Single Buoy Mooring System for Handling Oil
Pipeline dia from both SPMs to tank farm at Vadinar is 42”
Single Point Mooring (SPM)

- **What is an SPM?**
  - A complete, self-contained single point offshore terminal facility which provides the means for both mooring and transferring cargo of very large crude oil carriers (VLCC) or floating offshore facilities.

- **Why an SPM is required?**
  - VLCC and ULCC have significant cost-advantages, they need very high draft (more than 20 metres) for movement which is mostly not available near shores. SPM systems are regarded as instant port since they can be installed in deeper areas without any need for construction of jetties.
  - SPM system facilitate faster turnaround of vessels.
  - When production facilities are into deep sea, an SPM is best way for cargo transfers via vessels.
Salient Features of an SPM System

• All SPMs moor a vessel to a single point and allow the vessel to weather-vane about that point, in response to dynamic sea environment of varying sea current and wind.

• SPM systems are designed not to be rigid and contains energy absorption means such as stretchable mooring ropes and anchor chains catenaries.

• All SPMs have a floating buoy anchored to seabed through anchor chains secured on piles. This buoy has a floating hose system for cargo transport, comprising of floating hoses and sub-sea hoses. The floating hoses connect between the buoy and the vessel whereas the sub-sea hoses connect between buoy and the sub-sea pipeline.
Types of Single Point Mooring Systems

- **CALM (Catenary Anchor Leg Mooring)**
  - It consists of a buoy anchored by 4 or more chains extending in catenaries to anchor points on sea floor.

- **SALM (Single Anchor Leg Mooring)**
  - It consists of a buoy which is anchored to a base on sea floor through a pre-tensioned single anchor leg consisting of a pipe riser pivoted on universal joint and a short anchor chain with a chain swivel.

- **VALM (Vertical Anchor Leg Mooring)**
  - It consists of a buoy with 3 or more vertical pre-tensioned chains anchored on seabed.

- **SPMT (Single Point Mooring Tower)**
  - It consists of a rigid structure erected on seabed and extended up to above water surface with a mounted turret on a swivel.
SPM: An Overview

- **SALM Buoy**
  - Chain
  - Chain Universal Joint
  - Swivel
  - Pipeline on Sea-bed
  - Riser Universal Jt.
  - Mooring Base

- **VALM Buoy**
  - Pre-tensioned Chains
  - Swivel

- **Single Point Mooring Tower**
  - Platform
  - Swivel
  - Riser
  - Sub-sea line

- **Sea-bed Anchor Pile**
Single Point Mooring Tower
CALM TYPE BUOY

SHUTTLE TANKER

MOORING HAWSERS

FLOATING HOSE STRINGS

ANCHOR LEG

SUBSEA HOSES (CHINESE LANTERN)

FLOATING COLLARS

PLEM

SUBSEA PIPELINES
There are 5 main components of an SPM system:

a. Buoy with central swivel and rotating arm
b. Anchoring System (Chains)
c. Product Transfer System (Floating & Underbuoy Hoses)
d. Mooring System
e. Pipeline End Manifold
Major Components of an SPM System

- Buoy
- Anchoring System (Buoy Mooring system)
- Mooring System (Tanker Mooring system)
- Product Transfer system
- Support & Safety Equipments
Major Components of Buoy

- **Major components**
  - Floating Buoy
  - Turntable
    a) Mooring Arm
    b) Pipe Arm
    c) Balance Arm
  - PDU
Major Components of Buoy

- Balance Arm
- Navigation Light
- Mooring Arm
- Mooring Ropes
- Pipe Arm
- Floating Hoses
Buoy Hull

- Buoy Hull is circular, all welded steel structure that is subdivided into Seven (Six radial & one central) water tight compartments separated by radial bulk heads.
- Alternative radial compartments are filled with foam for buoyancy.
- Central compartments is designated as access / storage compartments and is provided with following:
  - PLEM Hydraulic Control Unit
  - Manual Bilge pump with suction & discharge hose
  - DCP fire extinguisher
  - Portable explosion proof hand lantern
  - Miscellaneous items required by operators
- Chain Hawser pipe is integral with six radial bulk heads
- Six deck mounted pad eyes integral with water tight bulk heads for lifting the entire buoy.
PDU & Chain Hawser System
Types of Turn table

- **Turn table on Central Swivel Bearing**
  
  Turn table rotates on central bearing. Wear and tear due to rotation of turn table is less. However, if bearing fails, in situ replacement is not possible. Requires to be changed during dry dock only.

- **Turn table on Bogey Wheels**
  
  Turn table is mounted on bogey wheels moving on lower deck of Buoy. Due to wear on bogey wheels, replacement of the same are required at frequent intervals. Wear on buoy body necessitates dry docking at frequent intervals.

- **Turn table on Wheels & Rail Track**
  
  Turn table is mounted on wheels moving on rail track which is positioned on the deck of Buoy.
RAIL TRACK & MAIN BEARING TYPE BUOYS
Typical Buoy dimensions

Main Bearing

PDU Bearing
## Buoyancy of SPM

<table>
<thead>
<tr>
<th>Buoy ID</th>
<th>Buoy Dia (Outer)</th>
<th>Buoy Dia (Inner)</th>
<th>Buoy Draft (Installed)</th>
<th>Buoy Height</th>
<th>Freeboard Buoyancy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mtr</td>
<td>Mtr</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Displacement</td>
<td>Displacement</td>
<td></td>
</tr>
<tr>
<td><strong>1087</strong></td>
<td><strong>11.00</strong></td>
<td><strong>3.73</strong></td>
<td><strong>3.20</strong></td>
<td><strong>4.82</strong></td>
<td><strong>138.91 MT</strong></td>
</tr>
<tr>
<td>(S)</td>
<td></td>
<td></td>
<td><strong>274.38 MT</strong></td>
<td><strong>413.29 MT</strong></td>
<td></td>
</tr>
<tr>
<td><strong>1218</strong></td>
<td><strong>12.50</strong></td>
<td><strong>0.00</strong></td>
<td><strong>2.20</strong></td>
<td><strong>4.26</strong></td>
<td><strong>257.73 MT</strong></td>
</tr>
<tr>
<td>(I)</td>
<td></td>
<td></td>
<td><strong>275.24 MT</strong></td>
<td><strong>532.97 MT</strong></td>
<td></td>
</tr>
<tr>
<td><strong>1555</strong></td>
<td><strong>12.50</strong></td>
<td><strong>0.00</strong></td>
<td><strong>2.30</strong></td>
<td><strong>4.27</strong></td>
<td><strong>246.47 MT</strong></td>
</tr>
<tr>
<td>(II)</td>
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<td></td>
<td><strong>287.75 MT</strong></td>
<td><strong>534.22 MT</strong></td>
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Buoy Mooring System
Anchoring System of Buoy

395 +/- 5 M
# Pile Dimensions of Buoy and PLEM

<table>
<thead>
<tr>
<th></th>
<th>SPM-I</th>
<th>SPM-II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anchor Piles</td>
<td>PLEM Piles</td>
</tr>
<tr>
<td>No of Piles</td>
<td>06</td>
<td>04</td>
</tr>
<tr>
<td>Diameter</td>
<td>1000 mm</td>
<td>400 mm</td>
</tr>
<tr>
<td>Wall Thickness of Casing</td>
<td>38 mm</td>
<td>13 mm</td>
</tr>
<tr>
<td>Length of Pile</td>
<td>9 m</td>
<td>7 m</td>
</tr>
</tbody>
</table>
Details of Anchor Chain

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>05</td>
<td>6</td>
<td>3¾' STUD LINK W/ END &amp; ENLARGED LINK AT ONE END ONLY, 41.2 M LG.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>6</td>
<td>END JOINING SCHACKLE (ROUND PIN) FOR 3¾' CHAIN</td>
<td>34.5</td>
<td>57.3</td>
<td>59</td>
</tr>
<tr>
<td>03</td>
<td>36</td>
<td>KENTER JOINING SCHACKLE FOR 3¾' CHAIN</td>
<td>33.5</td>
<td>58.6</td>
<td>55.7</td>
</tr>
<tr>
<td>02</td>
<td>30</td>
<td>3¾' STUD LINK CHAIN ALL COMMON LINKS, 54.9 M LG.</td>
<td>32.5</td>
<td>60</td>
<td>52.4</td>
</tr>
<tr>
<td>01</td>
<td>6</td>
<td>3¾' STUD LINK CHAIN ALL COMMON LINKS, 27.4 M LG.</td>
<td>31.5</td>
<td>61.4</td>
<td>49.3</td>
</tr>
</tbody>
</table>

CHAIN TENSIONING TABLE

<table>
<thead>
<tr>
<th>H (M)</th>
<th>Θ (DEG)</th>
<th>S (M)</th>
<th>X (M)</th>
<th>T (KN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.5</td>
<td>57.3</td>
<td>59</td>
<td>51.6</td>
<td>119</td>
</tr>
<tr>
<td>33.5</td>
<td>58.6</td>
<td>55.7</td>
<td>48.2</td>
<td>111</td>
</tr>
<tr>
<td>32.5</td>
<td>60</td>
<td>52.4</td>
<td>45</td>
<td>103</td>
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<td>31.5</td>
<td>61.4</td>
<td>49.3</td>
<td>41.8</td>
<td>95</td>
</tr>
<tr>
<td>30.5</td>
<td>62.9</td>
<td>46.2</td>
<td>38.8</td>
<td>88</td>
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</tbody>
</table>

Typical Mooring Leg Elevation

SPM-II
Major Components of Buoy

- **Major components**
  - Floating Buoy
  - Turntable
    - a) Mooring Arm
    - b) Pipe Arm
    - c) Balance Arm
  - PDU
Major Components of Buoy

- Balance Arm
- Navigation Light
- Mooring Arm
- Mooring Ropes
- Pipe Arm
- Floating Hoses
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Anchoring System of Buoy

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Details of Anchor Chain

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<td></td>
</tr>
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<td></td>
</tr>
<tr>
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<td></td>
<td><strong>CHAIN TENSIONING TABLE</strong></td>
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<td></td>
<td></td>
<td>32.5</td>
<td>60</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>31.5</td>
<td>61.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30.5</td>
<td>62.9</td>
</tr>
</tbody>
</table>

SPM-II
Tanker Mooring System
Components of Tanker Mooring System

1. 110 t shackles
2. Mooring Chain
3. Mooring Hawser
4. Antichaffing Chains
5. Support Buoy
6. Wire Pendent
7. Messenger Rope
8. Pickup Rope
9. Pick Up buoy
Tanker Mooring Arrangement

- Supporting buoy - net buoyancy-2170 KG
- 110 t shackle
- Mooring Rope- 14” Cir.
- Thimble
- ANTI CHAFFING CHAIN
<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
<td>16” x 18”</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>D shape</td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td>Grade U3 of EN 24T or AISI 4340</td>
</tr>
<tr>
<td><strong>Safe Working Load</strong></td>
<td>110 T</td>
</tr>
<tr>
<td><strong>Proof Load</strong></td>
<td>217 MT</td>
</tr>
<tr>
<td><strong>Breaking Load</strong></td>
<td>310 MT (Min)</td>
</tr>
</tbody>
</table>
# Mooring Hawser

<table>
<thead>
<tr>
<th>Designation</th>
<th>SO 1087</th>
<th>IM 1555</th>
<th>IM 1218</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hawser arrangement</td>
<td>Twin lines</td>
<td>Twin lines</td>
<td>Twin lines</td>
</tr>
<tr>
<td>Material</td>
<td>Nylon</td>
<td>Nylon</td>
<td>Nylon</td>
</tr>
<tr>
<td>Hawser length (m/feet)</td>
<td>54.8 / 180</td>
<td>54.8 / 180</td>
<td>54.8 / 180</td>
</tr>
<tr>
<td>Dyn. design mooring force (tonnes)</td>
<td>250</td>
<td>270</td>
<td>220</td>
</tr>
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</table>
## Mooring Hawser

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
<td>14” circumference x 180’ length</td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td>Nylon</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>8 strand plaited type, Grommet end for end splice in the center for each leg.</td>
</tr>
<tr>
<td><strong>Min new dry breaking strength (NDBS)</strong></td>
<td>470 MT for single rope strength</td>
</tr>
<tr>
<td><strong>End Connection</strong></td>
<td>Hot dip galvanised reusable bell mouth Thimbles</td>
</tr>
<tr>
<td><strong>Reserve Buoyancy</strong></td>
<td>120%</td>
</tr>
<tr>
<td><strong>Type of flotation</strong></td>
<td>27 nos. lace on pocket type floats</td>
</tr>
</tbody>
</table>
Anti Chaffing Chain

- **Size**: 3"
- **Material**: Grade U2
- **Proof load**: 219 MT
- **Breaking Load**: 307 MT

<table>
<thead>
<tr>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>One 3” end link, One 3” enlarged link, 9 common links of 3”, One center Shackle 3”, One common link 3”, Triangular plate 90mm thick, One common link 3”, One center Shackle 3”, 7 common links of 3”, One center Shackle 2 7/16”, One common link 2 7/16”, One center Shackle 2 7/16”</td>
</tr>
<tr>
<td>Specifications</td>
</tr>
<tr>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Over all length</td>
</tr>
<tr>
<td>Length of Floatation</td>
</tr>
<tr>
<td>Dia. Of Floatation</td>
</tr>
<tr>
<td>Net Buoyancy</td>
</tr>
<tr>
<td>Core</td>
</tr>
<tr>
<td>Skin</td>
</tr>
<tr>
<td>Swivel assembly</td>
</tr>
<tr>
<td>Swivel finish</td>
</tr>
<tr>
<td>Central steel work</td>
</tr>
</tbody>
</table>
Chain Lockers

Inboard view of chain stopper showing messenger rope

Chain stopper with hydraulically-operated claw in the locked shut position
Product Transfer System
Product Transfer System

- Floating Hoses
- J-tube
- Deck & Central Well Valves
- Expansion Joint
- Product Distribution Unit
- Sub Sea Hoses
Floating and Sub Sea Hoses

- **Sub Sea Hoses or Under Buoy Hoses**
  - Single Carcass
  - Double Carcass

- **Floating Hoses**
  - Half Float – First from Buoy
  - Decreasing Stiffness
  - Full Float
  - Tapered
  - Tanker Rail Hose – Last from Buoy
Floating Hose String

- Floating hose string consists of hoses of varying degrees of stiffness to help transition stress from the start of the floating hoses to the ship’s manifold.
- Decreasing stiffness hoses is provided after first hose off the buoy.
- Tapered hoses as well as metallic reducers with built-in flotation are also used.
- At the end of the tanker rail hose, the thickness of the foam layer is increased to compensate for the weight of butterfly valve, spool piece, blind flange etc.
- The total no. of electrical discontinuous hose sections depend on the maximum free-board of the tankers using the SPM.
Hose to Buoy Connection

- Responses of buoy and the hose to wave, wind and current stress are different.
- The environment forces create cyclic bending moments & tension, compression and torsional loadings.
- Due to this problem arise in the first and second hose off the buoy.
- These problems can be reduced by:
  - Maintaining the centre of the hose/overboard pipe connection apprx. At mean sea level.
  - The face of the flange of vertical pipe is kept at 15° with the vertical.
# Typical Floating Hose String

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Type of hoses</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>FLOATING HOSES</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>24” x 40’ Half float hose</td>
<td>01</td>
</tr>
<tr>
<td>2</td>
<td>24” x 40’ Decreasing stiffness hose</td>
<td>01</td>
</tr>
<tr>
<td>3</td>
<td>24” x 35'/40' Full float hose</td>
<td>22 / 21</td>
</tr>
<tr>
<td>4</td>
<td>20” x 35'/40' Full float hose</td>
<td>01</td>
</tr>
<tr>
<td>5</td>
<td>20” - 16” x 35’ Tapered hose</td>
<td>01</td>
</tr>
<tr>
<td>6</td>
<td>16” x 35' Full float hose</td>
<td>02</td>
</tr>
<tr>
<td>7</td>
<td>16” x 30’ Tanker rail hose</td>
<td>01</td>
</tr>
<tr>
<td>II</td>
<td><strong>SUB SEA HOSES</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>20” x 35' Submarine hose</td>
<td>04</td>
</tr>
<tr>
<td>2</td>
<td>20” x 37.5’ / 40’ Submarine hose</td>
<td>02</td>
</tr>
</tbody>
</table>
Tanker Mooring System
Components of Tanker Mooring System

1. 110 t shackles
2. Mooring Chain
3. Mooring Hawser
4. Antichaffing Chains
5. Support Buoy
6. Wire Pendent
7. Messenger Rope
8. Pickup Rope
9. Pick Up buoy
Tanker Mooring Arrangement

- Supporting buoy - net buoyancy: 2170 KG
- Mooring Rope: 14” Cir.
- 110 t shackle
- Thimble
- Anti Chaffing Chain
## 110 T Shackle

- **Size**: 16” x 18”
- **Type**: D shape
- **Material**: Grade U3 of EN 24T or AISI 4340
- **Safe Working Load**: 110 T
- **Proof Load**: 217 MT
- **Breaking Load**: 310 MT (Min)
## Mooring Hawser

<table>
<thead>
<tr>
<th>Designation</th>
<th>SO 1087</th>
<th>IM 1555</th>
<th>IM 1218</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hawser arrangement</td>
<td>Twin lines</td>
<td>Twin lines</td>
<td>Twin lines</td>
</tr>
<tr>
<td>Material</td>
<td>Nylon</td>
<td>Nylon</td>
<td>Nylon</td>
</tr>
<tr>
<td>Hawser length (m/feet)</td>
<td>54.8 / 180</td>
<td>54.8 / 180</td>
<td>54.8 / 180</td>
</tr>
<tr>
<td>Dyn. design mooring force (tonnes)</td>
<td>250</td>
<td>270</td>
<td>220</td>
</tr>
<tr>
<td><strong>Mooring Hawser</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>14” circumference x 180’ length</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td>Nylon</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>8 strand plaited type, Grommet end for end splice in the center for each leg.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Min new dry breaking strength (NDBS)</strong></td>
<td>470 MT for single rope</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>End Connection mouth Thimbles</strong></td>
<td>Hot dip galvanised reusable bell</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reserve Buoyancy</strong></td>
<td>120%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Type of flotation</strong></td>
<td>27 nos. lace on pocket type floats</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Anti Chaffing Chain

- Size: 3”
- Material: Grade U2
- Proof load: 219 MT
- Breaking Load: 307 MT

Components:
- One 3” end link, One 3” enlarged link, 9 common links of 3”, One center Shackle 3”, One common link 3”, Triangular plate 90mm thick, One common link 3”, One center Shackle 3”, 7 common links of 3”, One center Shackle 2 7/16”, One common link 2 7/16”, One center Shackle 2 7/16”
## Support Buoy

- **Over all length**: 2.3 M to 2.7 M
- **Length of Floatation**: 1.7 M to 2.0 M
- **Dia. Of Floatation**: 1.3 M to 1.5 M
- **Net Buoyancy**: 2.2 T
- **Core**: Polyethylene Foam (special close cell, low density, low water absorbent)
- **Skin**: 12 mm Polyurethane elastomer
- **Swivel assembly**: 16 T proof load
- **Swivel finish**: Hot dip galvanised Carbon steel
- **Central steel work**: Carbon Steel
Chain Lockers
Product Transfer System
Product Transfer System

- Floating Hoses
- J-tube
- Deck & Central Well Valves
- Expansion Joint
- Product Distribution Unit
- Sub Sea Hoses
Floating and Sub Sea Hoses

- **Sub Sea Hoses or Under Buoy Hoses**
  - Single Carcass
  - Double Carcass

- **Floating Hoses**
  - Half Float – First from Buoy
  - Decreasing Stiffness
  - Full Float
  - Tapered
  - Tanker Rail Hose – Last from Buoy
Floating Hose String

- Floating hose string consists of hoses of varying degrees of stiffness to help transition stress from the start of the floating hoses to the ship’s manifold.
- Decreasing stiffness hoses is provided after first hose off the buoy.
- Tapered hoses as well as metallic reducers with built-in flotation are also used.
- At the end of the tanker rail hose, the thickness of the foam layer is increased to compensate for the weight of butterfly valve, spool piece, blind flange etc.
- The total no. of electrical discontinuous hose sections depend on the maximum free-board of the tankers using the SPM.
Hose to Buoy Connection

- Responses of buoy and the hose to wave, wind and current stress are different.
- The environment forces create cyclic bending moments & tension, compression and torsional loadings.
- Due to this problem arise in the first and second hose off the buoy.
- These problems can be reduced by:
  
  Maintaining the centre of the hose/overboard pipe connection approx. At mean sea level.

  The face of the flange of vertical pipe is kept at $15^0$ with the vertical.
Typical Floating Hose String

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Type of hoses</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>FLOATING HOSES</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>24” x 40’ Half float hose</td>
<td>01</td>
</tr>
<tr>
<td>2</td>
<td>24” x 40’ Decreasing stiffness hose</td>
<td>01</td>
</tr>
<tr>
<td>3</td>
<td>24” x 35'/40’ Full float hose</td>
<td>22 / 21</td>
</tr>
<tr>
<td>4</td>
<td>20” x 35'/40’ Full float hose</td>
<td>01</td>
</tr>
<tr>
<td>5</td>
<td>20” - 16” x 35’ Tapered hose</td>
<td>01</td>
</tr>
<tr>
<td>6</td>
<td>16” x 35’ Full float hose</td>
<td>02</td>
</tr>
<tr>
<td>7</td>
<td>16” x 30’ Tanker rail hose</td>
<td>01</td>
</tr>
<tr>
<td>II</td>
<td>SUB SEA HOSES</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>20” x 35’ Submarine hose</td>
<td>04</td>
</tr>
<tr>
<td>2</td>
<td>20” x 37.5’ / 40’ Submarine hose</td>
<td>02</td>
</tr>
</tbody>
</table>
Floating Hose String (An example)

<table>
<thead>
<tr>
<th>Hose No.</th>
<th>Hose Desc.</th>
<th>Hose Size</th>
<th>Hose Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Half Float Hose</td>
<td>24&quot; x 40'</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>Decreasing Stiffness</td>
<td>24&quot; x 40'</td>
<td>48</td>
</tr>
<tr>
<td>3-22</td>
<td>Floating Hoses</td>
<td>24&quot; x 40'</td>
<td>72</td>
</tr>
<tr>
<td>23</td>
<td>Full Float Hose</td>
<td>24&quot;-20&quot; x 4.67'</td>
<td>Condition based</td>
</tr>
<tr>
<td>24</td>
<td>MBC</td>
<td>20&quot; x 40'</td>
<td>60</td>
</tr>
<tr>
<td>25</td>
<td>Tapered Hose</td>
<td>3.75'</td>
<td>Condition based</td>
</tr>
<tr>
<td>26</td>
<td>Full Float</td>
<td>20&quot;-16&quot; x 35'</td>
<td>60</td>
</tr>
<tr>
<td>27</td>
<td>Full Float Hose</td>
<td>16&quot; x 35'</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Tanker Rail</td>
<td>16&quot; x 30'</td>
<td>45</td>
</tr>
</tbody>
</table>

- **Hose No.**
- **Hose Desc.**
  - Half Float Hose
  - Decreasing Stiffness
  - Floating Hoses
  - Full Float Hose
  - MBC
  - Tapered Hose
  - Full Float
  - Full Float Hose
  - Tanker Rail
- **Hose Size**
  - 24" x 40'
  - 24" x 40'
  - 24" x 40'
  - 24"-20" x 4.67'
  - 20" x 40'
  - 3.75'
  - 20"-16" x 35'
  - 16" x 35'
  - 16" x 35'
  - 16" x 30'
- **Hose Life**
  - 30
  - 48
  - 72
  - Condition based
  - 60
  - Condition based
  - 60
  - 45
  - 45
  - 30
Hose Length in SPM System

Required Overall Length of floating hose string can be designed as per the following formula:-

$$TL = C + (R \times (1+E))+(B/2)+L+H+M+G$$

WHERE:

- **TL**: REQUIRED OVERALL LENGTH
- **C**: DIAMETER OF BUOY
- **R**: LENGTH OF MOORING HAWSER
- **E**: MAX. ELONGATION OF MOORING ROPE
- **B**: BEAM OF TANKER
- **H**: MAXIMUM FREEBOARD
- **L**: DISTANCE BETWEEN BOW AND MANIFOLD
- **G**: HEIGHT OF MANIFOLD FROM DECK
- **M**: DISTANCE BETWEEN RAIL AND SHIP MANIFOLD
Sub Sea Hose String

**SBM-I**
- Each String Consists of
- Hose No.: 1 2 3 4
- Hose Size: 20” x 35’ 20” x 37.5’ 20” x 37.5’ 20” x 35’

Total Length – 145’ / 44.20 M

**SBM-II**
- Each String Consists of
- Hose No.: 1 2 3 4
- Hose Size: 20” x 35’ 20” x 40’ 20” x 40’ 20” x 35’

Total Length – 150’ / 45.72 M
Configuration of Sub Sea Hose String

BUOY

END FLOAT

BODY FLOAT

WATER DEPTH

45.720 M

32.500 M
PLEM
Pipeline End Manifold- PLEM
Pipeline End Manifold- PLEM

24" BALL VALVE (HYD OPERATED)
Pipeline End Manifold-PLEM
Pipeline End Manifold-PLEM
PLEM VIEW
ACCESSORIES IN FLOATING HOSE STRING
Metallic Reducer
Marine Breakaway Coupling

- **Size**: 20” NB (19.25” ID) (Max. Dia: 28.75”, Length: 11.75”)
- **Make**: M/s Gail Thompson Environmental plc, UK
- **Double energized anti pollution petal vane closer**
- **Design Parting Load**: 45 T
- **Design Pressure**: 225 psi
- **Design Temperature**: -100°C to 850°C
- **Design Closure Speed**:
  - Upstream: Instantaneous
  - Downstream: Adjustable to prevent damage to system
4. End Gear Equipment for Floating Hose Line

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gasket</td>
</tr>
<tr>
<td>2</td>
<td>Butterfly Valve (Lever Operated Type)</td>
</tr>
<tr>
<td>3</td>
<td>Butterfly Valve Connecting Bolt and Nuts</td>
</tr>
<tr>
<td>4</td>
<td>Camlock Flange with Spool</td>
</tr>
<tr>
<td>5</td>
<td>Studded Comblock Flange and Separated Spool Piece</td>
</tr>
<tr>
<td>6</td>
<td>Light Weight Blind Flange</td>
</tr>
<tr>
<td>7</td>
<td>Hang-Off Chain</td>
</tr>
<tr>
<td>8</td>
<td>Pick-Up Chain</td>
</tr>
<tr>
<td></td>
<td>Marker Buoy</td>
</tr>
</tbody>
</table>
End Gear Arrangement of Floating Hose
Butter fly Valve

- Size: 16”
- Flange: ANSI 150#
- Type: Sandwich
- Lever Operated
**BUTTERFLY VALVES**  
CODE: BFV519

![Diagram of Butterfly Valves]

For sizes 12" and smaller items 8, 9, 10 are replaced by stainless steel cap, item 3 reduced.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Quantity</th>
<th>Item No.</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Body</td>
<td>1</td>
<td>9</td>
<td>Thrust Bearing</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Body Liner</td>
<td>1</td>
<td>10</td>
<td>O-Ring</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Shaft Seal</td>
<td>1</td>
<td>11</td>
<td>Locking Cap</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Disk</td>
<td>1</td>
<td>12</td>
<td>Bolt</td>
<td>DIN 933</td>
</tr>
<tr>
<td>5</td>
<td>Shaft</td>
<td>1</td>
<td>13</td>
<td>Nut</td>
<td>DIN 934</td>
</tr>
<tr>
<td>6</td>
<td>Bearing</td>
<td>2</td>
<td>14</td>
<td>Taper Pin</td>
<td>DIN 1</td>
</tr>
<tr>
<td>7</td>
<td>Taper Pin</td>
<td>DIN 1</td>
<td>15</td>
<td>Lever</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Cover Plate</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Camlock Coupling
Camlock Coupling
Specifications for Snubbing chain (Item code 0871151321)

- **Description**: Chain stud link 1” dia x 32 feet length butt welded
- **Grade**: U2
- **Coating**: Hot dip Galvanized
- **Safe Working Load**: 12 T
- **Proof load**: 28.3 T
Manifold Connection
Thank You