VECTOR technology group

INDUSTRIAL AND POWER

Company Information

Vector TG structure

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A Freudenberg Oil & Gas Company

SUBSEA

TOPSIDE

INDUSTRIAL & POWER

- **Centre of Excellence Port Talbot (UK)** — R&D
- centre of excellence Drammen (Norway) — SPO compact flange
- centre of excellence Port Talbot (UK) — OPTIMA subsea connector
- centre of excellence Port Talbot (UK) — TECHLOK clamp connector
- area business unit USA
  - US
  - Brazil
  - West Canada
- **Centre of Excellence Port Talbot (UK)** — FLANGELOK, SLIMLOK, CUSTOM FLANGES

What makes Vector different is that we are a technology owner.

Company Information




Vector Designs, manufactures and tests high integrity, zero leakage pipe connectors and sealing technology for all industry sectors.

- Founded in 1978
- T/O 2012 78M Euro
- Offices in UK, Norway, Malaysia, Australia, USA, Brazil.
- Manufacturing in UK, USA and Malaysia
- Acquired by Freudenberg Oil and Gas 2013

Power generation, Chemical, Petrochemical, Oil and Gas, Renewables, Mining, LNG, CNG, Gas containment, SubSea, Pressure test equipment.

Code Compliance

CODES: Vector manufactures components to ASME VIII Div1,Div2, B31.1, B31.3, B31.8 , EN 13445 , EN1591, API, BSI ,PED, DNV, Norsok, ASME III and many other international design codes.

PED: Connectors are not legally entitled to carry a CE mark. Vector will however comply with all of the requirements of PED for design and manufacture and obtain a 3rd party witness statement to prove compliance.

ASME U / U2: Vector is undergoing stamp qualification.

ACCREDITATIONS: ISO 9001. / ISO 14001/ Working towards ISO 18001

Conventional flange Design

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Conventional flange Design

Summary of ANSI / API / Crush seal failure paths

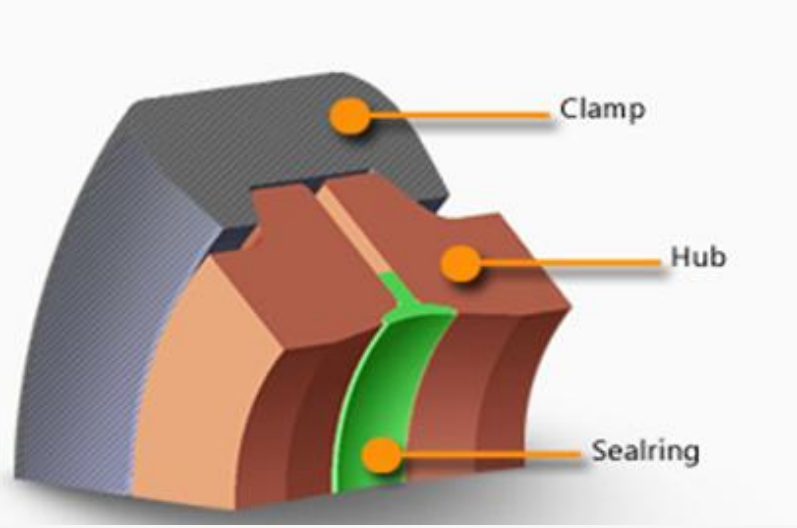
- Poor assembly resulting in higher bolt torques being used resulting in bent flanges and incorrectly seated and compressed gaskets
- Bolt creep due to stress relaxation or high temperature induced.
- Gasket creep
- Excess loading due to axial / bending and temperature loads being applied
- Load cycling
- Differential temperatures of flanges / bolts and gaskets

Note: In Europe the EN 1591 flange code (which is based on ASME flange rules) includes several extra sections concentrating on many of the above failure conditions in a bid to make the ANSI flanges more reliable.

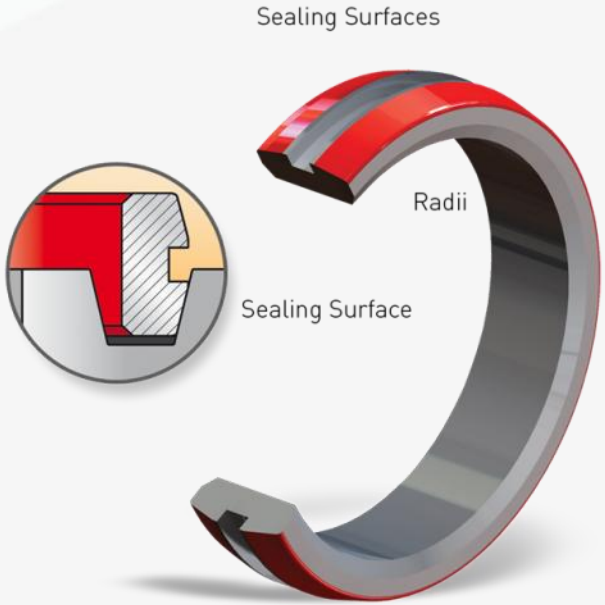
What is the main reasons for these problems?

- ANSI flange design has not changed in over 100 years
- ANSI / API flanges are geometrical design which assumes all flanges are made from the lowest grade material which makes them bulky, inefficient and oversized
- The gasket seating stress is directly proportional in the direction of the bolt and loading of the bolt all times.
- The gaskets are plastically crushed offering no elastic recovery if the flanges separate.

Using internal pressure to our advantage



Techlok Seal ring

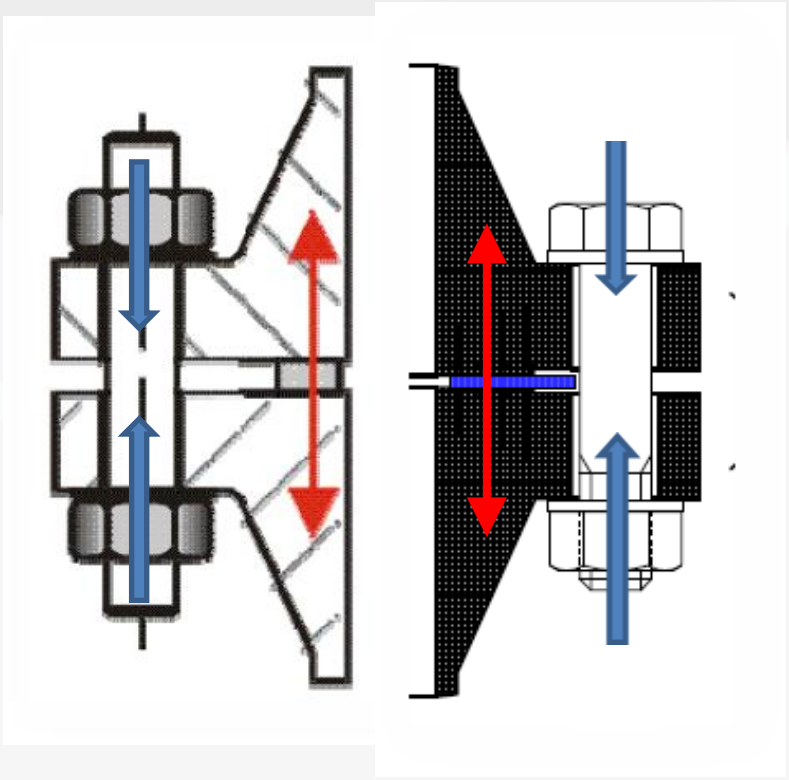


SPO IX Seal ring

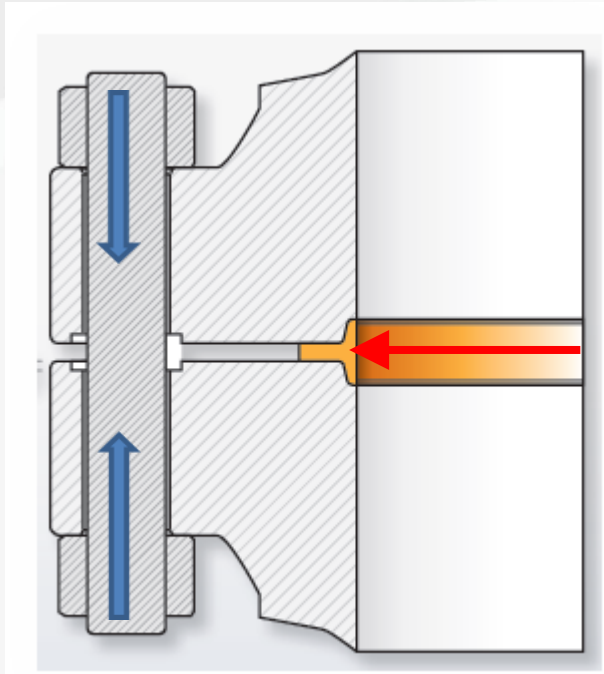
Pressure Energisation:

Internal pressure acts on the inner diameter of the sealring pushing the seal harder into the seat. The greater the internal pressure the greater the sealing force (gasket pressure)

Vector Metal to Metal Seals



Conventional Gasket Forces are generated by Bolt Load only



Pressure Energised Gasket Forces are generated by initial interference then by internal pressure

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Vector Metal to Metal Seals

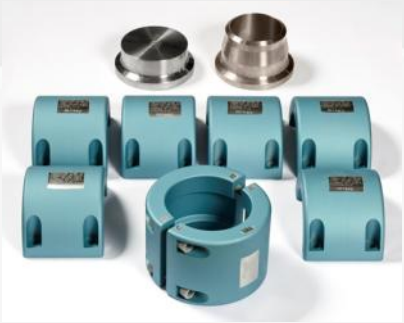
There are many reasons to specify a Vector metal to metal sealed connector over a traditional ANSI connector

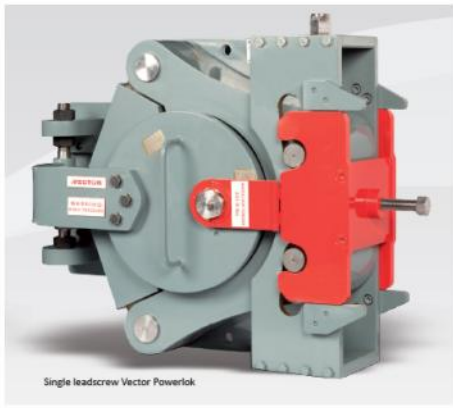
Up to 75% weight Savings

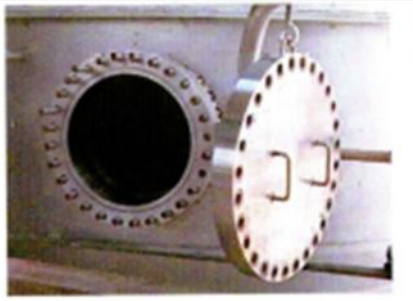
More Compact Design

Zero Leakage

Vector Products







Case Studies

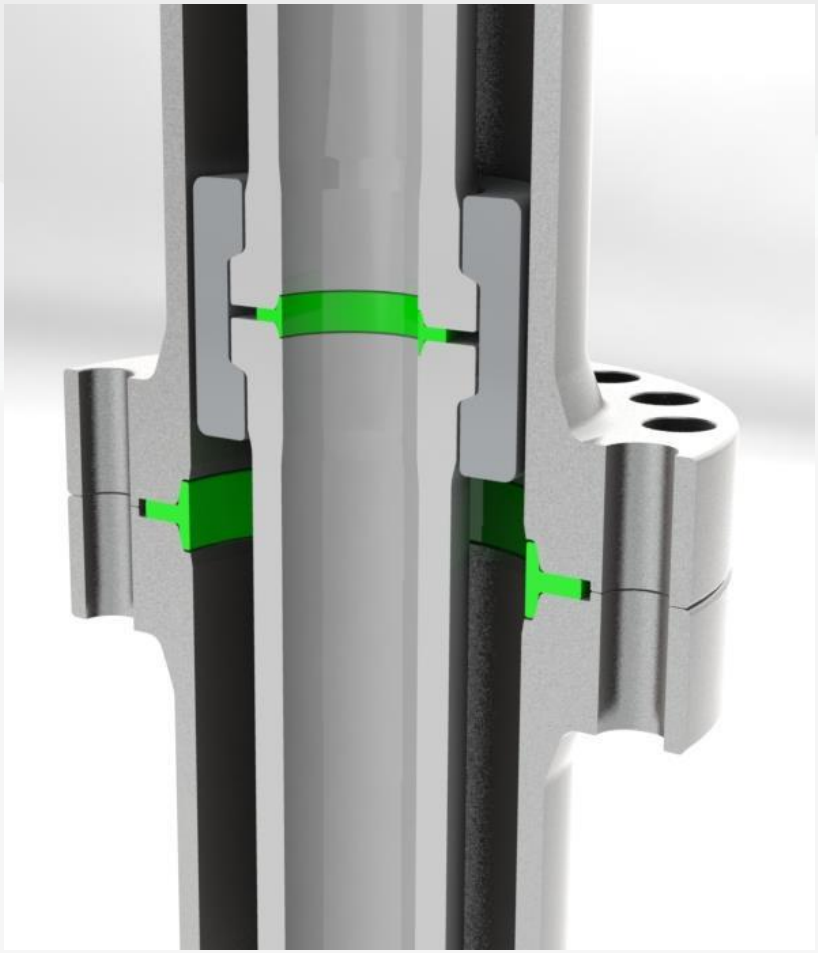
Customer Based Projects and Experience

PIN: Gas to Liquid - Microlok

Specialist catalyst pipe closures custom developed for a high temprature prototype reformer chemical reactor that converts gas to liquid. The media was Hydrogen at 600°C. Banks of closures that require periodic opening and closing to install catalyst direct to the reactor. Low leakage to atmosphere was a key requirement.

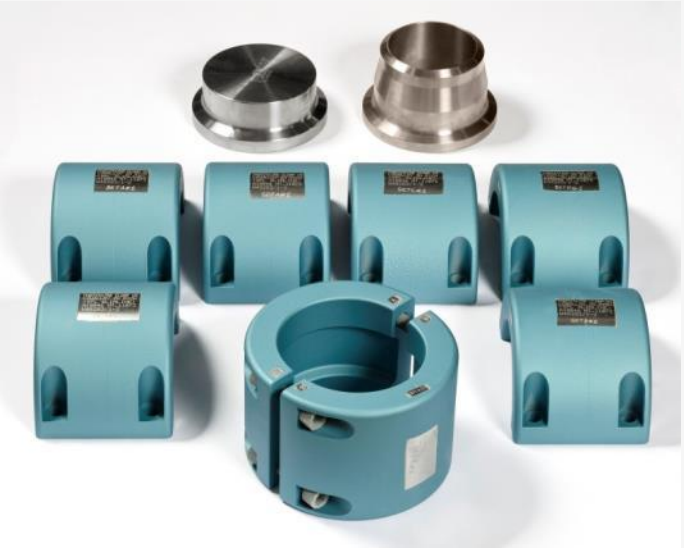
Customer Based Projects and Experience

PIN: Pipe in Pipe Application



Slimline clamps allow the benefits of a techlok clamp arrangement in a more compact package space. This project required that a inner pipe be sealed within an outer pipe using a connector. The slimline clamp was custom designed to minimise the package space for the required pressure and still allow media to pass through the outer pipe.

- Design Pressure 10,000Psi
- Internal Media: Crude Oil
- External Media: Steam
- 7.25” Clamp OD VS 4” HD Techlok 11.75”



PIN: Supercritical Water Oxidation

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Supercritical Water Oxidation (SCWO) for destruction of wastewater and sludge

Challenge:

- High pressure 290 bar.
- High temperature 423°C (793F)

Solution:

- 1/2" – 2" SPO Compact Flanges with IX seal rings.
- Flanges: Inconel 625,
  Bolts: Nimonic 80A,
  Seal rings: Inconel 625.
- High reliability, low maintenance no need for bolt re- tightening after process start.
- Compact package space

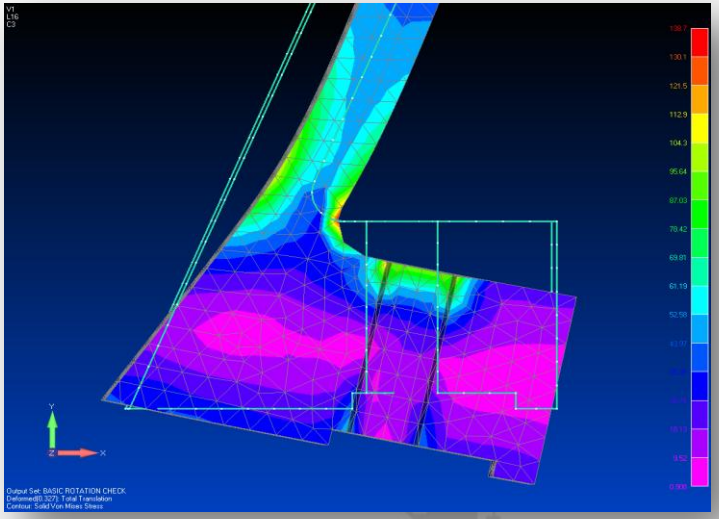
Customer Based Projects and Experience

PIN: Reactor Cone Flanges

The customer had repeated failures on existing flanges after in-service temperature spikes that resulted in warping and leaks.

Vector designed a flange to withstand the high temperatures and random temperature spikes. The flange was installed, sealed first time and has proved reliable in service with no failures. The design has been replicated in various sizes for similar applications.

- Fixed rotation custom flanges designed using FEA.
- Conical inner profile for hopper application.
- Cam profile gaskets
- 400^{o}C operating 800^{o}C spikes.
- ASME VIII Div2 Appendix 2 & 5



Customer Based Projects and Experience

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HEXAG: Converting Heat Exchangers to use Techlok Seals

After 9 months of unsuccessful attempts to seal the heat exchanger flanges at the plant the original seal arrangement was scrapped. The Heat Exchangers were sent to Vector to be machined to accept techlok seals and flown direct to the plant in China. Where they were installed successfully and still remain in service.

Customer Based Projects and Experience

HEXAG: Retrofit of Heat Exchangers that use dollar plate

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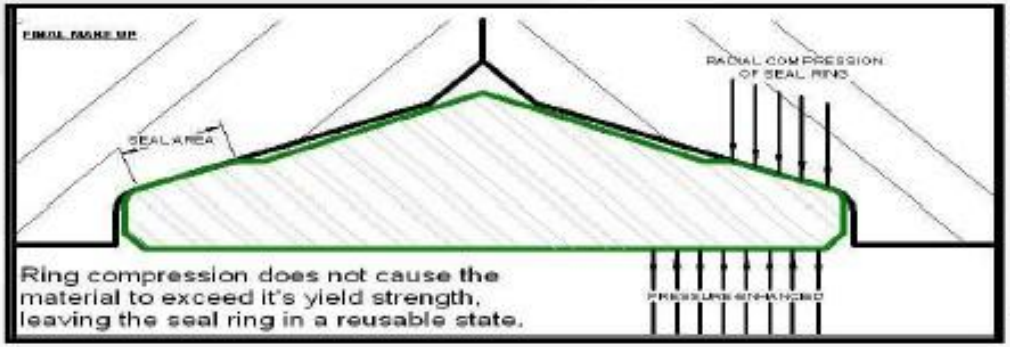

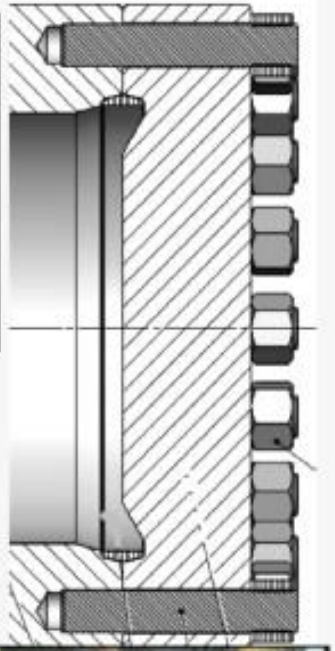

Conversion Procedure

1. Remove dollar plate
2. Remove diaphragm seal
3. Field machine the Vector metal seal pocket into vessel
4. Insert Vector seal ring into seat pocket
5. Install new closure or converted blind over existing bolt pattern
6. Tension studs

Customer Based Projects and Experience

HEXAG: Powerstation Heat Exchanger Flanges

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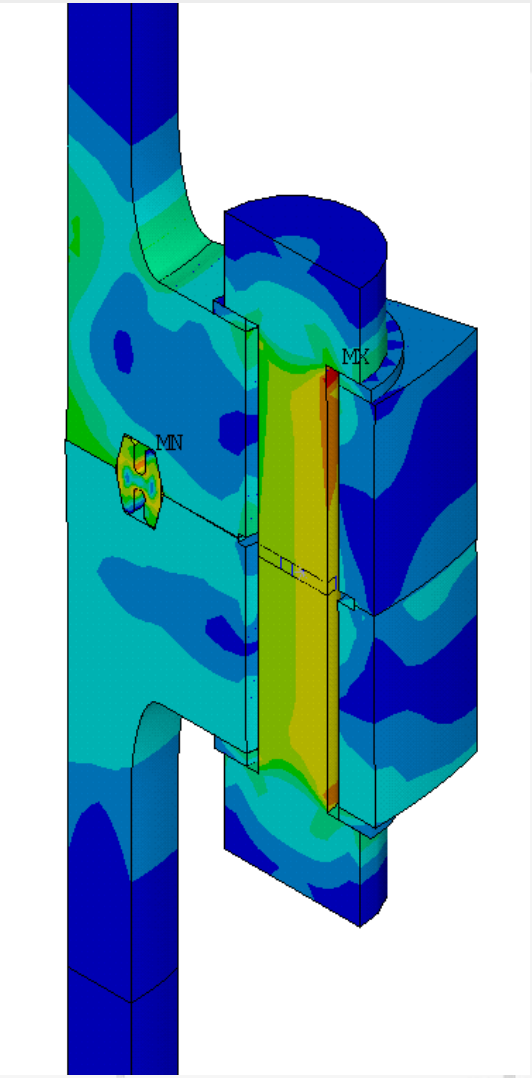
Specification:

- Heat exchanger flange: stainless steel
- High temperature pipework flange : carbon steel
- Inconel 718 bolting, Inconel 718 HX seal
- Differential thermal expansion causing shear on flange interfaces and seal.
- Temperature: 590 C
- Pressure: 290 Bar.

Design:

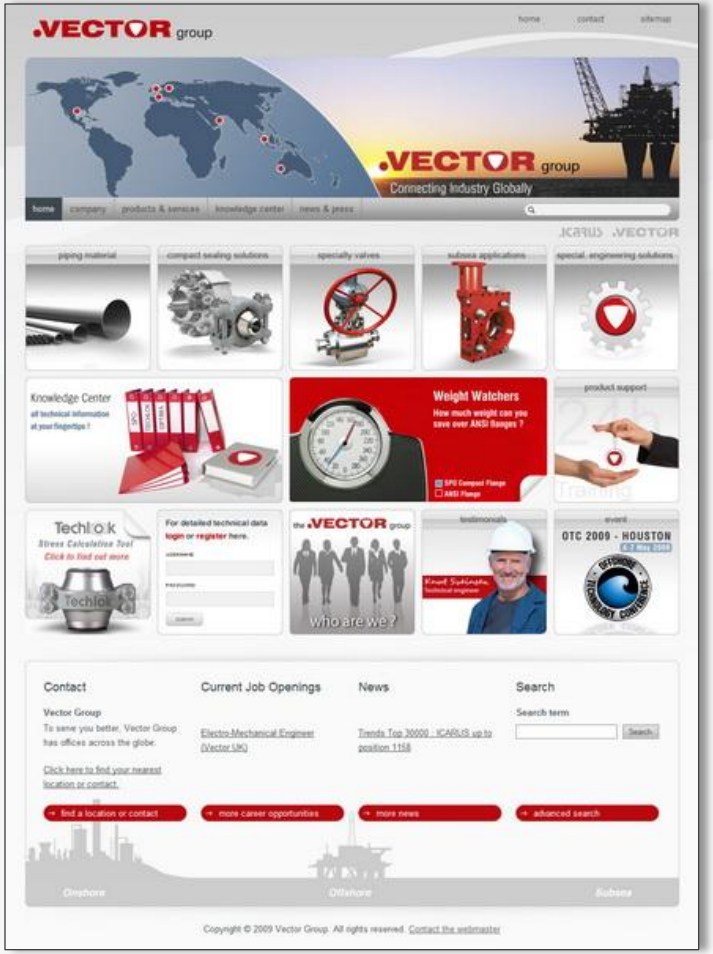
- Elastic Plastic material models
- Strain based analysis
- Transient thermal analysis (hot, cold and warm starts)
- Transient with insulated conditions
- Fatigue and creep
- Plastic shake down analysis
- Functionality (Flange capacity, heel, seal ring, bolt stress



SPO Compact Flange

Website

Vector Online



Vector online **www.vectortg.com**

- Find more detailed information on our products & services (download brochures, certificates & approvals and other product related documentation)
- **Knowledge center :** Technical information about SPO Compact flange, Techlok Clamp Connector and Optima
- Weight Watchers : how much weight can you save with Vector products?
- Stay informed about the latest projects and developments

Industrial & Power Division

VECTOR technology group

Customer Reference List

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