DRAFT EAST AFRICAN STANDARD

The storage and handling of liquid fuel — Large consumer installations — Code of practice

EAST AFRICAN COMMUNITY

© EAC 2019
First Edition 2019
Copyright notice

This EAC document is copyright-protected by EAC. While the reproduction of this document by participants in the EAC standards development process is permitted without prior permission from EAC, neither this document nor any extract from it may be reproduced, stored or transmitted in any form for any other purpose without prior written permission from EAC.

Requests for permission to reproduce this document for the purpose of selling it should be addressed as shown below or to EAC’s member body in the country of the requester:

© East African Community 2016 — All rights reserved
East African Community
P.O. Box 1096
Arusha
Tanzania
Tel: 255 27 2504253/8
Fax: 255 27 2504481/2504255
E-mail: eac@eachq.org
Web: www.eac-quality.net

Reproduction for sales purposes may be subject to royalty payments or a licensing agreement. Violators may be prosecuted.
Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in the East African Community. It is envisaged that through harmonized standardization, trade barriers that are encountered when goods and services are exchanged within the Community will be removed.

In order to achieve this objective, the Community established an East African Standards Committee mandated to develop and issue East African Standards.

The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

EAS was prepared by Technical Committee EASC/TC.
The storage and handling of liquid fuel — Large consumer installations — Code of practice

1 Scope
This Draft East Africa Standard gives recommendations for the storage and handling of petroleum products that are stable at atmospheric temperature and pressure at large consumer installations.

This standard does not cover the handling and storage of LPG.

2 Normative references
DEAS 1, Storage and distribution of petroleum products in above ground bulk installations
DEAS 2, The petroleum industry — The installation of underground storage tanks, pumps/dispensers and pipe work at service stations and consumer installations — Code of practice
API Standard 650, Welded Steel Tanks for Oil Storage
API Standard 2000, Venting Atmospheric and Low-Pressure Storage Tanks: Non-refrigerated and Refrigerated
ASME B31.4, pipeline transportation systems for liquid hydrocarbons and other liquids

Terms and definitions
For the purposes of this code the following definitions shall apply:

3.1 acceptable
that which meets the requirements of the approving authority

3.2 approved
that which has been authorized by the approving authority

3.3 approving authority
the relevant competent authority in the respective Partner States

3.4 backfill soil
clean, sieved subsoil or sand of grain size not exceeding 2.5 mm

3.5 competent person
a person who has the necessary knowledge of and ability with regard to the particular process or type of plant and equipment to which this standard refers and approved by the approving authority to render him/her capable of performing the work involved

3.6 large consumer installation
an installation where the storage capacity, in any one location, exceeds 200 m³

3.7 service tank
an auxiliary tank used for a liquid fuel having a flash point not lower than 38 °C, that should be isolated from the main storage tank(s) and that will be used for immediate consumption

3.8 flash point
the lowest temperature at which a flammable liquid can form an ignitable mixture in air

4 Storage tanks

4.1 General construction and design

4.1.1 Use all-welded tanks of sound-quality steel that are designed and constructed in accordance with sound engineering practice and in accordance with recognized applicable standards (e.g. API 650).

NOTE 1 Do not use galvanized materials in the construction of a tank because of the possible chemical reaction between the zinc coating and certain compounds usually present in the fuel.

NOTE 2 If a tank is suitable for storage of different hydrocarbon categories, the tank accessories should be arranged in accordance with the hydrocarbon category requiring the strictest conditions.

4.1.2 The tank shall be cylindrical in shape and mounted horizontally or vertically (see Figures 1 and 2).

4.1.3 For aboveground tanks, the following considerations shall apply while calculations are being made:

i) Filling of water;

ii) Pressure and depression determined by the user;

iii) Net weight of the tank top for the fixed-roof tanks;
iv) Resistance to overload due to the wind force;

v) Resistance of the bottom;

vi) Floating-roof tanks should be designed by also considering the countercurrent effect of the wind.

4.1.4 Maximum working values of the metal casings (containing a substance with a density of $1 \text{g/cm}^3$) should be as follows:

i) 50 % resistance to tensile force for 22 mm or thinner sheets and sheets above 22 mm in case of general radiographic control over welding points during manual welding or over welding nodes during automatic welding.

ii) 50 % resistance to tensile force for sheets above 22 mm in case of no general radiographic control mentioned above.

4.2 Supports

4.2.1 Provide, for each tank, a non-combustible supporting structure of sufficient strength and rigidity to support the tank when it is filled with water.

4.2.2 The metal structures, wooden foundations or concrete poles with a height of at least 1 m and carrying hydrocarbon tanks should be shielded with a fireproof material.

4.2.3 The shield should be up to a height of 4.5 m from the ground or if the tank height is lower than 4.5 m, it should cover the tank up to the top.

i) This shield should not damage the welding points between the metal structure and the tank.

ii) Allow for a clearance of at least 150 mm under the lowest fitting on the tank, e.g. a shut-off valve.

4.3 Testing

4.3.1 General

An above-ground tank should preferably be tested by filling it with water, while for an underground tank, the method specified in DEAS 2 should be used. Maintain the test pressure for 30 min to allow for thorough examination of the tank, and then check for freedom from leakage and excessive permanent distortion.

4.3.2 The maximum distortion of any flat surface and of any surface with a radius of curvature greater than 50 mm shall not exceed 2 % of the maximum dimension (e.g. diameter or edge) of that surface.

4.3.3 For fixed-roof tanks, this test is carried out by filling water up to a level 0.10 m higher than the maximum level of usage. An additional test is carried out by applying the overpressure that the tank is likely to be subjected to.

4.3.4 The depression resistance of the tank should be confirmed with another test by applying the specified depression using a liquid level of approximately 1 m in the tank.

4.4 Cleaning and protection against corrosion
i) Thoroughly clean all external surfaces and protect them from corrosion by suitable painting/coating appropriate to the location, cathodic protection or sacrificial anode.

ii) Before commissioning a tank, thoroughly clean it, e.g. by flushing, the tank and associated pipes and fittings in order to prevent subsequent contamination of the fuel.

4.5 Tank fittings

4.5.1 Filling Pipe

i) Provide each tank with a filling pipe, of internal diameter at least 100 mm that is fitted with a connector piece that can be mated tightly with the delivery vehicle hose. Provide the connector with a captive lockable dust or filler cap that is secured in such a manner that it is watertight and dustproof and cannot be tampered with easily.

ii) Unless the filling pipe is of the self-draining type, fit it with a valve (e.g. a non-return valve) immediately adjacent to the connector (to prevent spillage from the backflow when hoses are connected or disconnected).

iii) Provide a small inspection hole or groove in the fill point connector-threading to establish that the valve is fully closed before the dust or filler cap is completely removed.

iv) Fit an overhead filling pipe within a tank so that it extends to a depth of not more than 100 mm from the bottom of the tank (to prevent the free fall of product during filling operations). Provide an anti-siphon hole in the filling pipe wall in the vapour space of the tank.

v) Where fuel is stored in more than one tank, provide each with an independent filling pipe.

vi) Position or protect a filling pipe such that it will not be damaged by the delivery vehicle or other vehicles using the site.

4.5.2 Fuel Level Indicators

4.5.2.1 Each tank shall be provided with at least one suitable means for ascertaining the liquid fuel level.

4.5.2.2 Suitable means include the following:

i) A float-gauge;

ii) A hydrostatic pressure gauge;

iii) A dipstick or dip-tape.

iv) Radar gauge; and

v) Servo-gauge

4.5.2.3 Hydrostatic pressure gauges shall be re-calibrated if the relative density of the fuel changes considerably.

4.5.2.4 Sight glasses or tubes are considered dangerous and shall not be used.

4.5.4.5 Design the entry hole of any indicator mechanism into the tank such that the mechanism is sheltered from the weather and the entry of dust, and that the fuel cannot leak under normal operating conditions.

NOTE 1 Certain suitable fuel level indicators may be placed remote from the tank.
NOTE 1 It is desirable to provide a dipstick or dip-tape in addition to any other form of fuel level indicator.

NOTE 3 Tank equipment should be designed and installed so that they will not be subjected to overpressures in cases of tearing, earth piling, etc. It is particularly forbidden to lay flexible pipes below the maximum liquid level between the tank and cocks-valves or stop flaps.

NOTE 4 Hydrocarbon tanks should be equipped with steel safety valves.

NOTE 5 If the tanks are located near shielding piles or surrounding walls, these valves should be installed toward the shields or walls as much as possible.

NOTE 6 The gauging openings of the storage tanks with a maximum service pressure of 60 mbar should be equipped with a device to prevent gas emissions during measurement.

4.5.3 Manholes and other openings

4.5.3.1 Manholes

i) When required, a tank may be provided with a manhole in an accessible position, preferably on the top of the tank.

ii) The minimum size of elliptical manholes is 410 mm x 300 mm and the minimum inside diameter of circular manholes is 600 mm, and the maximum length of neck is 300 mm.

iii) Where access is provided to a vertical tank exceeding 3 m in height or to a horizontal tank exceeding 3 m in diameter, an additional manhole may be provided, one manhole being situated at the top (or one end) of the tank, and the other at or near the bottom (or other end) of the tank. In the case of a vertical tank, as an alternative to the additional manhole a permanent internal ladder may be fitted, thus providing access from the top manhole.

4.5.3.2 Covers

i) Using bolts, studs, or set screws and a gasket of fuel-resisting material, securely fit each manhole and other opening with a liquid-tight and vapour-tight door or cover of thickness at least 6 mm.

   NOTE Use set screws only where it is impracticable to use studs or bolts and ensure that the tapped holes do not penetrate the tank plate.

ii) Seal-weld any stud that may penetrate the tank plate. Use bolts to secure the cover to the neck flange.

4.5.3.3 Connections on covers

Where pipes (e.g. suction pipes, return pipes, heating pipes) pass through a manhole cover, provide them with suitable flanges or double coupling units to facilitate the removal of the cover.

4.6 Vent pipes

4.6.1 Fit the top of each tank with a vent pipe that allows the escape of displaced vapours during filling operations.

The cross-sectional area of the vent pipe connection and the vent pipe shall be large enough to ensure that the tank will not be subjected, during filling (even in the event of it being filled to overflowing), to a pressure greater than that for which it was designed. Methods for calculating venting requirements are given in API Standard 2000.
4.6.2 Ensure that the vent pipe is free from sharp bends and restrictions of its nominal bore, and that it has a continuous rise.

4.6.3 The vent outlet shall be located in such a way that it;

i) allows unrestricted venting to the open air;

ii) is at least 0.6 m above roof level, or

a) at least 3.5 m above ground level,

b) at least 1.5 m from any door, window, or other opening in a building; and

c) at least 4.5 m from any chimney opening, any hot surface, or any source of ignition;

iii) if possible, within sight of the filling point (under certain circumstances, where the vent outlet is not within sight of the filling point, the approving authority may require that an alternative warning system/procedure be employed to guard against the possibility of overfilling;

iv) are not installed within 3.0 m of any electrical and electronic equipment. In the case of power lines, the distance shall be as determined by the power system operators or electricity regulators in the relevant Partner States.

v) discharges horizontally or upwards.

4.6.4 Screen the vent outlet with a gauze of nominal aperture size not exceeding 5.0 mm.

4.7 Drainage and sludge removal

Fit a tank with at least one steel drain valve for drainage and the removal of sludge, or where gravity drainage is not practicable, with a sediment suction pipe that allows the tank to be pump-drained.

Valve(s) shall,

i) have fire-resistant components;

ii) be of the quick-acting type;

iii) be of sufficient bore to ensure adequate drainage.

Use of semi-rotary pump with pipeline extension is also permitted for underground tanks.

4.8 Outlet valves and pipes

4.8.1 General

i) all valves fitted to a storage tank shall be made of steel.

ii) Locate the entry of any outlet pipe as far from the drain valve(s) as possible.

4.8.2 Pipe supports
Pipe supports shall be metal or any other non-combustible material and placed as follows:

i) Mechanical forces resulting from elongation, shrinkage and expansion should not pose any risk for the strength of the pipes;

ii) The contact points between the supports and the pipes should not rust or otherwise the rust should be easily controllable.

**4.8.3 Flexible pipes for Class A hydrocarbons**

**4.8.3.1** Flexible pipes should be changed whenever necessary and:

i) **5 years**, at the latest from the date of manufacture, if the maximum service pressure is 4 bars or higher;

ii) **7 years**, at the latest from the date of manufacture, if the maximum service pressure is below 4 bars.

**4.8.3.2** The use of flexible pipes continuously (for a time longer than 1 month) in place of fixed pipes is prohibited.

**4.8.3.3** As for the classes B, C or D hydrocarbon distribution stations, continuous use of flexible pipes can be accepted if the channels coming from the storage tanks are equipped with automatic or remote control valves.

**4.8.3.4** Flexible pipes should be as short as possible.

**4.8.4 Pipes passing through bund**

**4.8.4.1** The use of screwed type hydrocarbon pipes with a diameter of higher than 50 mm in retaining bund is forbidden if screwing is not reinforced with a welding bead.

**4.8.4.2** The pressure increase due to the temperature increase in the pipes in case of fire should be prevented by using a pressure reducing method.

**4.8.4.3** The non-leaking property of the pipes passing on the inner edges of the bund should be made so as to be fire-proof.

**4.8.4.4** An expansion allowance should be available on the pipes passing through the walls.

**4.8.4.5** The pipes which exist under the bund all along, but irrelevant with the facility can be kept provided that they meet the necessary conditions such as indicating the underground pipes with signboards, minimum embedding depth, special maintenance and repair instructions for embedded pipes.

**4.8.4.6** Tanks are not permitted to be positioned on the pipes irrelevant with the facility and on the embedded electric cables.

**4.8.5 Hydrocarbon valves**

**4.8.5.1** Valves of cast iron in hydrocarbon locations are not allowed.

**4.8.5.2** Valves located on lower side of the tanks should be made of galvanized iron, aluminum and aluminum alloys. Thermoplastic materials shall not be used.

**5 Tank location**
5.1 General

5.1.1 The siting of a storage tank is largely dependent on local conditions. Avoid, if possible, low-lying areas that are liable to flooding or that are subject to a seasonally high water table. If the location of a tank or tanks in such an area is unavoidable, secure the tank(s) so as to prevent displacement.

NOTE Do not install a storage tank (a service tank is not considered to be a storage tank) inside or on the roof of any building or on any floor above ground level.

5.1.2 A storage tank for liquid fuel having a flash point lower than $38^0C$ and that has a capacity not exceeding 85000 L shall be located underground in a pit (see 5.4.2) or in a sand-filled chamber (see 5.4.4). A suitable storage tank for fuel having a flash point lower than $38^0C$ and that has a capacity exceeding 85000 L may be located underground, subject to approval by the approving authority concerned and implementation of all the relevant safety recommendations given in DEAS 1.

5.1.3 Where space and other conditions permit, erect each tank above-ground and locate it so that it is not exposed to mechanical damage, interference, or temperatures above flash point of the corresponding product, and, in addition, locate it in such a manner that in the event of fuel spillage the fuel cannot reach any heated surface.

5.1.4 In order to reduce the possibility of a product fire directly under a tank, any tank mounted on supports that allow an air space under the tank should preferably be sited on sloping ground that allows spillage of product and vapour to drain away. If located on flat ground, a sloping or inverted V-shaped concrete base should be constructed under the tank to prevent the accumulation of product or vapour.

5.1.5 Where conditions are such that above-ground installation is impracticable, place the tank(s) in an excavated tank-pit.

NOTE: In the case of tanks installed in a chamber where certain critical operational problems (e.g. with the provision of adequate ventilation) may arise, the entire installation shall be designed with exceptional care.

5.2 Above-ground tanks

5.2.1 General

a) Locate each above-ground tank so as to provide adequately for uncongested working area, bund, piping, maintenance, etc., and to allow it to be so protected and maintained as to prevent it from constituting a hazard to adjacent properties by reason of possible escape of fuel or other eventuality.

b) The distances between above-ground tanks and between tanks and boundaries, etc., shall be as specified in DEAS 1.

NOTE: Attention is drawn to the fact that recommendations covering the storage of other liquids stipulate minimum safety distances that shall, when relevant, also be observed, e.g. those given in KS 1967.

5.2.2 Supports

Install a tank or its supports on a solid foundation that is strong enough to carry the mass of the tank when full of water, together with any external loads. Supports shall be constructed of non-combustible material of sufficient strength and rigidity to carry the mass of a full tank and any external loads (such as wind-loading), which may reasonably be anticipated with the tank full or empty.

5.2.3 Bund walls

5.2.3.1 General
5.2.3.2 Bunding is required for all above ground installations and for all conditions including where liquid fuel might escape from an above-ground tank and the installation and cause pollution or damage to adjacent properties.

5.2.3.3 If there is only one tank in the bund, the usable capacity should be equal to at least the 110% of the capacity of this tank.

5.2.3.4 If there are groups of tanks in one bund, the usable capacity of the bund should be 110 % of the capacity of the biggest tank.

5.2.4 Bund separation

5.2.4.1 The bund containing more than one tank should be divided into sections. The number of these sections are determined according to the total capacity of the tanks (V) as follows:

i) For a bund with a total capacity (V) of lower than 80,000 m$^3$:

<table>
<thead>
<tr>
<th>Capacities</th>
<th>Number of sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>V &lt; 10,000 m$^3$</td>
<td>2</td>
</tr>
<tr>
<td>10,000 m$^3$ ≤ V &lt; 20,000 m$^3$</td>
<td>3</td>
</tr>
<tr>
<td>20,000 m$^3$ ≤ V &lt; 80,000 m$^3$</td>
<td>4</td>
</tr>
</tbody>
</table>

If the rule gives a higher value, the number of sections is made equal to the number of tanks in the bund.

ii) For a bund with a total capacity (V) of 80,000 m$^3$ or higher:

In this case, the bund is divided into sections so that, in each section, there will be one tank of 20,000 m$^3$ or higher or, one or more tanks with a total capacity of 20,000 m$^3$ or lower.

In both situations above (i) and ii)), the bund walls shall be at least 0.70 m high.

iii) For a bund containing horizontal and vertical tanks:

In a bund containing horizontal and vertical tanks, these tanks should be grouped in different sections.

5.2.5 Bund wall height

Bund walls should be at least 1 m higher than the inner ground level.

5.2.6 Special rules for the storage of heavy fuel-oil

The following rules are only applicable for the bund allocated for the storage of heavy fuel-oils.

5.2.6.1 Usable retaining capacity

5.2.6.1.1 If the bund contains one or more tanks with a total capacity of lower than or equal to 10,000 m$^3$, the usable capacity of the bund should be equal to at least the biggest one of the following values:

i) 50 % of the capacity of the biggest tank.
ii) 20% of the total capacity of all the tanks.

5.2.6.1.2 If the bund contains one or more tanks with a total capacity of higher than 10,000 m³, the usable capacity of the bund should be equal to at least the biggest one of the following values:

i) 100% of the capacity of the biggest tank.

ii) 20% of the total capacity of all the tanks.

5.2.7 Bund on the inclined terrains

5.2.7.1 If the surface on which the tanks are placed is inclined, the provisions about the minimum height of the bund wall or shield are not applicable for the high side of the inclination.

5.2.7.2 Wall and shield heights should be adjusted according to the required retaining capacity. If the topography permits the prevention of the spread of the accidental spills, the sides of the bund may be without any wall or shield.

5.2.7.3 If, due to inclination, shields are required on the lower sides of the terrain and the heights of these shields block the entry and exit in case of any emergency, some arrangements should be made to facilitate the entry and exit at the corners at which the shield height is lowest.

5.2.8 Bund without tank

5.2.8.1 If the measures taken ensure that the bund retain the spills, although the tanks are not in these bund, and direct the flows to other zones with lower risk, the tanks are allowed to be positioned at a certain distance outside the bund provided that they meet the following conditions:

i) The perimeter of the tank should direct the spills, if they occur, to the bund by means of the terrain characteristics and inclination;

ii) The road between the tank of spill and the retaining bund should not pass through a zone having naked flame or through tank entry and exit roads.

5.2.8.2 The rules for bund partitioning are not applicable for the bund without tank. The spill spreading areas of more than one tank connected to one bund should be separated with walls or shields of at least 0.15 m for the purpose of preventing these spills to be mixed and thus to affect all tanks.

5.2.8.3 The minimum bund depth should be 1 m.

5.2.9 Bund construction and positioning

5.2.9.1 Bund can be made by excavation, landfill or a combined method. In order to prevent the bund to fall down in case of fire, particularly, bund inner walls should be coated with soil shield or brick masonry so as to make durable against hydrocarbon pile pressure.

5.2.9.2 The walls should resist a high temperature fire for four hours. The expansion of the materials used at the joints should not shorten this durability time. Corners should also be reinforced.

5.2.9.3 If the bund is surrounded by walls, wall parts covering at least the half of the bund circumference can be at most 3 m higher than the outer ground floor.

5.2.9.4 The beginning of the earth shields forming the inner walls of the bund should be at least 1 m far away from the vertical projection of the tanks in the bund.

5.2.9.5 The inner walls of the bund should be at a distance of at least 3 m to the vertical projection of the tanks in the bund. This distance is 1 m for the tanks with a unit capacity of less than 50 m³.
5.2.9.6 Side walls of the bund should be impermeable. In case of soil shield, this impermeability may be achieved naturally or by a special treatment.

5.2.9.7 Minimum 2.5 m wide access roads (roads, areas and passages) should be arranged around the bund at least on the half of the circumference.

5.2.9.8 In the bund with impermeable floor on an inclined terrain, a mechanism should be arranged to discharge the waters coming from the gutters, the effluents and the waters used for cooling the tanks. These normally closed mechanisms should be made of fire-proof materials, durable against hydrocarbon in closed position and controllable outside the bund. They can be directed toward the outside of the bund only if they are not contaminated.

5.2.9.9 Oil/water separators shall be outside the area bounded by bund walls.

5.2.9.10 The construction of a bund wall shall be such that it is leak free (fuel-tight) and forms a reservoir for preventing the spread of fuel.

5.2.9.11 Bund walls of earth, concrete, solid masonry, or steel, shall be constructed depending on the type of contingency to be expected.

5.2.9.12 Provision shall be there for the drainage of rain and seepage water from a bund wall through an oil/water separator pit and a valve (which shall be normally kept closed) on the outside of the bund wall.

5.2.9.13 A bund wall shall not enclose any tank that contains anything other than liquid fuel.

5.3 Fire walls

Whenever a fire wall is required, design it in such a way as to have a fire rating of 4 h. The wall construction shall be such that it is self-supporting and rests on adequate foundations.

NOTE A wall constructed of brickwork, masonry, or concrete of thickness at least 200 mm or of reinforced concrete of thickness at least 150 mm is deemed to have a fire-resistance rating of 4 h.

5.4 Underground tanks

5.4.1 General

i) Locate an underground tank at a minimum distance of 1.5 m away from the foundations of any building or canopy and from pipelines and other tanks as is consistent with sound engineering practice and as is in accordance with the requirements of the approving authority.

ii) Where an underground tank is located under roads that are accessible to vehicles or areas in which they park, take adequate precautions to ensure the safety of the tank and its accessories.

iii) So install tanks that their drain points are at their lowest levels. Periodically draw off water and sediment by means of a suitable hand pump or thief pump or both.

5.4.2 Tanks in Pits (see Figure 3)
i) Make the excavation for a tank-pit large enough to permit proper backfilling on all sides of the tank. Make the tank-pit deep enough to allow for a depth of at least 150 mm of backfill soil at the bottom (i.e. under the tank) and to provide the necessary cover.

ii) Cover the tank with a layer of consolidated backfill soil of thickness at least 750 mm. Alternatively, cover it first with a consolidated layer of backfill soil having a minimum thickness of 300 mm, and then with a reinforced concrete slab of thickness at least 150 mm and that overlaps the tank on all sides by at least 600 mm. Where the tank may be subjected to vehicular traffic or other superimposed loads, so increase the strength of the concrete slab as to accommodate the maximum expected stresses and loads.

iii) In areas where a high water-table could give rise to the danger of floating of underground tanks, securely anchor or saddle the tank.

iv) Supply an underground steel tank with effective corrosion protection. Where aggressive soil conditions exist, consider the provision of cathodic protection.

v) Connections to a tank may for the sake of convenience be incorporated in the manhole lid, in which case provide screwed connections to facilitate removal of the manhole cover. Terminate the sediment suction pipe (when fitted) on the manhole lid, and keep its open end plugged.

vi) Where it is desired to provide access to a manhole, tank fittings, etc., an access pit may be used (see 4.4.5).

vii) Pipeline flanges should have copper continuity line to prevent accumulation of the static charges.

viii) The tank manhole inspection chamber shall be constructed in such away to be water tight.

5.4.3 Tanks in Chambers (see Figure 4)

i) When special circumstances require the use of a tank chamber, construct the chamber with walls that have a fire rating of 4 h (see 5.3).

ii) The roof shall be of concrete of thickness at least 150 mm, and the floor of brickwork, stone, reinforced concrete, or other material of equivalent strength. Do not construct the floor of earth or an asphaltic material. Where a tank chamber may be subjected to superimposed loads, increase the thickness of the roof, or walls, or both, as deemed necessary. Provide a clear space of width at least 450 mm between the tank and the walls and roof of the chamber.

iii) Protect each doorway in the walls of the chamber with two fire doors. Raise the sill of each doorway to form a fuel bund wall that will entrap spillage. Ensure that the bund has a net capacity at least equal to that of the largest tank plus 10% of the aggregate capacity of all the other tanks that it protects.

iv) Adequately vent the chamber to the open air in a safe location and in accordance with 4.6. Adequately protect any metal ventilating duct over its entire length inside the building by completely bricking it from its exit from the tank chamber to its exit from the building.

v) Provide a permanent connection for a sump pump to clear any product from the chamber.

5.4.4 Sand-Filled Chambers (see Figure 5)
Construct a sand-filled chamber in accordance with the recommendations of 5.4.3 except that the distance from tank to wall shall be at least 150 mm and the distance from tank to roof shall be at least 300 mm. Place the tank on a bed of backfill soil of thickness at least 150 mm and, except as allowed in terms of 5.4.5, fill other spaces with well consolidated backfill soil.

5.4.5 Access Pits

a) Where a tank is to be installed as in 5.4.2 or 5.4.4 and it is desired to have access to a manhole or other fittings on the tank, one or more access pits may be provided, but only one of these may be left without a sand or earth filling. Ensure that any unfilled access pit has a horizontal cross-sectional area not exceeding 0.8 m².

b) Construct an access pit with walls of reinforced concrete of thickness at least 75 mm, or brick (masonry) of thickness at least 100 mm, or mild steel plate of thickness at least 6 mm.

c) Ensure that the access pit extends from the top of the tank to the surface above and fit it with a circular manhole cover that will prevent entry of fire into the pit. The components of the manhole and cover shall be of heavy duty cast iron or other suitable material that is capable of withstanding the maximum legal axle loadings of the vehicles that may be driven over them.

Rectangular manhole covers are not recommended as the corners tend to break off under heavy load. Use manholes of such size as to provide adequate access to pipe work for repair and maintenance and, to prevent the ingress of water, ensure that the rim projects at least 50 mm above finished ground level.

Pipe work, fittings, and valves

6.1 General

Use only pipes, fittings, and valves of approved materials and design.

6.1.1 At the ends of the gutters equipped with hydrocarbon pipes as well as at every 25 m as a maximum, hydrocarbon leakage preventing mechanisms should be in place.

6.1.2 If the pipes are placed in gutters in places that do not pose any risk in case of a leakage, this distance can be increased to 100 m.

6.1.3 Beside that, if the capacity of the storage facility is higher than 30,000 m³, the distance between both mechanisms can be increased to 100 m.

6.2 Pipe work and fittings

6.2.1 Seamless black steel pipe or class C mild steel pipe used with welded fittings or malleable iron taper-screwed fittings are recommended, but pipes and fittings of synthetic materials may also be used subject to approval by the approving authority.

6.2.2 Flexible metallic, metal-reinforced, or armoured piping may be used only in places where it is necessary to reduce the effect of vibration or where the use of rigid connections is impracticable.
and provided that such piping is protected in the event of failure by a fuel shut-off device. Such piping shall be approved as suitable for the operating pressure and temperature for which it is intended.

6.2.3 Secure fuel pipelines to walls or other supports and adequately protect them from mechanical damage.

6.2.4 Ensure that fuel pipelines are as short as practicable, have the minimum of directional changes (where these are necessary, use long radius bends rather than elbows), and are laid in such a manner that they can be completely drained without dismantling.

6.2.5 Pipe-work shall not be encased in any material likely to induce corrosion and adequately protect all copper and steel pipes from corrosion. Lay buried pipes at a good depth (except at points of entry or exit from the soil) and provide for expansion of the pipes. Ensure that trenches in which pipes run have dimensions large enough to allow for access to drain valves and fittings, that they are fitted with removable covers, and that they can be drained.

6.2.6 Where a fuel pipeline passes under a driveway or similar roadway, adequate protection for example by encasing in concrete or use of steel sleeves shall be provided to guard the pipeline from maximum probable imposed loads and stresses.

6.2.7 Ensure that fuel pipelines do not pass under the main parts of any building or other structure, and so install pipe work as to avoid the build-up of an excessive fuel delivery pressure resulting from static head.

6.2.8 Care shall be taken at all times during the installation of pipe work to avoid:

i) damage caused by the application of unnecessarily high mechanical loads, and

ii) the impairment of external corrosion-resistant coatings.

NOTE Any damage to an external corrosion-resistant coating shall be made good at the completion of the installation.

6.2.9 In order to reduce the risk of undetected fuel leakage, which may cause pollution or a fire hazard, fuel pipelines shall not be laid in service ducts or channels.

6.2.10 Where necessary, lag or warm fuel pipelines (or do both).

6.2.11 Where there is a possibility that a fuel pipeline may be exposed to abnormally high temperatures take special precautions to protect the pipeline.

6.2.12 Do not lay a liquid fuel pipeline through transformer or refrigerator rooms, or rooms containing electrical distribution boards and related equipment, or in any other position prejudicial to the safety of the pipes, e.g. in close proximity to hot water and steam, ventilation and drainage, flammable liquids and gases, and oxygen.

6.3 Suction lines

i) Ensure that the layout, length, and bore of any suction line are such that under the severest conditions of use the pump will still be able to lift the fuel.

ii) Where a fuel suction pipe rises through the top of a tank, fit a non-return valve as near to the pump as practicable, and ensure that the pipe does not extend to within 75 mm of the bottom of the tank.

iii) Protect all pumps (except the pump at the burner that is normally protected by a filter) by fitting them with suitable suction strainers.
6.4 Valves

i) Where a main fuel supply pipeline divides into branches, so fit valves (in addition to the tank valves) as to enable the fuel supply to each branch to be shut off individually.

ii) Lockshield (Wheel head)/gate valves with lockable devices valves may be used for isolating purposes to ensure that unauthorized persons cannot operate them.

iii) Fit an external pressure-relief valve to each positive displacement pump, to any enclosed apparatus in the fuel system that may be isolated and heated, and at the end of each “dead leg” and in each section that may be isolated between two valves. A relief valve shall so discharge in a safe location that the discharge will not result in fire, contamination, or other hazardous conditions.

NOTE An alternative to a pressure-relief valve is a suitable expansion chamber.

iv) Where necessary, clearly indicate the position of a valve either by the use of a marker post or by a suitably marked cast-iron lid on top of an access chamber.

6.5 Pressure gauges

i) Where pressure gauges are fitted, they shall be equipped with isolating valves complying with an approved standard. An isolating valve shall also be fitted where the gauge is connected to a tapping point by pipe work (other than its siphon).

ii) Pressure gauge dials shall be graduated for a range of at least 1.5 times the maximum operating pressure and the units of graduation shall be clearly indicated. Clearly label all remote gauges to indicate the type of fuel for which the gauge is being used.

NOTE Do not braze or solder Bourdon tubes, but weld them.

7 Storage tank filling operations

i) Clearly label and colour the filling points on tanks to indicate the type of fuel which the tank holds, and the capacity of the tank.

ii) Provide a tank that is filled from a road or rail tanker with a filling pipe that has a termination capable of making a fuel-tight joint with the tanker hose. In cases where a tanker is not permitted to approach within 6 m of a storage tank lay a permanent filling line, also equipped with a fuel-tight terminal, from the tank to a point where the tanker can conveniently approach during filling operations. Provide safe road access for all road tanker deliveries. (Typical filling operation arrangements are shown in Figures 6, 7, 8, 9 and 10.)

8 Power-operated pumps and electrical equipment

8.1 Power-operated pumps

Where fuel pumps are installed the following points should be observed:

i) Materials used in the manufacture of a fuel pump shall not be deleteriously affected by the fuel.

ii) Except in the case of centrifugal pumps, every power operated fuel pump shall be equipped with an efficient pressure relief valve that is in a closed circuit. The discharge from the relief valve may be led back to the suction side of the pump or, preferably, back to the storage tank. In the
case of a single pipeline system only, the relief valve may also be used for controlling the delivery pressure of the fuel to the burners of an appliance or appliances, in which case the relief valve shall be adjustable. However, if an adjustable relief valve is used, a pre-set safety relief valve that is set at a pressure not exceeding the maximum allowable working pressure for which the installation is designed shall also be incorporated.

iii) Where practicable, an automatic pump that does not form an integral part of a burner should be fitted with an automatic cut-out that stops it in the event of an excessive flow of fuel, e.g. in the case of pipeline breakage on the delivery side of the pump.

iv) Provide a suitable switch, located in a readily accessible position remote from the pump(s), for shutting off the power to any pump in cases of emergency.

8.2 Electrical equipment
i) Use approved items of fixed electrical equipment (including motors, starters, and control gear). They shall be adequately rated for the required duty. Automatic control equipment shall be of the fail-safe type.

ii) Ensure that wiring to equipment in underground and above-ground chambers is carried out in armoured cable, mineral-insulated metal-sheathed cable, or wiring in conduit, as appropriate.

iii) Wiring to external equipment (such as level-sensing or control equipment) should be carried out in suitable armoured cable and ensure that, where it is laid underground, it is protected by interlocking cable covers of an approved pattern. It shall also be ensured that the metal enclosures of all items of electrical equipment are weatherproof, electrically continuous, and connected to earth.

8.3 Measures against lightning

When a metal is connected to earth, a rotating cone shaped protection area is formed around the connection point. The top of this cone is the top of the structure, axis is vertical and the base radius is twice the height of the structure.

The equipment and metal structures outside this protection cone should be connected to the earthing line.

9 Fuel heating

NOTE The design, construction and use of fuel tank heaters are covered in greater detail in BS 799: Parts 4 and 5. All heaters shall be manufactured and tested in accordance with an approved code (or where no such approved code exists, in accordance with an acceptable standard).

9.1 Storage tank heating

Where it is required to heat liquid fuel in a tank, the following points should be observed and the relevant recommendations followed:

i) The fuel may be heated by the circulation of steam or other heat transfer medium in coils (heating units) installed inside the tank, or by electric units. Alternatively, the fuel may be heated by circulating it through a line heater (see 9.3).

ii) Recommended storage temperature for high viscosity liquid fuels are given in Table 1.
Table 1 — Storage Temperatures

<table>
<thead>
<tr>
<th>Fuel viscosity, mm²/s</th>
<th>Storage temperatures, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>Atmospheric</td>
</tr>
<tr>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>120</td>
<td>25</td>
</tr>
<tr>
<td>150</td>
<td>30</td>
</tr>
<tr>
<td>180</td>
<td>35</td>
</tr>
<tr>
<td>240</td>
<td>20</td>
</tr>
<tr>
<td>280</td>
<td>25</td>
</tr>
<tr>
<td>320</td>
<td>25</td>
</tr>
<tr>
<td>380</td>
<td>30</td>
</tr>
<tr>
<td>420</td>
<td>35</td>
</tr>
</tbody>
</table>

iii) Fit a thermometer or other suitable temperature indicating device in an easily visible position to indicate the temperature of the fuel at the hottest spot adjacent to the heating unit.

iv) Ensure that heating coils within the tank are manufactured of seamless steel or electric-resistance-welded steel pipe. It is advisable that the pipe should be without joints within the tank body. Where joints are unavoidable, weld them in accordance with the recommendations of an approved standard, e.g. ASME B31.4.

v) Readily accessible means for isolating each heating unit shall be provided.

vi) All fuel heating devices shall be controlled by at least two thermostats.

vii) Sensing element of each thermostat shall be located close to and above the unit but below the lowest operating level of the fuel in the tank, and set it to operate in such a way that the temperature of the fuel in the tank will not exceed the appropriate maximum given in Table 1.

viii) It is undesirable for condensate from a steam-operated heater to be returned directly to a boiler water feed system because of the possibility of fuel contaminating the boiler feed water as a result of tube leakage or fracture in the heater. Where the return of such condensate to the boiler water feed system cannot be avoided, provide adequate facilities for inspection and testing of the condensate.
ix) Ensure that each electric heater unit is of robust design and is fitted with a steel sheath of such thickness as will ensure that the tube cannot easily be dented or deformed.

x) Support the unit at suitable intervals along its length, and in such a manner that it is wholly below the lowest operating level of the fuel in the tank. Arrange it also in such a way that there is always free circulation of fuel around the heater unit. The rating of a heater unit shall, unless otherwise recommended by the supplier of the liquid fuel, not exceed the appropriate value given in 9.2.3 (ii).

xi) Fit each electric heating unit or group of units with an isolating switch located close to the tank and in a readily accessible position.

9.2 Line heating

9.2.1 General

9.2.1.1 Although the basic purpose of a line heater is to heat the fluid to a temperature to enable it to be conveniently handled and pumped, line heating may also be used as a means of heating the fuel to the temperature required by the burners for efficient atomization and combustion. The heating may be carried out by steam, other fluid, or electricity. Where fuel is to be heated to above 95 °C, to prevent the formation of vapour pockets caused by the presence of moisture in the fuel, the pre-heater should have an automatic vent or alternatively the fuel pressure shall be above the vapour pressure of the fuel.

9.2.1.2 A line heater shall

i) comply with an approved code and be able to withstand with safety the maximum pressure to which it will be subjected in service;

ii) be fitted with a relief valve;

iii) be so arranged that there is no space in contact with the source of heat in which a pocket of vapour or air might be trapped;

iv) be fitted with a thermostatic control unless it is a heater that has a heating medium with a potential temperature not greater than 100 °C

v) be so arranged as to ensure that when the system is in operation there is a definite convective or forced circulation of fuel around the heating surfaces;

vi) have provision for indicating the temperature of the fuel at the hottest point in the heater; and

vii) have provision for venting air and vapours from the heater.

9.2.2 Steam and other heat-transfer-medium line heaters

i) Internal tubes of line heaters shall be made of seamless or electric-resistance-welded steel pipe. The tubes of a heater should be without joints within the heater body, but, if joints are unavoidable, weld them in accordance with an approved standard

ii) So arrange each line heater as to drain freely and thus avoid any condensation of steam (and water hammering) in the coils.

iii) It is undesirable for condensate from steam-operated fuel line heaters to be returned directly to a boiler water feed system because of the possibility of fuel contaminating the boiler feed water as a
result of tube leakage or fracture in the fuel heater. Where the return of such condensate to the boiler water feed system cannot be avoided, provide adequate facilities for inspection and testing of the condensate.

iv) Fit a non-return valve in each steam line to a heater if it is possible for the oil pressure ever to exceed the minimum steam pressure.

v) The maximum temperature of the heating medium shall not exceed:
   a) 175 °C for fuels with a kinematic viscosity of less than 50 mm²/s at 50°C
   b) 195 °C for fuels with a kinematic viscosity in the range 50-150 mm²/s at 50°C;
   c) 210 °C for fuels with a kinematic viscosity greater than 150 mm²/s at 50°C.

9.2.3 Electric line heaters

i) An electric heating unit shall be of robust construction and have a steel outer sheath or enclosure of such thickness that the sheath or enclosure cannot easily be dented or deformed.

   Support the unit as necessary at suitable intervals along its length and in such positions that it is completely below the lowest fuel level. So arrange the unit that there is always a convective or forced circulation of fuel around the unit.

ii) In order to prevent thermal damage to the film of oil in contact with the heater surface, the maximum loading of any element shall not exceed
   a) 1.8 W/cm² for fuels with a kinematic viscosity of less than 50 mm²/s at 50°C
   b) 1.6 W/cm² for fuels with a kinematic viscosity in the range 50-150 mm²/s at 50°C
   c) 0.9 W/cm² for fuels with a kinematic viscosity greater than 150 mm²/s at 50°C.

iii) A unit should be so designed and constructed that it is of as low a heat storage capacity as possible.

iv) Fit a thermostat to control the electricity supply to the heating unit. Provide also a second thermostat, located as close to the unit as practicable, to cut off the electricity supply if, because of failure of the first thermostat or from any other cause, the temperature of the fuel or of the unit becomes excessive. This second thermostat shall be of the manual reset type to ensure that the electricity supply remains cut off until the cause of the defect has been corrected.

NOTE Electric line heaters may be of the type in which the fuel is surrounded by the heater, in which case a fusible cutout may be used as the second (safety) control, provided that the surface of the fusible metal is not in contact with the fuel and provided also that the electricity supply has to be manually restored.

9.3 Fuel pipe heating

9.3.1 General

9.3.1.1 Where it is desired to provide means of heating fuel pipelines to overcome heat loss or to reduce the viscosity of fuel that has been allowed to cool in the pipeline, such heating may be effected by steam or other heat transfer medium, or by electric heating.
9.3.1.2  Ensure that the heat source can be shut off whenever the fuel pipe is not in service; and, where the rate of input of heat can significantly exceed the rate of loss by natural dissipation, ensure that the means of heating is thermostatically controlled.

9.3.2  Heating by tracer pipes

9.3.2.1  Where heating is carried out by steam or other heat transfer medium in tracer pipes, lay the pipes in contact with the fuel line, the two lines being clipped and bound together with lagging applied overall.

9.3.2.2  Clips and lagging shall be of types that allow for the relative movement arising from differential expansions. It is recommended that, to facilitate dismantling without undue disturbance of the lagging, connections from both fuel and tracer lines be adjacent to one another. Where tracer pipelines are carried around flanges, valves, and other fittings in the fuel line, the loops shall be horizontal (to avoid condensate pockets and air traps).

9.3.3  Heating by jackets and internal pipes

9.3.3.1  Where the heating of the fuel pipe is by steam or other heat transfer medium in jackets on the fuel pipelines or in pipes inside the fuel pipelines, the components shall be designed in accordance with an approved standard. Such systems shall also be designed in accordance with all the appropriate recommendations of 9.2.1, 9.2.2 and 6.4.

9.3.3.2  So arrange all fuel and heat transfer medium joints that they are adjacent to one another. Where steam is used as the heating medium, so arrange the jacket or internal pipes that condensate can be easily drained.

9.3.3.3  Where successive runs of jackets or internal pipe are connected by pipe loops, the loops shall be horizontal (to avoid condensate pockets and air traps). So design the entry of the heating medium into any jacket as to prevent impingement damage to the pipe or jacket.

9.3.3.4  It is undesirable for condensate from a steam-operated heater to be returned directly to a boiler water feed system because of the possibility of fuel contaminating the boiler feed water as a result of tube leakage or fracture in the heater. Where the return of such condensate to the boiler water feed system cannot be avoided, provide adequate facilities for inspection and testing of the condensate.

NOTE  Steam tracer pipes may not be used as internal heating pipes inside fuel pipelines.

9.3.4  Electric heating

9.3.4.1  When heating of fuel pipes is by means of heating cables applied to the external surfaces of the pipes, lay a heating cable in contact with a pipe and apply appropriate insulation over the whole length of the pipe. The closeness of winding shall be such that the heat input does not greatly exceed the rate of loss by natural dissipation at the operating temperature.

9.3.4.2  The closeness of winding, fastenings, and lagging shall be such as to allow for the relative movement arising from differential expansions.

Testing, inspection and maintenance

10.1 General
It is recommended that storage tanks, pumps, pipelines, electrical equipment, and all controls be inspected by competent persons during initial testing.
10.2 Tanks
It is recommended that, after installation, tanks be tested in accordance with an approved standard and, when so required by the purchaser, which a test certificate to this effect be issued (see 4.3).

10.3 Pipe work
Before it is commissioned and, where applicable, before the closing of the trench(es) in which a line is laid, ensure that each completed pipeline is properly fabricated and free from leaks by subjecting it, for at least 1 h, to a pressure of 1.5 times its maximum working pressure or, provided that at least 10% of all welds have been tested by NDT (Non-Destructive Test) methods, to a pressure equal to its maximum working pressure.

10.4 Electrical equipment
i) All electrical apparatus and wiring shall be thoroughly examined by a competent person before they are put into use initially, and after each repair, adjustment, or modification.

ii) Regularly maintain all electrical equipment in accordance with the appropriate recommendations of approved standards. An integral part of such maintenance shall be the inclusion of a full range of tests that simulate the operation of all fuel-level-gauging and pressure-sensing equipment to ensure satisfactory operation.

10.5 Flushing of the system
i) Carry out the flushing of the system in the following two stages:-

a) During the first stage flush the suction pump(s) and delivery line to the point of connection to the distribution pipe work.

b) After satisfactory flushing during the first stage, flush the distribution pipe work using, to flush the line, a quantity of fuel equal to at least 13 times the volume of the line to be flushed and flushing until the product that leaves the pipeline upon completion of the flushing procedure shows no sign of sediment.

ii) Collect the fuel used for flushing the lines and dispose of it in such a manner as to prevent pollution of water courses, sewage drains, and the surrounding ground area.

10.6 Periodic inspections
10.6.1 Inspect all equipment after each repair, adjustment, or modification, and test it as appropriate.

10.6.2 Develop maintenance procedure and checklists for daily, monthly, quarterly, biannually and annual inspections.

10.6.3 For equipment, the checklist should be based on manufacturer’s specifications/recommendations

11 Fire fighting systems
Appropriate firefighting equipment shall be provided in accordance with relevant standards and legislations in Partner States.
12 Colour coding

Appropriate color codes and warning signs shall be used for:

a) Product pipelines
b) Product tanks
c) Valves at loading and offloading points
Figure 2 — Typical vertical cylindrical storage tank for above ground storage of liquid fuel
Figure 3 —Typical underground horizontal cylindrical storage tank
Figure 4 — Typical tank installation in underground chamber.
Figure 5 — Typical tank installation in underground sand-filled chamber
Figure 6 — Rail tank car delivery to horizontal tank
Figure 7 — Rail tank car delivery to vertical tank
Figure 8 — Bulk tanker delivery to horizontal tank
Figure 9 — Bulk tanker delivery to vertical tank
Figure 10 — Bulk tanker delivery to buried tank