OIL, CHEMICAL AND PETROCHEMICAL STORAGE TANK

“INTERNAL FLOATING ROOF”

Head Office

Yeşilköy Mah. Atatürk Cad. No: 12
EGS Business Park B2 Kat:11 No:348
34149 Bakırköy İSTANBUL/TÜRKİYE
Tel: +90 212 485 40 07
Fax:+90 212 485 40 42

www.ergil-storagetech.com

www.ergilgroup.com

e-mail: sales@ergilgroup.com
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1. INTRODUCTION:

STORAGETECH is a major supplier of internal roofs and seals, which fully complies with API 650 standards. STORAGETECH provides full contact internal aluminum panel, and pontoon type floating roofs to eliminate the evaporation losses of stored products, such as jet fuels, gasoline, diesel and crude oil. In addition to STORAGETECH floating roof's cost-effective benefits, they also protect the environment by not releasing toxic gases to the atmosphere. STORAGETECH floating roofs are easy to install. They are manufactured in small pieces to fit from the storage tank manhole covers. You do not need a special tool and cutting for the installation.

2. FUEL LOSS AND ATMOSPHERIC POLLUTION IN OIL STORAGE TANKS:
There are five refineries in our country producing big amount of petrol products and storing facilities. Immature and processed products are stored in tanks %99 percent of which have fixed roof. Petroleum products must be stored many times in their production progress. In normal storage conditions and normal usage conditions products which have fixed pressure of steam have some loss of fuel problems.

In fixed root storage systems there are two types of fuel loss. One of them evaporation and the other transfer loss. Fuel lost level changes with weather conditions, tank size, tank type, one year filling and discharging values, fuel type and applied systems for protecting fuel for loss.

With using pressure vacuum vents in storage tanks %30 of total fuel loss decrease. Crude oil, petrol products and chemical items are storing in three types of storage tanks fixed roof (ceiling), floating roof(ceiling) and internal floating roof.

2.1. FIXED ROOF (CEILING) STORAGE TANK:

Fixed roof tanks have been in use for the storage of volatile liquids for many years. Being used all around the world these tanks are built with API 650 standards.

Fixed roof tanks have low endurance to internal pressure and vacuum. During the regular operations, in order to protect the tank from extreme pressure and vacuum, it is important to provide sufficient air venting within the tank. Based on the tank specifications, it is required to have breathing holes on the tank for venting; however, such venting holes as well as the sampling holes cause fuel loss.

2.2. FLOATING ROOF STORAGE TANKS:

Floating roofs have been designed and used for more than a century. Floating roof tank allow the explosive gases in petroleum tanks to vent to atmosphere in a safe way. Today controlled gas venting in to the atmosphere is becoming more and more important due to environmental regulations.

Compared to fixed roof storage tanks, fuel loss due to evaporation in floating roof tanks is considerably less. Floating roofs are installed inside the fixed roof storage tanks, which enables the roof to rise and fall based on the level of the fuel. As such design creates a no-vapor zone between the fuel level and the floating roof, the fuel evaporation is minimized.

2.3. STORAGE TANKS WITH FIXED AND INTERNAL FLOATING ROOFS:

After proving the profitability of the internal floating roofs due to its fuel loss reductions, the internal floating roofs’ assembly has been improved drastically.
Our sandwich panel internal roofs in a straight horizontal level they do not allow any space between the fuel level and the internal roof and achieve a vapor-free zone

2.3.a. WHY “INTERNAL FLOATING ROOF”?

Below table illustrates why internal floating roof application is highly recommended.

Graph 1.
Fixed and floating roof evaporation comparison

<table>
<thead>
<tr>
<th></th>
<th>370</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Roof (Ceiling)</td>
<td></td>
</tr>
<tr>
<td>Internal Floating Roof</td>
<td>1.95</td>
</tr>
</tbody>
</table>

Fixed Roof (Ceiling)  Internal Floating Roof

Fixed roof tank loss : **370 m³/year**

Floating roof tank loss : **1.95 m³/year**

Stored product : Gasoline
Tank Capacity : 5000 m³
Tank Color : Grey
Operation ratio : 100,000 m³/Yıl
Breathing standart: API 2518
Floating roof standart : API 2519
Graph 2.
Product loss comparison between single and dual seal internal floating roofs

<table>
<thead>
<tr>
<th></th>
<th>Single Seal</th>
<th>Dual Seal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stored Product:</td>
<td>Gasoline</td>
<td></td>
</tr>
<tr>
<td>Calibre of tank:</td>
<td>30 m</td>
<td></td>
</tr>
<tr>
<td>Operation ratio:</td>
<td>200,000 m³/Year</td>
<td></td>
</tr>
<tr>
<td>Storage temperature:</td>
<td>10°C</td>
<td></td>
</tr>
<tr>
<td>Temperature difference:</td>
<td>7°C</td>
<td></td>
</tr>
</tbody>
</table>

Loss of fuel with single seal: **41 m³/Year**
Loss of fuel with dual seal: **6.9 m³/Year**
2.3.b. Features of Internal Floating Roof
- Long life time,
- Significant evaporation prevention,
- Maximum fuel and chemical impermeability,
- High temperature insulation,
- High corrosion durability,
- Static electric protection,
- Minimum evaporation area,
- No necessity for tank calibration,
- Designed to never sink,
- Minimum maintenance,
- Easy to clean,
- Applicable to be used as a working platform.

2.3.c. Design and Engineering of Internal Floating Roof:
STORAGETECH provides internal floating roof’s design, manufacturing, assembly and after sales support for all types of chemical and petroleum tanks according to the highest industry standards.

We design our internal floating roofs with adjustable legs, which enable you to decide on the height of the legs for internal maintenance. The floating roof manhole cover allows you to go on top of the floating roof.

It is ensured that when the floating roof and vacuum vent sink at the bottom of the tank, the existing fluid runs out without vacuum.

The internal floating roof is equipped with suitable seals as per the floating roof type, size and the product type to be stored in accordance with the API 650 standards.

2.3.d. Assembly of Internal Floating Roof:
The Internal Floating Roof is designed in accordance with the specifications of each storage tanks such as incline and cone. Every component of the internal floating roof is
designed and manufactured in order to be to pass from 20 and 24 inches manholes and assembled in the tank. As the manufacturing and the installation of the internal floating roof is fairly quick, it does not cause the tank to stay out of usage for a long time. Assembly of the internal floating roofs is done by our high quality and experienced staff. It is possible to mount the floating roof without uninstalling any equipment over the tank.

2.3.e. Evaporation Loss Calculation based on API Standard
Calculations and previous applications have proved that the internal floating roofs pay off quickly as they play an essential role for preventing the fuel loss and increase profitability.

Evaporations calculations are calculated during the use of the tank. It is also easy to calculate the evaporation ratio after installing the internal floating roof. The data gathered before the existence of internal floating roof and after the installation is calculated and compared based on the TNO formula of the API 2519 standards. Our experts perform the calculations in full compliance with these standards.

2.3.f. Cleaning of Tank:
Same cleaning methods of fuel and chemical tanks can be used in internal floating roofs.
3. INTERNAL FLOATING ROOF ACCESSORIES:

1- Floating roof
2- Seal
3- Foam protective shield
4- Anti-Rotation cable
5- Balancing wire bow system
6- Feet
7- Internal floating roof measurement hole
8- Antistatic cable system (Ground System)
9- Internal floating roof manhole
10- Measurement hole hatch
11- Support holes sealing.
12- Vacuum hatch
13- Fire foam top pourer (foam chamber)
14- Pressure vacuum vent
15- Tank Manhole

3.1.1 FULL CONTACT TYPE INTERNAL FLOATING ROOF
Aluminum sandwich panels are used for the construction of internal floating roof. With such design the internal floating roof is mounted on the plastering and covers the whole surface, thus minimizes the evaporation. For the material of the ceiling, API 650 compliant aluminum Polyurethane or honeycomb type sandwich panels are used. Wiper type seals are used between the floating roof and the surface of the tank. The aluminum panels are made of AA1050 type alloy aluminum plates. The aluminum plates are filled with Polyurethane hard filling by using a special technic or attached with aluminum or stainless steel honeycombs.

3.1.a. Sandwich Filling Polyurethane Specifications

Polyurethane (PIR) is generally known as hard polyurethane. Due to its closed cell structure it is not affected by water, moisture and petroleum products. Polyurethane foam is resistant to fire with halogen or/and phosphor ingredients and become DNI 4192 B2 compliant.

Cores provide fire resistance of up to 1 hour. When exposed to flame, PIR forms a strong, carbonaceous char that protects the core foam from ignition. PIR is recognized by the industry as the fire safe alternative to other foam cores, including polyurethane.

3.1.b Honeycomb Specifications

Honeycomb design provides strong but lightweight, design for internal floating roofs. Thanks to it specifications, it is one of the best solutions for internal floating roofs. Besides its strong structure, it also high resistance to corrosion, provides perfect thermal conductivity, and not combustible product.

3.1.2. PONTOON TYPE INTERNAL FLOATING ROOF

Pontoon type internal aluminum floating roofs are the most widely used floating roofs in the industry, due to their cost effectiveness and efficiency. Aluminum Pontoon Floating Roofs are designed as per API 650 Appendix H and meet the dimensional tolerance in API 650 (Welded Steel Tanks for Oil Storage). It can be equipped with various kinds of seals, such as single & double wiper foam seals, and mechanical seals. The STORAGETECH floating roofs are designed to exceed API Appendix H point load requirements. Our 8” & 10” standard pontoons are custom designed and fabricated in house. All pontoons are inspected and tested against leakage.
3.2. SEAL TYPES (IMPERMEABILITY EQUIPMENT):

3.2.a. Selection of Impermeability Equipment

Impermeability equipment (SEAL) is designed for sealing the contiguity of the stored liquid and the air between the tank inner walls and the internal floating roof in order to reduce evaporation loss, potential for vapor space explosions and fire hazards. The seals are custom designed according to user requirements as single or dual seals. Seal dimensions are compliant with API 650 standards appendix H.

3.2.b. Seal Material Specifications

The seals (Impermeability equipment) are comprised of polythene plates due to their irresponsiveness to petroleum products. These seals are intended to prevent the vaporized liquid from escaping over the floating roof.
3.2.b. Seal Material Specifications:

1. Low thermo permeability
2. Closed cell structure
3. Effective sound absorption.
4. Perfect use and installation due to flexibility
5. Not Flammable (B1)
6. Resistant to fuel
7. Resistant to structure chemicals.
8. Environment friendly
9. Odor free

<table>
<thead>
<tr>
<th>Property</th>
<th>VALUE</th>
<th>NORM</th>
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<tbody>
<tr>
<td>Density</td>
<td>35 Kg/m³</td>
<td>DIN 53420</td>
</tr>
<tr>
<td>Thermo conductivity parameter</td>
<td>Λ=0.035W/mK</td>
<td>DIN 52613</td>
</tr>
<tr>
<td>Usage temperature</td>
<td>(-40°C +105°C)</td>
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<tr>
<td>Damp permeability</td>
<td>μ ≥2500</td>
<td>DIN 52615</td>
</tr>
<tr>
<td>Water absorption sensitivity</td>
<td>(96 saat) % 0.4</td>
<td>ISO 7214</td>
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<tr>
<td>Stroke sound lowering</td>
<td>23-25 db</td>
<td>DIN 52210</td>
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<tr>
<td>Fracture resistance (height)</td>
<td>0.40 N/mm²</td>
<td>DIN 53571</td>
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<tr>
<td>Fracture resistance (width)</td>
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<td>DIN 53577</td>
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<tr>
<td>Fracture elongation (height)</td>
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</tr>
<tr>
<td>Fracture elongation (width)</td>
<td>%68</td>
<td>DIN 53571</td>
</tr>
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</table>

Image 6. (Internal Floating Roof Seal)
3.3. FOAM PROTECTION SHIELD:

Foam protective shield plays a crucial role to prevent any possible fire, which can generate from the seal, by filling the foam.

3.4. ANTI - ROTATION CABLE:
Anti-rotation mechanism keeps the floating roof in rotation; and helps to move only up and down direction. It protects floating roofs to move through the tank shell. Depending on the tank size, anti-rotation mechanism can be more than two.
3.5. ANTI – ROTATION SPRING MECHANISM:

Anti-rotation cables are provided in SS 304 material.
3.6. LEGS:

Legs are used to keep the internal floating roof at a certain height when there is not any liquid inside the storage tank. Generally, there are two types of settings:

1st Level: This level is being used for setting the tank level of discharge.
2nd Level: Second setting is for the tank inside cleaning operations. It is basically allow people to work inside the tank.
3.7. INTERNAL FLOATING ROOF MEASUREMENT HOLE:

Measurement level hole is like a funnel shape on the top of the floating roof, which is sealed with Teflon membrane to minimize the evaporation loss.
3.8 ANTISTATIC GROUNDING CABLE

Grounding cable is connected the floating roof and the fixed roof gauge hatch and marked with a warning to protect it.

3.9. INTERNAL FLOATING ROOF MANHOLE COVER:

Image 15. (Manhole Cover)

It allows access to the top of the floating roof. In special conditions, it is opened when tank is over loaded and protects the tank against high pressure.
3.10. SAMPLING GAUGE HATC:

Gauge hatches are used for the sampling holes. They are set as per required set pressure, so minimize the vapor loss.

Image 16. (Locking type gauge hatches)

Non-atmospheric gauges hatches are used for sampling and metering. Thanks to their design, it doesn’t allow vapor out, when it is used.

Shape 17. Non-atmospheric gauge hatch.

3.11. SUPPORT SEALING SYSTEM:
Depending on the design of the tank, StorageTech floating roofs come with support hole sealing. Teflon seal withstand the majority of the stored liquids and minimize vapor loss.
3.12. VACUUM HATCH:

Vacuum hatch are located one of the longest leg of the roof and opens when the leg support touch the bottom of the tank. When it opens, it protects tank from the vacuuming.

Image 20. Vacuum Hatch
The number of the foam chambers are installed as per the tank size. Foam chamber pours the foam on the floating roof foam shield, which covers the floating roof seal and minimize the vapor and fire, then foam covers whole floating roof top.
3.14. PRESSURE VACUUM VENT WITH FLAME ARRESTER:

It is mounted on the top of the tank to protect the storage tank against pressure and vacuum.

2.15. TANK MANHOLE:

When installing internal floating roof to fixed roof having systems, floating roof equipments are designed to inserting the tank from 20 inch or 24 inch manhole hatch. Internal floating equipments are inserted from the manhole hatch and assembly to tank inside.