

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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Contents

Foreword *iii*

1	Scope	1
2	Normative references	1
3	Definitions	3
4	Classification of fuels	5
5	Storage and handling temperatures for petroleum oil fuels	6
6	Oil tanks and equipment	6
7	Oil handling systems from storage tank to oil-using equipment	17
8	Accommodation for oil storage and service tanks	25
9	Fuel selection considerations	31
10	Selection of burners for furnaces	31
11	Selection and application of burner types for furnaces	32
12	Accommodation for and installation of furnaces	36
13	Waste gas handling equipment – Chimneys	38
14	Means of heat recovery from waste gases	40
15	Air supply facilities	40
16	Arrangements of additional ventilation where flammable solvents are evaporated in furnaces (ovens)	41
17	Explosion relief	41
18	Standby generator sets	42
19	Control of standby generators	47
20	Exhausts	47
21	Commissioning, performance tests and handover	48
22	Maintenance	53
23	Furnace, kiln and oven operating and maintenance instructions	55
24	Combustion and safety controls for burners	55
25	Waste gas removal	57
26	Fans (induced draught or recirculation)	61
27	Ejectors	61
28	Waste gases cleaning equipment	61
29	Electrical equipment	62
30	Automatic shut-off valves and manually operated isolating valves	63
31	Process regulated control devices	63
32	Valve actuators	64
33	Ignition equipment	64
34	Starting-up, shutting-down and flame monitoring control devices	65
35	Pressure indicators	65
36	Temperature indicators	65
37	Flow meters and flow indicators	65
38	Instrumentation	66
39	Proving devices	66
40	Safety control devices	67
41	Visual supervision facilities	68
42	Hazards from use of air filters in combustion systems	69
43	Hazards arising from accumulation of unburnt oil in furnaces	69

Annexes

Annex A (informative) Types of burner 70

Annex B (informative) Maintenance schedule for standby generators 72

Bibliography 77

List of figures

Figure 1 – Remote fuel transfer system 19

Figure 2 – Gravity feed fuel transfer supply system 43

Figure 3 – Typical standby generator set control and accessory wiring 46

List of tables

Table 1 – Minimum storage, outflow and handling temperatures 6

Table 2 – Types of oil tank and locations for which they are suitable 6

Table 3 – Minimum tank, outflow and handling temperatures for liquid fuels 13

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 28

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 29

Table B.1 – Maintenance schedule for standby generators 72

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 78, an inside back cover and a back cover.

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 expertise. Building owners are never to attempt to cut up old oil storage tanks themselves.

NOTE 1 Attention is drawn to the Construction (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:

- Construction (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 15940¹⁾.

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 15940¹⁾, *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 path 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 should 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 facility is 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:

- 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;
- outflow heaters provided with thermostatically controlled steam, water or electrically heated elements;
- method b) together with partial tank heating similar to method a), particularly for classes F, G and H oils; or
- 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:

- internal (immersion or submersion); or
- 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 overflow 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

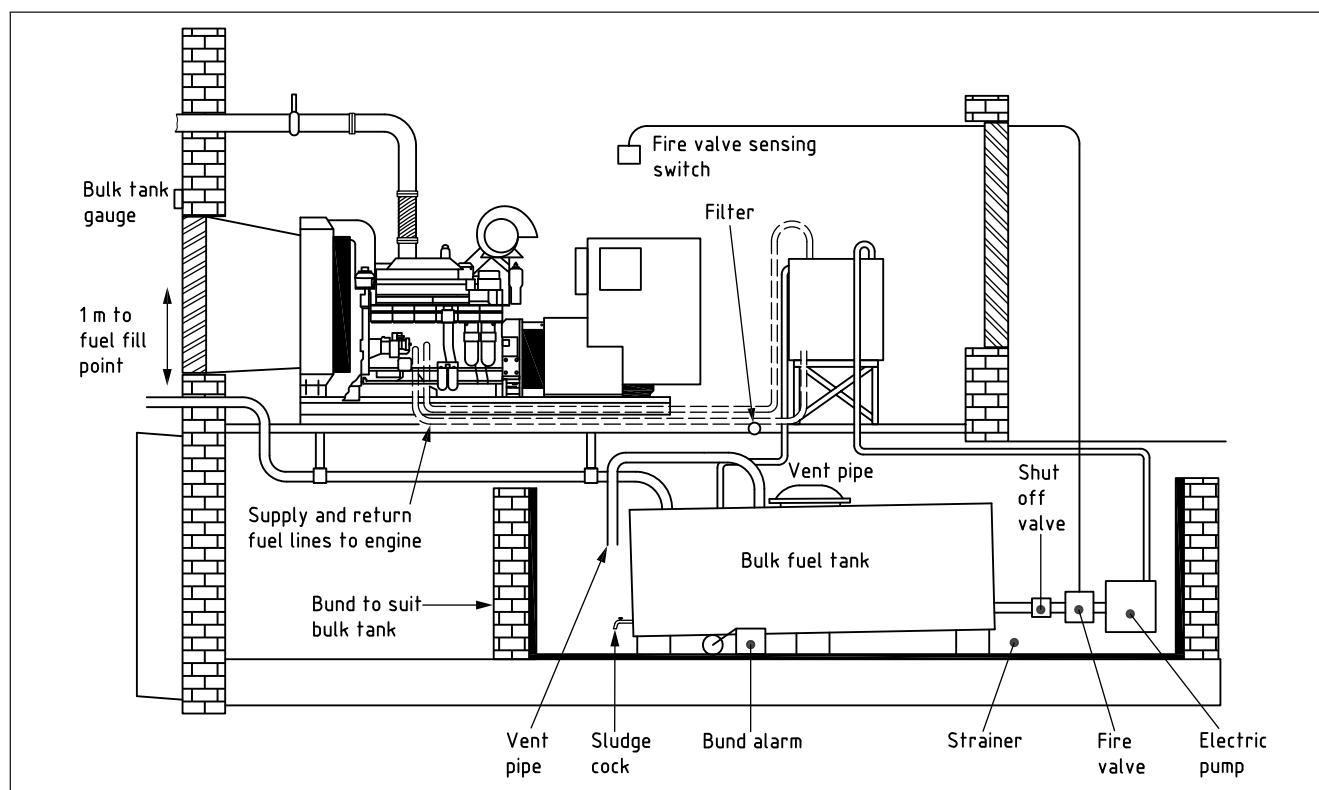
NOTE In this system, the two pipe connection to the oil burning equipment is run directly to and from the bulk storage tank.

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 hygroscopic 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.