



BSI Standards Publication

Liquid fuel firing

Part 3: Installations for liquid fuelled standby generators,
furnaces, kilns, ovens and other industrial purposes —
Code of practice

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Summary of pages

This document comprises a front cover, an inside front cover, pages I to VIII, pages 1 to 77, 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 28 February 2023. It was prepared by Technical Committee RHE/13, *Liquid fuel firing*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 5410-3:2016, which is withdrawn.

Information about this document

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

- the use of biofuel 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 are minimum recommendations for the liquid fuel firing installation aspects of furnaces, kilns, ovens, liquid fuelled standby generators and other industrial plants so that equipment manufacturers, suppliers, installers and users 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 liquid fuel-using equipment within its scope.

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

Hazard warnings

WARNING. Decommissioning and disposal of liquid fuel storage tanks

The decommissioning and disposal of liquid fuel storage tanks, which can become necessary as part of the maintenance cycle of a liquid fuel fired system is a very hazardous procedure, and it is imperative that it is only undertaken by specialist operatives who have the right equipment and expertise.

NOTE 1 Attention is drawn to the *Construction (Design and Management) Regulations 2015* [[1](#)], which class such work as a “demolition project”.

NOTE 2 Guidance on decommissioning and disposal of liquid fuel storage tanks is given in *OFTEC Technical Book 3* [[N1](#)].

NOTE 3 Attention is drawn to *The Dangerous Substances and Explosive Atmospheres Regulations 2002 (Amendment 2015)* [[2](#)].

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 for space heating and hot water supply purposes for domestic buildings*;
- Part 2 – *Installations providing space heating, hot water and steam supply services to non-domestic buildings*; and
- Part 3 – *Installations for liquid fuelled standby generators, furnaces, kilns, ovens 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 2015 [\[1\]](#);
- Dangerous Substances and Explosive Atmospheres Regulations 2002 (Amendment 2015) [\[2\]](#);
- Building Regulations 2010 [\[3\]](#);
- Building (Amendment) (Wales) Regulations 2014 [\[4\]](#);
- Building (Scotland) Regulations 2004 [\[5\]](#);
- Building Regulations (Northern Ireland) 2012 [\[6\]](#);
- Environmental Protection Act 1990 [\[7\]](#);
- Control of Pollution (Special Waste) (Amendment) Regulations 1988 [\[8\]](#);
- Control of Pollution (Oil Storage) (England) Regulations 2001 [\[9\]](#);
- Water Resources (Control of Pollution) (Oil Storage) (Wales) Regulations 2016 [\[10\]](#);
- Control of Pollution (Oil Storage) (Amendment) Regulations (Northern Ireland) 2011 [\[11\]](#);
- Construction (Design and Management) Regulations (Northern Ireland) 2016 [\[12\]](#);
- Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) [\[13\]](#);
- Waste (England and Wales) Regulations 2011 (as amended) [\[14\]](#);
- Hazardous Waste (Amendment) Regulations (Northern Ireland) 2015 [\[15\]](#);
- Special Waste (Amendment) (England and Wales) Regulations 2001 [\[16\]](#);
- Special Waste Amendment (Scotland) Amendment Regulations 2004 [\[17\]](#);
- Building (Approved Inspectors etc.) Regulations 2010 [\[18\]](#);
- Building (Forms) (Scotland) Regulations 2005 (as amended) [\[19\]](#);
- Waste Incineration Directive (UK) [\[20\]](#);
- Medium Combustion Plant Directive (UK) – MCPD (EU 2015/2193) [\[21\]](#);
- Non-Road Mobile Machinery Regulation – NRMM (EU 2016/1628) [\[22\]](#);
- Industrial, Emissions Directive (UK) – IED (EU 2010/75) [\[23\]](#);

- Environmental Permitting (England and Wales) (Amendment) Regulations 2018 [[24](#)];
- Pollution Prevention and Control (Scotland) Amendment Regulations 2017 [[25](#)];
- Pollution Prevention and Control (Industrial Emissions) (Amendment) Regulations (Northern Ireland) 2018 [[26](#)].

1 Scope

This part of [BS 5410](#) gives recommendations and guidance on the design, installation, commissioning and maintenance of liquid fuel consuming equipment used in conjunction with industrial installations, such as standby generators, furnaces, kilns and ovens. 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 consuming liquid fuel conforming to BS 2869, [BS EN 16900](#), BS EN 590, including biofuels conforming to BS EN 14214, and blends thereof, and BS EN 15940.

NOTE For the avoidance of doubt, the scope of this British Standard does not include equipment in relation to liquid gases.

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 liquid fuel storage tanks associated with these installations.

This British Standard is primarily intended for use by designers, specifiers, installers and building owners of systems having an environmental impact and seeking to use the best available technologies that have the potential for improvement through design where practical.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions of this document¹⁾. 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 799-3](#), *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 1710](#), *Specification for identification of pipelines and services*

BS 2869, *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 liquid fuel firing – Part 1: Installations for space heating and hot water supply purposes for domestic buildings*

[BS 5410-2](#), *Code of practice for liquid fuel firing – Part 2: Installations providing space heating, hot water and steam supply services to non-domestic buildings*

[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*

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

¹⁾ Documents that are referred to solely in an informative manner are listed in the Bibliography.

[BS 7671](#), *Requirements for electrical installations – IET Wiring Regulations*

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

BS EN 267, *Forced draught burners for liquid fuels*

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

BS EN 746 (all parts), *Industrial thermoprocessing equipment*

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 other than for heating and cooling of buildings*

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, *Liquid petroleum products – Fatty acid methyl esters (FAME) for use in diesel engines and heating applications – Requirements and test methods*

BS EN 15940, *Automotive fuels – Paraffinic diesel fuel from synthesis or hydrotreatment – Requirements and test methods*

[BS EN 16900](#), *Fast pyrolysis bio-oils for industrial boilers – Requirements and test methods*

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

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

[BS EN IEC 60947-4-1](#), *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

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

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*

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] HEALTH AND SAFETY EXECUTIVE. *The storage of flammable liquids in tanks*. Health and Safety Executive document HSG 176. London: 2015.

[N6] SAE INTERNATIONAL. *Emulsified Water/Fuel Separation Test Procedure*. SAE J1488 2010_10. Warrendale, PA: 2010

[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] ENERGY NETWORKS ASSOCIATION. Engineering Recommendation G99. *Requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019*. London: Energy Networks Association, 2020.

[N9] OIL FIRING TECHNICAL ASSOCIATION. *Filters and Water Separation for use with Oil Supply Systems*. OFS E104. Ipswich: OFTEC.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE The term furnaces includes ovens, kilns, etc.

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

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

NOTE 1 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 2 A bund can be provided as an integral part of a liquid fuel storage tank.

NOTE 3 Liquid fuel storage tanks manufactured to BS EN 12285 (all parts) do not provide secondary containment with 110% minimum leakage containment by design.

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 while passing through the furnace.

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

3.5 critical application standby generator

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 double skinned tank

tank having two skins which do not provide full 110% secondary containment and overfill containment for above ground storage applications

NOTE Liquid fuel storage tanks manufactured to BS EN 12285 (all parts) do not provide secondary containment with 110% minimum leakage containment by design.

3.7 direct fired furnace

COMMENTARY ON 3.7

There are two types of direct fired furnace (see [3.7.1](#) and [3.7.2](#)).

3.7.1 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.

3.7.2 semi-muffle furnace

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

3.8 drip tray

vessel with a minimum capacity of 3 L to collect any spillage resulting from the connection and disconnection of delivery hoses

3.9 fire screen wall

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

3.10 flammable liquids

liquid fuels with a flashpoint of 60 °C or below

NOTE This liquid fuel is 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.

3.11 flue duct

connection to carry the products of combustion from combustion equipment outlet to the entry of a chimney

3.12 furnace

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

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

3.13 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 produced by the fuel firing equipment

3.14 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.

3.15 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 produced by the fuel firing equipment

3.16 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.

3.17 primary tank

vessel used for the containment of liquid fuel

NOTE This can be located within a bund.

3.18 service tank

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

3.19 standby generator

on-site electricity generation equipment providing an electricity supply in the event of the mains connected electricity supply failing

3.20 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, autoignition temperatures etc., reference should be made to BS 2869, BS EN 590, BS EN 15940, [BS EN 16900](#), BS EN 14214 and the manufacturer's material safety data sheet.

5 Storage and handling temperatures for liquid 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 tank, outflow and handling temperatures for liquid fuels

Temperature	Classes of mineral oil (BS 2869, BS EN 590)					Biofuels Fatty acid methyl esters (FAME) blends B50D and B75K (BS EN 14214, BS EN 15940)
	A2, C2, D	E	F	G	H	
Minimum temperature in tank, °C	Ambient	10	25	40	45	10
Minimum temperature for outflow from tank and for handling, °C	Ambient	10	30	50	55	10

NOTE When heating fuel, attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 (Amendment 2015) [2].

6 Liquid fuel storage tanks and equipment

6.1 Liquid fuel tank construction

Manufacturers of oil storage tanks should provide written confirmation that the equipment has a 20-year expected working life when correctly installed, used and maintained. Owners should retain records of installation and maintenance, for the lifetime of the installation (see [Clause 22](#)).

Tanks should also conform to the relevant standard in [Table 2](#).

Table 2 — Types of liquid fuel storage 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 banded tank	Above ground, internal or external
BS EN 13341	Thermoplastics primary tank	Above ground, internal or external up to 10 000 L storage capacity
OFS T100 [N3]	Medium density polyethylene primary tank or integrally banded 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

Concrete tanks and bunds should be designed by specialists in consultation with the engineers responsible for the layout of the liquid fuel firing and storage system. The application of linings impervious to liquid fuel, 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 not be used as liquid fuel storage tanks due to penetration of liquid fuel, and eventual leakage, at the joints.

The users of this British Standard should advise building owners that when their tank reaches the end of its useful life they should never attempt to cut up their old liquid fuel storage tanks themselves.

6.2 Capacity

The minimum net capacity of liquid fuel storage tanks for high volume installations should be either:

- a) two weeks' supply of liquid fuel calculated at the maximum rate of consumption; or
- b) two weeks' supply of liquid fuel calculated at the maximum rate of consumption, plus the usual quantity ordered for one delivery.

The liquid fuel supplier should be consulted before finalizing the minimum net capacity.

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

- 1) minimum quantity of liquid fuel 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/or [6.14](#) as appropriate); and
- 4) the additional volume required to accommodate heating equipment and any other equipment fitted within the tank.

Where liquid fuel 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 the specific location it is to be installed.

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

- a) *single skinned tanks. These provide primary containment only;*
- b) *double skinned tanks and tanks in accordance with BS EN 12285 (all parts). These provide primary containment only; and*
- c) *integrally banded 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 Equipment for measurement of contents of liquid fuel storage tanks

6.4.1 Tank contents control and gauging

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

- a) electronic device for local and/or remote reading;
- b) hydrostatic device for local and/or remote reading;
- c) pneumatic device for local and/or remote reading;
- d) mechanical device for local and/or remote reading; or

e) 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 liquid fuel-level indicator, in order to check the accuracy of the indicator.

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

The liquid fuel contents indicator should be marked “0” or “EMPTY” to show when the liquid fuel 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 not exceeding 95% of brimful capacity for tanks with a capacity up to and including 20 000 L and at a level not exceeding 97.5% of brimful capacity for tanks with a capacity of over 20 000 L.

The reaction time of the overspill protection device to prevent an overspill occurrence should also be taken into account.

NOTE Further information can be found in BS EN 13616-1.

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 include a means for the level of liquid fuel 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 person(s) 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 Filling and monitoring procedures of liquid fuel storage tanks

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

- a) ascertain when a new delivery is necessary;
- b) determine how much liquid fuel can be ordered;
- c) determine if the new delivery can be accommodated; and
- d) monitor fuel consumption.

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

- 1) supervision of all fuel stocks by a responsible person;
- 2) supervision of all fuel deliveries by a responsible person;
- 3) precautions against overfilling of tanks, including:
 - i) contents indicators clearly visible from the filling point;
 - ii) an overfilling alarm system, or an automatic delivery shut-off device;
 - iii) a bund alarm; and
 - iv) 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 or low light conditions are envisaged, illumination of the filling point and contents gauge should be provided.

NOTE 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 [27].

6.6 Fill pipes and connections

Where the filling point is outside the tank bund, it should be provided with a drip tray, suitable for collecting drips during filling operations, 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 liquid fuel 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 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 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 liquid fuel-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 class F and class G oils plus some biofuels, fill pipes containing undrained liquid fuel 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.

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 Where 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 liquid fuel flow if an overfill occurs.

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. 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 and tanks should be emptied by pumping out from above.

6.9 Multiple storage tanks with return line connections

Where the liquid fuel burning system requires the connection of a return line to the storage tanks, the returned liquid fuel should pass back to the 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 liquid fuel storage tanks

Foundations and/or supports should be completed before delivery of the liquid fuel 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 load-bearing capacity of the soil should be assessed for its suitability for the proposed loads. The foundation should be designed for 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 two coats of rust inhibiting solution 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 rust inhibiting solution 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 rust inhibiting 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 rust inhibiting-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 should be taken into account under the following circumstances:

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

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 Protection of steel tanks on site

The outside of the steel tanks should be applied with a protective coating suitable for the environment in which the tank is located. The manufacturer's recommendations should also be taken into account to maintain any guarantees. Any damage to the tank or coatings should be remediated on site after installation.

6.12 Heating for liquid fuel storage 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 class E, class F, class G and class H fuels, including its suitability for the required heating.

Storage and handling equipment for fuels of class E, class F, class G and class H should be equipped with heating facilities to raise the temperature of the liquid fuel in order to reduce its viscosity to enable it to flow to the pumps and burners of the liquid fuel 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 1](#).

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

When fuels are heated prior to reaching the appliance so as to maintain adequate flow characteristics, the temperature should not be elevated above 10 °C below its minimum flash point.

Heaters for steel liquid fuel storage tanks should conform to [BS 799-5](#).

The heating of the liquid fuel 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 class F, class G and class H fuels; or
- d) other types of electric heating, e.g. trace heating.

NOTE 3 For temperatures for liquid fluids, see [Table 1](#).

6.12.2 Whole-tank heating only

In cases where a residual grade of liquid fuel 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.

The minimum temperature maintained within the tank for each class of liquid fuel should be in accordance with [Table 1](#), i.e. the outflow and handling temperature. External thermal insulation should be used for any tank where the minimum temperature of the liquid fuel is to be maintained.

Liquid fuel should be stored at the temperatures in accordance with [Table 1](#).

NOTE This is particularly important for class E fuels.

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 oversized 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 fuels as heat input to the heater is local to the heater and not distributed to the tank contents. If the bulk contents are at a temperature below the minimum value given in [Table 1](#) there might be difficulty in maintaining fuel flow to the outflow heater when using fuels of class F, class G, class H and some biofuels.

Outflow heaters should be sized to raise the temperature of the maximum amount of liquid fuel required by the burner equipment, including fuel returned from the burner equipment, from the minimum storage temperature to the minimum outflow temperature, in accordance with [Table 1](#).

6.12.4 Tank heating combined with outflow heaters

To reduce heat losses from tanks, the fuel 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 fuel in its vicinity to the recommended minimum handling temperature in accordance with [Table 1](#).

The minimum storage temperature for the fuel should be in accordance with [Table 1](#).

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

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 class F and class G fuels 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 liquid fuel storage tanks

Electric heater elements should be in accordance with the maximum loadings given in [BS 799-4:1991](#), 6.6.2.

Where high-pressure hot water is the primary heating medium, a heat exchanger should be used so that 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 (350 000 Pa).

Steam at a higher pressure should not be used as control is easier at lower pressures and a larger heating surface at a lower temperature is more effective.

When siting liquid fuel 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 1 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 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 prevent the heater system from being used when the liquid fuel 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 plastic 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 liquid fuel contained in condensate or in circulated hot water from liquid fuel heating facilities from entering boiler systems.

Any condensate from liquid fuel 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 liquid fuel content trapped and not discharged to drainage systems or waterways.

If the heating medium is steam at a pressure less than the liquid fuel pressure in the tank, a non-return valve should be fitted in the steam supply line in order to prevent liquid fuel 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 liquid fuel 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 liquid fuel.

NOTE 2 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 so placed as to prevent any escaping liquid fuel from reaching hot surfaces (see also [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 be not less than 100% of the diameter of the fill line.

Measures should be taken to prevent the service tank from being subjected to an excessive pressure head during a dumping operation overfill event.

A fire valve should be fitted on the outlet pipe of the service tank serving combustion equipment other than standby generators (see also [7.6](#)).

6.13.2 Heating of service tanks

Where liquid fuels 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, class F, class G and class H liquid fuels.

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 where 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. Rooftop tanks 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 liquid fuel reaches a predetermined level. The tank should be fitted with an overflow prevention device and a bypass 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.

6.15 Environmental elements

All tanks should be labelled at the fill point with the nominal capacity, with 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; and
 - 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.

NOTE 1 Attention is drawn to the use and application of the appropriate Oil Care Campaign tank sticker.

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 [27].

7 Liquid fuel handling systems from storage tank to fuel-using equipment

7.1 General

COMMENTARY ON 7.1

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, therefore temperature and viscosity are factors.

The liquid fuel handling system should contain filtration to remove excess particulates, water and contaminants so as to maintain fuel quality in accordance with the equipment manufacturers' requirements. Information on the condition of the fuel required at the liquid fuel-using appliance should be obtained from the equipment manufacturer.

Distillate grades of fuel to BS 2869 should be handled at ambient temperatures. Systems for distillate fuels should be in accordance with [7.2](#).

NOTE 1 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, the liquid fuel in the tank should be conditioned so it remains above its cloud point.

NOTE 2 This can be achieved by utilization of a tank immersion heater capable of maintaining the liquid fuel and/or pipeline trace heating, as specified in [7.2.2.6](#).

When deciding the route by which fuel is to be transferred from the bulk storage tank to the liquid fuel burning equipment day tank or service tank, the likelihood of mechanical damage to the pipeline transferring the liquid fuel 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.

Liquid fuel supply systems to liquid fuel burning equipment should incorporate a fire protection system for the isolation of liquid fuel to the liquid fuel 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

COMMENTARY ON 7.2.1

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, 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 liquid fuel 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 [N6], to remove all water in the liquid fuel supply pipe.

For standby generators, a liquid fuel 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 liquid fuel supply line supplies more than one item of liquid fuel-using equipment, it should be of such size that any variation in liquid fuel 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 General

7.2.2.1.1 Day tank

In instances where the relative position or level of service tanks and liquid fuel burning equipment do not allow a gravity feed, a day tank (service tank) should be used for transferring the liquid fuel 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 liquid fuel 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

COMMENTARY ON 7.2.2.1.3

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