Chapter 9: Petroleum Product Storage and Distribution

Petroleum Product Storage

- Fixed roof tanks
- Internal floating roof tanks
- External floating roof tanks

<table>
<thead>
<tr>
<th>Product</th>
<th>Volatility</th>
<th>VP Range</th>
<th>Tank Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude, lube oils</td>
<td>Low</td>
<td>&lt;1.5 psia</td>
<td>Fixed</td>
</tr>
<tr>
<td>Kerosene, gasoline, fuel oils</td>
<td>Moderate</td>
<td>1.5-11.1 psia</td>
<td>Float</td>
</tr>
<tr>
<td>Butane, propane</td>
<td>High</td>
<td>&gt;11.1 psia</td>
<td>Pressure</td>
</tr>
</tbody>
</table>
Fixed Roof Tank

- Pressure vacuum vent
- Fixed roof
- Float gauge
- Roof column
- Liquid level indicator
- Inlet nozzle
- Outlet nozzle
- Roof access hatch
- Gauger's platform
- Gauger hatch/sample well
- Spiral stairway
- Cylindrical shell
- Shell access hatch

Breathing Losses

Working Losses
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Internal Floating Roof Tank

Floating Roof Construction

- Aluminum panel with honeycombed core
- Aluminum deck on aluminum framework
- FRP panel
- Steel pan

Vapor Mounted Foam Seal
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Liquid Mounted Foam Seal

- Resilient foam-filled seal (liquid-mounted)
- Tank wall
- Contact internal floating roof
- Non-contact internal floating roof
- Liquid
- Vapor

Elastomeric Wiper Seal

- Elastomeric wiper seal
- Tank wall
- Pontoon
- Non-contact internal floating roof
- Metal seal ring
- Liquid
- Vapor

Rim Mounted Secondary Seal

- Secondary seal
- Primary seal immersed in VSL
- Contact type internal floating roof
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Roof Penetrations
- Column wells
- Roof legs
- Vacuum breakers
- Gauge-float wells
- Sample wells
- Access hatches
- Ladder wells

Roof Leg

Gauge-Flop Well
Sources of VOC Losses

- Rim seal
- Roof fittings
- Non-welded deck seams
- Wet tank wall

External Floating Roof Tank

Types of External Floating Roofs
Roof Penetrations

- Guide-pole wells
- Sample wells
- Roof drains
- Rim vents

Unslotted Guide Pole Well

Slotted Guide Pole Well
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Sample Well

Overflow Drain

Rim Vent
Sources of VOC Losses

- Rim seal
- Roof fittings
- Wet tank wall
Emission Control Techniques

Fixed Roof Tanks

- Internal floating roof
- Vapor recovery system
Basic Internal Floating Roof Design

- Non-contact bolted roof
- Primary vapor mounted wiper seal
- Uncontrolled fittings

Distribution of VOC Losses for Internal Floating Roof Tanks

<table>
<thead>
<tr>
<th>Loss Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rim seal losses</td>
<td>35%</td>
</tr>
<tr>
<td>Fitting losses</td>
<td>35%</td>
</tr>
<tr>
<td>Deck seam losses</td>
<td>18%</td>
</tr>
<tr>
<td>Withdrawal losses</td>
<td>12%</td>
</tr>
</tbody>
</table>

Controlled and Uncontrolled Internal Floating Roof Deck Fittings

<table>
<thead>
<tr>
<th>Deck Fitting Type</th>
<th>Equipment Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access hatch</td>
<td>Unbolted, ungasketed cover; or unbolted, gasketed cover; Bolted, gasketed cover</td>
</tr>
<tr>
<td>Gauge float well</td>
<td>Unbolted, ungasketed cover; or unbolted, gasketed cover; Bolted, gasketed cover</td>
</tr>
<tr>
<td>Column well</td>
<td>Built-up column with sliding cover, ungasketed; Built-up column with sliding cover, gasketed; or pipe column with flexible fabric sleeve seal</td>
</tr>
</tbody>
</table>
Controlled and Uncontrolled Internal Floating Roof Deck Fittings (continued)

<table>
<thead>
<tr>
<th>Deck Fitting Type</th>
<th>Equipment Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Uncontrolled</td>
</tr>
<tr>
<td>Ladder well</td>
<td>Ungasketed sliding cover</td>
</tr>
<tr>
<td></td>
<td>Gasketed sliding cover</td>
</tr>
<tr>
<td>Sample well</td>
<td>Slotted pipe with sliding cover, ungasketed; or slotted pipe with sliding cover, gasketed</td>
</tr>
<tr>
<td>Vacuum breaker</td>
<td>Weighted mechanical actuation, ungasketed</td>
</tr>
<tr>
<td></td>
<td>Weighted mechanical actuation, gasketed</td>
</tr>
</tbody>
</table>

Internal Floating Roof Rim Seal System Control Efficiency

<table>
<thead>
<tr>
<th>Seal System Description</th>
<th>Efficiency Relative to Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vapor mounted primary seal only</td>
<td>Baseline</td>
</tr>
<tr>
<td>Mechanical shoe or liquid mounted primary seal only</td>
<td>55%</td>
</tr>
<tr>
<td>Vapor mounted primary seal with secondary seal</td>
<td>63%</td>
</tr>
<tr>
<td>Mechanical shoe or liquid mounted primary seal with secondary seal</td>
<td>76%</td>
</tr>
</tbody>
</table>

Basic External Floating Roof Design

- Welded steel roof
- Mechanical shoe primary seal
- Uncontrolled fittings
### Distribution of VOC Losses for External Floating Roof Tanks

<table>
<thead>
<tr>
<th>Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rim seal losses</td>
<td>68%</td>
</tr>
<tr>
<td>Fitting losses</td>
<td>28%</td>
</tr>
<tr>
<td>Withdrawal losses</td>
<td>4%</td>
</tr>
</tbody>
</table>

### Controlled and Uncontrolled External Floating Roof Deck Fittings

<table>
<thead>
<tr>
<th>Deck Fitting Type</th>
<th>Equipment Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access hatch</td>
<td>Unbolted, ungasketed cover; or unbolted gasketed cover</td>
</tr>
<tr>
<td></td>
<td>Bolted, gasketed cover</td>
</tr>
<tr>
<td>Gauge-float well</td>
<td>Unbolted, ungasketed cover; or unbolted, gasketed cover</td>
</tr>
<tr>
<td></td>
<td>Bolted, gasketed cover</td>
</tr>
<tr>
<td>Guide-pole well</td>
<td>Unslotted pipe with sliding cover, ungasketed</td>
</tr>
<tr>
<td></td>
<td>Unslotted pipe with sliding cover, gasketed</td>
</tr>
</tbody>
</table>

(continued)
## External Floating Roof Rim Seal System
### Control Efficiency

<table>
<thead>
<tr>
<th>Seal System Description</th>
<th>Efficiency Relative to Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vapor mounted primary seal only</td>
<td>Baseline</td>
</tr>
<tr>
<td>Vapor mounted primary seal with secondary seal</td>
<td>66%</td>
</tr>
<tr>
<td>Mechanical shoe primary seal only</td>
<td>84%</td>
</tr>
<tr>
<td>Mechanical shoe primary seal with shoe mounted secondary seal</td>
<td>95%</td>
</tr>
<tr>
<td>Liquid mounted primary seal only</td>
<td>95%</td>
</tr>
<tr>
<td>Mechanical shoe primary seal with rim mounted secondary seal</td>
<td>99%</td>
</tr>
<tr>
<td>Liquid mounted primary seal with rim mounted secondary seal</td>
<td>99%</td>
</tr>
</tbody>
</table>

## Emission Regulation

- Review records maintained by source
- Observe condition of tank
- Observe floating roof
- Measure rim seal gap areas

## Process Inspection
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Review Records Maintained by Source

- Design information
  - Type of floating roof
  - Type of rim space seals
  - Type of penetration seals
- Operational information
  - Liquid stored
  - Period of storage
  - Maximum true VP
- Maintenance information

Observe Condition of Tank

- Evidence of corrosion
- Liquid or vapor leaks
- Condition of relief valves

Observe Floating Roof

- SAFETY
- General condition
- Roof floating on liquid
- Liquid accumulation on roof
- Condition of rim space seals
- Roof penetrations
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Process Inspection

- Review records maintained by source
- Observe condition of tank
- Observe floating roof
- Measure rim seal gap areas

Gasoline Marketing System

Emission Control Techniques

Collect vapors emitted at end of chain and transport to beginning of chain for recovery or destruction
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**Tank Trucks**

- Must be equipped with vapor return piping
- System must be free of significant leaks

**Bulk Terminals**

**Bulk Plants**
Service Stations

- Stage I controls
- Stage II controls

Stage I Control

Stage II Control
Onboard Stage II Control System

- Displaced vapors sent to onboard carbon adsorber
- Carbon regenerated while vehicle is in operation
- Recovered vapors sent to engine air intake and burned
Emission Regulation

Process Inspection
- Obtain source information
- Check tank truck and storage tank equipment
- Observe operating procedures
- Check for vapor and liquid leaks
- Check vapor recovery system operation
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Obtain Source Information

- Determine method of refueling
- Determine daily maximum and annual throughput
- Determine number and location of loading stations and what materials are loaded
- Determine emission control method
- Review maintenance records

Check Tank Truck and Storage Tank Equipment

- Determine if properly equipped for vapor recovery
- Determine if tank truck has valid leak-tightness certification
- Verify submerged fill

Observe Operating Procedures

- Verify that vapor return line is connected
- Verify that other return lines are closed
- Verify that overfill sensor is connected
- Verify that relief valves do not open
- Check for switch loading
Check for Vapor and Liquid Leaks

- Check piping, hoses, connectors, covers and relief valves for vapor leaks
- Check piping, hoses, connectors, covers and tank shell for liquid leaks
- Verify no spills or excessive drips when lines are disconnected

Check Vapor Recovery System Operation

- Verify system is operating during loading or when accumulator is full
- If not operating, verify accumulator is filling
- Verify that pressure relief valves are closed