

# Thor tie-in system

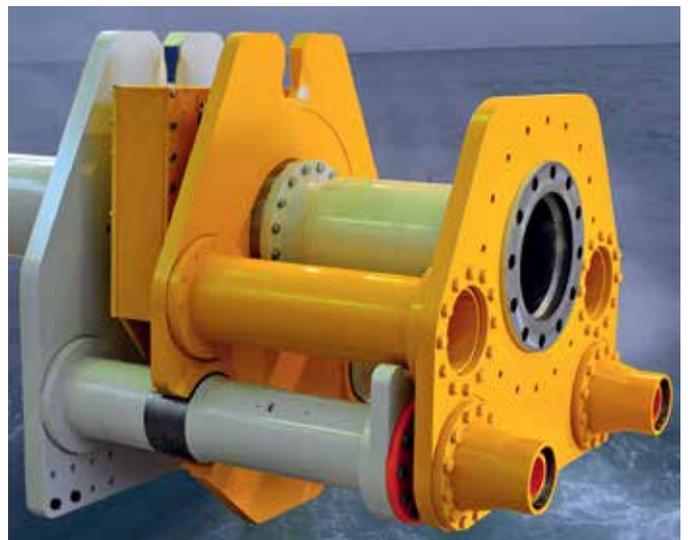


The tie-in system is designed to transfer a part of the external moments seen during normal operating conditions in the connection point into the supporting structure, reducing loads on connectors, pipelines and adjacent valves.

Should accidental loads occur, the system is designed to transfer most of these into the supporting structure, ensuring the integrity of the inboard side of the tie-in point, even in the extreme case of loads capable of breaking the connected pipeline.

The system's design has a high structural capacity on all sub-components and there is a low risk of damage to the components. The Thor tie-in system is independent of any type of connector or connection system and any preferred solution may be adapted into the system. The simple design makes the Thor system attractive while still being easy to machine, assemble and install. The main carbon steel components have bolted connections allowing modular transportation to the site location.

The compact design reduces inventory and the Thor system is easy to install so only one supervisor is required per shift to monitor the actual assembly and subsea installation.

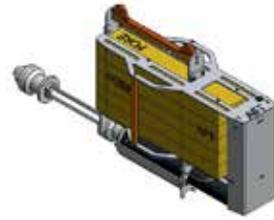


## Thor tie-in system - Main system components

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### Stroke tool

The stroking tool is used to guide the termination into the porch before hub-clamping. It is installed into slots on the termination and porch. The stroking tool is WROV operated, with a dual working hydraulic cylinder and optional hot stab or quick connection interfaces. It is buoyancy compensated with a built-in mechanical stroke limiter and visual indicator.



### Torque tool

The standard torque tool can be used for the clamp connector (API bucket interface).



### Termination

The termination is the landing and guiding structure for the pipe end. It is mounted onto the pipe end via the outboard hub with a bolted flange connection. The termination then transfers part of the pipeline loads into the porch. It is equipped with lifting points for deck handling and deployment.



### Seal replacement and hub cleaning tool

The cleaning tool is installed to the slots on the termination and porch. The tool is hydraulically operated with the hot stab or quick connection interfaces to a WROV. The cleaning tool is buoyancy compensated for enhanced WROV workability.



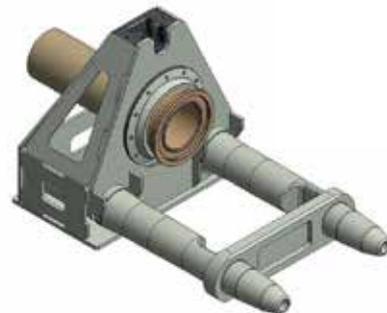
### Guidepost

A standard guidepost is used.



### Porch

The porch is the receiving structure for the termination. It can be mounted to the base structure via a bolted or welded arrangement.

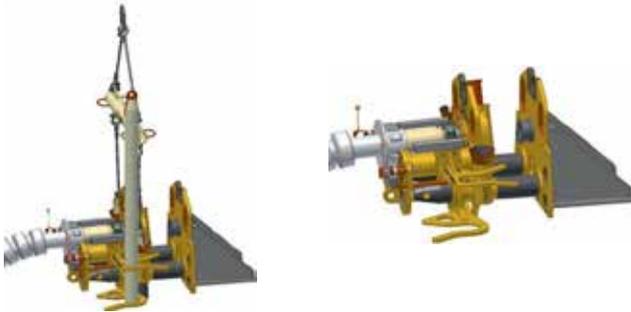


## Thor tie-in system - Installation sequence

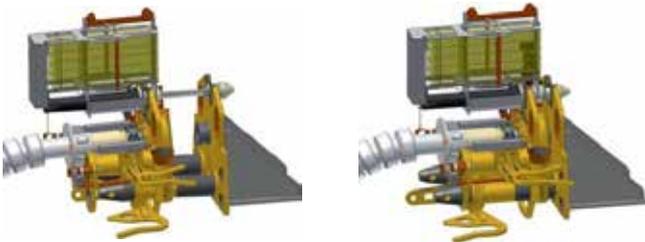
### Flexible flowline/jumper installation



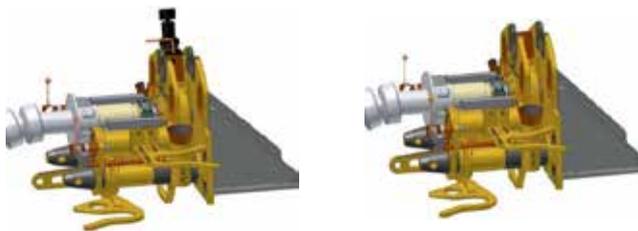
The bumper frame is pre-installed by WROV and the flexible flowline is aligned and pushed forward by the installation vessel's cranes/winches.



The spool is guided forward until the termination is landed into the porch.



The stroke tool is installed and the termination with outboard hub is moved into engagement with the inboard hub.

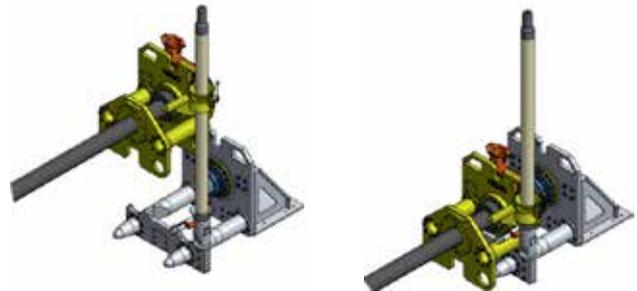


The torque tool is deployed and the clamp connector is made up. Back seal testing is performed. The torque and stroking tools are recovered. The tie-in is complete.

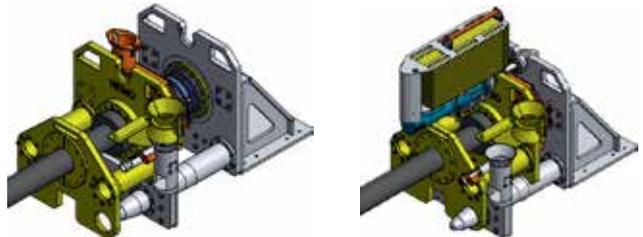
### Rigid spool installation



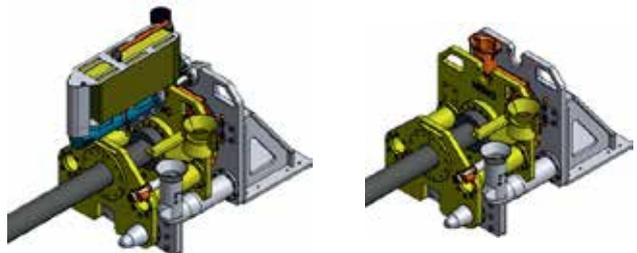
A guidepost is pre-installed, the spool is established on guide wires and guiding is assisted by a WROV.



The spool is continuously lowered onto the guidepost via guide wire until the termination is landed into the porch.



The guidepost is recovered to surface, stroke tool is installed, and the termination with outboard hub is moved into engagement with the inboard hub.



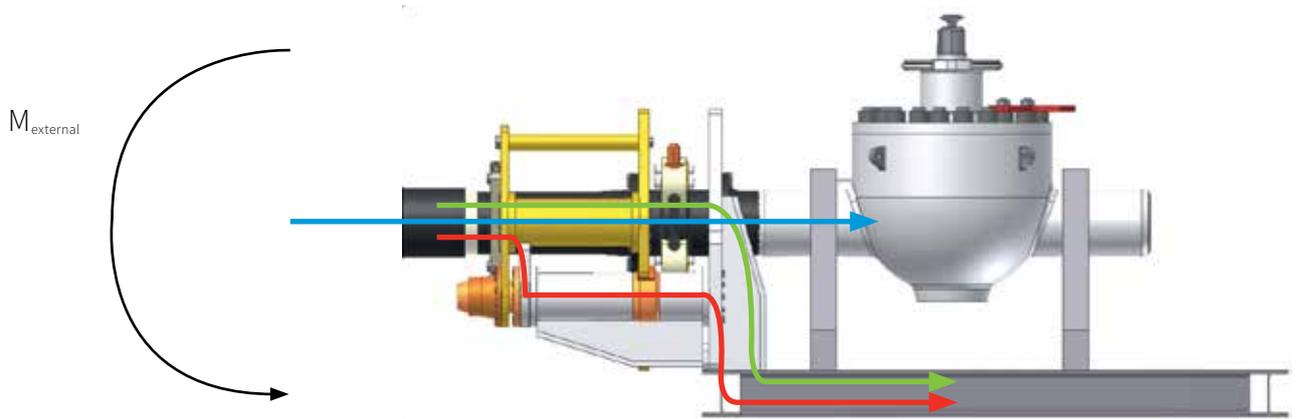
The torque tool is deployed and the clamp connector is made up. Back seal testing is performed. The torque and stroking tools are recovered. The tie-in is complete.

## Thor tie-in system - Specifications

Nominal clamp diameter (inches):	8	12	14	24
Width (mm):	1250	1710	2100	2500
Length (mm):	2950	3090	3090	3090
Height (mm):	1350	1725	1850	2000
Weight, porch exclusive hub (kg)*	775	1420	1875	3950
Weight, termination, exclusive hub and connector (kg)	1575	2500	3450	4500
Hub separation prior to stroking (mm)	500	500	500	510
Axial stroking capacity (kN)	210	350	420	500
Primary guiding, max. misalignment (deg)	±10	±10	±10	±10
Secondary guiding, max. misalignment (deg)	±2	±2	±2	±2
Maximum landing speed (m/s)	0.5	0.5	0.5	0.5
Alignment capacity, (kNm) (1) = 345 bar (2) = 220 bar	220 (1)	700 (1)	800 (1)	2730 (1)
Accidental load capacity, Thor guide arrangement distribute external accidental load directly into support structure.	Approximately + 25% on nominal spool maximum allowable bending moment			
Materials	Structural steel: S355, Bolts: A320L7			
Coating system	NORSOK, paint system 7			
Service life	Similar to subsea structure			

\*without horizontal support

-  Moments absorbed via termination, guiding tubulars into support structure
-  Moments absorbed via termination, connector into support structure
-  Moments absorbed via termination, connector into piping



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