

BS 5410-2:2013



BSI Standards Publication

Code of practice for oil firing

Part 2: Installations over 45 kW output capacity for space heating, hot water and steam supply services

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to vi, pages 1 to 88, an inside back cover and a back cover.



Foreword

Publishing information

This part of BS 5410 is published by BSI Standards Limited under licence from The British Standards Institution and came into effect on 31 March 2013. 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This part of BS 5410 supersedes BS 5410-2:1978, which is withdrawn.

Relationship with other publications

BS 5410 is published in three parts as follows:

- *Part 1: Installations up to 45 kW 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 services;*
- *Part 3: Installations for furnaces, kilns, ovens and other industrial purposes.*

Information about this document

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

- condensing boilers are now included;
- boilers burning biofuels are now covered.

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 the present 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 should never 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 Detailed guidance on decommissioning and disposal of oil storage tanks is given in OFTEC Technical Book 3 [2].

Use of this document

As a code of practice, this part of BS 5410 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 part of BS 5410 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.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

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:

- The Boiler (Efficiency) Regulations 1993 as amended by the Boiler (Efficiency) (Amendment) Regulations 1994 and the Boiler (Efficiency) (Amendment) Regulations 2006 [3];
- The Building Regulations [4], [5], [6];
- The Environmental Protection Act 1990 [7];
- The Control of Pollution (Special Waste) (Amendment) Regulations 1988 [8];
- The Control of Pollution (Oil Storage) (England) Regulations 2001 [9];
- The Control of Pollution (Oil Storage) (Amendment) Regulations (Northern Ireland) 2011 [10];
- The Water Environment (Oil Storage) (Scotland) Regulations 2006 [11];
- The Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) Regulations 2010 (as amended) [12];
- The Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) (Scotland) Regulations 2001 (as amended) [13];
- The Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations (Northern Ireland) 2003 [14];
- The Hazardous Waste (England and Wales) Regulations 2005 (as amended) [15];
- The Hazardous Waste Regulations (Northern Ireland) 2005 [16];
- The Special Waste (Amendment) (England and Wales) Regulations 2001 [17];
- The Special Waste Amendment (Scotland) Amendment Regulations 2004 [18];
- The Building (Approved Inspectors etc.) Regulations 2010 [19];
- The Building (Forms) (Scotland) Regulations 2005 (as amended) [20].

1 Scope

This part of BS 5410 gives recommendations and guidance on the design, installation, commissioning and maintenance of oil burning installations for heating, hot water and steam supply services having a total rated output of over 45 kW and/or an oil storage capacity above 3 500 L.

This part of BS 5410 is applicable to installations burning liquid fuel conforming to BS 2869:2010+A1, including biofuels, for example those containing fatty acid methyl esters (FAME) conforming to BS EN 14214, and blends thereof.

The standard covers the provision of new installations and also gives guidance on the modernizing of existing installations. The standard also gives recommendations and guidance on the selection and installation of oil tanks associated with these installations.

This part of BS 5410 is applicable to the oil burning equipment forming part of a multi-fuel installation in which oil is not burnt simultaneously with any other fuel. It is not applicable to oil fired systems for marine installations. The standard also gives recommendations on thermal fluid heaters and on portable plants, for example those used for emergency or temporary heat supply.

The standard is intended for use by designers, specifiers, installers and building owners.

2 Normative references

The following referenced documents are indispensable for the application of this document. 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 476-21, *Fire tests on building materials and structures – Part 21: Methods for determination of the fire resistance of loadbearing elements of construction*

BS 476-22, *Fire tests on building materials and structures – Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction*

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, *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 1212-1, *Float operated valves – Part 1: Specification for piston type float operated valves (copper alloy body) (excluding floats)*

BS 1212-2, *Float operated valves – Part 2: Specification for diaphragm type float operated valves (copper alloy body) (excluding floats)*

BS 1212-3, *Float operated valves – Part 3: Specification for diaphragm type float operated valves (plastics bodied) for cold water services only (excluding floats)*

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, *Code of practice for thermal insulation of pipework and equipment in the temperature range –100 ° C to +870 ° C*

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

BS 7671, *Requirements for electrical installations – IET Wiring Regulations – Seventeenth edition*

BS 9999, *Code of practice for fire safety in the design, management and use of buildings*

BS EN 267, *Automatic forced draught burners for liquid fuels*

BS EN 303-1, *Heating boilers – Part 1: Heating boilers with forced draught burners – Terminology, general requirements, testing and marking*

BS EN 303-2, *Heating boilers – Part 2: Heating boilers with forced draught burners – Special requirements for boilers with atomizing oil burners*

BS EN 303-4, *Heating boilers – Part 4: Heating boilers with forced draught burners – Special requirements for boilers with forced draught oil burners with outputs up to 70 kW and a maximum operating pressure of 3 bar – Terminology, special requirements, testing, marking*

BS EN 1254-2:1998, *Copper and copper alloys – Plumbing fittings – Part 2: Fittings with compression ends for use with copper tubes*

BS EN 1567, *Buidling valves – Water pressure reducing valves and combination water reducing valves – Requirements and tests*

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 12514-2, *Installations for oil supply systems for oil burners – Part 2: Safety requirements and tests – Parts, valves, pipes, filters, oil de-aerators, meters*

BS EN 13076, *Devices to prevent pollution by backflow of potable water – Unrestricted air gap – Family A – Type A*

BS EN 13077, *Devices to prevent pollution by backflow of potable water – Air gap with non-circular overflow (unrestricted) – Family A – Type B*

BS EN 13341, *Static thermoplastic tanks for the 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 13831, *Closed expansion vessels with built-in diaphragm for installation with water*

BS EN 13959, *Anti-pollution check valves – DN 6 to DN 250 inclusive – Family E, type A, B, C and D*

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 14622, *Devices to prevent pollution by backflow of potable water – Air gap with circular overflow (restricted) – Family A, type F*
- BS EN 55014-1, *Electromagnetic compatibility — Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*
- BS EN 60079-14, *Explosive atmospheres – Part 14: Electrical installations design, selection and erection*
- BS EN 60079-15, *Explosive atmospheres – Part 15: Equipment protection by type of protection “n”*
- BS EN 60079-30-1, *Explosive atmospheres – Part 30-1: Electrical resistance trace heating – General and testing requirements*
- BS EN 60079-30-2, *Explosive atmospheres – Part 30-2: Electrical resistance trace heating – Application guide for design, installation and maintenance*
- BS EN 62271-106, *High voltage switchgear and controlgear – Part 106: Alternating current contactors, contactor based controllers and motor starters*
- BS EN 60947-4-1, *Specification for low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*
- BS EN 62395-1, *Electrical resistance trace heating systems for industrial and commercial applications – Part 1: General and testing requirements*
- BS EN ISO 4126-1, *Safety devices for protection against excessive pressure – Part 1: Safety valves*
- DD CLC/TS 62395-2, *Electrical resistance trace heating systems for industrial and commercial applications – Part 2: Application guide for system design, installation and maintenance*
- SAE J513:1999, *Refrigeration tube fitting – General specification*

Other publications

- [N1] OIL FIRING TECHNICAL ASSOCIATION. OFS T200 *Steel oil storage tanks and tank bunds for use with distillate fuels, bio-fuels, lubrication oils and waste oils. Construction standards and test procedures*. Issue 10. Ipswich: OFTEC, 2012.
- [N2] OIL FIRING TECHNICAL ASSOCIATION. OFS T100 *Polyethylene oil storage tanks and tank bunds for distillate fuels. Construction standards and test procedures*. Issue 8. Ipswich: OFTEC, 2012.
- [N3] HEALTH AND SAFETY EXECUTIVE. HSG 176 *Storage of flammable liquids in tanks*. Sudbury: HSE Books, 1998.
- [N4] MASON, P.A., AMIES, H.J. and G. SANGARAPILLAI, et al. *Construction of bunds for oil storage tanks*. CIRIA report 163, 1997.
- [N5] ENERGY INSTITUTE. *Performance specification for underground pipework systems at petrol filling stations*. 2001.

3 Terms and definitions

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

3.1 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.

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 may be provided as an integral part of an oil storage tank.

3.3 fire screen wall

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

3.4 chimney

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

NOTE The passages are known as "flues".

3.5 flue duct

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

3.6 oil storage system

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

3.7 primary tank

vessel used for the containment of liquid fuel

NOTE This can be located within a bund.

3.8 service tank

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

4 Work undertaken in connection with oil fired installations

The installation, commissioning and replacement of oil fired appliances and oil storage and supply installations is work covered by the Building Regulations [4], [5], [6] and the Control of Pollution (Oil Storage) Regulations [9] [10] [11]. This type of work should be undertaken by competent technicians, subject to supervision by a registration body.

In England and Wales, if a person registered with an approved scheme is used for such work then it is not required that application is made to the local authority building control department for approval prior to the work commencing and such firms can self-certify compliance of their work at completion.

NOTE 1 In England and Wales, where documentation is required by the local authority to confirm competent installation work, form CD/10 [21] has been approved for use.

NOTE 2 Attention is drawn to the Building Regulations [4], [5], [6] with respect to structural alterations to buildings.

5 Liquid fuels

5.1 Types of liquid fuel

Liquid fuel conforming to an appropriate class specified in BS 2869:2010+A1, and biofuels including FAME (fatty acid methyl esters) conforming to BS EN 14214, as specified by the equipment manufacturer, should be used with the equipment covered by this standard.

The specifier of the installation and the user should consult the local authority regarding any local controls which might limit the types of liquid fuel that may be used.

5.2 Liquid fuel characteristics

Users should obtain information on the characteristics of the fuel supplied and advice on the safe storage and handling of this from their fuel supplier.

A full safety data sheet giving information required under the Control of Substances Hazardous to Health (COSHH) Regulations [22] for the United Kingdom should be obtained from the fuel supplier or from the fuel producer.

6 Application of oil burners

6.1 General

A specification should be drawn up and agreed with the purchaser, covering the performance of the oil burning equipment in terms of heat output and efficiency, in addition to all other operating and safety criteria.

6.2 Choice of class of liquid fuel

6.2.1 General

The four main factors which should be taken into account when choosing the class of liquid fuel are described in 6.2.2, 6.2.3, 6.2.4 and 6.2.5.

6.2.2 Size of plant

There is a minimum boiler rating below which it is not practicable to burn residual oils. The recommended minimum boiler ratings for different classes of residual oil are as follows:

- class E: 140 kW;
- class F: 250 kW;
- class G: 400 kW;

NOTE Class H oils should only be used for special applications.

It might be necessary to arrange for a small summer-load boiler in a boiler plant consisting of larger units to be fired by class D oil in order to achieve satisfactory conditions.

6.2.3 Environment

In addition to statutory requirements, in certain areas of high population density the local authority might already possess, or subsequently take, powers whereby acceptable fuels in that area are restricted to low-sulfur bearing varieties, e.g. class D, in order to limit the sulfur dioxide emissions. In other cases where there is doubt about the effects of emissions containing high concentrations of sulfur dioxide on, for example, buildings and exposed plant, the use of fuels of lower sulfur content should be considered.

6.2.4 Steam/water temperature conditions

Where boiler heating surfaces can fall below the acid dewpoint, the corrosion effect of sulfur dioxide is increased considerably. This can occur with low-temperature hot water boilers and in such cases a distillate fuel of lower sulfur content should be used to reduce the corrosion rate and increase useful boiler life.

6.2.5 Plant operating schedule

The operating schedule of the plant can affect the grade of fuel needed and the control system required. For example, where plant requirements are such that fully automatic, virtually unattended performance is required, with night and weekend shutdown and minimal maintenance requirements, a distillate fuel might be necessary. A similar plant operating on continuous load with more expert supervision/maintenance could utilize a residual oil. In the former case, the cost savings in supervision and maintenance need to be balanced against the higher costs of using a distillate fuel and additional control equipment.

6.3 Appliances

6.3.1 General

Reliable and efficient operation of a boiler installation depends upon satisfactory coordination of the designs of the boiler, the oil burning equipment and the system. New boilers are frequently supplied as packaged units in which the boiler, burner and certain ancillary equipment are supplied to site pre-assembled. This practice, which can be applied to all but very large units, facilitates pre-matching and pre-testing the boiler-burner assembly as a standardized design.

When specifying oil burners, whether for use with new appliances or with existing boilers that have previously been fired by other fuels or by other oil burners, the suitability of the proposed burner for the conditions and intended duty should be taken into account.

The classification of boilers used in this standard has been adopted to serve as a basis for consideration of factors relating to oil burning equipment and is not intended to be a general or exhaustive classification of all boiler types.

Burner units conforming to BS EN 303-1, BS EN 303-2 and BS EN 303-4, as appropriate, should be used.

NOTE Attention is drawn to the Boiler (Efficiency) Regulations 1993 as amended by the Boiler (Efficiency) (Amendment) Regulations 1994 and by the Boiler (Efficiency) (Amendment) Regulations 2006 [3].

6.3.2 Boiler sizes in relation to load requirements

Boiler sizes should be selected to match the actual load requirements. Where boilers are oversized in relation to the load, the oil burners are subjected to frequent on/off operation and long off periods that produce the following undesirable effects:

- a) a reduction in overall "seasonal" efficiency of the boiler plant;
- b) increased fouling of boiler gas-side heating surfaces;
- c) increased danger of corrosion of boiler heating surfaces, flue ducts and chimneys;
- d) increased wear and tear on control gear, contractors, motors, etc.;
- e) fluctuations in steam pressure or in temperature of water flow from the boiler plant;

- f) difficulties with feed-water treatment and continuous blow-down control of steam boilers.

A curve showing anticipated loadings should be produced and the boiler sizes selected such that under normal load conditions the oil burners are working within their high/low or modulating range.

A boiler should be selected which has a range of outputs, with a turn-down ratio of the burner, i.e. the ratio between high and low levels of output, as given in Table 1.

Table 1 Recommended maximum turn-down ratios for different types of boilers

Type of boiler	Maximum turn-down ratio
Condensing boilers	3+:1
Cast iron sectional boilers	2:1
Small shell and other steel boilers (up to 2 000 kW)	2:1
Large hot water shell and other steel boilers (over 2 000 kW)	3:1
Large steam shell boilers (over 2 000 kW)	4:1

With large water-tube boilers fitted with multiple oil burners the turn-down ratio may be extended beyond the range given in Table 1 depending upon the particular boiler and system design under consideration, but the risk of acidic corrosion at low output should be taken into account.

Annual variations in anticipated loadings should be taken into account. Special attention should be given to the summer load, which might be much less than winter demand where no process heat is required, and to schemes with a phased development, where the ultimate load might not be reached for several years.

Standby capacity should be provided either by means of a separate standby boiler or by selecting boiler units with extra capacity where this can be done in accordance with the load matching principles above.

Where a plant consists of a mixture of condensing and non-condensing boilers, the condensing boilers should cover the base load and the non-condensing boilers should be used for peak and standby purposes.

6.3.3 Quality of boiler water

6.3.3.1 Feed water for steam boilers

Feed water for steam boilers should be pre-treated to ensure that it meets the quality limits set by the boiler manufacturer. In order to protect the boiler, the quality of the boiler feed water should be subject to continuous monitoring and control to ensure it remains within the limits specified by the boiler manufacturer. Advice should be obtained from a water treatment specialist and that advice should be followed at all times.

6.3.3.2 Water for hot water boilers

Although hot water systems are regarded essentially as "closed circuits", make-up water is necessary, the quantity depending upon the amount of leakage from such items as pump glands and from draining down for maintenance purposes, etc.

The water for the initial fill, and the make-up water, should be pre-treated to ensure it meets the limits set by the boiler manufacturer to protect the boiler, taking into account the intended operating temperature of the system.

NOTE This treatment can range from simple chemical dosing to full demineralization with the application of oxygen scavenging and pH corrective chemicals.

Frequent checks on internal water conditions as recommended in 6.3.3.1 should also be carried out.

6.3.4 Condensing boilers

A condensing boiler utilizes the latent heat remaining in the flue gases by causing the condensation of the water vapour in these gases. Therefore these boilers are fitted with a condensate drain. Condensing operation can only be achieved when the return water temperature is low, typically around 55 °C. The lower the return water temperature, the greater the condensation and the higher the efficiency. The relatively cool flue gases lack buoyancy and therefore fans are needed to drive them out of the flue systems. Fuels with very low levels of sulfur should be used for these boilers to minimize acid corrosion from the condensate.

6.3.5 Cast iron sectional boilers

6.3.5.1 General

This clause covers boilers of cast iron construction in which the rating of the boiler can be selected, within limits, by the number of assembled sections. The usual configuration covers a horizontal combustion space, but subsequent travel of the flue gas can be via a multiplicity of passes in series and/or in parallel and arranged horizontally or vertically.

With all cast iron boilers, the associated system should be designed to maintain the water return temperature at a high enough value to minimize condensation and sulfur corrosion.

6.3.5.2 Purpose-made boilers

Purpose-made boilers use combustion spaces at a positive pressure so inter-section sealing is very important. These boilers are less sensitive to flue conditions, but the boiler manufacturer's recommendations regarding flue conditions should be followed. In these boilers, it is essential that all flue-way doors and observation windows are gastight, and that any excess-pressure relief door is sufficiently loaded to withstand the normal operating pressure without leakage.

Owing to the higher rates of heat release from purpose-made boilers, correct circulation of the water is very important and pumps and associated equipment should be of sizes that ensure adequate circulation at all times.

6.3.6 Shell boilers

6.3.6.1 General

The term "shell boilers" is applied to a group of boilers in which the flue gases usually traverse the boiler horizontally between the burner and the off-take. One or more furnace tubes, usually of circular cross-section, are fitted and these may be arranged for through or reversed flow of the combustion gases. After leaving the furnace tube the products of combustion pass through one or more longitudinal externally water-cooled return passages before reaching the chimney gas off-take. The gas passages may consist of nests of externally water-cooled tubes or of annular spaces. This group includes:

- a) economic boilers, in which the rear chambers, known as "combustion chambers", may be refractory lined (dry-back) or water-cooled (wet-back);
- b) reverse flame furnace tube boilers.

6.3.6.2 Installation design – Relevant factors

The specification of burners should be undertaken in collaboration with the burner manufacturer, or burners should be chosen from appliance manufacturer's approved listing for the equipment concerned and the liquid fuel being used.

NOTE Attention is drawn to the Clean Air Act 1993 [23] and the Clean Air (Northern Ireland) Order 1981 [24]. Chimney and flue gas ducts should be designed and matched to the requirements of the appliance manufacturer's specification.

6.3.6.3 Replacement of oil burning equipment – Burner to appliance matching

6.3.6.3.1 The specification of burners should be undertaken in collaboration with the burner manufacturer, or burners should be chosen from the appliance manufacturer's approved listing for the equipment concerned and the liquid fuel being used. When the boiler plant is supplied by the manufacturer complete with the oil firing equipment, the specifier should inform the equipment manufacturer of the fuel specification to be used.

6.3.6.3.2 In the older types of shell boilers the gas passages were so proportioned that the pressure drop experienced by the gases in passing from furnace to chimney was small, usually a gauge pressure of less than 60 mm of water. Such boilers were intended for operation under zero or negative draught pressure, and the design of smoke boxes, excess-pressure relief devices, access doors and other fittings is unlikely to be suitable for use with newer forced-draught oil burners without modification.

6.3.6.3.3 When modifying these older types of boiler, special attention should be given, particularly in the case of dry-back boilers, to the following:

- a) tightness of gas joints between front and rear smoke boxes and the boiler shell;
- b) sealing between brickwork or insulation and shell of smoke boxes;
- c) seals of access doors;
- d) suitability of excess-pressure relief devices for resisting gas leakage under forced-draught conditions including those on start-up of burners;
- e) suitability of existing refractory linings covering non-water-cooled surfaces for the increased surface temperature likely with oil firing.

6.3.6.3.4 The quality of the refractory brick should be such as to withstand a temperature of not less than 1 100 °C. However, where the brick surfaces cannot reradiate heat to any nearby water-cooled surfaces a quality of refractory brick capable of operating at temperatures up to 1 400 °C should be used.

6.3.6.3.5 The use of hot-face insulating bricks for the construction of the combustion space is sometimes desirable and the boiler manufacturer should be consulted. Where the burner design makes use of a brick quarl to ensure flame stability, care should be taken to follow exactly the quarl shape specified. The burner maker's advice should be sought on the design of the burner quarl. If necessary, refractory material should be fitted to exclude heat from the burner plate, and from those parts of the furnace tube not water-cooled, particularly the weld between the furnace tube and the head plate.

6.3.6.3.6 The suitability of tube attachment at the entry end of the first tube pass to withstand the changed conditions should be considered. It is recommended that the ends of welded stay tubes and of seal-welded plain tubes should be dressed flush with the weld, and plain tubes that are not welded should be no more than 1.5 mm proud of the tube plate.

6.3.6.3.7 The suitability of water-side circulation in tubed hot water boilers to sustain the higher rates of heat transfer in the region of the first tube pass entry when changing from solid fuel to oil firing should also be examined.

6.3.6.3.8 The combustion space should be such that combustion at the maximum required output is completed within the available length of furnace tube so that the flame does not make contact with the water-cooled surface of the furnace tube. The combustion space should also be such that the fuel can burn efficiently within the volume available.

6.3.6.3.9 Special problems might arise when converting boilers of riveted construction since the changed heat distribution within the boiler might cause old riveted joints to work loose and leak. If the boiler is old, this problem can be difficult to overcome.

6.3.6.4 New equipment

Where the boiler is supplied separately from the firing equipment the recommendations given in **6.3.6.3** should be followed. When a matched boiler-burner unit is supplied, details of the requirements for the temperature and pressure of the fuel supply and draught arrangements at the boiler outlet should be obtained from the manufacturer.

6.3.7 Water-tube boilers

6.3.7.1 The oil firing of water-tube boilers requires special consideration by the specifier in collaboration with the boiler and burner makers in respect of furnace volume, rate of heat release, the number of burners and their location, their proximity to the combustion space boundaries and the length of flame. Attention should be paid to the necessity for a low rate of firing when starting the boiler from cold. This is particularly important when superheaters are fitted.

6.3.7.2 When the bottom of the combustion space is not water-cooled, arrangements should be made to limit the heat flow into the boiler room floor. This can be achieved by the provision of an air gap below the hearth, which should be adequately cooled by natural convection or by induced or forced ventilation.

6.3.7.3 The specification of burners should be undertaken in collaboration with the burner manufacturer, or burners should be chosen from the appliance manufacturer's approved listing for the equipment concerned.

6.3.7.4 Adequate standards for water treatment should be determined to meet the new conditions, see **6.3.3**.

6.3.7.5 Air leaks into the combustion chamber, gas passes and flue ducts should be reduced to a minimum.

6.3.7.6 When it is intended to use the existing fans, the suitability of their performance should be checked.

6.3.7.7 The sulfur content of liquid fuels can cause low-temperature acidic corrosion problems and steps should be taken to reduce the resulting effects. In the case of boilers fitted with economizers, corrosion can be reduced by the following methods:

- a) removal of sections of the economizer;
- b) recirculating feed water through the economizers;
- c) increasing the feed-water inlet temperature of the economizer by external means;

- d) selection of burners suitable for operation at near stoichiometric conditions over the required turn-down range.

6.3.7.8 Flue ducts should be adequately insulated to prevent low metal temperatures.

6.3.7.9 Where the replacement of a burner has necessitated the reconstruction of a combustion chamber incorporating large quantities of refractory material, it is essential to ensure that the boiler operators bring the plant slowly up to maximum working load. This is so that the refractory material is dried out slowly so as not to affect its structural integrity. When heated too quickly the surface can harden before the moisture in the deeper parts has dried. This can later boil and affect the adhesion of the refractory material onto the supporting structure and to itself. The advice of the installer or a specialist refractory engineer should be sought.

6.3.8 Instantaneous steam and instantaneous hot water generators

Instantaneous steam generators are a group of appliances characterized by pressure parts consisting of a continuous coil of pipe that provides the convected heat transfer zone and can also completely or partly surround the combustion space. Water is fed into the coil under pressure and is largely or entirely converted into steam before reaching the other end of the coil. Instantaneous hot water generators are similar but designed so that the water is heated during passage through the coil to the required outlet temperature.

Units of this type are usually supplied as fully packaged appliances. This type of equipment necessitates a degree of interlock between the water pumping rate and the firing rate; the combustion chambers are often of compact size and shape. For these reasons the appliances should be fired only by the burner supplied by the appliance manufacturer.

In certain cases it is possible to convert the appliance to use a fuel different from that for which it was originally designed but in view of the considerations outlined above such a conversion should be carried out only by the original equipment manufacturer.

The manufacturers' instructions in respect of chimney and fuel supply conditions should be precisely followed.

6.4 Warm air heaters

6.4.1 General

For the purposes of this standard, a warm air heater is defined as a self-contained appliance for supplying warm air for heating commercial and industrial premises.

NOTE The requirements for warm air heaters are specified in BS EN 13842.

The appliance is generally an enclosed unit containing a burner and a heat exchanger system. The air to be heated is circulated by a fan across the heat exchanger and the warm air is then distributed directly into the heated space or via ductwork to the space to be heated.

The heat exchanger consists generally of a metal-walled combustion chamber where the combustion of the fuel is completed and a secondary section in which further heat is transferred from the products of combustion prior to their discharge into the flue system.

Warm air heaters are designed with the heat exchanger system operating under either a negative or a positive pressure. To enable the correct condition to be achieved the chimney and flue duct should be of such size as to provide the draught specified by the manufacturer, which might involve the fitting of an induced-draught exhaust fan. This fan may be built into the heater unit or supplied as an additional item of equipment, but in either case interlocking with the burner control is essential to ensure that the burner cannot operate unless the fan is running.

6.4.2 Conversion of gas fired heaters to oil firing

It is recommended that when conversion of gas fired equipment to oil firing is required, the manufacturer of the heater should be consulted. It is possible that the heater was originally designed for either of these fuels and a simple substitution of burner and controls might be adequate to bring about the conversion.

Many manufacturers of warm air heaters use packaged gas burners supplied by independent burner manufacturers. In these cases the burner manufacturer can usually supply a suitable oil burner. If not, a suitable burner should be obtained from an independent burner supplier.

When a substitute oil burner is not available from the heater manufacturer, consideration should be given to the gas firing characteristics so that a suitable type of oil burner can be selected.

Where the gas burner has been incorporated as a special part of the heater design, physical difficulties can arise when attempting to fit an alternative oil burner. It is then advisable to consult the manufacturers of both the heater and the oil burner. It is unlikely that heaters fitted with atmospheric gas burners can be converted to oil firing.

With pre-mix units, advice should be obtained from the burner manufacturer as to the suitability for conversion.

The specification of burners should be undertaken in collaboration with the burner manufacturer, or burners should be chosen from appliance manufacturer's approved listing for the equipment concerned.

A check should be made on the heater to ensure that there is sufficient airflow across the heat exchanger to limit the air temperature rise to that recommended by the heater manufacturer.

All joints in the combustion system should be sealed to avoid any leakage of combustion gases into the warm air flow or the heater surroundings. For the same reason, it is essential to ensure correct fitting of excess-pressure relief devices.

The heat exchange system should be checked. Particular attention should be paid to inspection of the combustion chamber for any cracking or broken welds due to excessive thermal stressing, and checking of the secondary section for leakage caused by corrosion. Faulty parts should be repaired or, if necessary, replaced.

6.4.3 Installation of new warm air heaters

The specifier and/or the designer should ensure that the size or number of heaters to be installed is sufficient to meet the maximum load requirements of the space to be heated. Over-sizing of heaters causes frequent shut-downs and long periods of inactivity, resulting in inefficient operation.

Where high/low/off heaters are to be installed, they should be selected so that the maximum designed heating load falls between the high and low flame outputs.

6.4.4 Installation design

Warm air heaters should be sited to ensure that air inlets are not restricted in any way and that there is sufficient clearance for maintenance of burner, controls, heater, and exhaust flue. Heaters should be isolated from any combustible materials or flammable vapours, see 10.6.

Flue-gas ducts and chimneys should be designed to satisfy the draught requirements specified by the heater manufacturer and to ensure that the products of combustion cannot be re-circulated to the air inlets.

7 Selection of burners

7.1 General

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

- a) the type of plant unit, e.g. shell boiler, water-tube boiler, warm air heater;
- b) the class of liquid fuel to be used, see Clause 5;
- c) utilization pattern of plant, e.g. constant output, variable output such as variations in heating load.

NOTE Attention is drawn to the Clean Air Act 1993 [23] and the Clean Air (Northern Ireland) Order 1981 [24].

7.2 Types of burner

7.2.1 General

The types of burner are listed in BS 799-4 and BS EN 267, the differentiation of type being designated by the methods of atomization used. The characteristics of these types are as described in 7.2.2 and 7.2.3.

7.2.2 Pressure-jet burners

7.2.2.1 General

In this type of burner oil is supplied, under pressure and at a suitable viscosity, to a nozzle in which some of the pressure is used to impart rotation (swirl) to the oil before it is discharged through the final orifice. On issuing from the final orifice, a film is produced which atomizes into oil droplets.

7.2.2.2 Simplex pressure-jet

In this type of atomizer the droplet size increases with reduction of oil pressure. Consequently the range of turndown is limited.

NOTE Variations of the simplex pressure-jet atomizer have been devised to overcome this limitation.

7.2.2.3 Spill return pressure-jet

This type of atomizer has flow and return oil passages. Turndown is effected by returning oil from the atomizer to the tank or other parts of the system.

7.2.2.4 Duplex pressure-jet

This type of atomizer has two flow passages designated pilot and main. It has two sets of swirl passages, a common swirl chamber and final orifice. At low flow, oil is only supplied to the pilot passages, and at high flow, the oil is supplied to both pilot and main passages.

7.2.2.5 Duple pressure-jet

This type of atomizer has two flow passages, pilot and main. It has two sets of swirl passages, two swirl chambers and two final orifices that are concentric. At low flow, oil is only supplied to the pilot passage and jet, and at high flow, the oil is supplied to both pilot and main passages and jets.

7.2.3 Two-fluid type

7.2.3.1 General

In this type of burner oil droplets are produced by promoting high rates of shear in the oil by the use of an additional fluid such as air or steam.

7.2.3.2 High pressure air or steam type

Oil is fed at a controlled rate to the nozzle where a stream of air or steam under a gauge pressure generally of over 1 bar meets the oil and atomizes it by impact.

7.2.3.3 Medium pressure air type

Oil is fed at a controlled rate to the nozzle where a stream of air under pressure meets the oil and atomizes it by impact. Burners of this class generally use air at gauge pressures from 70 mbar to 1 000 mbar.

7.2.3.4 Low pressure air type

Oil is atomized by the impact of air supplied by a fan at gauge pressures generally from 30 mbar to 100 mbar.

7.2.3.5 Spinning cup or rotary type

Oil is supplied at a controlled rate to the interior of a hollow conical cup, rotated by means of an electric motor or by a turbine driven by air or steam. Oil leaves the outer lip of the cup as a thin film under the influence of the centrifugal force. Atomization is carried out by the impact of a stream of air supplied through an annular nozzle surrounding the rotating cup.

7.2.3.6 Emulsifying type

Oil atomization is substantially effected by a nozzle, normally using air as the atomizing medium. Oil at a suitable viscosity is metered and mixed with a controlled proportion of air at the inlet to a compressor from which the mixture emerges as an emulsion, and is conveyed to the nozzle.

In some burners, oil saturated air and emulsified oil are separated from the compressor in a stabilizing chamber before remixing at the nozzle.

7.2.3.7 Steam or air assisted pressure-jet type

The air or steam is introduced concentrically with the pressure jet orifices. The air or steam is used to improve atomization and to maintain it when the oil pressure is too low. In this way the turndown range of the pressure-jet is increased.

7.3 Types of burner control

Any of the types of burner described in 7.2 may be controlled by any of the following methods:

- a) flame-monitored hand control;
- b) partly automatic control;
- c) flame-monitored and partly automatic control;

- d) fully automatic control.

These types of control are fully described in BS 799-4 and BS EN 267.

For installations where supervision by entirely competent staff (see Clause 4) is not available a fully automatic control method, [item d)], is strongly recommended.

The control of a burner comprises three distinct systems:

- 1) control of starting and stopping to ensure safe conditions;
- 2) control during running to ensure maintenance of safe conditions;
- 3) control of variation (if any) in heat output.

Items 1) and 2) are burner safety controls and should conform to BS 799-4 and BS EN 267.

Variations in heat output [item 3)] can be controlled by operating the burner:

- i) on/off, or high/low/off; or
- ii) fully modulating over the turn-down range.

7.4 Choosing oil burning equipment – Factors to consider

The maximum output of the burner(s) has to be sufficient to meet the maximum rating of the boiler or warm air heater.

Depending upon the type of burner employed, the method of operation of the burner should be chosen from one of the following types to meet the varying load requirements:

- a) on/off;
- b) on/off, with transitional low-flame start;
- c) high/low/off;
- d) fully modulating over the turn-down range.

The flame size and shape should be such as to be confined within the combustion space of the unit under the conditions specified by the boiler or heater designer. It is often difficult to judge visually, if a flame is impinging on the surface within the combustion space or if it appears to be impinging, whether it will cause damage. If flame impingement is occurring, because of chilling of the flame, carbon will build up on the surface or it will be impossible to reduce the carbon monoxide level below a level of 0.01%, or the smoke number (Bacharach scale) of the exhaust gases may be higher than for normal operation.

NOTE Attention is drawn to the Clean Air Act 1993 [23] and the Clean Air (Northern Ireland) Order 1981 [24].

Many types of oil burners have been developed commercially to meet individual requirements for heating and steam raising. The range of burners available is very wide and even with experience, the selection of a particular type for an application can prove difficult.

Guidance on burner selection should be obtained from the burner manufacturer.

8 Oil tanks and equipment

8.1 Oil tank construction

Oil storage equipment should be selected which has been manufactured so as to provide a 20 year expected working life.

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 (see 8.10) and maintenance (see Clause 15) 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 [9], [10], [11]. Attention is also drawn to the DEFRA Guidance note for the Control of Pollution (Oil Storage) (England) Regulations 2001 [25], which states: "It is recommended that you purchase a fixed container expected to last for a minimum of 20 years before it needs to be replaced.".

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

For the storage of kerosene, see 10.8.

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 [N1]	Steel fabricated primary tank or integrally bundled tank	Above ground, internal or external
BS EN 13341	Thermoplastics primary tank	Above ground, internal or external
OFS T100 [N2]	Medium density polyethylene primary tank or integrally bundled tank	Above ground, internal or external
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 are the preferred option.

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

8.2 Capacity

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

- 3 weeks' supply of oil calculated at the maximum rate of consumption; or
- 2 weeks' supply of oil calculated at the maximum rate of consumption, plus the usual quantity ordered for one delivery.

Consultation with the oil supplier is advisable 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 8.14;
- 4) the additional volume required to accommodate heating equipment and any other equipment fitted within the tank.

NOTE Where biofuel is to be used, consideration should be given to selecting a size of tank that will prevent large quantities of biofuel being stored for long periods.

8.3 Selection of tanks

It is usually preferable to have a single tank, sized to meet the requirements of the installation. The use of tanks to manufacturers' standard sizes can be less expensive than using specially made tanks.

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 banded tanks*. These provide both primary and secondary containment in a single unit.

NOTE 1 Under the Control of Pollution (Oil Storage) (England) Regulations 2001 [9], the Control of Pollution (Oil Storage) (Amendment) Regulations (Northern Ireland) 2011 [10] and the Water Environment (Oil Storage) (Scotland) Regulations 2006 [11], single skinned tanks, and double skinned tanks installed above ground are required to have secondary containment and tanks that are to be buried below ground are required, as a minimum, to be double skinned.

NOTE 2 This is distinct from placing a tank below ground within an oil-tight chamber which provides secondary containment.

The following shapes of tanks are commonly available:

- 1) rectangular;
- 2) horizontal cylindrical;
- 3) vertical cylindrical.

NOTE 3 Other shapes can be fabricated to order.

8.4 Provision for measurement of contents of oil storage tanks

8.4.1 Tank contents control and gauging

Facilities should be provided to determine the quantity of oil in a tank 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;
- 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.
- 5) dip stick or dip tape for local reading.

It is recommended that 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.

8.4.2 Tank contents display systems

8.4.2.1 General

A tank contents display should be provided, for use by the persons responsible for stock control and by personnel responsible for delivering fuel into the tank.

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

Tank contents display systems should incorporate the following features, in accordance with **8.4.2.2** and **8.4.2.3**:

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

Where electronic devices are used with kerosene, the guidance given in Health and Safety Executive document HSG 176 [N3] should be followed.

8.4.2.2 Local display

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

Where local access is used for stock control, arrangements should be made for the contents display to be read at suitably frequent intervals.

Where delivery is made directly into the tank, local display of 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.

8.4.2.3 Remote display

Remote display can either be 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. Many remote gauging systems can accept signals from such devices, which can usually also provide an overfill warning alarm.

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.

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.

8.5 Safety and environmental precautions

The Control of Pollution (Oil Storage) (England) Regulations 2001 [9], the Control of Pollution (Oil Storage) (Amendment) Regulations (Northern Ireland) 2011 [10] and the Water Environment (Oil Storage) (Scotland) Regulations 2006 [11] require that all tanks are labelled at the fill point with the nominal capacity, and that the following precautions are 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:
 - 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.

NOTE Attention is drawn to the Control of Pollution (Oil Storage) (England) Regulations 2001 [9], the Control of Pollution (Oil Storage) (Amendment) Regulations (Northern Ireland) 2011 [10] and the Water Environment (Oil Storage) (Scotland) Regulations 2006 [11] regarding safety and environmental precautions.

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

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 [26].

Where electronic devices are used with kerosene, the guidance given in Health and Safety Executive document HSG 176 [N3] should be followed.

8.6 Filling 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 [N1] or OFS T100 [N2], respectively.

Filling pipe connections should be in accordance with 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 filling pipe should be provided for each tank. Each tank and each corresponding filling pipe should be clearly numbered. If this is not convenient with a multi-tank installation storing the same grade of fuel, a common filling line may be used, provided that the following conditions are met.

- a) Independent connections fitted with isolating valves are made between each tank and the common filling line. These isolating valves should be readily accessible and should indicate whether they are open or closed.
- b) Each tank is clearly numbered and the same number is displayed on or close to the corresponding oil-level indicator and on the corresponding isolating valve.

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

Filling 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. Filling pipes for classes F and G oils plus some biofuels 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 inadvertent 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.

8.7 Vent pipes

Vent pipes should be in accordance with BS 799-5, OFS T100 [N2] or OFS T200 [N1], 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.

NOTE Attention is drawn to the Control of Pollution (Oil Storage) (England) Regulations 2001 [9], the Control of Pollution (Oil Storage) (Amendment) Regulations (Northern Ireland) 2011 [10] and the Water Environment (Oil Storage) (Scotland) Regulations 2006 [11] which require vent pipes to be directed to discharge directly into the secondary containment.

The vent pipe should be free from sharp bends, should have a continuous rise and, while being as short as convenient, 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.

A separate vent pipe should be provided for each tank.

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 such an occurrence, 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.

8.8 Drainage and de-sludging facility

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 be in accordance with BS 799-5, OFS T100 [N2] or OFS T200 [N1], as appropriate.

Drainage and de-sludging facilities may 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.

NOTE Attention is drawn to the Control of Pollution (Oil Storage) (England) Regulations 2001 [9], the Control of Pollution (Oil Storage) (Amendment) Regulations (Northern Ireland) 2011 [10] and the Water Environment (Oil Storage) (Scotland) Regulations 2006 [11] which preclude fitting of low level drainage valves in bunds and require oil and/or water to be pumped out of the bund from above.

8.9 Multiple storage tanks with return line connections

Where the oil burning system requires the connection of an oil return line to the storage tanks, see 9.2.2.4, it is essential that the returned oil always passes back to the tank from which it has been drawn. If this is not arranged, overflow of the other tanks could occur.

On plants with 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.

8.10 Installation of oil storage tanks

8.10.1 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 [N1]. For plastic tanks refer to BS EN 13341 or OFS T100 [N2].

NOTE 2 Attention is drawn to the Building Regulations [4], [5], [6].

8.10.2 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 adequate 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.

8.10.3 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, using the method given in BS 799-5. All traces of water, welding debris, scale, and other foreign matter should be removed from inside the tank.

8.10.4 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 will 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 should be 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.

- b) Those surfaces of the tank that will 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.

8.10.5 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 quickly 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.

8.10.6 Where earthing is provided it should incorporate adequate electrical conductivity in accordance with BS 7430.

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

- a) Buried tanks might tend to lift under flooded conditions and they should be suitably anchored. For detailed information regarding buried tanks see **10.7.4** and **10.7.5**.
- b) Above-ground tanks are liable to be affected by wind pressure and by floatation caused by flooding and should therefore be suitably secured to their foundations to allow for this in accordance with the tank manufacturer's instructions.

8.11 Painting and cleaning of steel tanks on site

8.11.1 Where the steel tank has not been painted by the manufacturer before delivery in accordance with BS 799-5, painting and cleaning of steel tanks on site should be in accordance with BS 799-5 and the recommendations given in **8.11.2** to **8.11.6**.

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

8.11.3 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.

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

8.11.5 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.

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