design stage.

24.5 Plant breakdown

The overall plant control system should include interlocks to ensure a “fail safe” condition in the event of any breakdown.

24.6 Excess temperature

In the event that a normal temperature control fails to function and process temperature continues to rise, provision should be made for a limiting temperature control, set at a higher temperature, to shut off the burner.

The limiting temperature control should be of the hand-reset type and if necessary the shut off should be coupled to an alarm.

NOTE The limiting temperature control could be arranged, where appropriate, to reduce the heat input to a safe limit until the normal temperature control is restored.

24.7 Change from selected oil pressure conditions

NOTE Most oil burning systems are sensitive to a change in oil pressure either above or below the selected values.

Pressure gauges should be provided having the selected values marked. With automatic control systems, pressure switches should be provided, linked into the burner control system.

24.8 High or low oil temperature change

In installations using fuels requiring preheating, the selected temperature should remain constant to avoid changes in the viscosity of the fuel.

The preheating device should be under the control of a thermostat. A further limiting thermostat with manual reset should also be installed to guard against excess oil temperature. A minimum temperature thermostat to prevent the burner starting until the oil is raised to the required temperature should also be installed.

The position of such a thermostat depends on the type of oil burner system used but in cases of packaged burners the thermostat is usually part of the burner and should be fitted by the manufacturer.

24.9 Fan failure

Provision should be made to guard against fan failure.

It is essential that if any fans fail, including any recirculation fans if fitted, then the fuel supply to the burner is shut off immediately.

NOTE 1 It is usual to design control circuits so that the fans are electrically linked in sequence.

Further protection should be added to the system by fitting air pressure or air flow switches inserted into a proving circuit.

NOTE 2 Such precautions have the added advantage that an installation cannot be started up except in the correct sequence.

24.10 Fire at appliance

Where the installation is not under the supervision of an operator, automatic means such as heat-sensitive devices should be provided to operate the shut-off valve and stop the supply of oil to the burners in the event of an external fire (see **7.6**).

24.11 Remote alarms

Where oil burners are automatically controlled or remotely supervised, a remote warning signal, either audible or visual, should be provided.

25 Waste gas removal

25.1 Height of chimneys

NOTE Attention is drawn to the Clean Air Act [18] and the Regulations made under it and to the Clean Air Act Memorandum on Chimney Heights [20], also the Clean Air (Northern Ireland) Order 1981 [19].

The height of a chimney should be such that:

a) draught is provided for the correct operation of the equipment when operating under all working conditions with either natural draught or a combination of natural and mechanical draught;

b) gas dispersion is provided to limit the concentration of the pollutant content of the gas;

c) down draughts are not created within the chimney, and chimney emission does not cause a nuisance to the surroundings.

The top of any chimney which forms part of or is in close proximity to a building should be carried up clear of the roof of the building or of any adjacent building.

25.2 Number of chimneys or flues

For installations comprising more than one source of waste gas, individual chimneys or multiflue chimneys should be provided.

It is essential, however, that separate chimneys or flues are used for equipment using oil and equipment using solid fuel, i.e. that the products of combustion from oil burning equipment are not discharged into flues being used at the same time by equipment burning solid fuel, or vice versa.

In the case of oil burning and gas burning equipment, the design should take account of the requirements of the suppliers of both fuels and also the insurers.

When furnaces are operating at high temperatures with a reducing atmosphere, they should have independent flue systems and independent chimney systems.

25.3 Chimney cross-sectional area

The internal cross-sectional area of the flue(s) should be chosen to take into account the pressure drop resulting from the friction of the gases and from the dynamic energy loss at the exit under all gas flow and temperature conditions.

25.4 Chimney exit

In order to prevent inversion, the exit velocity of the flue gases from the chimney should not be less than 3 m/s at minimum chimney gas flow rate.

NOTE This exit gas velocity can be achieved by the fitting of a tapered head with an angle to the vertical of 13° to 15° to the chimney top.

Where multicore chimneys are used, the design of such chimneys should take account of the differential expansion that occurs when one or more cores are out of use.

To prevent chimney internal surface temperatures being reduced below the dew point temperature of the waste flue gases, insulation should be fitted externally to the chimney to minimize heat losses.

Where chimney internal surface temperatures are below the acid dew point (e.g. where wet washing grit arresters are incorporated as with sand and stone dryers) the materials of construction should be corrosion resistant, e.g. mild steel should not be used.

25.5 Internal surfaces of flues

Internal surfaces of flues should be as smooth as possible so as to minimize gas friction.

25.6 Types of construction

NOTE 1 Oil fired boilers can operate at high efficiencies and might have low flue gas temperatures.

A well designed thermally efficient path should be provided for the flue gases to leave the appliance and be discharged safely. Single skin uninsulated chimneys and flue pipes should not be used because they are likely to be damaged by corrosion caused by condensation.

NOTE 2 It is likely that existing chimneys might need modification if they have been previously used for solid fuel.

The following types of chimney and flue should be used with oil fired equipment:

a) custom built masonry chimneys incorporating the following types of components:

1) steel liner assessed in accordance with BS EN 1859 and conforming to BS EN 1856;
2) clay/ceramic liner conforming to BS EN 1457 and BS EN 13063;
3) concrete liner conforming to BS EN 1857;
4) outer construction conforming to BS EN 12446.

b) prefabricated construction system chimneys of the following types: factory made insulated chimneys assessed in accordance with BS EN 1859 and BS EN 13216-1 and conforming to BS EN 1856 and BS EN 13069.

NOTE 3 Insulation of the space between the liner and the inside surface of the chimney can be adopted if permitted by the chimney manufacturer.

The insulation should be fixed in place so that it cannot penetrate the flue liner if damage occurs.

For special appliances, e.g. condensing boilers, reference should be made to the appliance manufacturer's instructions.

25.7 Lightning conductors

Where lightning conductors are fitted, there should be correct protective bonding.

25.8 Clean-out access

A removable clean-out door should be provided at the base of all chimneys and in the individual flues in multiflue chimneys. The volume of the pocket, below the lowest flue duct entry, should, however, be kept to a minimum. For larger chimneys, entry should be possible at the base, unless access through the flue duct is possible.

25.9 Connecting flues

Connecting flues to carry waste gases from sources of combustion and process to chimneys should contain as few bends as possible and bends should be easy. Where practicable, ducts should lead up to the chimneys at an incline. Unlined brick or concrete flues should not be used.

Where more than one source of waste gas connects to a chimney, a separate connecting flue run from each source to the base of the chimney should be used rather than a common flue duct. Where a common connecting flue is used, entries from sources should be inclined in the direction of the flue gas travel.

Where metal connecting flues enter chimneys they should not project beyond the inner surface of the chimney. When designing connecting flue entries to chimneys, excessive pressure drop should be avoided, see **7.2.2.4**.

NOTE 1 This applies particularly where there is more than one duct entry.

NOTE 2 Vertical staggering of the entry points might be an advantage in minimizing mutual interference of the flow of the flue gases. Alternatively this can be achieved by the use of a mid-feather for part or all of the height of the chimney, with the discharges from the connecting flues arranged appropriately.

Connecting flues should be:

a) supported and arranged to allow movement for expansion without fracture or distortion;

b) jointed with a suitable material to remain gastight under all conditions; and

c) insulated where necessary, to reduce unwanted heat emission or to prevent internal surface temperatures falling below the acid dew point of the flue gases.

Where soft insulation material, e.g. mineral wool, is used externally, it should be protected on the outside, preferably with metal cladding, and where necessary weatherproofed (see BS 5970).

Removable clean-out doors should be provided in flue ducts at intervals throughout their length and particularly at changes of direction.

NOTE 3 Depending on the size, facilities for entry might be desirable.

25.10 Dampers, draught control and combustion excess-pressure relief devices

NOTE 1 Dampers are a means provided for isolating the furnace from the chimney. They can also be used for regulating the draught.

The use of dampers should be determined by the following factors:

a) where the process allows, a damper should not be fully closed. Where fully closing dampers are fitted, an inter-lock should be incorporated to ensure that the oil burner cannot operate when the damper is in the fully closed position;

b) for very high temperature furnaces, dampers should either be constructed of refractory materials or be water cooled;

c) for waste gas temperatures up to about 600 °C, dampers made of high strength alloy cast iron should be used. For temperatures up to 450 °C mild steel dampers should be used;

d) dampers that are to be manually controlled should be positively secured at the operating position and external indication is provided to show the amount of damper opening; and

e) where dampers are automatically controlled, e.g. for regulating the furnace pressure, they should fail safe.

Dampers located in flue ducts can be manually or automatically operated and should be positively interlocked with the oil burner controls to ensure a safe open position for purging and operating. Any closure of the damper to less than the safe open position should cause the oil burner to shut down.

Automatic dampers should fail safe so that in the event of a malfunction they are opened by any excess pressure of flue gas and provide pressure relief into the chimney. Butterfly type dampers should not be fitted.

NOTE 2 Cases have occurred in which unbalanced butterfly dampers have closed as a result of excess pressure occurring in the combustion space thereby causing a restriction in the flue duct.

Automatic gastight dampers should be used, where appropriate, as they close whenever the burners shut down, thereby reducing loss of heat to the chimney and preventing ingress of cold air to the boiler and flue system.

NOTE 3 This in turn reduces thermal shock and any tendency for smut emission from the chimney.

Draught control should be provided automatically by means of damper motors operating under the control of draught sensors in the boiler combustion system, or at the boiler outlet.

Draught control should not be by means of the introduction of air to the flue duct or at the base of the chimney by means of a draught stabilizer, owing to its effect of chilling the flue gases and the risks of condensation in the chimney and of smut formation.

Combustion excess-pressure relief devices should be in accordance with **40.4**.

25.11 Induced-draught fans

NOTE 1 Fans might be required in flue ducts in order to augment the natural draught provided by the height of the chimney, to overcome the friction in the flue gas system, and to meet the draught requirements at the boiler outlet.

The construction of fans should take into account the temperature and constitution of the flue gases. Where fans have water-cooled bearings, the cooling water should be monitored.

*NOTE 2 Fans can be fixed speed or, for draught control purposes, variable speed. Alternatively, draught control could be achieved by means of modulating dampers (see **25.10**).*

The operation of induced-draught fans should be monitored by means of an air flow switch to verify operation before initiating burner purging and firing and also to cause shut-down in the event of malfunction of the fan.

25.12 Balanced flues

Where balanced flues integral to the boiler are used, the installation of the terminal should be in accordance with BS 5410-1.

26 Fans (induced draught or recirculation)

NOTE Fans can be used in the waste gas system to overcome the friction of the gases in the flue and chimney (induced draught) or they can be used to provide some recirculation of the waste gas back to the process. They could be interposed between the combustion chamber and the process, e.g. when used for drying processes.

The construction and materials adopted for fans should take into account the type, condition and temperature of the gases or vapours being handled, e.g. conditions such as reducing, oxidizing, abrasive, and corrosive.

Where the combustion air is induced into the furnace by a fan, the fan control should be interlocked with the fuel supply. Provision should be made for the fuel to be shut off in the event of fan failure.

Where the failure of the fan could result in hazardous conditions arising in the process, safeguards against fan failure should be incorporated. Where fans having water cooled bearings are used, the cooling water supply should be monitored, e.g. flow into a tun dish or visual flow indicator.

27 Ejectors

Ejectors should be used for providing the required furnace pressure and for providing the induced draught in cases where fans cannot be conveniently used due to high waste gas temperatures or where the waste gases are of a particularly corrosive nature.

NOTE The power required by ejectors is considerably more than that required by fans for the same duty.

28 Waste gases cleaning equipment

NOTE Where waste gases have entrained solid matter from the process, it might be necessary to fit cleaning equipment before their discharge to atmosphere especially to minimize pollution.

Specialist advice should be sought regarding the selection of the gas cleaning equipment. In respect of processes scheduled in legislation, the requirements of the relevant inspector should be consulted.

29 Electrical equipment

29.1 General

Components that are electrically operated should be marked with voltage, supply frequency, number of phases and current consumption.

Electrical appliances and components should be protected from hot gases that might issue from standby generator exhausts.

29.2 Wiring

NOTE 1 Attention is drawn to BS 7671 with regard to the arrangement of circuits and wiring.

Wherever possible, all connections to motors and controls should be run in metallic conduit with screwed connections or in mineral-insulated metal-sheathed cable (MIMC) with appropriate glands. Flexible sections should be inserted to allow for the withdrawal of burners, controls and other devices that require removal for servicing.

Heat-resistant cable or mineral-insulated metal-sheathed cable should be used in hot positions.

Wiring installed near oil firing equipment, where spillage could occur, should have oil-resistant insulation.

High-tension leads to ignition equipment should be separately run and terminated with high-tension connectors. Metallic-sheathed cable should not be used for this purpose. Where high-tension equipment is employed it should be clearly marked "DANGER, HIGH VOLTAGE".

The wiring of detector devices for flame failure should be in accordance with the manufacturer's instructions.

NOTE 2 These instructions might limit the length of run and indicate the need for the wiring to be run separately from other wiring, or in special cable to avoid the risk of spurious signals developing.

29.3 Electrical isolation of standby generators

Means for the complete electrical isolation of individual standby generators should be provided in an accessible position adjacent to each standby generator.

In multiple standby generator installations, the isolation of any individual standby generator should not interfere with the correct operation of the remaining standby generators.

A notice of such durable material should indicate the means of isolation for an individual boiler and in the case of multiple boilers, clear indication for each boiler should be provided.

29.4 Electrical enclosures, components and cabling

All electrical enclosures, components and cabling should be suitable for the environment in which the system is situated, in particular with regard to any hazardous area classification temperature and the effects of dust.

NOTE 1 Attention is drawn to the Dangerous Substances and Explosive Atmospheres Regulations 2002 [2] and their supporting codes of practice, HS(L)134 [23], HS(L)135 [24], HS(L)136 [25], HS(L)137 [26] and HS(L)138 [27], and INDG 370 [28]).

In addition:

a) all electrical components, cables, etc. should be suitable for the electrical supply available;

b) all electrical components with voltage range selectors should be adjusted to the value of the voltage available at the supply;

c) all electrical components should be in accordance with the manufacturer's instructions;

d) any electrical component requiring removal for periodic servicing should be provided with ready means of disconnection, such as plugs and sockets, and should be sited so as to be readily accessible;

e) all earth and electrical protective bonding conductors should be copper and of sufficient cross-sectional area;

f) the insulation provided on any earth or protective bonding conductors should have the colour combination yellow and green; and

g) all overload earth fault and excess current protection should be rated.

Motor control gear should be in accordance with BS EN 62271-106 and BS EN 60947-4-1.

NOTE 2 Maintenance of motor control gear is dealt with in BS 6626.

30 Automatic shut-off valves and manually operated isolating valves

NOTE 1 For generating sets used for standby operation a separate disconneciting device for secondary machines might be necessary; for example, fire sprinkler systems.

Automatic shut-off valves should conform to BS EN ISO 23553.

Such valves, whether electrical, electromagnetic, hydraulic, pneumatic or mechanical, should be installed to fail safe.

*NOTE 2 Valves are provided to isolate the fuel oil supply to the burner in the event of an interruption in the normal operating signal from such safety and control devices conforming to Clause **31** and Clause **40**.*

Location of valves should take account of limiting ambient temperatures imposed by the manufacturers.

Valves should be correctly specified to operate under all variations of oil fuel viscosity and temperature, e.g. under start-up and operating conditions.

NOTE 3 Automatic opening of automatic shut-off valves is permissible where automatic sequence ignition of the burner is provided.

For manually ignited burners, valves should be of the manual reset type or be interlocked to prevent opening before the relighting procedure is established. All automatic shut-off valves should be preceded by a manually operated isolating valve.

31 Process regulated control devices

Process regulated control devices should conform to BS EN ISO 23553.

Valves and oil pressure regulators governing the rate of flow of oil fuel to the burner should be controlled by temperature or pressure sensing devices to suit the process.

NOTE 1 Valve movement might be affected by electrical, electromagnetic, pneumatic or hydraulic means and could be of the stepped position or modulating type.

Where mechanical linkage is to be employed, the design should minimize the risk of slipping out of adjustment and provide means for lubrication and cleaning.

*NOTE 2 Where process regulated control devices are provided for on/off control of the fuel oil supply automatic shut-off valves can be used (see Clause **30**).*

NOTE 3 In some cases the combustion air supply to the burner is regulated with the oil flow. In smaller units the oil fuel and air regulating valves could be operated by linkage from a single actuator.

32 Valve actuators

Where a valve actuator is not integral with the valve assembly, care should be exercised in matching these two items.

NOTE Actuators are usually in the form of positioning electric motors, pneumatic diaphragm actuators or pneumatic or hydraulic piston actuators.

Actuators should be fitted with feed-back positioning devices.

The actuators should be positioned to allow access for regular lubrication and maintenance to ensure correct long-term operation.

The manufacturers should be consulted with regard to limiting ambient temperatures around the plant.

33 Ignition equipment

33.1 Maximum gas heat input

The maximum gas heat input of gas pilots or igniters should not exceed 10% of the potential light-up heat input rate of the main oil burner.

33.2 Types of ignition equipment

33.2.1 Hand torch

A hand torch should be in the form of a portable igniter unit designed for this purpose.

Burners operating in positive pressure combustion zones should be provided with fixed igniters.

33.2.2 Direct spark ignition

Direct spark ignition should be used for classes C and D fuels (see **29.2** and BS 799-4:1972, **5.1.1**).

NOTE Generally limited to burners with a maximum capacity not exceeding 110 L/h.

33.2.3 Permanent gas pilot

A permanent gas pilot should be used for installations using multiple small capacity burners up to about 36 L/h operating in negative pressure combustion zones.

Pilot flame failure detectors should be provided.

NOTE Permanent gas pilot ignition is suitable for large capacity burners.

33.2.4 Spark/gas igniters

*NOTE Spark/gas igniters can be used with most types and sizes of burners (see BS 799-4:1991, **5.1.2**).*

The maximum gas heat input of gas pilots or igniters should not exceed 10% of the potential light-up heat input rate of the main oil burner.

34 Starting-up, shutting-down and flame monitoring control devices

Starting-up, shutting-down and flame monitoring control devices should be in accordance with BS 799-3 and BS 799-4.

35 Pressure indicators

Oil pressure indicators should be provided at pump outlets and, where possible, burner inlets.

NOTE Pressure indicators can be fitted at the pump inlet.

Combustion air and atomizing air fans and compressors should be provided with pressure indicators. Indicators should also be fitted at the burner inlet.

Where the possibility of combustion zone pressure variation exists, combustion zone pressure indicators should be provided.

Where the combustion zone pressure is large in proportion to the burner air supply pressure, differential air pressure indicators should be used to measure the pressure drop across the burner.

The scales of pressure indicators should be calibrated to approximately 1.5 times the maximum working pressure. The maximum working pressure should be marked. Where vibration is anticipated, pressure indicators should be remotely mounted.

Where remote indication of residual type fuel (classes E, F, G and H) oil pressure is required, the connecting piping between the measuring point (tapping) and the indicator should be either heated and thermally insulated or permanently filled with a light oil.

An isolating cock should be provided at the pressure tapping point to allow for replacement of the indicator and its connecting piping.

36 Temperature indicators

Where residual type fuel oils of classes E, F, G and H are used, temperature indicators should be provided to indicate oil temperature in storage, at outflow heater discharge connection, at line heater discharge connection and preferably at the burner inlet.

NOTE Temperature indicator can be used at the pump inlet.

Where preheated combustion air is used, air temperature indication should be provided at the burner inlet.

37 Flow meters and flow indicators

Integrating flow meters and rate of flow indicators, when required, should be situated in the oil suction line to the pumping unit. For multiburner installations requiring individual metering, the meters should be placed at each burner inlet.

NOTE Where the burners are fed by a hot oil ring main, differential flow meters might be required.

Oil filters should be fitted at the meter inlet and should be in accordance with the meter manufacturer's instructions.

38 Instrumentation

COMMENTARY ON Clause ***38***

For small and simple plants, fixed instrumentation might not be necessary, with reliance put on the routine use of portable instruments. For large and complex plants, full instrumentation might be appropriate where staff are available to make proper use of the information provided.

NOTE 1 The purpose of instrumentation on oil firing equipment is to provide means of monitoring performance and efficiency.

NOTE 2 Attention is drawn to the Building Regulations 2010 [3], the the Control of Pollution (Oil Storage) Regulations [5], [6], [7], [8] and the guidance note for the Control of Pollution (Oil Storage) Regulations.

38.1 Essential instrumentation

Regular and thorough maintenance and recalibration of instruments is essential.

Instrumentation should be provided for making the following measurements:

a) flue gas analysis;

b) flue gas temperature; ambient temperature; Bacharach smoke number;

c) draught/combustion pressure; and

d) oil input rate.

In larger plants additional instrumentation should be provided for measuring the following:

1) steam or hot water flow-rate;

2) steam pressure and temperature;

3) feed-water temperature; and

4) hot water flow and return temperatures.

38.2 Other instrumentation

To provide general information on the operation of the plant, instrumentation should be provided for measuring the following:

a) smoke density;

b) oil pressures at significant points;

c) oil temperatures at significant points;

d) oil tank contents;

e) oil tank high/low warning alarm; and

f) oil tank bund leak/overfill warning alarms.

39 Proving devices

Proving devices should be provided to ensure that burner ancillary service and combustion zone conditions are established and maintained throughout the starting and running periods of operation of the burner.

NOTE 1 Additional devices might be required for proving that the shut-down sequence has taken place correctly. Such devices might be connected to provide interlocks to permit the starting sequence and shut-down of the burner in the event of a fault developing during running.

NOTE 2 Indicator lights showing the function position of the devices and audible alarms might be desirable, where appropriate.

Functions requiring such proving depend on the type of fuel but should include:

a) fuel oil pressure;

b) combustion air pressure or flow;

c) atomizing air or steam pressure;

d) combustion zone pressure;

e) fuel oil temperature;

f) flue or combustion air damper positions;

g) induced draught fan or chimney pressure;

h) instrument air pressure;

i) ignition gas pressure; and

j) pilot flame establishment.

NOTE 3 Secondary systems which allow periodical, but non-operational, checking of the proving devices condition, are useful additions.

40 Safety control devices

40.1 General

In addition to the flame monitoring control devices referred to in Clause **34**, provision should be made for a fire valve system (see **7.6**).

Regular functional checks of the safety control devices should be carried out.

40.2 Oil handling system

The design of the oil handling system should take account of the following:

a) cut-off valves (see **7.2.1**);

b) oil pressure relief valves (see **6.14** and **21.3.3.3**);

c) route of oil lines (see **7.1**); and

d) fire valve systems (see **7.6**).

40.3 Housekeeping

Combustible waste materials should not accumulate within oil storage and burner equipment areas and any spilt oil should be completely cleared away.

In tank farm areas, weeds and grass should be removed.

NOTE Attention is drawn to the increased fire hazard associated with the use of some chemical weed killers.

40.4 Protection against combustion explosions

If a fault condition occurs and the burner fails to light, and the exact cause is unknown, multiple start-ups by repeated re-setting of the lock-out button should not be attempted. The cause should be identified and rectified before a restart is attempted.

NOTE 1 It might be possible to provide some additional protection against the effects of explosion by the provision of excess-pressure relief devices.

If such devices are fitted, the following should be carried out to ensure correct operation and the safety of personnel:

a) the relief opening should be sufficiently large in area, see BS 799-4:1991, Annex A;

b) the door or panel should be of very low inertia and so retained that it can give way instantly under a small pressure rise;

c) no part of the device should be able to fly off as a missile;

d) the relief opening should be in direct connection with the firing zone in order to give effective pressure relief;

e) the door or panel should be sealed against leakage of combustion products during operation; and

f) the relief should be sited in a position where explosion products issuing from it cannot affect personnel or important equipment.

If relief devices are provided in flue ducts or at the base of the chimney they should be so constructed that they remain closed and gas tight under all normal working conditions (including start-up of the burner) but provide a free discharge area. They should be so constructed and arranged that their opening and the discharge of gas does not endanger personnel.

NOTE 2 Requirements applying to pressure relief devices are often incompatible with other factors in the design and siting of boilers and warm air heaters; unless these requirements can be fully met a pressure relief device is of little value and could be dangerous.

The following actions should be taken into account to ensure the safety of personnel and equipment:

1) ensure that the attachment of the burner to the combustion equipment is as robust as is reasonable;

2) ensure that the firing zone and other parts that could be directly affected by an explosion are able to contain the pressure likely to be developed;

3) fit duplicate oil shut-off valves to burners for class D fuels, where leakage has been known to cause explosions; and

4) ensure that the flue gas dampers are operating and proving correctly.

40.5 Fire precautions

Fire precautions should be confirmed with the local fire and rescue service.

NOTE 1 The responsibility for ensuring the adequacy of the general fire precautions in the building and/or site in which the combustion appliance or the oil storage tank is situated rests with:

a) the employer occupying the building or site, where the building is being used as a workplace; or

b) in other premises and sites, the person in control (as occupier or otherwise).

NOTE 2 In a building under construction, the responsibility can rest with the developer or the owner.

NOTE 3 The full definitions of "responsible person" and "general fire precautions" are given in the Regulatory Reform (Fire Safety) Order 2005, articles 3 and 4 [29].

41 Visual supervision facilities

Viewing ports should be provided in such a way that an operator could see such part of the flame as is necessary to establish that combustion is proceeding properly. The port should be so placed and of such construction that the operator is not be at risk from a sudden pressure increase in the combustion chamber.

The viewing port should incorporate a screened safety glass or mica or some other transparent material with strength and heat resistance or, if this is not possible, a mirror should be provided so that the operator's eyes can be protected.

42 Hazards from use of air filters in combustion systems

Combustion air should be preferably drawn from a dust-free zone so as to avoid the use of air filters.

Where the use of air filters is unavoidable, they should be cleaned and/ or changed in order to reduce the likelihood of incomplete combustion with consequent risk of explosion.

As a result of the above risk, the air supply should be monitored where air filters are used so that the fuel is automatically shut off if insufficient combustion air is available.

In addition to monitoring, filters should be examined and maintained to avoid reliance upon the safety interlock.

43 Hazards arising from accumulation of unburnt oil in furnaces

As indicated in **24.3**, if liquid oil has accumulated in the combustion zone, it should be removed before a light-up is attempted. With a hot furnace, no source of ignition should be introduced until it is definitely established that the complete furnace is vapour-free or cold.

Oil level indicator and overfilling alarm control should be fitted to the tank to which the oil fill pipe is connected. The tops of all tanks should be at the same level.

Annex A (informative) Types of burner

A.1 General

NOTE The types of burner are listed in BS 799-4 and BS EN 267, the differentiation of type being designated by the methods of atomization used.

The characteristics of these types of burner are as described in **A.2** and **A.3**.

A.2 Pressure-jet burners

A.2.1 General

In this type of burner, oil is supplied, under pressure and at a suitable viscosity, to a nozzle in which some of the pressure is used to impart rotation (swirl) to the oil before it is discharged through the final orifice. On issuing from the final orifice, a film is produced which atomizes into oil droplets.

A.2.2 Simplex pressure-jet

In this type of atomizer the droplet size increases with reduction of oil pressure. Consequently the range of turndown is limited.

NOTE Variations of the simplex pressure-jet atomizer have been devised to overcome this limitation.

A.2.3 Spill return pressure-jet

This type of atomizer has flow and return oil passages. Turndown is effected by returning oil from the atomizer to the tank or other parts of the system.

A.2.4 Duplex pressure-jet

This type of atomizer has two flow passages designated pilot and main. It has two sets of swirl passages, a common swirl chamber and final orifice. At low flow, oil is only supplied to the pilot passages, and at high flow, the oil is supplied to both pilot and main passages.

A.2.5 Duple pressure-jet

This type of atomizer has two flow passages, pilot and main. It has two sets of swirl passages, two swirl chambers and two final orifices that are concentric. At low flow, oil is only supplied to the pilot passage and jet, and at high flow, the oil is supplied to both pilot and main passages and jets.

A.3 Two-fluid type

A.3.1 General

In this type of burner oil droplets are produced by promoting high rates of shear in the oil by the use of an additional fluid such as air or steam.

A.3.2 High pressure air or steam type

Oil is fed at a controlled rate to the nozzle where a stream of air or steam under a gauge pressure generally of over 1 bar meets the oil and atomizes it by impact.

A.3.3 Medium pressure air type

Oil is fed at a controlled rate to the nozzle where a stream of air under pressure meets the oil and atomizes it by impact. Burners of this class generally use air at gauge pressures from 70 mbar to 1 000 mbar.

A.3.4 Low pressure air type

Oil is atomized by the impact of air supplied by a fan at gauge pressures generally from 30 mbar to 100 mbar.

A.3.5 Spinning cup or rotary type

Oil is supplied at a controlled rate to the interior of a hollow conical cup, rotated by means of an electric motor or by a turbine driven by air or steam. Oil leaves the outer lip of the cup as a thin film under the influence of the centrifugal force. Atomization is carried out by the impact of a stream of air supplied through an annular nozzle surrounding the rotating cup.

A.3.6 Emulsifying type

Oil atomization is substantially effected by a nozzle, normally using air as the atomizing medium. Oil at a suitable viscosity is metered and mixed with a controlled proportion of air at the inlet to a compressor from which the mixture emerges as an emulsion, and is conveyed to the nozzle. In some burners, oil saturated air and emulsified oil are separated from the compressor in a stabilizing chamber before remixing at the nozzle.

A.3.7 Steam or air assisted pressure-jet type

The air or steam is introduced concentrically with the pressure jet orifices. The air or steam is used to improve atomization and to maintain it when the oil pressure is too low. In this way the turndown range of the pressure-jet is increased.

A.4 Types of burner control

Any of the types of burner described in **A.2** could be controlled by any of the following methods:

a) flame-monitored hand control;

b) partly automatic control;

c) flame-monitored and partly automatic control;

d) fully automatic control.

These types of control are fully described in BS 799-4 and BS EN 267. For installations where supervision by entirely competent staff is not available a fully automatic control method, [item d)], is strongly recommended. The control of a burner comprises three distinct systems:

1) control of starting and stopping to ensure safe conditions;

2) control during running to ensure maintenance of safe conditions;

3) control of variation (if any) in heat output.

Items 1) and 2) are burner safety controls and conform to BS 799-4 and BS EN 267. Variations in heat output [item 3)] can be controlled by operating the burner:

i) on/off, or high/low/off; or

ii) fully modulating over the turn-down range.

A.5 Low NOx burners

A definition of a low NOx burner is one that achieves class 3 emissions in BS EN 267 testing.

The methods employed of reducing NOx could generically be described as:

a) primary abatement, i.e. configuring the burner combustion head to create flue gas recirculation within the appliance combustion chamber at the head of the burner;

b) secondary abatement, for example, diverting some of the flue gas exiting the appliance and re-injecting that back into the burner.

Other means of secondary abatement are available to reduce NOx emission and can be discussed with the appliance manufacturer.

A.6 Multi-fuel burners

Many burner manufacturers produce burners capable of operating with more than one fuel, principally main stream dual fuel burners, which are only designed to operate with one fuel at a time.

More specialized burners can operate with more than two fuels, and additionally some burners with other designs can operate with two fuels being burnt at the same time.

Industrial applications might produce a combustible waste product that is intended for use in the combustion process (e.g. a waste oil from a cooking or other process), but the supply of which is insufficient to meet full load requirements. Where such technology is utilized, those special burners that operate using a combustible waste product and normal heating oil or gas at the same time are often described as "co-firing" or "co-combustion" burners.

Annex B (informative) Maintenance schedule for standby generators

Table B.1 **Maintenance schedule for standby generators** *(1 of 5)*

System	Maintenance model	Maintenance contents	Daily or every 20 h	Weekly	Monthly	3 months or 100 h	6 months or 200 h	12 months or 800 h	24 months or 2 000 h
Lubrication system A)	Check	Any leakage	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Lube oil level	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Engine oil pressure	Every 12 months						
	Replace	Lube oil filter	—	—	—	—	Yes	Yes	Yes
		Lube oil	—	—	—	—	Yes	Yes	Yes
		Lube oil and Lube o il filter	Oil and oil filter need to be changed for first 50 h for new or overhauled engine						
	Clean	Breather of crankcase	—	—	—	—	Yes	Yes	Yes

Table B.1 **Maintenance schedule for standby generators** *(2 of 5)*

System	**Maintenance model**	**Maintenance contents**	**Daily or every 20 h**	**Weekly**	**Monthly**	**3 months or 100 h**	**6 months or 200 h**	**12 months or 800 h**	**24 months or 2 000 h**
Cooling system	Check	Any leakage	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Any blocks of radiator	—	—	Yes	Yes	Yes	Yes	Yes
		Pipes and connectors	—	—	Yes	Yes	Yes	Yes	Yes
		Coolant level	—	Yes	Yes	Yes	Yes	Yes	Yes
		Antifreeze and anticorrosive	—	—	Yes	Yes	Yes	Yes	Yes
		Strap and it's degree of tightness	—	—	—	Yes	Yes	Yes	Yes
		Fan driver and water pump	—	—	—	Yes	Yes	Yes	Yes
		Belt and fan driver of radiator (optional for remote pulley type radiators)	Every 250 h						
	Add	Lubricator of fan driver (optional for remote pulley type radiators)	500 h			Yes	Yes	Yes	Yes
	Replace	Coolant	Every 12 months						
	Clean	Cooling system							

Table B.1 **Maintenance schedule for standby generators** *(3 of 5)*

System	**Maintenance model**	**Maintenance contents**	**Daily or every 20 h**	**Weekly**	**Monthly**	**3 months or 100 h**	**6 months or 200 h**	**12 months or 800 h**	**24 months or 2 000 h**
Fuel system	Check	Air induction	—	—	Yes	Yes	Yes	Yes	Yes
		Air filter	—	Yes	Yes	Yes	Yes	Yes	Yes
		Pipes and connectors	—	—	—	Yes	Yes	Yes	Yes
	Replace	Air filter core	—	—	—		Yes	Yes	Yes
	Check	Any leakage	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Fuel level	—	Yes	Yes	Yes	Yes	Yes	Yes
		Nozzle of fuel pump	—	—	—	—	—	Yes	Yes
		Pipes and connectors	—	—	—	—	Yes	Yes	Yes
		Fuel pump	—	—	Yes	Yes	Yes	Yes	Yes
		Fuel filters	—	—	Yes	Yes	Yes	Yes	Yes
	Clean	Fuel polishing system	—	—	Yes	Yes	Yes	Yes	Yes
		Drain fuel tank	—	—	Yes	Yes	Yes	Yes	Yes
		Drain water separator	—	—	—	—	—	Yes	Yes
	Replace	Fuel filter	—	—	—	—	Yes	Yes	Yes
		SAE J1488 filter	—	—	—	—	Yes	Yes	Yes
	Check	Nozzle and valves	—	—	—	—	—	—	Yes
	Adjust	Fuel injection timing	Every 12 months						
		Rocker and valve	—	—	—	—	Yes	Yes	Yes
Exhaust system	Check	Any leakage	—	—	Yes	Yes	Yes	Yes	Yes
		Exhaust restriction	—	—	—	—	—	—	Yes
		Exhaust bolting	—	—	Yes	Yes	Yes	Yes	Yes

Table B.1 **Maintenance schedule for standby generators** *(4 of 5)*

System	**Maintenance model**	**Maintenance contents**	**Daily or every 20 h**	**Weekly**	**Monthly**	**3 months or 100 h**	**6 months or 200 h**	**12 months or 800 h**	**24 months or 2 000 h**
Electrical system	Check	Charger alternator strap and it's degree of tightness	—	—	Yes	Yes	Yes	Yes	Yes
		Battery	—	Yes	Yes	Yes	Yes	Yes	Yes
		Specific gravity of electrolyte	—	—	Yes	Yes	Yes	Yes	Yes
		Switch and alarm	—	Yes	Yes	Yes	Yes	Yes	Yes
		Connector of starter motor	—	—	—	—	—	Yes	Yes
		Starter	Every 12 months						
		Alternator	Every 12 months						
Others	Check	Vibration is normal or not	—	Yes	Yes	Yes	Yes	Yes	Yes
		Turbo-charger bearing clearance	—	—	—	—	—	—	Yes
		Turbo-charger compressor wheel and diffuser	—	—	—	—	—	—	Yes
		Tightening degree with base frame	—	—	—	—	—	Yes	Yes
	Clean	Gen set	—	—	—	—	Yes	Yes	Yes
Operate the Gen Set under no load for 5 min (optional for standby generator sets)	Check	Ease of starting	—	Yes	—	—	—	—	—
		Colour of exhaust smoke	—	Yes	—	—	—	—	—
		Abnormal vibration	—	Yes	—	—	—	—	—
		Abnormal noise	—	Yes	—	—	—	—	—
		Abnormal smell	—	Yes	—	—	—	—	—
		Parameter indication	—	Yes	—	—	—	—	—

Table B.1 **Maintenance schedule for standby generators** *(5 of 5)*

System	Maintenance model	Maintenance contents	Daily or every 20 h	Weekly	Monthly	3 months or 100 h	6 months or 200 h	12 months or 800 h	24 months or 2 000 h
Operate the Gen Set with more than 0.5 load for 5 min (optional for standby generator sets)	Check	Ease of starting	—	—	—	Yes	Yes	Yes	Yes
		Colour of exhaust smoke	—	—	—	Yes	Yes	Yes	Yes
		Abnormal vibration	—	—	—	Yes	Yes	Yes	Yes
		Abnormal noise	—	—	—	Yes	Yes	Yes	Yes
		Abnormal smell	—	—	—	Yes	Yes	Yes	Yes
		Parameter indication	—	—	—	Yes	Yes	Yes	Yes

[A)] For the engines with manual added lubricant for fuel pump. Lubricant for fuel pumps need to be checked once every month and the lubricant needs to be replaced every three months.

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