

Strohm 

Thermoplastic Composite Pipe

**No corrosion, lower cost
and less CO₂**





Thermoplastic Composite Pipe:
The disruptive, **maintenance free** and
field proven pipe solution for offshore
Renewables and Energy applications

Strohm

Formerly known as Airborne Oil & Gas, Strohm is the world's first and leading company to have developed Thermoplastic Composite Pipe (TCP).

We develop TCP products for high end applications in the Energy and Renewable sectors. Our pipe products do not corrode, reduce total cost of ownership and have a small carbon footprint.

We manufacture flowlines, jumper spools and risers with a focus on offshore and subsea, for two markets:

Renewables: carbon capture utilization and storage (CCUS), hydrogen and other related applications

Energy: conventional Oil & Gas applications including hydrocarbon service, gas lift, water injection and chemical well treatment

We are proud to be certified climate neutral as organization.



Thermoplastic Composite Pipe

TCP is a high performance, spoolable pipe that does not corrode, reduces total installed cost and has a smaller carbon footprint compared to steel.

The benefits at a glance:

- No corrosion and excellent chemical resistance, reducing maintenance and avoiding the need for the use of corrosion inhibitors
- Certified small carbon footprint, reducing total footprint by more than 50% compared to steel

- Light weight, reducing transportation costs
- Spoolable in long lengths, reducing installation costs
- Smooth inner bore for optimized flow, whilst maintaining collapse resistance
- Suitable for CO₂ and Hydrogen transport, as well as hydrocarbons and a wide range of chemicals
- High internal pressure rating
- Flexibility

We have case studies and project references available. Contact us for more information.



Carbon - PVDF 121 °C / 250 °F

Carbon - PA12 80 °C / 176 °F

Glass - HDPE 65 °C / 150 °F

Energy Market: TCP reduces the carbon footprint of your infrastructure

In today's Oil & Gas industry, operators are working hard to reduce their carbon footprint as part of their sustainability efforts.

One of our shareholders, Shell, is aiming to decrease the net carbon footprint of the products they sell, with 30% by 2035 and with 65% by 2050. A growing list of operators have similar ambitions to reduce the carbon footprint of their operations and products they sell. As such the oil and gas industry is taking unprecedented steps towards a lower carbon energy system.

Strohm, with our goal of supporting our clients towards net zero, is working hard to reduce the CO2 footprint related to our product, TCP. Today we are climate neutral as organization, certified by Climate Neutral Group. For the product TCP, on an installed basis we see that TCP can reduce the footprint by 60% or more, when compared to steel.

Through our efforts, technology and product we help our clients to achieve their sustainability goals.



TCP Flowline

With the introduction of our non-metallic, fully bonded TCP Flowline, corrosion is no longer a threat to the integrity of your subsea infrastructure and corrosion mitigation measures is something of the past. This reduces operational expenditures to near zero. Our TCP Flowline is delivered in long, spooled lengths on standard offshore reels, enabling cost effective transport and allowing for horizontal installation methods using small vessels such as Multi Purpose Vessels.

The TCP Flowline offers the following advantages:

- No corrosion
- Flexible and spoolable
- High internal and external pressure ratings
- Smooth bore - fully piggable
- Simple, reliable and field-mountable end fittings
- Low U-value compared with steel pipe
- Continuous lengths of 3,000 to 6,000 metres depending on diameter and pressure rating
- Quick installation by horizontal lay or surface tow method
- Lowest total installed cost and total cost of ownership ("Totex")

Strohm's TCP Flowline is qualified under DNV and by many operators, and field track record includes hydrocarbon production and water injection.





TCP Jumper Spool

Subsea spools are used as interface between flowlines, risers, manifolds and wellheads and need to absorb dynamic and static loads and displacements. Conventional steel spools are often complex 3D structures and come with a number of design, installation and operational challenges.

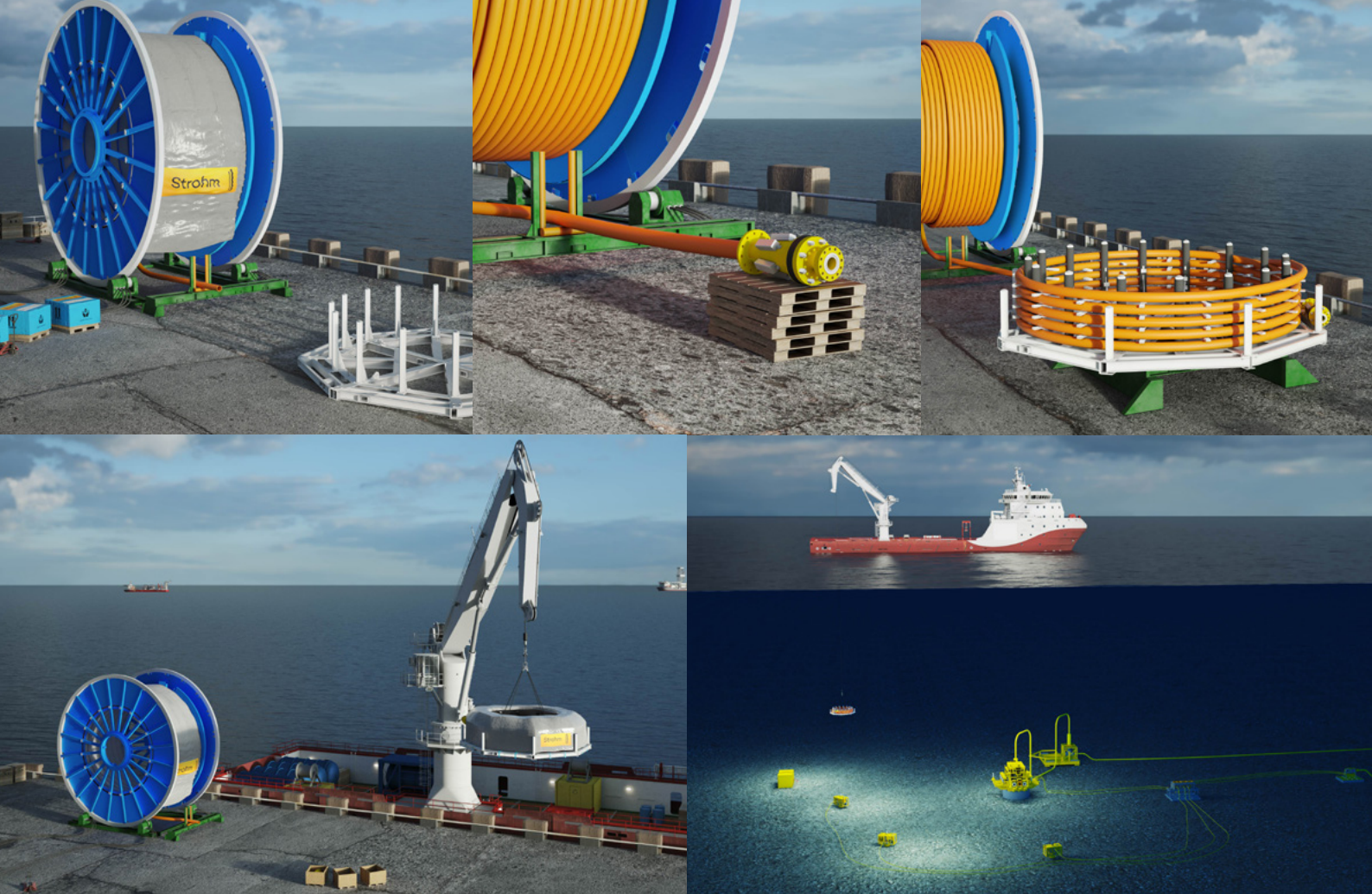
One of the most prominent issues and main cost driver is the metrology to establish the final jumper geometry. In addition, the manufacturing time of a conventional steel spool is typically adding 2 months to the project critical path, resulting in longer time to first oil.

The TCP Jumper Spool is our answer to these challenges;

the TCP is flexible and can absorb significant installation tolerances, pipeline expansions and dynamic riser motions. Therefore, accurate metrology is not required, leading to lower installation cost, shorter time frames and less risk for the overall project.

The TCP Jumper Spool offers the following advantages:

- No metrology required
- Manufactured and terminated at required lengths, or in long lengths to be cut and terminated on site
- No complex geometry to weld and insulate
- Significantly more tolerance in length than rigid pipe
- No buoyancy required on most designs
- Reduced transport and installation costs
- Can be coiled down on deck or on reels
- More pipe can be transported in a single mobilization
- Lower specification of vessel
- Multiple methods of deployment
- Direct over-boarding via VLS/HLS
- Conventional with less complex spreader bar
- Reduced barge / transport vessel costs, more jumpers per mobilization



Jumper On Demand

The TCP Jumper Spool offers the option of having a length of TCP readily available near site, reducing schedule risk and cost.

Clients can take advantage of a single pre-agreed continuous design shipped on a reel that can be spooled off to the required length, when and as required.

Our simple and quick to terminate End Fittings are shipped separately, ready to be terminated onsite at short notice by Strohm technicians or by our clients' own trained and qualified personnel. Strohm can provide the TCP Jumper Spool with all required ancillaries and with subsea deployable pallet on rental basis.

The Value Proposition of Jumper On Demand:

- De-risk and fully own the schedule
- Take advantage of volume cost optimizations
- Logistics costs reduced, simplified and known
- Ready to deploy in days, not months

“The ability to cut TCP to the required length and terminate in country simplifies our project, reduces our cost and de-risks our schedule.”

TCP Riser

Deepwater risers connect wells on the seabed at water depths of more than 3000 m, with the production facility at the surface.

The challenges associated with the use of deepwater risers are large vessel payloads, complex riser layouts and associated high procurement and installation cost. Corrosion, fatigue and flow assurance further increase the design difficulties.

The TCP Riser is lightweight, able to cope with high internal and external pressures and features superior chemical resistance. It can be used for highly corrosive fluids and gases, including high contents of CO₂ and H₂S.

In particular, the TCP Riser allows for simple riser configurations that otherwise would not be possible. In the free hanging catenary configuration using TCP, the top tensions are low, well within the riser and end fitting capacity and without added buoyancy. Compared to conventional risers, the TCP Riser does not

require any buoyancy modules and is lighter, reducing installation cost dramatically while still reducing the weight at the floating platform.

The TCP Riser offers the following advantages:

- No corrosion, capable of handling high CO₂ and H₂S
- Low top tension, higher allowable topside payload
- Simple free hanging catenary configuration, less components & interfaces
- Lower installation cost
- Superior fatigue properties

To meet the challenging conditions of deepwater risers, Strohm is developing a superior TCP Riser based on carbon fibre in a PVDF polymer matrix with an integrated weight coating. Today, we are executing a comprehensive qualification program in Brazil, supported by our partners.

Renewables Market

Since our inception in 2007, Strohm has been at the forefront of bringing disruptive, enabling TCP technology to the marketplace.

We are the first company to have developed Thermoplastic Composite Pipe (TCP), introduced it to demanding offshore applications successfully and enjoyed its widespread use across the globe. Today, we have the largest track record on TCP in the world in various applications.

We have been successful in working closely with our clients, contractors and operators, taking their requirements as starting point for our product and technology development and with that, develop the new products when and where needed. Today we are supporting the Renewables market in the segments of Carbon Capture, Utilization and Storage, Hydrogen as well as multiple other Renewable initiatives.





Carbon Capture, Utilization and Storage

Carbon Capture, Utilization and Storage, CCUS, is one of the primary methods to achieve the objectives of the Paris Agreement. It can be realized relatively quickly and it is cost effective, so long as the corrosion issue is tackled: TCP as a non-corrosive pipe is a pipeline candidate with high potential.

CCUS is an important element of the roadmap to achieve the climate objectives as laid down in Paris Agreement:

- It has the potential to remove large quantities of CO₂ from the environment
- It can be implemented in the short term
- It is cost effective

The drawback of CO₂ is that, especially when combined with seawater, it is extremely corrosive. In addition, CO₂ in dense phase can cause running ductile fractures in steel; both issues are unknown to TCP.

TCP therefore is well suited for CO₂ transport:

- Our current TCP qualifications already cover CO₂ exposure and as such is qualified for CO₂ transport already
- TCP is insensitive to CO₂ – even in combination with seawater, a lethal mix for conventional flexibles and steel and steel. This means that when using TCP the CO₂ does not require purification
- TCP when installed offshore reduces total installed cost and the system's carbon footprint
- TCP can be pulled through existing pipelines and J-tubes, avoiding expensive shore approaches or platform modifications



Hydrogen

Hydrogen, especially green hydrogen, holds a great promise in the energy transition:

- When burning it produces water, not CO₂
- It is an energy carrier which can be stored
- It can be used to decarbonise industries that are hard to electrify

Hydrogen can cause a phenomenon called “hydrogen embrittlement” in steel pipelines which makes it challenging to (re) use steel for hydrogen transport.

TCP is well suited for Hydrogen transport:

- TCP qualifications already cover H₂ exposure and as such is qualified for hydrogen transport

- TCP is insensitive to hydrogen embrittlement
- The flexibility of TCP and ease of installation through horizontal lay provide a step change in cost reduction for use on offshore hydrogen creation
- The carbon footprint associated to TCP in scopes 1, 2 and 3 results in significant footprint reduction benefits

Strohm works with several parties on studies for offshore hydrogen generation, including bottom fixed turbines and floating wind. Contact us for more information.

Track Record, End Fittings and Manufacturing

Track Record

To date, we have supplied TCP around the globe for hydrocarbon production, water injection, gas lift, methanol injection and chemical well treatment. We have many records including the world's first TCP for hydrocarbon service, and the deepest operating TCP in 2,140 meters water depth.

Contact us for more information on our track record or visit our website.

End Fittings

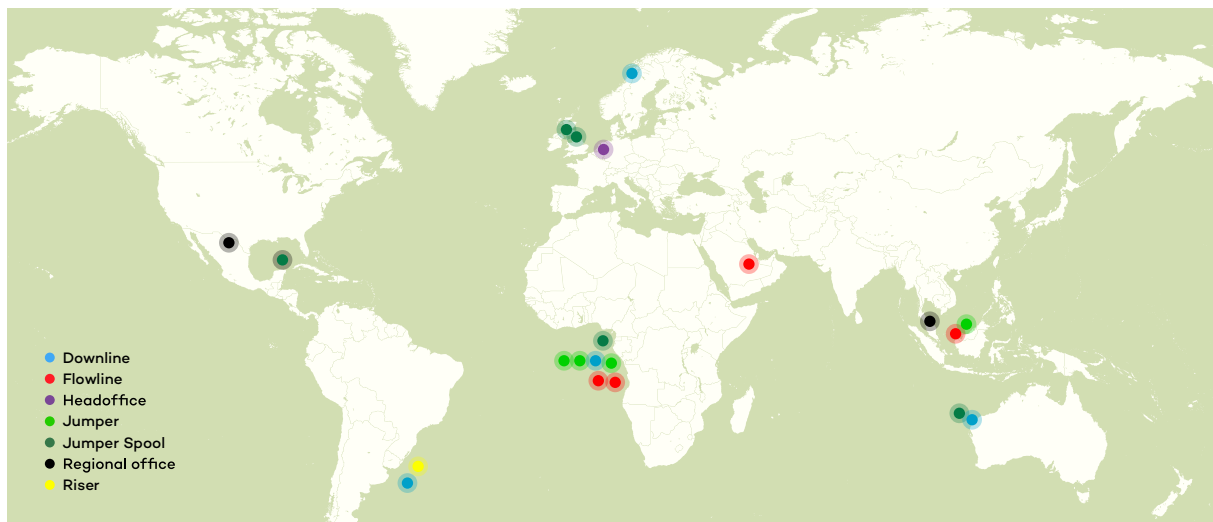
Our end fitting design excels in simplicity. Due to the fully bonded construction of our TCP products there are no individual reinforcement layers that require complicated termination.

Instead, it relies on proven mechanical clamping and sealing methods, which allow termination at any length, both in the field and in our manufacturing facility.

In addition, we can supply all relevant ancillary items, such as bend restrictors, bend stiffeners, buoyancy modules, etc.

Manufacturing

Strohm's manufacturing facility is based in IJmuiden (Port of Amsterdam), The Netherlands. The manufacturing facility has direct sea access and our spoolable TCP products can be loaded directly on our clients' vessels. The quay has a length of 330 m with a water depth of 9.5 m.



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