

# PRODUCTS



 **CRUX**  
PRODUCTS

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## CRUX Grout Seals

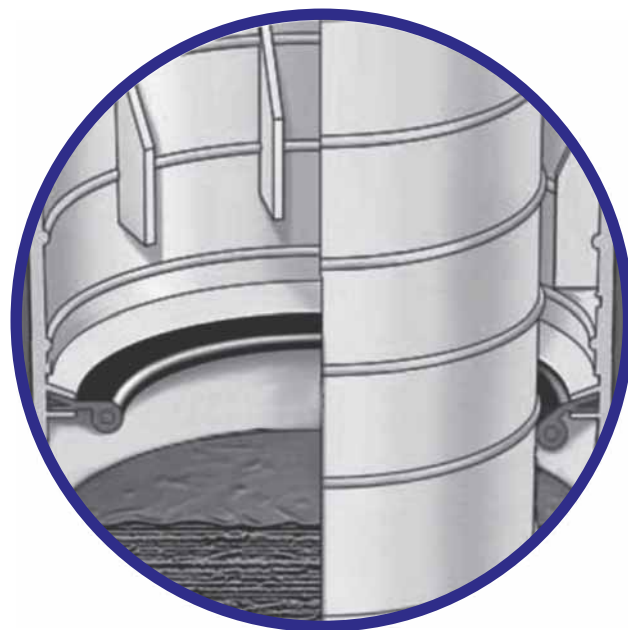
The **CRUX Grout Seal** is a passive grout support system, requiring no activation. The action of pile installation through the Grout Seal sets up a hoop tension in the reinforced bulbous ring. The resultant radial reaction of the bulbous ring acting against the pile associated with the hoop tension then counteracts the grout pressure forces.

The system accepts the tolerance, which must be provided within pile centralisers without significant loss of capacity. The bulbous ring positions itself to locate around the pile at its position within the centraliser shims.

A single Grout Seal unit has the capacity to support 30 metres or more of submerged grout. Capacity can be increased by adding more core fabric within the bulbous ring. Where grout pressure heads exceed the level for which it is prudent to use a single unit, capacity can be achieved by provision of a dual system, with support capacity shared between two Grout Seals.

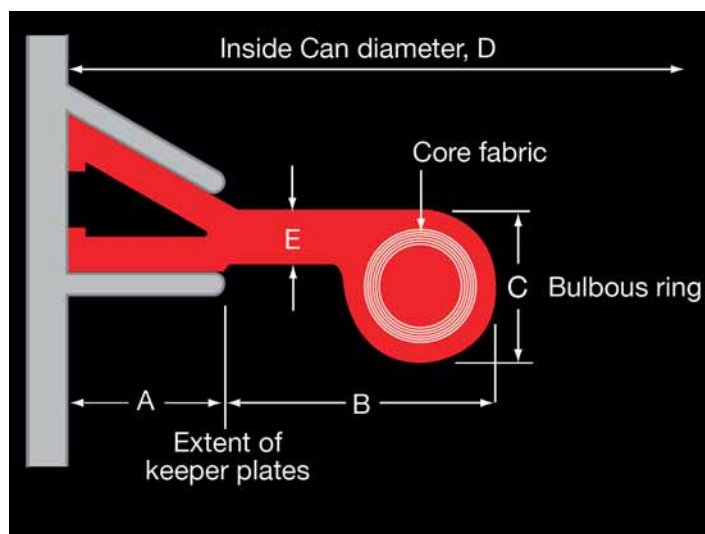
Fitting is achieved by insertion between two pre-installed keeper plates. The fixing toroid is then filled and pressurised with epoxy to provide an effective and secure fixing.

Grout Seals can be pre-fitted in Cans which are then delivered to the fabrication yard for connection to the structure or, alternatively, they may be site fitted. In either case no site commissioning is required.



### Advantages to using CRUX Grout Seal Systems

- No hoses, valves or other hardware to purchase, fit or test. This results in clear cost savings and eliminates the dominant cause of frequent grout support system failure.
- No site testing or commissioning required.
- The Grout Seal also functions as a wiper, preventing seabed material from entering the annulus to the detriment of grout connection strength.
- No offshore operation is required.
- No residual activation hardware remains to cause cathodic protection drain or diver hazard.



PILE SIZE in inches	DIMENSIONS in mm				
	A	B	C	D	E
20	50	65	50	702	20
24	60	71	50	830	20
30	60	75	55	980	20
36	62	78	60	1130	20
42	65	84	65	1290	22
48	65	84	65	1432	22
54	65	104	70	1614	22
60	65	104	70	1758	22
66	70	114	75	1928	24
72	70	114	75	2070	24
84	70	129	90	2382	25
96	70	134	90	2676	25
108	70	154	90	3000	25

NOTE: Inside Can Diameter, D, may be varied to a limited extent.

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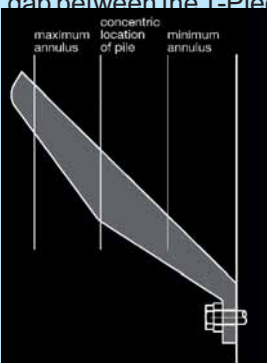
# CRUX Tongue Seals

The **CRUX Tongue Seal (TS)** has been developed to provide grout support for structures with pre-placed pile foundations. Its excellent record of reliability has been proven during the installation of the World's largest Offshore Wind Farms.

The TS is used for installations where the piles are pre-driven for Monopile/Transition-Piece foundations and Jacket/Tripod structures.

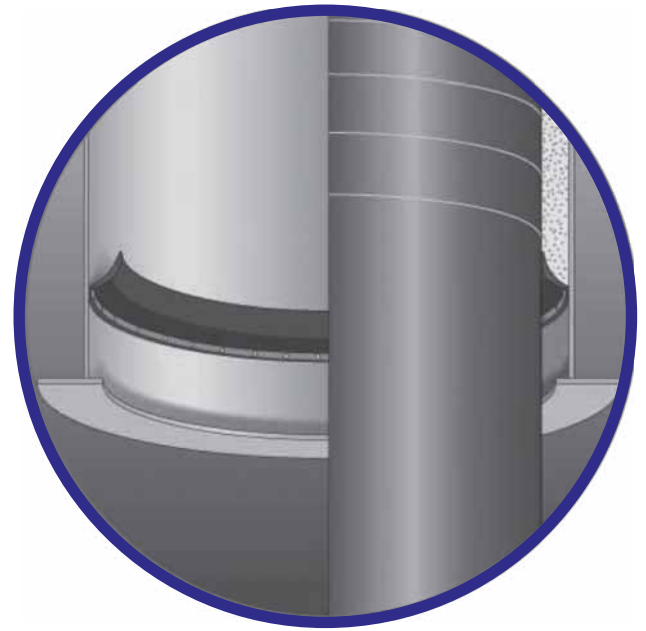
- A large range of diameters is supported. TS of less than 1m to over 5.5m diameter have been delivered.
- The TS design is adaptable to a wide range of annuli. Current designs have been developed to span up to a 500mm annular gap.
- The TS can be configured to attach to an inside circumference Transition Piece or to the outside circumference of Pile or Jacket Leg.

The fabric reinforcement of the TS gives it the strength required to support a large head of grout over a wide annular gap between the T-Piece and the Pile.



This is achieved while keeping the cross section of the TS narrow, allowing it to also fit in to a small minimum annulus. This is important to allow for the greatest installation tolerance of the pre-placed Pile.

The TS can be configured to attach to an inside circumference Transition Piece or to the outside

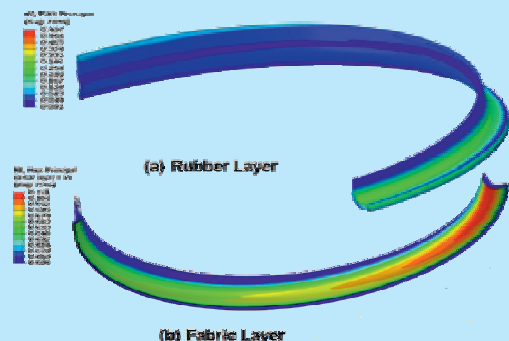


## Advantages to using CRUX Tongue Seals

- The Crux TS has a very high record of reliability, demonstrated by several hundred successful installations to date.
- The Crux TS is manufactured with continuous strength properties around its circumference - it has no glued joint to weaken it.
- Using fabric reinforcement gives the TS a far greater capacity than can be achieved using rubber alone

## CRUX Tongue Seal Finite Element Analysis

For each TS design, the deflection due to grout pressure is simulated using Finite Element Analysis. This allows the performance of the TS to be known in advance of it.

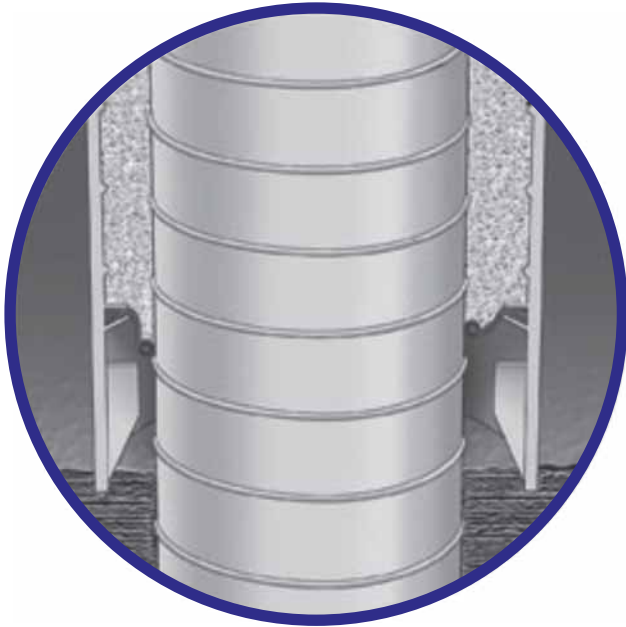


A 3D FEA model is used and the deflection of the TS determined as the annulus varies between its minimum and maximum values around the circumference. The maximum strains experienced by the seal materials are determined so they can be controlled.





## CRUX Grout Seals for Special Applications



### CRUX Eccent Seals

A special Grout Seal available for structures with pre-installed piles. Pile verticality and positioning tolerance dictates that greater eccentricity may occur between pile and sleeves.

The special Grout Seal is designed to accept the increased annular dimension with provision of shape allowing for extension.

### CRUX Vulcan Seals

This seal has been developed and tested for use on structures with relatively small pile sizes. The Seal is vulcanised onto the Seal Can. The Seal Can is of similar size to the structure member (leg or sleeve).

A single Seal can be used for limited pressure head (around 10 metres of grout) but two or more Seals can be used for greater pressure head (detail shows two Seals).



### Advantages to using CRUX Grout Seal Systems

- No hoses, valves or other hardware to purchase, fit or test. This results in clear cost savings and eliminates the dominant cause of frequent grout support system failure.
- No site testing or commissioning required.
- The Grout Seal also functions as a wiper, preventing seabed material from entering the annulus to the detriment of grout connection strength.
- No offshore operation is required.
- No residual activation hardware remains to cause cathodic protection drain or diver hazard.



# CRUX Heavy Duty Diaphragm Closures

**CRUX 'Heavy Duty' Diaphragm Closures** as required for the provision of auxiliary buoyancy, are made from rubber with fabric reinforcement. Fixing is achieved by clamping a solid core, around which the laminations of reinforcing fabric are wrapped, between two machined flanges.

The required Diaphragm strength for specified application is achieved by provision of appropriate fabric strength and number of plies.

Crux 'Heavy Duty' Diaphragms are unique in that they are manufactured with one side of the Diaphragm flat. The Diaphragm is then deformed to fit into the fixing grooves within the flanges by torquing the fixing bolts. This forced deformation of the Diaphragm ensures that a seal is obtained, even at early stages of bolt torquing. Tolerance to flange distortion resulting from welding is much better than with other competitor diaphragms.

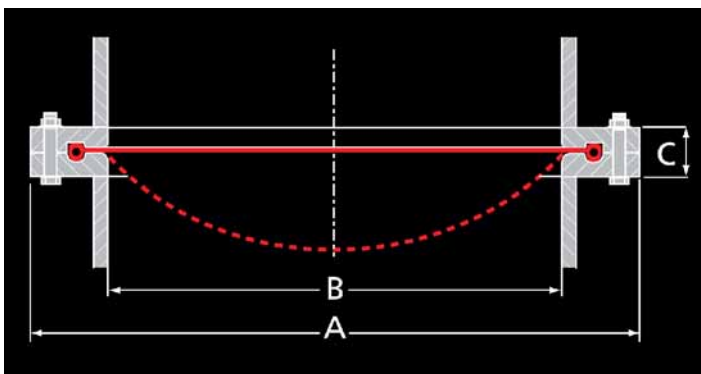
Flanges are constructed from steel material EN10025 Grade S275 (ASTM A36) or equivalent. High strength steel can be used where strength requirement or client specification dictates. All bolts and nuts used are zinc plated according to BS 3692 Grade 8.8.

Crux Heavy Duty Diaphragms command the largest share of the worldwide market.

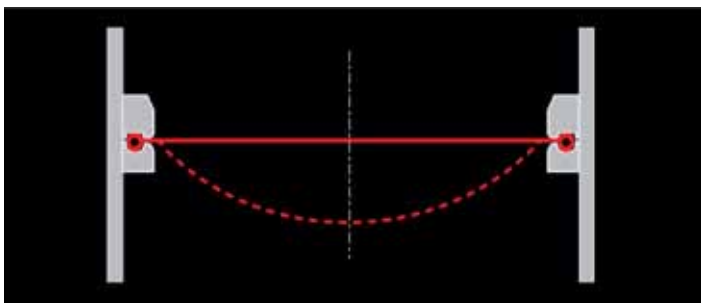


## Other features of the Crux Diaphragms

- Flanges are shaped to avoid stress concentrations within the Diaphragm.
- Diaphragms are designed to suit specific platform requirements and generally tested to 1.5 times the calculated hydrostatic pressure.



## Internal Diaphragm Closures



NOTE: Pile sizes are compatible with Grout Seals as noted. Diaphragm dimensions will vary according to actual member sizes and individual project requirement.

**Internal Diaphragms Closures** are provided where there can be no external projection on the subject tubular.

The Diaphragm specification is as above but the fixing is provided in the form of two rings.

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## CRUX Mud-Exclusion Diaphragms

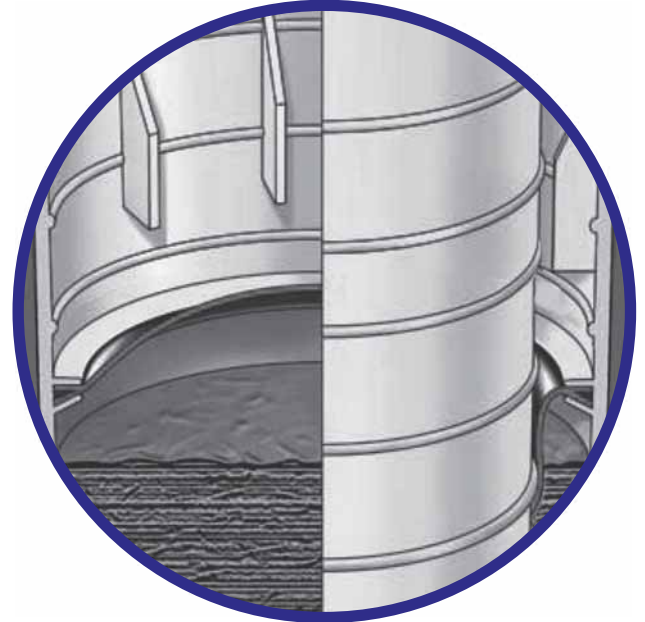
**CRUX Mud-Exclusion Diaphragms** are used to prevent seabed material from entering the annulus between the pile and pile sleeve or structure leg prior to pile insertion.

This type of Diaphragm is used in conjunction with Grout Seals where there are soft seabed conditions, such as encountered in the Gulf of Mexico. The combined action of the Mud- Exclusion Diaphragm and Grout Seal ensures that no seabed material ever enters the annulus.

These relatively lightweight Diaphragms are provided with a keeper plate fixing similar to that used for Grout Seals. Similar keeper plate geometry to that used for Grout Seals of similar size is maintained, thus providing consistent Can configuration.

This type of Diaphragm is manufactured without any tooling requirement and at consequent low cost. This and the avoidance of flange machining, as required for other types of Diaphragm, leads to major cost savings.

Mud-Exclusion Diaphragms have been used with complete success on many structures with pile sizes up to the largest in present day use.

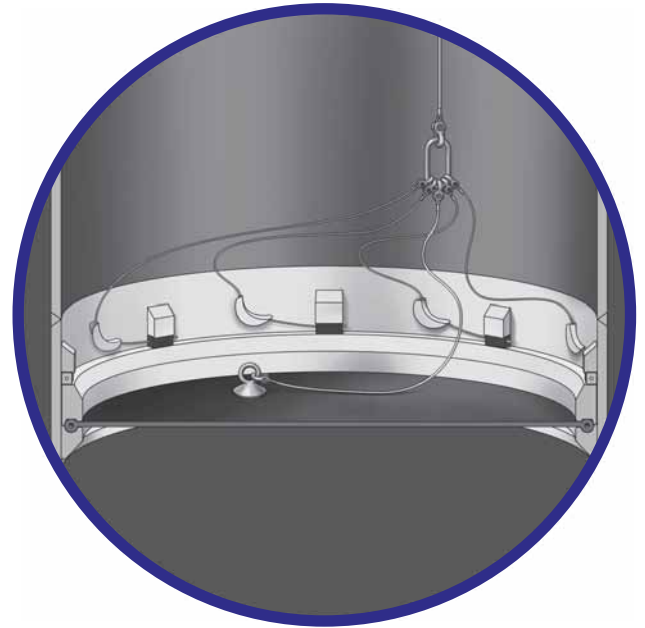
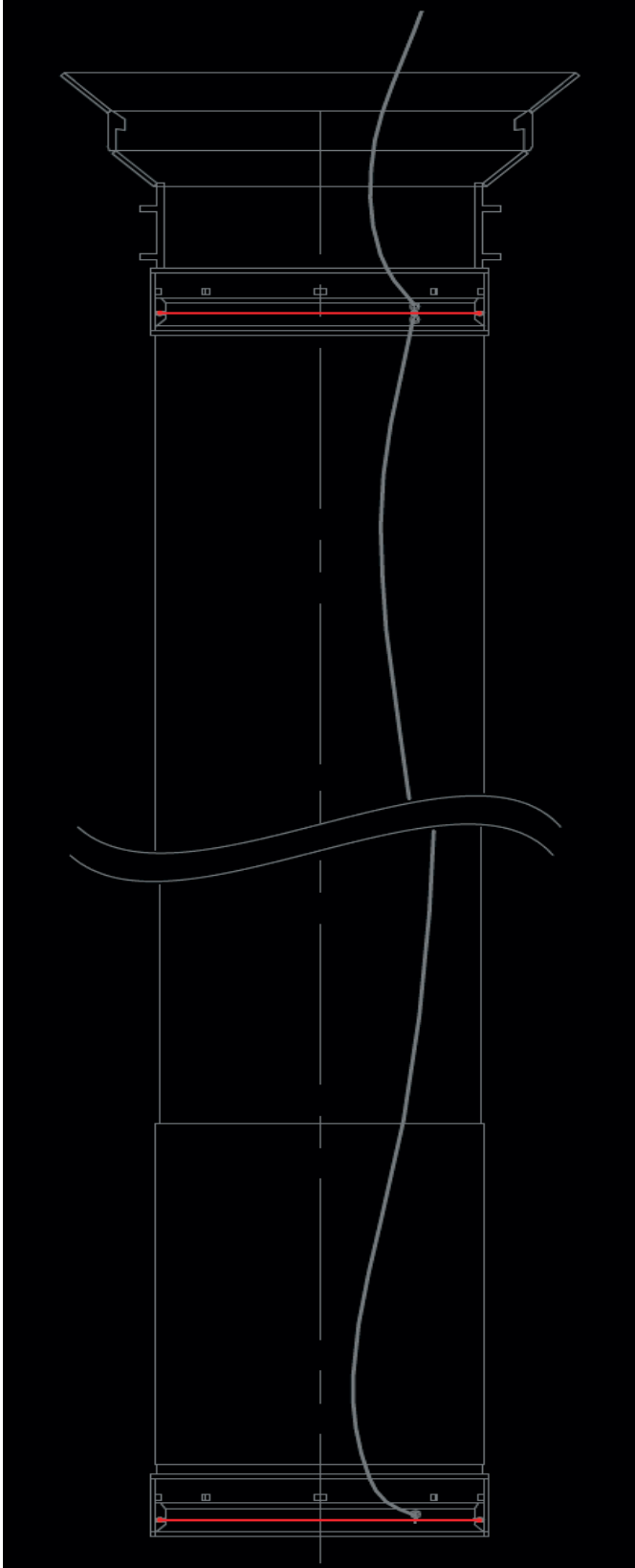


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# CRUX Fully Removable Diaphragm Closures



Diaphragms are fitted to top and bottom of sleeves to provide buoyancy of the sleeve during installation of the Jacket.

Fully Removable Diaphragms may be required where all remnants of the rubber diaphragm have to be removed to assist further operations. An example of this would be the installation of a Jacket, where drilling through the pile sleeves is required to facilitate pile placement.

The **CRUX Fully Removable Diaphragm** is supplied assembled in a can. Two Diaphragms may be linked and removed together, for example when fitted to the top and bottom of a pile sleeve. An arrangement of rigging allows the diaphragm to be completely removed from the pile sleeve in one action.







## CRUX Rip-Out Diaphragms

In certain circumstances Crux Rip-Out Diaphragms may be specified. These buoyancy diaphragms have an integral cutting tool attached which pierces the diaphragm when activated by means of wire rope rigging from the surface.



The function of Rip-Out Diaphragms is to accentuate the flooding of previously sealed jacket members or buoyancy tanks, by pulling a cruciform cutter through the diaphragm.

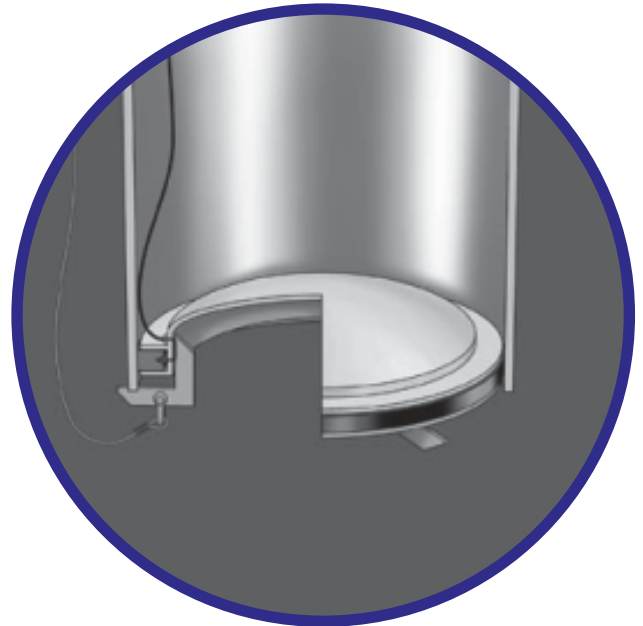




## CRUX Reusable End Closures

The Reusable End Closure is used to close ends of tubulars for buoyancy purposes. One or more radially expanding seals are seated within a core element and are activated by hydraulic or pneumatic pressure which closes the annulus.

The system was originated as a means of limiting the impact of 'damage condition design' for large compartments of a jacket, such as legs, where the compartments are to be kept open for post-installation purposes.



There are many applications for a Reusable End Closure including the following:

- To give buoyancy to piles to enable long piles to be lifted horizontally and placed in the water or launched before being upended by controlled flooding. This method of pile handling can eliminate the need to splice the piles offshore with consequent saving in costly offshore time and will be a necessity in relation to compliant tower design.
- To provide buoyancy in structure members (legs, pile sleeves etc) for installation purposes. Auxiliary buoyancy may be required in respect of jackets which are designed for launched installation or for jackets which are lift installed before being set on the seabed by controlled flooding. The reusable aspect of the concept may be particularly attractive in cases where jacket design has some standardisation of member sizes.
- To limit the impact of 'damage condition design' as relevant to jackets. A means of minimising the installation (lift) weight of a jacket is to design the jacket legs for temporary conditions (fabrication and installation) and then post-install a coaxial tubular in the leg, grouting the annulus to form a composite in-place leg section. The influence on jacket installation weight is very considerable and can often make the jacket light enough to install by lifting rather than launching with major resultant cost saving.
- To seal pipeline ends for repair purposes.





# CRUX Pile Grippers

load holding capacity 50—3000t

**CRUX Pile Grippers** are used to assist levelling during jacket installation and to eliminate movement between piles and sleeves during the grouting operation.

The design can be adapted to all pile sizes and load requirements. The hydraulic gripper jacks are usually operated from the surface but can also be operated by ROV or diver intervention.

Crux has been involved with Pile Gripper supply for many years and now works in collaboration with well established UK based suppliers of deep sea hydraulic systems.

Availability of Pile Grippers through Crux allows for single sourcing of related items such as Crux Grout Seals and Crux Diaphragm Closures.

