Industry adoption of game changing Thermoplastic Composite Pipe

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Thermoplastic Composite Pipe (TCP) - Concept

- Solid pipe structure: bonded
- Fit for purpose polymer: liner, matrix & coating
- Glass or carbon fibres fully embedded (true composite)
- Protective coating
Thermoplastic Composite Pipe (TCP) - End-Fitting

- Easy to install within 2 hours, field terminated
- Several material & flange options
- Fully qualified
Thermoplastic Composite Pipe (TCP) - Manufacturing

Airborne Manufacturing plant
- World’s first full scale thermoplastic composite pipe plant
- Sizes from 1 to 7.5 inch ID (equiv. to 8” nominal pipe size)
- Continuous length - 3000+ meters per spool
- Strategically located in Amsterdam Port Area
TCP: Products

<table>
<thead>
<tr>
<th>Subsea Umbilicals Risers Flowlines</th>
<th>Subsea Light Well Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flowlines &amp; Spools</strong></td>
<td><strong>Risers</strong></td>
</tr>
<tr>
<td><img src="image1" alt="Flowlines &amp; Spools" /></td>
<td><img src="image2" alt="Risers" /></td>
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</tbody>
</table>

### Key Proposition
- No corrosion
- Lower total installed cost
- Lowest total cost of ownership
- 50% weight reduction
- Lower riser cost
- Lower installation cost
- Collapse resistant 3000 m
- Smooth bore
- Flexible
- High flowrates
- Lower cost per intervention
- Long service life

### Key Applications
- In-field flowlines
- Spools & well jumpers
- Gas, water & HC service
- Deepwater
- Corrosive environments
- Gas, water & HC service
- Light well intervention
- Plug & Abandonment
- Pipeline pre-commissioning
- Light well intervention
- Plug & Abandonment
- Pipeline pre-commissioning
Proud of our Track Record
TCP - Qualification

- Airborne Oil & Gas is the world’s first company qualified in accordance to DNV RP F119
- Materials: E-glass PE (others in progress)
- Design: TCP & End-fitting
- Production

### Generic

<table>
<thead>
<tr>
<th>Full Scale</th>
<th>Representative Pipes</th>
<th>Laminate level</th>
<th>Ply level</th>
<th>Constituent level – Polymer &amp; Fibre</th>
</tr>
</thead>
</table>

### Product

<table>
<thead>
<tr>
<th>Dynamic Jumpers</th>
<th>Downlines</th>
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<tbody>
<tr>
<td><img src="image1" alt="OneSubsea" /></td>
<td><img src="image2" alt="Shell" /></td>
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<tr>
<td><img src="image3" alt="IKM" /></td>
<td><img src="image4" alt="SAIPEM" /></td>
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<tr>
<th>Spools</th>
<th>Flowlines</th>
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<tbody>
<tr>
<td><img src="image5" alt="WildWell" /></td>
<td><img src="image6" alt="Subsea" /></td>
</tr>
<tr>
<td><img src="image7" alt="Chevron" /></td>
<td><img src="image8" alt="PETRONAS" /></td>
</tr>
<tr>
<td><img src="image9" alt="SAIPEM" /></td>
<td><img src="image10" alt="TOTAL" /></td>
</tr>
</tbody>
</table>

*In progress*
TCP Downline

- **Field proven**: 65+ deployments to date
- **High flowrates**: one 3” ID coil = 25 BPM
- **Lower cost per intervention**: Multiple operations per year, for years, with one downline
- **Easy and safe** to operate: light-weight, no spring effect, no weight requirements, one single length no midline connections
- **Fast running**: 2,5 hrs to 2100 meters water depth, no clamping of ballast or buoyancy during deployment
TCP Downline – Reducing Cost per Intervention

- Fastest deployment, reducing vessel time
- One single conduit, fast hook up and short pressure testing
- 200+ deployments per pipe, superior fatigue performance
TCP Downline

Latest project:

- Statoil - Asta Hansteen
- Client - Subsea 7/IKM testing
- Pipeline precomm - 19 deployments completed to date
TCP Jumper

- World’s only smooth bore, non-collapsible flexible jumper
- 1” to 3” ID
- 10 ksi & 15 ksi
- Vacuum capability
- Can pump cement (smooth bore)
- High flowrates
- Field terminated
- Coating repair
TCP Jumper - deployment
TCP Flowline & Jumper Spools

- Up to 7.5 inch ID
- Up to 690 bar/10ksi
- 2500-5000m in one length
- Fit-for-purpose material selection

- No corrosion
- Flexible
  - Simplifying configuration
  - Simplyfing installation
  - Allowing reel lay

→ Lower Total Installed Cost
→ Lower Total Cost of Ownership
TCP Flowlines – Life Cycle Cost

Comparison with steel:

- **Lower Total Installed cost (CAPEX)**
  - Less seabed intervention works
  - No PLET, no spools, no metrology
  - No diving
  - Low installation vessel day rates

- **Lower Operating Cost (OPEX)**
  - No corrosion, no corrosion mitigation
  - Smooth bore, better flow
  - Less inspection, less pigging
  - Long design life

![Graph showing comparison of Total Installed Cost between Rigid Steel and TCP, with a 30% cost reduction for TCP.](comparison_graph.png)
TCP Jumpers Spools – Total Installed Cost

- Lower Total Installed Cost with TCP
  - 60% cost reduction compared to steel*
  - 40% cost reduction compared to unbonded flexibles*

*Overall as-installed cost based on 5 well jumpers
Ready for business