TCVN VIETNAM NATIONAL STANDARD

TCVN 5307: 2009

Third edition

PETROLEUM AND PETROLEUM PRODUCTS TERMINAL-DESIGN REQUIREMENTS

(This English version is for reference only)

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Foreword

TCVN 5307:2009 replaces TCVN 5307:2002.

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Third edition

Petroleum and petroleum products terminal – Design requirements

1. Scope

1.1. This standard specifies basic requirements for newly designing, renovating and expanding petroleum and liquid petroleum products terminal.

1.2. This standard can be applied for designing terminal for flammable and combustible liquids which have explosion and fire danger level similar to petroleum and petroleum product properties but under approval of relevant authority.

1.3. This standard is not applicable to design:

- Liquefied gas terminal;
- Petroleum and petroleum products terminal with solidification point equal and greater than 37.8^{o}C;
- Petroleum and petroleum products tanks belonging to equipments of technological line of other constructions;
- Petroleum and petroleum products reserve terminals in underground caverns and on floating dock at closed sea;
- Petroleum and petroleum products tanks at petroleum outlets.

2. Normative documents

Following normative documents are required when applying this standard. For normative documents stated with issuing year, stated version is applied. For normative documents not stated with issuing year, latest version (including changes/amendments) is applied.

TCVN 2622, Fire prevention and protection for buildings and structures - Design requirements

TCVN 4090 - Main pipelines for transporting of oil and oil products – Design standard

TCVN 5334:2007 - Electrical apparatus for petroleum and petroleum products terminal. Requirements on safety in design, installation and operation

TCVN 6608 (ASTM D 3828) - Petroleum products. Test method for determination of flash point by small scale closed tester

TCVN 5303- Fire safety Terminology and definitions

TCVN 7278 (ISO 7203) - Fire extinguishing media. Foam concentrates.

3. Terms and definitions

This standard uses terms and definitions stated in TCVN 5303 and following terms and definitions:

3.1. Petroleum and petroleum products terminal

Complex of building, construction, system of technical pipeline and tanks for containing, reserving, preparing, and supplying petroleum and petroleum products. This is hereby called in short as P&PP terminal or terminal.

3.2. Flammable and combustible material

Materials which under influence of flame or high temperature shall be caught fire, smouldered or carbonized and continue to smoulder or be carbonized after being isolated from firing source.

3.3. Hard flammable material

Materials which under influence of fire or temperature shall be caught fire, smouldered or carbonized and continue to burn, smoulder or be carbonized when having firing source. But when it is isolated from firing source, it stops burning or smouldering.

3.4. Non-flammable material

Materials which under influence of fire or high temperature shall not bust into flame, smoulder or be carbonized.

3.5. Fire resistance limit

Time period from moment when the sample starts to be tested for fire resistance according to standard until one of limited state of structure and components appears.

3.6. Fire resistance level

Fire resistance characteristic according to houses and buildings standard which is determined by fire resistance limit of main structures.

3.7. Flash point

The lowest temperature at which mixture of air and vapor of P&PP on liquid surface flashes in the shortest time in standard condition. (Test method up to TCVN 6608 (ASTM D3828)).

3.8. Fire fighting system

Combination of technical equipments creating one complete system specialized in extinguishing fire.

3.9. Fighting material

Natural materials or mixtures which can stop and extinguish fires (including air foamer, water, chemical powder, inert gas…)

3.10. Fire fighting foam

Foam fighting material created from liquids by mechanical or chemical procedure.

3.10.1. Low expansion foam

Fire fighting foam with expansion lower than or equal to 20 times compared with initial volume of foamer solution.

3.10.2. Medium expansion foam

Fire fighting foam with expansion greater than 20 times to 200 times compared with initial volume of foamer solution.

3.10.3. High expansion foam

Fire fighting foam with expansion greater than 200 times to 1000 times compared with initial volume of foamer solution.

3.11. Fire fighting vehicle

Vehicle carrying specialized equipments for application at firing places or in other emergency conditions.

3.12. Fixed fire-fighting system

Complex of specialized technical equipments, pipeline and fire-fighting material which is fixedly located for extinguishing fire.

3.13. Semi-fixed fire-fighting system

Combination of specialized technical equipments, pipeline and fire-fighting material for extinguishing fire of which one part is fixed and other part is only assembled for completion when fighting fire.

3.14. Density of ejecting foam solution

Amount of foamer solution ejected into fire by an unit of time on an unit of area ($l/s.m^2$).

3.15. Flying funnel

Space limiting obstacles at the top and rear of runway to ensure safety for airplanes.

3.16. Floating roof

Structure with different forms made of metal, composite material or combination of them and having floats upon the surface of P&PP for evaporation protection.

3.17. Fixed roof tank

Vertical cylindrical tank with a roof fixedly welded to the tank's wall.

3.18. Internal floating roof tank

Fixed roof tank with floats upon P&PP surface inside the tank.

3.19. Floating roof tank

Vertical cylindrical tank without fixed roof but with roof floating upon P&PP' surface.

3.20. Edge stopped foam

Steel structure attached on the float to contain fire fighting foam at enclosed buffer between float and tank's wall.

3.21. Pressure vacuum vent

Device for controlling residual pressure and vacuum inside the tank to prevent loss due to evaporation during operation.

3.22. Emergency ventilation

Exhalation of the tank in firing situation when normal ventilation cannot ensure the exhalation timely, in order to prevent breakage of tank's wall.

3.23. Level device

Metal component fixedly installed on tank's wall or tank's bottom to measure products inside the tank.

4. General requirement

4.1. Designing items in P&PP terminal shall meet requirements in current regulation.

4.2. Basing on flash point temperature, P&PP is classified into three types:

- Type 1: including P&PP with flash point temperature less than 37.8^{o}C.

- Type 2: including P&PP with flash point temperature from 37.8^{o}C to less than 60^{o}C.

- Type 3: including P&PP with flash point temperature from 60^{o}C upward.

4.3. P&PP terminal is classified into two groups:

- Group I: including commercial terminal, national reserve terminal and terminal of P&PP processing plant;

- Group II: including terminals of production units (industry, energy, transportation…)

NOTE:

1) Terminal of group II with capacity greater than capacity stated in 6.1 of this standard shall be designed as terminal of group I.

2) For national supply and reserve terminal with capacity less than 1000 m^3 for product type 1 and less than 5000 m^3 for product type 2, type 3, it is allowed designing according to standard for group II terminal. If it contains both of two types, 1m^3 of type 1 product shall be converted to 5m^3 of type 2, type 3 products.

4.4. Tanks, warehouses and items for containing P&PP can be designed in float or underground forms and regulated as follows:

- **Underground**: when tank or warehouse's floor is lay underground and has maximum P&PP level in the tank or total amount of P&PP in barrels broken and spilling over warehouse, which is lower than 0.2m compared with the lowest position of surrounding area (considering within 3m from tank's wall or wall of warehouse) shall be ensured.

  Underground tank must satisfy:

  + Floating tank having a roof covered with a soil layer of minimum thickness 0.3m and soil layer outside tank's wall has a thickness in perpendicular with tank's wall of equal or greater than 3m.

  + Floating tank surrounded by brick, stone or concrete wall of which outer edge is far from tank's wall by a distance equal or greater than 0.3m and upper part covered by brick, stone or concrete with thickness at least 0.3m.

- **Floating**: when requirements for underground tank and warehouses were not satisfied

NOTE:

1) Thickness of filled soil and surrounding wall for underground tank shall be determined according to calculations on static pressure of spilled liquid.

2) Space between surrounding wall and tank shall be filled strictly by sand or soil.

4.5. Depending on reserve product, P&PP shall be stored in fixed roof tank, floating roof tank and internal floating roof tank. Crude oil and products of type 1 shall be stored in floating roof tank or internal floating roof tank.

4.6. Material, components of houses and buildings in P&PP terminal (not including tank) shall have fire resistance limit corresponding to levels of houses and buildings specified in TCVN 2622.

NOTE: Load bearing structure of construction such as: roadway, waterway and railway import and export stations, pumping station, flow meter station are allowed to use steel structure.

4.7. It is required to have corrosion protection method in compliance with technological pipeline in P&PP terminal.

4.8. Corrosion protection for tank can be implemented by one of following methods:

- Coating tank's bottom surface.

- Increasing tank's bottom thickness when designing for corrosion prevention.

- Electrochemical corrosion protection for tank's bottom.

4.9. Basing on explosion and fire hazards, fire hazard and technological characteristics, items of P&PP terminal are classified into five (5) production classes as in Table 1.

Table 1 – Production ranking

Production rank	Production characteristics	Name of construction items and equipments in terminal
A Fire and explosion hazard	Storing, inputting and outputting, processing and using types of P&PP with flashpoint temperature lower than 37.8^{o}C.	Tanks, warehouse, container with vapor concentration. Import and export constructions, pumping station, barreling station, wastewater pumping system, loading and unloading space for P&PP with flashpoint temperature lower than 37.8^{o}C.
B Fire and explosion hazard	Storing, inputting and outputting, processing and using types of P&PP with flashpoint temperature from 37.8^{o}C to lower than 60^{o}C.	The same regulation specified for production class A, but applying for P&PP with flashpoint temperature from 37.8^{o}C to lower than 60^{o}C.
C Fire hazard	Storing, inputting and outputting, processing and using types of P&PP with flashpoint temperature greater than 60^{o}C.	Tanks, barrel terminal, import and export constructions, pumping station, waste water pumping system, loading and unloading space for P&PP with flashpoint temperature greater than 60^{o}C. Storage terminal for

		solid petroleum, substation of which each engine has over 60kg of lubricant oil, material terminal.
D	Production relating to non-flammable material and materials at heating state, melted with exothermal, spark phenomena. Production using solid, liquid material for fueling.	Workshops of forging, welding, repairing, producing barrel, thermal supplying station, power station, substation of which each machine has 60kg lubricant oil and lower.
E	Production relating to non-flammable material at cold state.	Mechanical workshop, water pumping station, refrigeration condenser.

5. Petroleum and petroleum products terminal group I

5.1. Total site

5.1.1. Depending on container capacity, P&PP terminal group I is classified as stated in Table 2:

Table 2 – Terminal classification

Terminal class		**Total terminal capacity, m^3**
I		Over 100 000
II	IIA	Over 50 000 to 100 000
	IIB	From 30 000 to 50 000
III	IIIA	From 10 000 to less than 30 000
	IIIB	Less than 10 000
NOTE: Total terminal capacity is total nominal capacity of containers and other tanks. When determining terminal capacity, it shall not take into account capacity of following containers: - Intermediate containers - Fuel tank for heating furnace		

- Fuel tank for diesel power generator of terminal

5.1.2. Distance for fire protection from production items and constructions with fire and explosion hazards and fire hazard (A, B, C production class in Table 1) of P&PP terminal to houses, construction items of office, factory or public constructions, residential complex and other works outside the terminal area shall follow requirement in Table 3.

Table 3 – Distance from items with explosion and fire hazards and fire hazard of P&PP terminal to constructions outside terminal area

Object to be determined for distance	Minimum distance (m)	
	Terminal class I	Terminal class II and III
1. Houses and buildings of adjacent factories	100	40
2. Forests:	20	20
- Broad-leaved tree	100	50
- Coniferous tree and alang grass		
3. Storages of wood, coal, cotton, hay, straw and open coal mine	100	50
4. Railway	100	80
- Railway station	80	60
- Goods unloading station and branches	50	40
- Main railway		
5. Nearest vehicle road bank-line		
- Road grade I, II and III	50	30
- Road grade IV and V	30	20
6. Distance from the nearest tank to houses and constructions of nearby residential area.	Not less than 2 times of tank diameter but not less than 60m	
7. Fuel filling column at petroleum stores.	30	30

<table>
<tr><td>8. Flambeau light of refining plants or other constructions</td><td colspan="2">100</td><td>100</td></tr>
<tr><td rowspan="3">9. Airport
- within flying funnel area.
- outside flying funnel area.</td><td colspan="3"></td></tr>
<tr><td>2000</td><td colspan="2">1000</td></tr>
<tr><td>1000</td><td colspan="2">1000
(500 terminal level III)</td></tr>
<tr><td>10. Electric post (outside terminal)</td><td colspan="3">1.5 time of electric post height</td></tr>
<tr><td colspan="4">NOTE:
1) Distance stated in the table is the straight line measured by plan projection among external side of structures, partition wall of houses and buildings. For vehicle road, it shall be measured to backline of the road. For railway import and export construction, it shall be measured to railway centre line. When terminal is arranged in woodland, then it is required to trim down the trees.
2) Construction items with production class C, the distance can be reduced by 15% except for point 9 and 10.
3) Construction items with production class D, E, it shall be determined according to requirements for construction, storage and operation.
4) When applying point 9 of Table 3, height of construction items in P&PP terminal shall meet requirements of aviation for vertical clearance for flying field.</td></tr>
</table>

5.1.3. When tanks of P&PP has the level higher than residential area, factories and public railway among which distance is less than 150m, there shall be fire protection dyke and spout discharging products contained in terminal in case of emergency to prevent P&PP from spilling over residential area, factories and public railway.

5.1.4. Designing P&PP terminal shall follow the Law on dyke and related regulations.

When arranging terminal inside dyke area, it shall be apart at least 100m from dyke's foot for terminal level I, 50 m for terminal level II and level III.

For terminal located outside the dyke or for river without dyke system, select the area not liable to scour and P&PP tanks shall be far from highest water level of 40m upward for terminal level I, II and III.

5.1.5. Safe distance from floating tank of P&PP to houses and buildings in terminal shall follow requirements in Table 4.

Table 4 – Minimum distance from floating tanks to terminal items

Terminal items subjected to distance determination	Distance from container according to terminal class (m)	
	I	II, III
1. Waterway import and export ports	75	50
2. Railway import and export construction	30	20
3. P&PP pumping station	20	15
4. Tanker oil filling station, waste water pumping station, barrel filling station; P&PP barrel reserve area; empty barrel site; terminal of P&PP barrels.	30	15
5. Houses and building using open fire: - P&PP tank of type 1. - P&PP tank of type 2, type 3.	50 30	40 20
6. Fire fighting water pumping station, water taking position of fire water reserve container or pond.	40	40
7. To waste water cleaning work: - Sedimentation pond, evaporation pond. - Decant pond, floatation tank, and sedimentation tank with capacity over 400m^3. - Decant pond, floatation tank, sedimentation tank with capacity from 100m^3 to 400m^3. - Decant pond, floatation tank, sedimentation tank with capacity lower than 100m^3.	 30 30 15 10	 30 20 15 10
8. Other houses and buildings of terminal, boundary walls	25	20
9. Overhead plain conductor	Equal to 1.5 times of the highest	

	electric post height, in general for all terminal classes.

NOTE:

1) For underground tank: point 6 is reduced by 25%; Points 1, 3, 4, 7 and 8 are reduced by 50%.

2) For underground tank to underground pumping station; it is allowed to have a distance up to 1m from the wall.

3) For lubricant oil pumping station, fuel oil pumping station (FO), lubricant oil tank or fuel oil tank, it is allowed to arrange with distance of 3m. Lubricant oil pump with explosion protection electric engine is allowed to be directly placed on lubricant oil tank

4) Distance from floating tank to houses and buildings toward their closed wall (without opening holes) of which fire resistance limit is not less than 2h can be reduced by 10%.

5) For terminal level III with floating tanks of capacity less than 5000m^3, distance from P&PP tank to buildings equipped with automatic fire fighting system can be reduced by 25% (except for point 5 and 6).

6) In special cases, under reasonable explanations and agreement of fire protection authority, distance value in table 4 can be reduced not over by 15%.

5.1.6. Safety distance from houses and buildings of P&PP terminal (excluding tank) to railway, tanker, waterway import and export stations shall be:

- For P&PP type 1: not less than 15m;

- For P&PP type 2, type 3: not less than 10m.

5.1.7. Fire safety distance from houses and buildings which during production open fire is used toward tanker and waterway import and export equipments, P&PP pumping station, valve cluster of pumping system, pumping station and oil contaminated water clarifying works, P&PP barrel storage area, barrel filling area shall meet following requirements:

- For P&PP type 1: not less than 40 m;

- For P&PP type 2, type 3: not less than 30m.

5.1.8. Distance from houses and buildings (excluding tank and production construction using open fire) to sedimentation pond, open-type oil collector shall not be less than 20m and not less than 10m for close-type collector.

5.1.9. Distance between two houses or two buildings not specified in above regulation shall be determined in Table 5.

Table 5 – Distance between two houses or two buildings

Fire resistance level of houses or buildings	Distance between buildings or constructions, m		
	Fire resistance level of nearby building or construction		
	I and II	III	IV and V
I and II	- Not regulated for houses and buildings with production class D and E. - 9m for building or construction with production class A, B and C	9	12
III	9	12	15
IV and V	12	15	18
NOTE: For houses and buildings with fire resistance level of I and II corresponding with production class A, B and C in Table 5, distance between houses and buildings shall be reduced by 9m to 6m if there one of two following conditions is present: a) Equipped with a fixed automatic fire alarm system. b) Mass of flammable materials regularly present in houses from 10kg/m^2 floor downward.			

5.1.10. Houses and buildings in P&PP terminal shall be arranged in functional divisions as in Table 6.

Table 6- Functional division of items in P&PP terminal

Area name	Name of houses and buildings within the area
1. Railway import and export area	Railway import and export, pumping station, air compressor, oil receiving tank, barrel warehouse, working space for workers and other constructions relating to railway import and export.
2. Waterway import and export	Import and export port, pumping station, chemical laboratory,

area	working room and other constructions relating to waterway import and export.
3. P&PP tank area	P&PP tank, vapor concentration tank, product heating equipment, pumping station, air compressor.
4. Road import and export area, production serving items	Tanker filling station, barrel filling station and other containers, barrel store, barrel space, pumping station, filtering equipment, weighting station.
5. Other auxiliary houses and buildings	Machine workshop, barrel repairing and clarifying workshop, electric generator station, transformer station, thermal source, material warehouse, chemical laboratory and other service constructions.
6. Office area	Office building, garage, standing security office…

5.1.11. There shall be vehicle road of at least 6m width connecting P&PP terminal to public vehicle road. For a floating road length over 1000m, it is allowed to build a vehicle road of 3.5m wide but each 250m length shall has a passing point with a width of 6m- the minimum length ensuring for the longest tanker go into the passing point. For dead end road, there shall be turning point for fire fighting vehicle.

5.1.12. P&PP terminal shall have boundary wall or fence made of non-flammable material with a height of at least 2m. Distance from terminal items to wall or fence is specified as follows:

- Railway import and export at both sides (from nearest edge to the fence): not less than 15m.

- Houses and buildings not relating to storing, inputting and outputting P&PP shall be far from the fence at least 5m (except for executive office, auxiliary houses and buildings).

5.1.13. Terminal level I and II shall have at lest two gates facilitating vehicle transportation and be connected to public vehicle road or terminal entrance. P&PP terminal level III is allowed to have one gate.

5.1.14. Road for fire fighting vehicle shall be arranged around tanks and toward closely to constructions relating to inputting, outputting and storing P&PP. Surface of road shall be at least 3.5m wide and covered by hard flammable material.

If tanks are arranged in a row, when agreed by fire protection authority, it is able to arrange vehicle road at one side of tank area, there shall be spaces at other sides to allow fire fighting equipments coming closely to tank area when necessary.

5.2. Petroleum and petroleum products tank

5.2.1. P&PP tank shall be made of non-flammable material and shall be in compliance with property of product type inside the tank.

5.2.1.1. Tank's bottom shall be covered by non-flammable or hard flammable material.

5.2.1.2. P&PP tank can be of welded, riveted, bolted connection or combination of them.

5.2.1.3. P&PP tank shall be equipped with following basic equipments:

- Pressure vacuum vent (with or without fire prevention equipment), light hole, pressure vent (when not installing pressure vacuum vent), manual level measurement hole, sampling hole, inlet gate, bottom water exhaust, level measurement equipment support pipe, level measurement panel.

- Stairway components, hand-rail for tank shall be conveniently and safely mounted for operation and forming standard level of the tank.

NOTE:

1) For product type 3 in fixed roof tank, or product type 1, 2 contained in internal floating roof tank, it is able to not require pressure vacuum vent.

2) When installing automatic measurement devices (level, density metering, sludge, temperature, overflow indication), it is required to arrange proper holes for those devices.

3) See 5.9 of this standard for installing equipment conducting fire fighting foam into tank.

4) Light hole and manual level device hole shall have air tight cover.

5.2.2. Pressure vacuum vent for fixed roof tank shall be designed in compliance with tank working condition. It is required to install fire protection equipments for pressure vacuum vent taking into account hindrance of fire protection equipment and other factors threatening the tank. Emergency ventilation for fixed roof tank is implemented by installing emergency safety valve on the tank roof, which is automatically opened when tank pressure exceeds safety value.

5.2.3. For internal floating roof tank not equipped with pressure vacuum vent, vents shall be mounted. Vents can be arranged near roof centre or edge under following regulations:

- Vent near roof centre has discharge area of at least 0.03 m^2.

- For vent arranged at roof edge, at least at each 10m perimeter there shall be one vent and not less than 4 vents in all cases. Total cross section of vents shall not be less than 0.06D m^2 (D- tank diameter, measured in meter).

5.2.4. For underground tank, pipe diameter and length mounting pressure vacuum vent shall be determined in compliance with import and export flow and tank designed pressure. Output end of vent

or pressure vacuum vent of underground tank containing product type 1 shall be arranged outside the tank at a higher position than input end and shall higher than surrounding ground at least 3.6m. For underground tank containing product type 2 and 3, it is required to be higher than input end and surrounding area at least 0.5m. Output end of vent or pressure vacuum vent shall be far from terminal constructions at least 3m and not affecting surrounding working area.

5.2.5. For tank equipped with measurement equipments automatically transmitting signal to centre (level, temperature, density, sludge, overflow indicator), safety as regulated in 5.11 of this standard must be ensured.

5.2.6. Underground and floating tanks in waterlogged area (due to flood, underground water) shall have a floating resistance method.

5.2.7. Floating tank area of P&PP shall be arranged by groups. Total capacity of each tank group is stated in Table 7.

Table 7- Total acceptable nominal capacity in a group of P&PP tank

Tank type	Nominal capacity of a tank stated in group (m^3)	Type of P&PP contained	Total acceptable nominal capacity in the group (m^3)
Floating roof tank	50 000 and greater	Not depending on type of product	200 000
	Less than 50 000	Not depending on type of product	120 000
Internal floating roof tank	50 000	Not depending on type of product	200 000
	Less than 50 000	Not depending on type of product	120 000
Fixed roof tank	50 000 and less	P&PP with flashpoint temperature over 37.8^{o}C	120 000
	50 000 and less	P&PP with flashpoint temperature equal and lower than 37.8^{o}C	80 000

For underground P&PP tank area, shared free surface area shall not exceed 14 000 m^2 and free surface area of each tank shall not be greater than 7000 m^2.

For horizontally laid cylindrical tank with capacity of each tank less than 100 m^3, capacity of each group shall not exceed 5000 m^3 when undergrounded. For floating tank group containing product type 1, group capacity shall not exceed 500 m^3 and for floating tank group containing product type 2 and 3, group capacity shall not exceed 2500 m^3.

5.2.8. Distribution of tanks in a group shall be as follows:

- Not exceeding 4 rows for tanks with nominal capacity less than 1000 m^3.

- Not exceeding 3 rows for tanks with nominal capacity from 1000 m^3 to 10000 m^3.

- Not exceeding 2 rows for tanks with nominal capacity from 10 000 m^3 upward.

5.2.9. Fire prevention distance among P&PP tanks:

5.2.9.1. Floating tanks with capacity less than or equal to 400 m^3 shall be arranged by groups of which capacity shall be less than or equal to 4000 m^3 in the same ground area. Safety distance among tank walls in the group shall be determined basing on constructing, maintaining and operating condition. Fire protection distance among nearest walls of neighboring groups with capacity up to 4000 m^3 shall not be less than 15m.

5.2.9.2. Minimum distance between two walls of floating tank in a group:

- For fixed roof tank, internal floating roof tank, floating roof tank with diameter equal to and less than 45m, distance shall be taken by 1/6 of total diameter of two adjacent tanks.
- For floating roof tank with diameter greater than 45m, distance shall be taken by ¼ of diameter of two adjacent tanks.
- For fixed roof tank, internal floating roof tank with diameter greater than 45m containing product type 1, 2, the distance shall be taken by 1/3 of total diameter of two adjacent tanks. For those tanks containing product type 3, the distance shall be taken by ¼ of total diameter of two adjacent tanks.

NOTE:

1) When two adjacent tanks contain different products, safety distance shall be determined according to products with lower flashpoint.
2) For horizontal cylindrical tank, minimum distance shall be 0.9m.

5.2.9.3. Distance among underground tanks in a group shall not be less than 1m.

5.2.9.4. Distance among nearest tank walls of an adjacent group (except for tank groups stated in 5.2.9.1 of this standard)

- For floating tank: at least 30m

- For underground tank: at least 15m.

5.2.10. Each floating tank group with capacity specified in 5.2.7 shall have fire protection boundary dyke of which structure shall be calculated by hydrostatic pressure of P&PP overflow.

- If boundary dyke is made of soil, the dyke top must have a width not less than 0.5m.
- If boundary dyke is made of bricked wall or concrete, dyke top must have a width not less than 0.25m.
- Height of fire boundary dyke outside the tank group shall be higher 0.2m compared with liquid level inside the greatest overflowed tank.

External fire boundary dyke shall not be higher than 2m compared with plan level inside and outside the dyke. When the fire protection dyke higher than 2m shall be done, it is required to ensure accessibility to the dyke for fire fighting of tank area and be agreed by relevant fire protection authority.

5.2.11. For each floating tank group, there shall be sub-dyke with a height not less than 0.8m to divide the group into sub-groups under following regulations:

- Total capacity of tanks in each sub-group not exceeding 20 000 m^3.
- Each tank with capacity equal to and greater than 20 000m^3 shall be separated by sub-dyke.

5.2.12. Distance from vertical cylindrical floating tank to internal edge of dyke foot that prevent fire from outside shall not be less than half of diameter of tank near the dyke and not over 15m. Distance from floating tank with capacity equal to and less than 100 m^3 to internal edge of dyke foot shall not be less than 1.5m.

NOTE: In special case and under agreement of relevant authority, distance from tank wall to internal edge of external fire boundary dyke can be reduced at maximum by 40% but still meeting requirements in 5.2.10.

5.2.13. Each floating tank group shall ensure at least 4 entrances toward face-to-face tank area and at least 2 entrances for independent vertical tank. When having fire sub-dyke, there shall be at least 2 entrances passing through the dyke, which are built by non-flammable material.

5.2.14. After newly installing repairing the tank, it is required to test quality of weld line of tank wall, tank bottom and test tightness of tank roof. Not allowed to carry out air pressure testing for tanks already containing P&PP.

5.2.15. Take hydrostatic pressure load test for tank before putting it into application for new installation and big repair. Time for this load test is stated as follows:

- For tank capacity under 5000 m^3, the test shall remain at least 24h.

- For tank capacity over 5000 m^3, the test shall remain at least 72h.

5.3. Technological pipeline in terminal

5.3.1. Terminal technological pipeline shall be made of non-flammable material and in accordance with property of carried product type. Technological pipeline diameter and thickness shall be calculated in compliance with speed, flow, transfer pump pressure and working environment. Pipe wall thickness is measured as in Annex A.

5.3.2. After completing installation of technological pipeline, it is required to have pressure test. The pipe section for pressure testing shall be separated with other pipes connected to it by a flange or stop valve and shall meet following requirements:

- Strength test with regulated testing pressure.

- Tightness test after reducing testing pressure to working pressure.

It is not allowed to take the air pressure test for used technological pipeline for P&PP transmission.

5.3.3. Time of hydraulic strength test for technological pipeline shall not be less than 6h. Then testing pressure shall be reduced to working pressure for tightness test and check the pipe section to be tested. Pipeline shall be considered to meet requirements of hydraulic test for strength and tightness if testing pressure does not change during 6h and the any leakage is detected on testing pipe section.

5.3.4. Hydraulic inspection for strength of pipeline shall be carried out as follows:

- For technological pipe with working pressure equal and lower than 5bar, testing pressure shall be 1.5 times of working pressure but not less than 2bar.
- For technological pipe with working pressure greater than 5bar, testing pressure shall be 1.25 times of working pressure or equal to working pressure added with 3bar, whichever greater.

5.3.5. Terminal technological pipeline can be placed on ground surface, in technological trench or buried underground. When it is placed inside technological trench, the trench structure shall be made of non-flammable material and its bottom shall dip toward the concentration pond connected to sludge collector system.

5.3.6. Horizontal distance from external edge of technological pipeline with working pressure less than 25bar to other houses or buildings is stated in Table 8.

Table 8 – Distance from technological pipeline to terminal items

Items subjected to distance determination	Minimum distance from technological pipeline edge, m	
	open pipeline	Pipeline inside trench or underground
1. Other house and building foundation	3 (0.5)	3.0
2. Wall of P&PP tank	3.0	4 (but not less than the distance from tank wall to water drain of tank foundation)
3. Foundation edge of terminal fence, headlight post, pipe support column, communication line	1.0	1.5
4. Railway centre line	4.0	4 (but not less than the distance from water drain to railway base)
5. Vehicle road: - Road edge - Slope of embankment	 1.5 1.0	 1.5 1.5
6. Edge of power post foundation: - Under 1kV and outer lighting - From 1kV to 35kV - Over 35kV	 1.0 5.0 10	 1.5 5.0 10
7. Water supplying pipeline, water drain pipeline	1.0	1.5
8. Heat pipeline (to outer side of trench's wall)	1.0	1.0
9. Pipeline with electric cable lower than 35kV and communication cable	10	10

NOTE:

1) Distance value in parenthesis is the distance to foundation edge with solid wall of building or construction.

2) Distance in point 1, 2 and 4 does not take into account pipe piece connected to import and export station of tanker wagon, other import and export works and tanks.

3) Distance in point 8 does not include heat pipeline of crude oil pipeline, fuel oil, as technology's requirement.

5.3.7. Distance from pipeline outside terminal area which is used to carry P&PP to the import and export station for waterway, railway, tanker, heat station of terminal and neighbor P&PP terminal with working pressure under 25bar and buried underground at least 0.6m shall be regulated as follows:

- To national railway, vehicle road, rail bridge, road bridge and other constructions not belong to P&PP terminal in parallel with technological pipeline; it shall not be less than 15m.
- To parallel public water supply and drain pipeline, it shall not be less than 10m.
- To overhead transmission line, subway cable and power station, distance shall meet current requirements for high voltage safety protection.

NOTE: The distance can be reduced by 30% if there is method for improving safety which is accepted by fire protection authority.

5.3.8. Vertical distance of technological pipeline is specified as follows:

For technological pipeline placed on ground surface: From ground surface to pipe bottom, it shall not be less than 0.3m. If surface is concrete, asphalt or metal floor, this distance shall not be less than 0.15m.

For technological pipeline passing through obstacles:

- From passenger road to pipe bottom: not less than 2.2m
- From vehicle road to pipe bottom: not less than 4.5m
- From top of railway to pipe bottom: not less than 6m.

NOTE: If technological pipeline crosses the road which is required to have support structure, the above distance shall be distance from road surface, rail top to the lowest position of pipe support structure. The support structure shall be made of non-flammable material.

5.3.9. Pipeline is not allowed passing through building foundation or passing over the houses and buildings not relating to P&PP import and export.

Technological pipeline for P&PP with flashpoint temperature under 37.8^{o}C shall be not allowed to be placed in the same trench with vapor pipeline.

Technological pipeline passing underground through vehicle road, railway shall be placed in bushes or trench to avoid vehicle load acting directly on the pipe. When installing bushes, diameter of bush shall be greater than external diameter of technology pipe (including cover layer) at least 100mm.

5.3.10. P&PP receiving terminal by main pipeline shall have pressure relief valve to ensure safety for equipments, tanks and technological pipeline in the terminal.

5.3.11. Heated or opened technological pipe shall be equipped with heat compensator. Thermal isolation shall be made of hard flammable material.

5.3.12. Buried technological pipeline shall be at the depth of at least 200mm from ground surface to the highest position of pipe wall.

5.4. Terminal and site of petroleum and petroleum products in barrel

5.4.1. Terminal for P&PP stored in barrels shall have following fire resistance level:

- P&PP storage in barrels with flashpoint temperature less than and equal to 120^{o}C or warehouse area from 300m^2 upward shall have at least fire resistance level II;
- P&PP storage with flashpoint temperature above 120^{o}C or warehouse area smaller than 300m^2 shall have at least fire resistance level III.

5.4.2. Terminal for storing P&PP in barrels can be arranged with barrel filling station or product pumping station but they shall be separated by fireproof wall with fire resistance limit of at least 1h and warehouse shall have direct exit outward.

5.4.3. Terminal for storing P&PP in barrels shall be divided into multiple chambers which shall be separated by fireproof wall.

Each chamber capacity is stated as follows:

- P&PP type 1 not exceeding 100m^3;
- P&PP type 2, 3 not exceeding 500m^3

Each warehouse capacity is stated as follows:

- P&PP type 1 not exceeding 600m^3;
- P&PP type 2, 3 not exceeding 3000m^3.

5.4.4. It is allowed storing barrels of petroleum type 1 with barrels of petroleum type 2, 3 but total capacity of two types stored in the same chamber shall not exceed 100m^3 and not exceed 600m^3 in the same warehouse.

5.4.5. Entrance and exit gates of P&PP terminal in barrels shall have dimensions ensuring safety for loading and transporting facilities and meet following requirements:

- Minimum gate width: 2.1m.

- Minimum gate height: 2.4m

- Gate shall be made from material have fire resistance limit of at least 0.6h.

- Doorstep over 0.5m height.

5.4.6. Floor of P&PP terminal in barrels shall be made of non-flammable material with proper slope and drain orienting flows toward concentration pond and connected to outside drainage system via stopping hole. Steps for warehouse shall be of at least 0.8m wide and made of non-flammable material.

5.4.7. Terminal for P&PP storage in barrels is specified as follows:

- Manual arrangement: Not over 3 stores of barrel.
- Arrangement on shelf: each shelf storey allows one layer of barrel. Shelf width shall not be greater than 2 times of barrel length
- Mechanical arrangement: P&PP type 1 can be loaded in overlapped layer but not over 3 layers. For P&PP type 2, 3, overlapped layers are allowed but not over 5 layers.

Barrels are loaded in rows, each row not over 2 barrels. Path for rolling barrel shall be not less than 1.8m wide. Path between two shelves shall be suitable for operation of shelf loading equipment and not less than 1m wide.

5.4.8. Floor, platform for unloading barrels of P&PP for railway carriage and vehicle shall be made of non-flammable material and spark resistance.

5.4.9. Space for P&PP type 2, 3 in barrels shall meet following requirements:

- Each space dimension: not exceeding 25m long and 15m wide.
- Path width for mechanical unloading facilities depending on type of facility but not less than 1.4m.
- Human pathway among spaces not less than 1m.
- Distance between spaces in one area not less than 5m. Distance between neighboring spaces not less than 10m.

5.5. Pumping station, chemical laboratory for P&PP terminal

5.5.1. Pumps for P&PP can be placed indoor, covered or in uncovered space. Pumps for lubricant oil and fuel oil shall be arranged far from lubricant oil tank and furnace fuel tank at least 3m.

5.5.2. Inside pumping station, it is allowed to have cathode station, room for installation of automatic control equipments in compliance with TCVN 2622.

5.5.3. Valve system for isolating, stopping incidents in technological pipeline which connects P&PP tanks to pumping station or from pumping station to railway import and export or tanker filling station shall be at least 3m.

NOTE:

1) Distance is measured from nearest valve centre line to external edge of boundary wall of pumping station.

2) If there is no boundary wall, distance shall be measured from valve centre line to external edge of support column of pumping station roof.

5.5.4. When technological valve space is arranged inside pumping station surrounded by boundary wall, number of main pumps (not including dredge pump, vacuum pump and backup pump) shall meet following requirements:

a) At terminal level I and II: not over 6 pumps for P&PP with flashpoint temperature lower than 120^{o}C (except for fuel oil (FO)) and not more than 10 pumps for P&PP with flashpoint temperature equal to and higher than 120^{o}C (including fuel oil).

b) At terminal level III: not over 10 pumps for P&PP with flashpoint temperature lower than 120^{o}C (except for fuel oil (FO)) and not regulating the pump quantity for P&PP with flashpoint temperature equal to and higher than 120^{o}C.

NOTE: When needed, technology valve space should be roofed preventing from sun and rain by non-flammable material without boundary wall. In this case, technology valve space is considered to be outside pumping station.

5.5.5. If P&PP pumps are placed indoor, pumping station shall have at least fire resistance level II.

Floor of valve cluster of pumping station shall have slope for water drainage and connected to water drainage system through stopping hole.

5.5.6. Distance between two adjacent pumps in a pumping station shall be convenient for installation, maintenance, operation and exit in emergency condition.

5.5.7. Walls separating pump space from other spaces where pipeline passes, shall be sealed to ensure not diffusing P&PP vapor from pumping station to other spaces.

5.5.8. Electric equipments in pumping station shall be explosion-proof. If pumping station is used for transfering various types of petroleum, it is required to take P&PP with lowest flashpoint temperature as a base for selecting explosion-proof equipments.

If using un-explosion proof electric engine, it must separate the electric engine space and pump space by partition wall with fire resistance limit of at least 0.75h. Aperture at the position where movement axle connects engine to pump passing through the wall shall be sealed by non-flammable material.

5.5.9. Chemical laboratory for P&PP shall have at least fire resistance level III. Allow to arrange chemical laboratory with other rooms in a same building but it shall be isolated by fireproof wall with fire resistance limit of at least 1h and shall have independent door to outer space or to the shared corridor

of building. Door of chemical laboratory shall be of reversed type. It is not allowed to arrange chemical laboratory within items with production class A and B.

5.5.10. Chemical laboratory shall have individual spaces for compressor, gas producer, sample storage and other chemicals for experiments but these spaces shall be isolated by fireproof wall with fire resistance limit of at least 1h and have reversed doors.

5.6. Railway import and export

5.6.1. Designing and building railway in P&PP terminal shall meet current regulations.

5.6.2. Railway import and export work shall be arranged on straight and flat area.

NOTE: For terminal level III, if import and export frame is only implemented at one side, it is able to arrange this frame at curve piece with radius not less than 200m.

5.6.3. Import and export work can be one side type or two side type. Structure of import and export frame shall be made of non-flammable material. Distance between steps of import and export frame shall not exceed 100m and there shall be stairway at the end and the top.

5.6.4. Distance from railway centre line permitting locomotive pass to nearest railway centre line having import and export construction shall not be less than 20m for P&PP with flashpoint temperature smaller than and equal to 120^{o}C and not be less than 10m for P&PP with flashpoint temperature greater than 120^{o}C.

Distance between two adjacent railway centre line of two parallel import and export works shall not be less than 20m.

5.6.5. Distance from railway center line to projected part of import and export work shall be determined corresponding with dimension of access rail carriage.

5.6.6. Stub branch length of railway having import and export work needs to increase by 20m from edge of tanker wagon to stopping column.

5.7. Dock and waterway import and export work for P&PP

5.7.1. Design of dock for inputting and outputting P&PP shall be in compliance with requirements of current regulations. Dock and import and export construction shall use non-flammable material; floor dimension and approach bridge shall be suitable for installation of import and export equipments, pipeline, path and operation space. It is required to arrange pipeline for foaming solution and fire fighting equipments at proper positions.

5.7.2. Safety distance for dock is stated as follows:

a) Safety distance from P&PP import and export docks on sea, lake to dry goods unloading dock, passenger ship dock, military port, tourist port and other docks is stated as follows:

- Dock for inputting and outputting P&PP type 1 (including aviation fuel): 100m.

b) Safety distance from P&PP import and export riverside dock at downstream to riverside objects is regulated as follows:

- Fixed military port, goods port: 200m.
- Hydroelectric constructions, domestic water system and other docks: 300m
- Other constructions: 50m

c) Safety distance from riverside import and export construction for P&PP at upstream to objects is stated as follows:

- Fixed military port: 1000m
- Hydroelectric constructions, domestic water system and other docks: 500m.
- Other constructions: 200m.

NOTE:

- For docks for inputting and outputting P&PP type 2, type 3, distance regulated in point a), b) and c) can be reduced by 35%.
- For import and export dock for transport equipments with load less than 300 tons, distance regulated in b) and c) can be reduced by 50%.
- Above distances shall be measured from outer edge of P&PP import and export dock to outer opposite edge of above objects.

5.8. Tanker filling and barrel filling place

5.8.1. Place for tanker filling shall be arranged so that tanker get emergency exit in the soonest for fire situation. The place can be covered or uncovered. Cover shall have at least fire resistance level II.

It is allowed to arrange filling equipments for P&PP type 1, type 2 and type 3 at the same place.

5.8.2. Safety distance from tanker filling site to constructions (excluding tank) in P&PP terminal shall be in compliance with requirements in 5.1.6 and 5.1.7 of this standard.

5.8.3. P&PP filling equipments into barrels and other small containers can be arranged at roofed site or indoor but with at least fire resistance level II. In terminal level III, filling of products with flashpoint temperature equal to or greater than 120^{o}C, roof or house shall have at least fire resistance level III.

5.8.4. Tanks for filling into barrel or other smaller containers shall have capacity for each equal to or less than 25m^3 and total capacity shall not be greater than 200 m^3, placed next to solid wall of filling site and far from external edge of wall not less than 2m. Tank gap shall not be less than 1m.

Tanks for filling products with flashpoint temperature equal to or greater than 120^oC and with capacity smaller than 25m^3 can be arranged inside of work for filling into barrels and/or other smaller containers.

5.9. Water supply, fire prevention and protection

5.9.1. Besides meeting requirements in this standard, water supply system, fire prevention and protection system for P&PP terminal shall be designed in compliance with standard for urban water supplying system, fire fighting standard for houses and buildings and current regulations on environment protection.

5.9.2. Regulations on density of ejecting foam solution, time of ejection, and number of ejecting nozzles for tanks in this standard shall be only applied for designing fire protection system by spraying foam on surface of P&PP and only using foamer with low and medium expansion. When other fire fighting method or foamer with high expansion are used, that method shall be proved for safety level and approved by relevant fire protection authority.

5.9.3. P&PP terminal shall be equipped with fire fighting vehicles and fire fighting pump system as follows:

- Terminal level I: shall have at least two fire fighting vehicles.
- Terminal level IIA: shall have at least one fire fighting vehicle and one mobile fire fighting pump with capacity similar to fire fighting vehicle's pump.
- Terminal level IIB and level III: shall have at least one mobile fire fighting pump and one backup pump having same specifications of main pump.

Fire fighting vehicle and pump shall have required flow and pressure as well as the property of fire extinguishment by water and foam.

5.9.4. P&PP terminal shall be equipped with initial fire fighting equipments with numbers and types as in Annex C.

5.9.5. Terminal shall be equipped with fire fighting system as follows:

5.9.5.1. Fixed fire fighting system shall be equipped for:

- Floating tank with diameter equal to or greater than 18m.

- Floating tank with capacity equal to or greater than 2000 m^3.

- Floating tank with height equal to or greater than 15m.

NOTE: Container area arranged with 3 rows of tank shall meet clause 5.2.8 of this standard.

5.9.5.2. Semi-fixed fire fighting system shall be equipped for:

- Floating tank with diameter smaller than 18m.

- Floating tank with capacity from 400m^3 to less than 2000 m^3.

- Floating tank with height from 6 to less than 15m.

- Underground tank with capacity equal to or greater than 1000m^3.

NOTE: For terminal of fuel oil, arranged in one or two tank rows (not depending on tank capacity or dimension), it is able to equip semi-fixed fire fighting system under agreement of relevant fire protection authority.

5.9.6. For terminal allowed to be equipped with semi-fixed fire fighting system, at least following equipments of the system shall be fixedly installed:

- For floating tank: foaming nozzle, foaming solution conduit, wall cooling pipe fixedly installed on tank wall and lengthening at least to waiting pipe throat that is placed outside fire prevention dyke.
- For underground tank: pump, valve cluster of tank containing foaming solution (foamer containing equipment), foam mixer, foaming solution conduit, water conduit toward waiting throat.

5.9.7. For waterway import and export port, if no individual fire fighting system is present, there shall be foam pipeline connected from the shared foam piping system of the terminal to the port and arrange foam column at suitable position for fire fighting implementation. Initial fire fighting equipments for the port shall be determined as in Annex C.

5.9.8. For tanks with capacity less than 400m^3, it is not required to have fixed or semi-fixed fire fighting system but be able to use fire fighting pump mounted in the terminal.

5.9.9. For terminal having tanks with different roof type and dimensions, containing products with different flashpoint temperature, amount of foamer and water for fire fighting shall be determined as for greatest demand of fire fighting solution (calculations as stated in Annex B of this standard).

5.9.10. For fixed roof tank (without internal floating roof), minimum ejection time, ejection density and number of ejection nozzles for fire fighting for water tanks are stated as follows:

5.9.10.1. When foaming nozzles are fixedly installed on tank using foamer with medium expansion multiple, follow regulations in Table 9:

Table 9 – Density of ejecting foam solution with medium expansion multiple

Type of P&PP	**Density of ejecting foam solution,** $l/s.m^2$	**Ejecting time,** min
For P&PP with flashpoint temperature less than and equal to 37.8°C	0.08	10
For P&PP with flashpoint temperature greater than 37.8°C	0.05	10

5.9.10.2. When foaming nozzles are fixedly installed on tank using foamer with low expansion multiple, it is required to follow regulation in Table 10.

Table 10 - Density of ejecting foam solution with low expansion multiple

Type of P&PP	**Density of ejecting foam solution,** $l/s.m^2$	**Ejecting time,** min
For P&PP with flashpoint temperature less than and equal to 37.8°C	0.068	55
For P&PP with flashpoint temperature greater than 37.8°C to 93.3°C	0.068	30
Crude oil	0.068	55
NOTE: Foaming nozzles used in this term are those installed on tank wall with screen plate to guide the foam or nozzle set on floating roof.		

5.9.10.3. Number of foaming nozzles fixedly installed on fixed roof tank is stated in Table 11.

Table 11 - Number of foaming nozzles fixedly installed on fixed roof tank

Tank diameter, m	**Minimum number of nozzles**, unit
Up to 24	1
Greater than 24 up to 36	2
Greater than 36 up to 42	3
Greater than 42 up to 48	4
Greater than 48 up to 54	5
Greater than 54 up to 60	6

5.9.11. For floating roof tank, when the roof is manufactured in form of metallic double disc or single disc attached on metallic float, the minimum ejection time, ejection density and distance for arrangement of nozzles as well as free surface area for injecting are regulated as follows:

For foam with low expansion:

- Foam ejection density: 0.2/l/s.m^2.
- Minimum ejection time: 20 minutes
- Nozzle gap corresponding to tank perimeter, depending on height of foam stopped edge.
- Ejection free surface area: equal to annular area within tank wall and foam stopped edge.

For foam with medium expansion:

- Foam ejection density: 0.25/l/s.m^2.
- Minimum ejection time: 10 minutes
- Nozzle gap corresponding with tank perimeter, depending on height of foam stopped edge.
- Ejection free surface area: equal to annular area within tank wall and foam stopping edge.

NOTE:

1. Way to input foam into floating roof tank and internal floating roof tank are stated in Annex D.

2. Form of double disc floating roof, single disc roof and foam stopped edge, see Annex E. Other floating roofs are not subjected to this requirement.

5.9.12. For internal floating roof tank

5.9.12.1. When internal roof is a metallic double disc, single disc attached on metallic float or when floating metallic roof has metallic floating components which prevent foam penetration, the ejection time, ejection density and distance for arranging foaming nozzles as well as foaming free surface area shall be determined in accordance with clause 5.9.11 of this standard.

5.9.12.2. For internal floating roof other than types stated in 5.9.12.1, then ejection time, ejection density, free surface area and distance for arranging foaming nozzles shall be determined as for fixed roof tank stated in clause 5.9.10 of this standard. If this case applies clause 5.9.11 of this standard, it shall be approved by relevant fire protection authority.

5.9.13. In a tank block with total capacity less than 4000 m^3 and the greatest tank has capacity less than 400m^3 , arranged as in 5.2.9.1, tanks in the block shall be considered as a tank and conventional free surface area for determining foaming solution shall not be greater than 300m^2 in all cases.

5.9.14. In addition to foam ejection equipments fixedly installed on the tank, it is required to arrange auxiliary foam solution column outside the fire prevention dyke to extinguish fire inside the dyke caused by oil spilling. Foam flow for each column shall be at least 189l/min. Number of additional foam columns and its minimum operation time shall meet requirements in Table 12 and Table 13. Amount of foam solution for the tank shall be equal to the total amount of foam solution determined in this article and amount determined as in 5.9.9 of this standard.

Table 12 - Number of additional foam solution columns

Maximum tank diameter, m	**Number of additional columns**, unit
Less than 19.5	1
From 19.5 to 36	2
Greater than 36	3

Table 13 - Minimum operation time for foam solution columns

Maximum tank diameter, m	**Minimum operation time ,** min
Less than 10.5	10
From 10.5 to 28.5	20
Greater than 28.5	30

5.9.15. Foam reserve factor (K) for fire fighting in P&PP tank area is stated as follows:

- For foam with medium expansion K = 3.
- For foam with low expansion K =2.

NOTE: Amount of reserve foam shall be calculated for the greatest fire.

5.9.16. Intensity and time for watering the fired tank perimeter and half of perimeter of neighboring tanks within a distance equal to or less than two times of fired tank diameter are stated as follows:

5.9.16.1. Watering intensity for floating tank:

- For fired tank: 0.5l/s per 1 m of tank perimeter.
- For neighboring tank: 0.2l/s per 1 m of tank perimeter.

5.9.16.2. Watering flow for underground tank (both fired and neighboring tanks) includes: watering flows for reducing ambient temperature, cooling surface on neighboring underground tank and cooling fireman shall be estimated as follows:

- 10 l/s for tank with capacity from 100 m^3 to 1000m^3.
- 20 l/s for tank with capacity from 1001m^3 to 5000 m^3.
- 30 l/s for tank with capacity from 5001 m^3 to 30000 m^3
- 50 l/s for tank with capacity from 30001 m^3 to 50000 m^3.

5.9.16.3. Time for determining water amount for cooling fired tank and neighboring tank shall be at least 3h and supposed for the greatest fire.

5.9.17. Amount of water for fire extinguishing, cooling and amount of foam shall always be sufficient. In case of loss or previous use, it is required to supplement to have adequate amount. Time for supplementing the reserve water amount shall be within 48h maximum, this time period can be longer for dry areas but not over 96h. Time for supplementing reserve foam shall be within 48h maximum.

5.9.18. When tank wall has a reinforcement contour mounted outside, it is required to build gutter guiding water flow to cool the whole area of tank wall.

5.9.19. Cooling water and foam solution pipelines shall be independently designed in circle network for tank area and stubs, then for terminal of P&PP in barrels, production pumping station, roadway import and export area, railway import and export and dock. Operation valves installed outside the dyke shall be convenient for operation in emergency condition at the tank area.

Cooling water pipeline fixedly installed on top of tank wall and operation valves shall be arranged to meet requirements in 5.9.16 for all cases of fires at tank area.

Water column and foam solution column shall be installed not far from road edge over 2.5m and at place convenient for mobile equipments combined for fire fighting.

5.9.20. For fixed foam fire fighting system using metering pump independent to water pump, it is required to install a backup foam pump with properties similar to the main foam pump ones.

5.9.21. Fire fighting water source for the terminal can be taken from river, pond, lake or public fresh water system but shall meet requirements in 5.9.17 of this standard.

When using fixed or mobile fire fighting system, there shall be at least two positions convenient to taking water of fire fighting vehicle. Distance from water taking place to the nearest tank is stated as follows:

- Greater than 40 m and less than 200 m when using fire fighting vehicle.

- Greater than 40m and less than 150m when using mobile fire fighting pump.

5.9.22. Required pressure for foam ejection system and cooling system for vertical tank shall be as follows:

- For foam equipments: determined according to requirements of type of installed equipment.

- For tank cooling system fixedly installed: pressure in front of ejection nozzle at the farest position no less than 0.6kg/cm^2.

NOTE: Foam solution pipeline and cooling water pipeline shall be hydraulically tested at pressure of 1.25 time of working pressure.

5.9.23. There shall be conventional clean water draining system separately from sludge draining system in P&PP terminal. Where:

- Conventional clean water draining system: domestic water, rain drops on site floor not relating to storage, import and export, filling of P&PP and has no risk of being contaminated by P&PP. This draining system is allowed to discharge directly to outer environment.

- Sludge draining system: system for draining water from following sources: water washing import and export floor, waste water of chemical laboratory, bottom discharge water and tank washing water, rain drops on site floor having risk of being contaminated by petroleum. This system shall be conducted to oil sedimentation tank before exhausting into waste water treatment system.

5.9.24. Sludge draining system in P&PP terminal group I, II shall be closed. It is allowed to use open type for terminal group III.

5.9.25. Draining system for P&PP contaminated water shall be equipped with stopping holes with water layer for fire prevention of at least 0.25m height at following positions:

- Joint position with draining branch of tank area.

- Joint position with draining branch from import and export site.

- Joint position with branch from valve area, pumping station, chemical laboratory, tanker filling station, barrel filling station...

- In front of and behind sedimentation tank in waste water treatment area with distance no less than 10m.

- Joint position with draining branch of railway import and export work.

- Along with the main draining system equipped with stopping holes of which distance between two holes shall be not over 400m.

5.9.26. Water draining pipeline from tank area to outside shall be equipped with valve:

- When using clape, it is required to arrange this valve type at the water collecting hole inside the dyke and valve control device outside the dyke or on dyke surface.

- When using stopping valve, this valve shall be arranged outside the dyke.

5.9.27. Along with railway import and export work, there shall be water draining gutter, every 50m length longitudinal to this work shall have a branch connected to the shared water draining system and stopping holes as stipulated in 5.9.25.

5.9.28. Floor of P&PP terminal in barrels, filling houses or other smaller containers shall have a slope for draining water to indoor draining gutter and sludge draining system of the terminal.

5.9.29. It is allowed to install local sedimentation tank at certain area. The sedimentation tank can be of closed or open type.

5.9.30. Sludge of the terminal shall meet current requirements for waste water before being exhausted into outer environment.

5.9.31. Oil-contaminated solid waste (oil-contaminated cloth, oil-contaminated mud…) in P&PP terminal shall be classified at source, collected and treated according to current regulation.

5.10. Heating and ventilation system

5.10.1. Heating and ventilation system designing for each item of terminal shall meet requirements in current standards on design of heating and ventilation system as well as requirements in this standard.

5.10.2. It is not allowed to install heating system under floor of terminal with hazards of explosion and fire. In special case, it is allowed to install heating pipeline next to entrance gate, terminal door but shall be placed in a trench and blocked tightly with sand and covered by non-flammable material. Heating exchangers shall meet requirement for fire protection.

5.10.3. It is allowed to use heating methods such as saturated vapor, thermal oil and electric equipments for heating products in P&PP terminal.

5.10.4. Ventilation system for houses and constructions inside P&PP terminal shall be designed basing on properties of products in storage, import and export to determine air exchange multiple stated in Table 14.

5.10.5. Gas inlet and outlet pipes shall be placed apart from entrance gate at least 2m, from chimney and thermal pipeline at least 4m, from ground surface at least 3m. End of the outlet pipe outside the house shall be far from inlet pipe at least 3m.

Inlet and outlet pipes shall be made of hard-flammable material.

Air inlet and outlet equipments shall be designed to minimize ignition.

Table 14 - Air exchange multiple inside house and constructions for storing and importing/ exporting P&PP

Type of product for storing, importing and exporting P&PP	Air exchange multiple in 1 hour	
	Without sulfur	With sulfur
1. Product with high content of sulfur (sulfur content over 2%)	-	10.0
2. De-sulfured product	6.5	8.0
3. Gasoline types	6.0	8.0
4. Kerosene, diesel, fuel oils	5.0	7.0
5. Lubricant oil, grease (without dissolved material)	3.5	5.5
NOTE: 1) In P&PP terminal storing products in barrels and other smaller containers, not depending on type of products, air exchange multiple shall not be less than one time in one hour. 2) Air exchange multiple in the table is stipulated for houses and buildings with height of 6m, for lower houses and buildings, air exchange multiple shall increase by 16% per each meter reduced in height.		

5.11. Electric, communication, automatic devices

5.11.1. Installation of dynamic electric devices, lighting system, communication device and automatic control device shall be in accordance with regulations in TCVN 5334 on safety in designing and installing of electric devices for P&PP terminal.

5.11.2. It is required to design lighting system both inside and outside P&PP terminal in accordance with standard for natural and artificial lighting system.

There shall be protection lighting system in P&PP terminal. Tank area shall have headlight mounted on columns outside fire prevention dyke.

5.11.3. There shall be communication system in P&PP terminal for communication within technology line periods and for communicating with the nearest fire protection authorities.

5.11.4. Fire alarm system shall be installed in P&PP terminal.

5.11.5. System for straight lightning protection, induction and electrostatic lightning protection due to friction of items in P&PP terminal shall be designed in accordance with current standard.

5.11.6. When designing roadway and waterway import and export dock, it is required to install earthing system for protecting vehicles and lightning and electrostatic protection system for import and export equipment.

5.11.7. For P&PP terminal with pipeline connected to main pipe system or connected to pipeline of import and export construction outside the terminal which is equipped with cathode station, it is required to install electric insulation equipments at the connection position.

6. Petroleum and petroleum products terminal group II

6.1. Total capacity of P&PP terminal group II including all types of flammable and combustible P&PP stored in the tank, barrel and other smaller containers is stated in Table 15.

Table 15 - Total capacity of P&PP terminal level II

Type of P&PP	**Maximum capacity of the terminal, m^3**	
	Floating	**Underground**
Type 1	2000	4000
Type 2, type 3	10000	20000
NOTE: 1) When determining capacity of both floating and underground terminal containing products of type 1, type 2 and type 3, it is able to convert as follows: 1 m^3 product of type 1 is equal to 5 m^3 product of type 2, type 3 and 1 m^3 of product floating contained is equal to 2 m^3 product contained underground. 2) Terminal group II with capacity greater than value stated in the Table shall be designed according to terminal group I.		

6.2. For buildings and production constructions with fire resistance level I and II, it is allowed to arrange tank area for P&PP with masses not greater than values in Table 16.

6.3. Different rooms related to storage and supply of P&PP are allowed to be arranged in the same house with:

- Storage room for P&PP in barrels or small containers.

- Room for equipments recycling lubricant oil, mixing lubricant oil.

- Petroleum products pumping station

- Room for equipments washing barrels and heating solvents.

- Room for barrel covers.

Room for pump and for storage of petroleum in barrels shall be isolated from the remained rooms by fireproof wall with fire resistance level of 0.75h. Doors shall be directly opened to outside and made of material with fire resistance level of at least 0.6h.

Table 16 - Regulation for mass of P&PP in production house

Storage equipments	**Amount of P&PP, m^3**	
	Type 1	**Type 2 and type 3**
Stored in barrels and placed in room isolated from other rooms by fireproof wall with fire resistance level greater than 0.75h, with direct exit	10	50
Stored in barrels and placed in houses and construction with production class of D and E	1	5
Stored in floating tank in room isolated from other rooms by fireproof wall with fire resistance level greater than 0.75h, with direct exit	As production requirement in one day but not exceed 30	150
Stored in underground tank in house	Not allowed	200
Stored in tank on support made of non-flammable material in houses and constructions with production level of D and E.	1	5
NOTE: 1) Fuel tank of station for testing engine shall be placed outside the station on direction of an open wall with minimum gap of 10m, for fixed wall it is not stated. 2) Floating tank with capacity larger than $1m^3$ when containing P&PP type 1 and $5m^3$ when containing P&PP type 2 and type 3 in production house shall have pipeline connected to emergency tank that is undergrounded outside the house by a distance not less than 1m toward tight wall and no less than 5m toward open wall. Capacity of emergency tank shall not be less than 30% total capacity		

of tanks and not less than capacity of the greatest tank. Emergency exhaust pipe shall have diameter not less than 100mm. In emergency exhaust, if exhaust cannot totally self-burning, it is required to installing one dredge pump at other room or outdoor. Emergency exhaust pipe shall be equipped with fire conduction protection device.

3) In underground storey with fire resistance level of I and II of rolling, quenching workshops and other workshops, allow arranging petroleum and petroleum products terminal with capacity not greater than 400 m^3 and not require having emergency pipeline and tank.

4) It is not allowed to exhaust the flammable and combustible P&PP vapor into room of these tanks.

6.4. Distance from floating tank for P&PP to other houses and constructions inside the terminal shall follow regulations in Table 17

Table 17 - Distance from P&PP floating tank to other items in terminal

Houses and constructions subjected to distance determination	**Minimum distance depending on type of stored product, m**	
	Type 1	Type 2, type 3
1. Pumping station, filling station into barrels and other small containers	10	8
2. Warehouse and reserving site for petroleum products contained in barrels, railway and roadway import and export stations for petroleum products, weighting house and other items of warehouse	15	10
3. Overhead bared electric wire	Equal to 1.5 time of power post height	

NOTE:

1) For underground tank, distance in point 1 and point 2 in this table can be reduced by 50%.

2) Distance from underground tank for P&PP with flashpoint temperature greater than 120^{o}C to pumping station is not regulated.

6.5. Distance from P&PP pumping station and terminal storing P&PP in barrels to center of railway for inputting and outputting P&PP type 1 shall not be less than 10m and type 2 and type 3 shall not be less than 8m.

6.6. Distance from floating tank and storage of P&PP in barrels, pumping station or tanker filling area, wagon tanker to railway or roadway shall not be less than values in Table 18.

Table 18 - Distance from floating tank and storage of P&PP in barrels, pumping station to railway or roadway

Type of railway, roadway	Minimum distance depending on type of stored product, m	
	Type 1	Type 2, type 3
1. Centre line of public railway	40	30
2. Centre line of local railway of production unit	20	10
3. Edge of public roadway	15	10
4. Edge of local roadway of production unit.	10	5
NOTE: 1) For underground tank, distance in this table can be reduced by 20%. 2) For tank, pumping station and storage of P&PP with flashpoint temperature greater than 120^{o}C, distance in point 2 is not regulated.		

6.7. Distance from floating tank, storage terminal of petroleum and petroleum products in barrels to construction items outside the terminal is stated as in Table 19.

Table 19 - Distance from floating tank, storage terminal of petroleum and petroleum products in barrels to items outside terminal area

Floating tank, storage terminal of P&PP	Distance to items outside terminal, m		
	Fire resistance level		
	I and II	III	IV and V
1. P&PP type 1			
- From 1000m^3 to 2000m^3	30	30	36
- From 600 m^3 to less than 1000m^3	24	24	30
- Less than 600m^3	18	18	24
2. P&PP type 2 and type 3			
- From 5000m^3 to 10000m^3	30	30	36
- From 3000 m^3 to less than 5000m^3	24	24	30
- Less than 3000m^3	18	18	24
- Less than 1000m^3	12	15	18
NOTE: 1) For underground tank or terminal, distance values in this table can be reduced by 20%. 2) Items outside terminal are residential houses, public construction sand constructions with production level of A and B, distance value in the table can be increased by 20%.			

6.8. When designing terminal group II, in addition to requirements in clause 6, it is required to apply corresponding requirements for designing terminal level III, group I of this standard.

ANNEX A

(For reference)

Method for determination of minimum design thickness of pressure pipe

Minimum design thickness of pressure pipe is measured as follows:

$$tm = t + c$$

Where: Standard for manufacture of pipe: API 5L Gr.B

tm is the minimum design thickness under pressure, measured in mm;

c is corrosion resistance tolerance, in general c = 0.5mm;

t is the minimum thickness under internal pressure, measured by following formula:

$$t = \frac{P \times D}{2(S \times E + P \times Y)}$$

Where:

P is internal pipe pressure, measured in kg/cm^2,

D is external pipe diameter, measured in mm.

S is material stress (S = 20psi ~ $1.406 kg/cm^2$ ~ 1.38 bar)

E is coefficient corresponding with material quality, for steel E = 0.8

Y is temperature coefficient, for temperature less than 400^oF (~ 204^oC), Y=0.4

During operation, after measuring pipe thickness, if the actual pipe thickness is less than minimum design thickness for bearing pressure (tm), then pipe shall be replaced or working pressure inside the pipe shall be reduced so that tm value shall be less than the actual pipe thickness.

ANNEX B

(Normative)

Method for determination of fire fighting foamer and water for floating tank in P&PP terminal

B.1. Measurement of required foam solution flow for extinguishing tank fire

Required foam solution flow for extinguishing fired tank, Q_{ct}, measured in l/s shall be determined by following formula:

$$Q_{ct} = S_c . J_{ct} \text{ (l/s)} \qquad \text{(B.1)}$$

Where:

S_c is area of fired tank surface, measured in m^2

J_{ct} is density of foam solution ejection, measured in $l/s.m^2$

When using foam nozzle fixedly installed on tank, J_{ct} shall be determined as follows:

- When using foam with medium expansion, J_{ct} shall be determined as in 5.9.10.1 (or 5.9.11)

- When using foam with low expansion, J_{ct} shall be determined as in 5.9.10.2 (or 5.9.11).

B.2. Calculations of required number of foam nozzles for fire fighting (when fired surface area is equal to cross section area of the tank)

Number of foam nozzles N_{LTB} (N_{LTB} - whichever greater integer), measured in units, is determined by following formula:

$$N_{LTB} = \frac{Q_{ct}}{q_L} \qquad \text{(B.2)}$$

Where:

Q_{ct} is foam flow required for fire fighting for tank, measured in l/s.

q_L is the foam ejection amount of the nozzle, measured in l/s.

NOTE: For fire fighting for tight buffer area of floating roof tank or internal floating roof tank, selection of qL shall take into account the distance for arrangement of ejection nozzle so that foam shall not be flowed over the foam proof edge.

B.3. Calculation of required reserve foam amount for tank fire fighting

Amount of required reserve foam for tank fire fighting, W_{dd}, measured in liters, is determined by following formula:

$$W_{dd} = K.N_{LTB}.q_L.t + W_d + W_{BT} \qquad (B.3)$$

Where:

N_{LTB} is number of foam nozzles, in units.

q_L is the nozzle foam ejection flow, in l/s

t is the foam ejection time, in seconds - As in 5.9.10 (or 5.9.11)

W_{BT} is amount of foam in dyke area, determined as in 5.9.14, measured in litters.

K is reserve factor (as in 5.9.15)

W_d is amount of stagnant foam inside pipeline, measured in litters.

When using fixed fire fighting system, W_d is measured as follows:

$$W_d = (0.785 \sum_{i=1}^{n}.d_i^2.l_i).1000$$

Where:

d_i is diameter of each pipe type, measured in meters.

l_i is length of each pipe type, measured in meters.

If amount of stagnant foam inside pipeline is less than 5% of required amount of foam for fire fighting, then it is not required to add that value into above formula, otherwise, it shall be added into the sum of formula result if it is equal to or greater than 5%..

B.4. Calculations of foam amount needed to reserve in terminal for fire fighting

Foam amount needed to reserve in terminal for fire fighting W_{CTB} measured in litters, is determined by following formula:

$$W_{CTB} = W_{dd}.\frac{C_B}{100} \qquad (B.4)$$

Where:

W_{dd} is the required reserve foam amount, in litters

C_B is concentration of foam in solution for fire fighting, %.

B.5. Calculation of water amount required for mixing foam into solution

Water amount required for mixing foamer into foam solution W_N, in litters, is determined by following formula:

$$W_N = W_{dd}.\frac{C_N}{100} \qquad (B.5)$$

Where:

W_{dd} is required amount of foamer for reserving, in litters

C_N is concentration of water in foamer solution, in %

B.6. Calculation of required water flow for cooling fired tank and neighboring tanks

Water flow required for cooling fired tank and neighboring tanks, Q_{TM}, in l/s, is determined by following formula:

$$Q_{TM} = P_c.J_1 + 0.5J_2\sum_{i=1}^{n}P_i \qquad (B.6)$$

Where:

P_c is fired tank perimeter, in meters.

P_i is perimeter of neighboring tank of fired tank within a distance of less than or equal 2 times of fired tank diameter, in meters.

J_1 is density of water ejection for cooling the fired tank, in l/s.m

J_2 is density of water ejection for cooling neighboring tank, in l/s.m

J_1, J_2 as in 5.9.16.

ANNEX C

(Normative)

Standard for installing initial fire fighting equipments for construction items

Name of construction items	Powder trolley** $\geq 25kg$	CO2 vessel		Powder 6-10kg	Sand can m^3		Spit, unit	Blanket **** m			Water barrel 200l (unit)	Water pail (unit)	Notes
		1.5-2kg	5-6kg		0.5	1		1x1	1x1.5	1x2			Each nozzle mouth outputting a vessel 6-10kg
1. Tanker import and export platform	1	-	-	1	-	-	-	-	-	1	1	2	Each nozzle mouth outputting a vessel
2. Railway import and export	1	-	-	-	-	-	-	-	-	-	-	-	Each side for a trolley
- Single side	-	-	-	1	-	-	-	-	-	1	1	2	Each nozzle mouth outputting a vessel
- Dual side	-	-	-	1	-	-	-	-	-	2	2	4	
3. Petroleum pumping station ($\leq 50m^2$ floor area)	-	-	2	2	-	-	-	-	-	-	-	-	Able to replace CO_2 by foam vessel
4. Terminal for P&PP in barrels (< $200m^2$ floor)*	1	-	-	2	-	-	-	-	-	-	-	-	
5. Barrel filling place ($\leq 50m^2$ area)	-	-	-	2	-	-	-	-	-	1	1	2	
6. Pumping column in the terminal	-	-	-	2	-	-	-	-	1	-	-	-	
7. Valve assembly ($50m^2$)	-	2	-	2	-	-	-	1	-	-	1	2	CO_2 extinguisher for electric valve group, foam extinguisher for normal valve group
8. Dock and waterway import and export ($\leq$ 50m long)*	1	-	2	4	-	-	-	-	-	1	1	2	

9. Electric motor station for pump	-	-	1	-	-	-	-	-	-	-	-	-	For each engine of the main pumping station
10. Barrel site (≤ 100m^2 area)*	-	-	-	2	-	1	2	-	2	-	-	-	
11. Laboratory (≤ 50m^2 floor area)*	-	-	1	2	-	-	-	-	-	2	2	4	
12. Electric welding, gas welding workshop (≤ 50m^2 floor area)*	-	-	1	1	-	-	-	1	-	-	1	2	
13. Air compression room	-	1	-	1	-	-	-	-	-	-	-	-	Each room
14. Processing station, oil recycling station (≤ 100m^2 floor area)*	1	-	1	2	-	1	2	-	-	2	2	4	
15. Metallic workshop (≤200m^2 floor area)*	-	1	2	3	-	-	-	-	-	-	-	-	
16. Domestic room (≤ 200m^2 floor area)*	-	-	1	1	-	-	-	-	-	-	-	-	2 vessel for each story
17. Computer centre	-	-	2	-	-	-	-	-	-	-	-	-	
18. Material warehouse (≤ 100m^2 floor area)*	-	-	1	2	-	-	-	-	-	-	-	-	
19. Boiler area (≤ 100m^2 floor area)*	-	-	1	2	-	-	-	-	-	-	-	-	
20. Water pumping station	-	-	1	-	-	-	-	-	-	-	-	-	
21. Power transformer station	-	-	2	1	-	-	-	-	-	-	-	-	
22. Garage (≤ 100m^2 floor area)*	-	-	1	2	-	-	-	-	-	2	2	4	
23. Power generator station	-	1	-	1	-	-	-	-	-	-	-	-	
24. Houses	-	-	-	-	-	-	-	-	-	-	-	-	
- Class A and B (≤ 200m^2 floor area)*	-	-	2	3	-	-	-	-	1	-	1	2	

- Class C and D (≤ 300m^2 floor area)*	-	-	-	2	-	-	-	-	-	-	-	-	
- Class D (≤ 400m^2 floor area)*	-	-	-	2	-	-	-	-	-	-	-	-	

* Values in parentheses is measurement unit

** It is able to replace powder trolley by foam trolley 100 or foam trolleys with equivalent property.

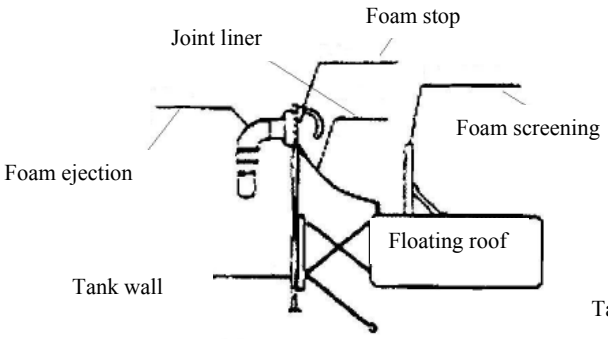
*** Powder extinguisher 6-10kg can be replaced by foam extinguisher AB 10 litters.

**** when using blanket soaked with fireproof material or asbestine blanket, it is not required to have water and water pail

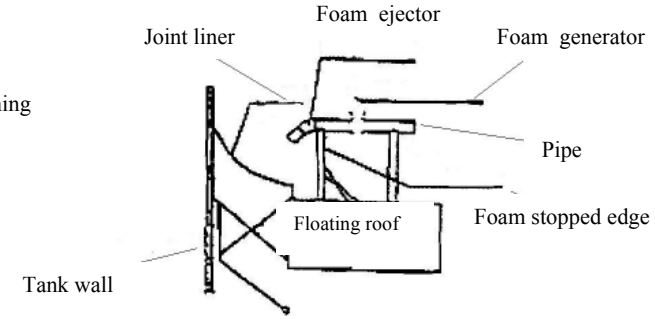
ANNEX D

(Normative)

Charts and methods for bringing fire resistance foam into floating roof tank and internal floating roof tank

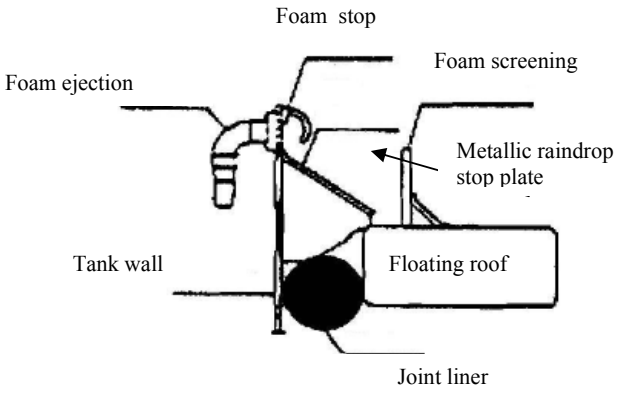


Installing ejection nozzle on tank wall

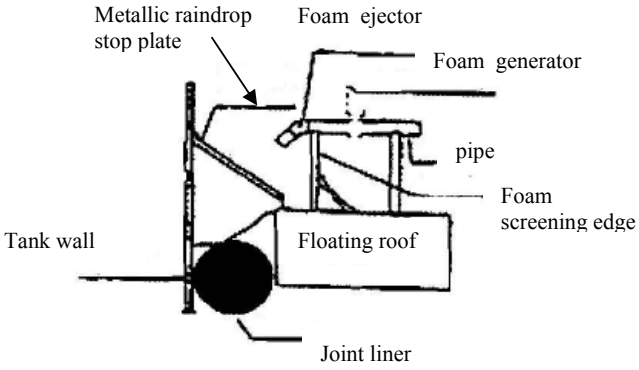


Installing foam ejection equipment on float

Foam ejection on metallic joint liner component (one joint liner)

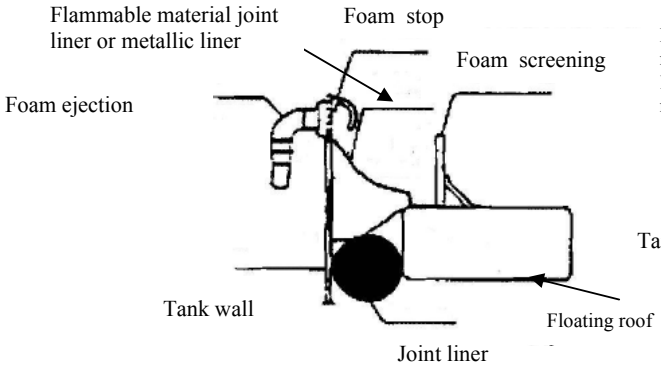


Installing ejection nozzle on tank wall

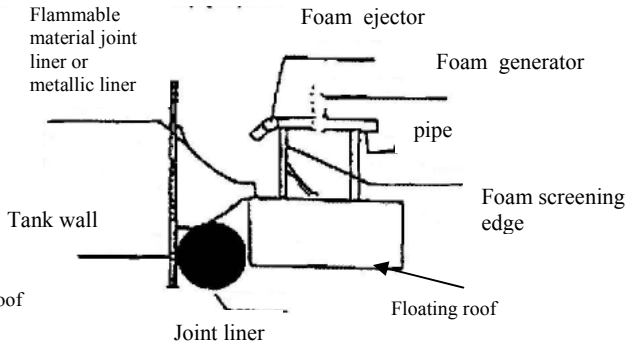


Installing foam ejection equipment on float

Foam ejection on metallic screen plate (one joint liner)

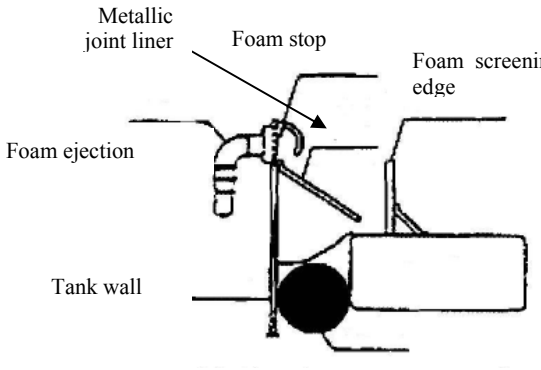


Installing ejection nozzle on tank wall

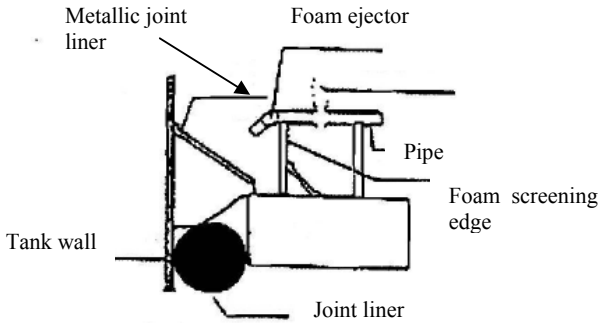


Installing foam ejection equipment on float

Foam ejection on flammable joint liner or metallic joint liner component (two joint liners)

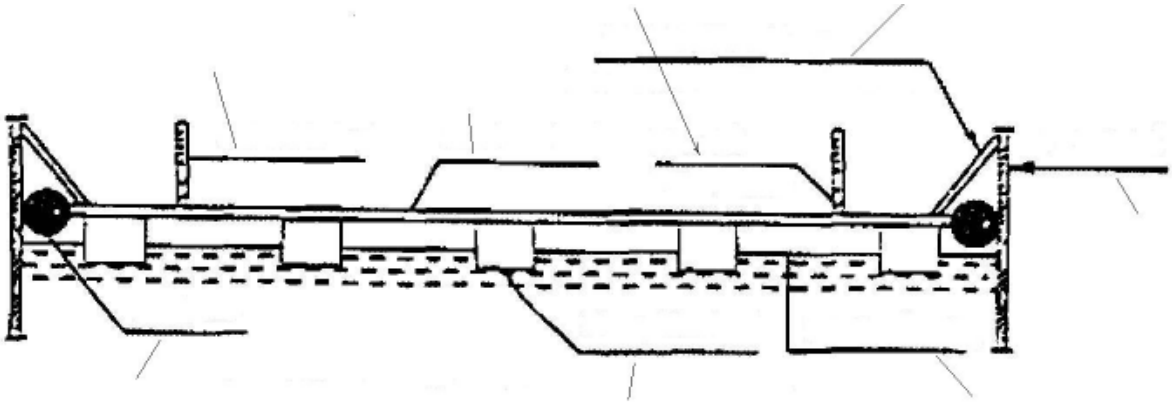


Installing ejection nozzle on tank wall



Installing foam ejection equipment on float

Foam ejection on metallic joint liner component (two joint liner)



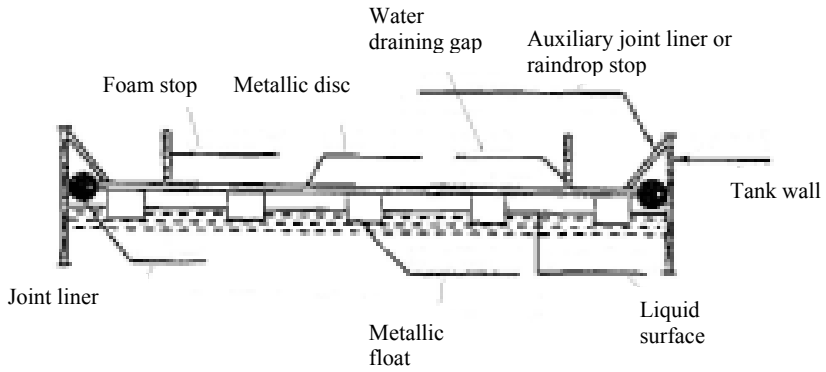
ANNEX E
(Normative)
Single disc, double disc of floating roof tank and foam screening edge

E.1. Metal single disc and double disc floating roof tank

- Single disc floating roof attached on the metal float that the liquid surface shall not be contacted to the disc; metal double disc floating roof one the liquid surface can contact to lower disc of the floating roof.

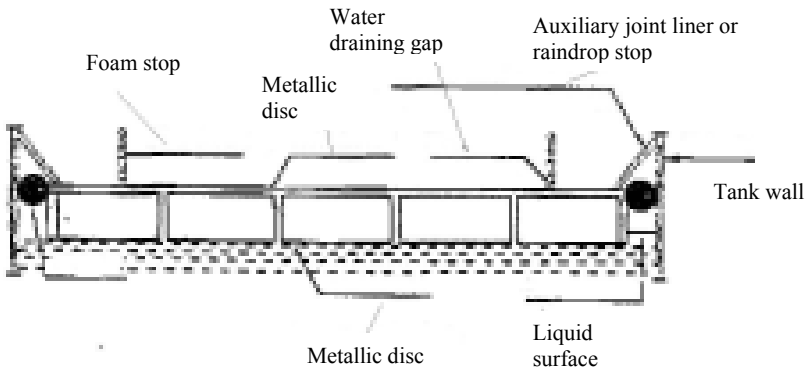
- Single disc floating roof, double disc floating roof and other floating roofs used for floating roof tank shall be considered for raindrop exhausting method on the roof to be suitable to construction site condition.

- Detail design for metal single disc floating roof, double disc floating roof and other floating roofs used for floating roof tank shall take reference from latest document and information.



Single disc attached on metallic float

Figure E.1 - Chart for the single disc attached on metal float



Double disc attached on metallic float

Figure E.2 – Chart for the double disc attached on the metal float

E.2. Foam screening edge

- Foam screening edge shall be made of metal and fixedly attached on the floating roof and keep the foam at joint liner so that the foam shall flow to broken point of the joint liner. The edge shall be at least 305mm high when having fire fighting foam with low expansion and be at least 610mm high when fire fighting by medium expansion foam. Foam screening edge shall be higher than the auxiliary joint liner at least 60mm.

- The distance from edge of the floating roof to foam screening edge shall be at least 0.3m but not greater than 0.6m when fire fighting by low expansion foam and not greater than 1m by medium expansion foam.

- For draining raindrop, there shall be a gap at foot of foam screening edge. Area of this gap shall be equal to 250mm^2 for a 1m^2 of foam screening edge.

Bibliography

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2. NFPA 30 – Flammable and Combustible Liquids Code. 2000 Edition

3. NFPA 11- Standard for Low, medium and high expansion foam

4. NFPA 15 – Standard for water spray fixed systems for fire protection

5. ASME B31 (American Society of Mechanical Engineers) – Standards of pressure piping.

6. API Standard 2000 – Venting Atmospheric and Low-pressure storage tanks

7. API Standard 2610 – Design, Construction, Operation, Maintenance and Inspection of Terminal and Tank Facilities

8. API Standard 653 – Tank Inspection, Repair, Alteration and Reconstruction

9. API 650 – Welded steel tanks for oil storage.