GSB SUBSEA
SINGLE BOLT CONNECTORS
The Destec GSB Subsea Single Bolt Connector is a purpose designed unit for operations where a conventional four bolt G-Range pipe connection would be impractical.

The GSB Connectors are supplied with a mounting plate which can if required accommodate guidance / pull-in systems for ease of alignment and provision for stab connectors for electrical and hydraulic circuits.

Standard G-Range or D-Range metal to metal Seal Rings can be used, or the customers own sealing arrangement can be employed.

Larger sizes and special designs (Dual Bore / Multi Bore / Concentric Bore) can also be accommodated. For example some GSB Connectors have been supplied with fabricated Spool pieces for mating to flexible risers.

For Subsea applications the GSB Connectors would be supplied with a combination of Molykote and Epoxy resin coatings. Designed for remote operations in the most demanding deep and ultra-deep water.

- The Destec GSB Single Bolt Clampset is a purpose designed unit
- Supplied with a Mounting Plate and provision for Stab connectors for Electrical and Hydraulic circuits
- Guidance / Pull-in Systems ease of alignment
- Size Ranges from 2" - 60"
- Codes ASME VIII, API, BS
- Clamp mounting in any orientation. (Vertical & Horizontal)
- Design Life in Excess of 25 years
- Trouble - Free Remote Installation
- Compatible with ROV pull-in systems
- Dual bore, Multi bore & Concentric bores
- Fabricated Spool pieces for mating to Risers
- Pressure Ranges: 3000, 5000, 10000, 15000psi
- Seal replacement with ROV carried tools
- Seal Test arrangement included
- Soft Landing Cylinder function
- Fitted with standard API torque receptacles
- Lloyds design verification / appraisal available on all sizes
- Functional testing including pressure testing up to 22,500 psi
- FAT tested

Alongside the standard clamp type connector there has always been a need for a connector where either repeated assembly, operation by remote operated vehicles, or powered drive has favoured the use of single bolt type connectors.

Destec Engineering now have many years of experience supplying these single bolt connectors in a very wide range of sizes, materials and pressure ratings. By using the range of Destec’s conical seal rings, the units are compact and cost effective, and have significant advantages where weight is a problem.
Most of the single bolt connectors have many customer’s unique special requirements which we are able to incorporate in the designs. Some of the main features and details are listed below:

- **WEIGHT SAVING BY USING DESTEC METAL SEAL RINGS, SEALING AT A MINIMUM DIAMETER, AND ALSO USING HIGH STRENGTH HEAT-TREATED AND TEMPERED MATERIALS FOR THE CLAMPS.**

- **MATERIALS SELECTED ARE COATED SUITABLE FOR MOST ENVIRONMENTS INCLUDING SUBSEA.**

- **AS THESE CONNECTORS ARE OFTEN REMOTELY OPERATED, THE DESTEC SEAL RINGS CAN EITHER BE PERMANENTLY ATTACHED TO ONE HUB OR MAY BE REMOVABLE OR REPLACED BY A REMOTE OPERATED TOOL.**

- **DRIVE TO THE SINGLE BOLT CONNECTOR CAN BE MANUAL, OR USE AIR, HYDRAULIC OR ELECTRIC TIGHTENING DEVICES.**

- **DESTEC CAN PROVIDE SYSTEMS WITH ALL THE NECESSARY LIMIT AND SAFETY CONTROLS FOR OPERATION.**

- **SUBSEA CONNECTORS OPERATED BY REMOTE OPERATED VEHICLES ARE EQUIPPED WITH STANDARD API TORQUE RECEPTACLES AND GUIDES.**

- **SECONDARY SEALING TOGETHER WITH TAPPINGS FOR LEAKAGE MONITORING. ON SUBSEA APPLICATIONS THIS WOULD BE PROVIDED WITH A STAB CONNECTOR.**

- **MULTIPLE PIPE CONNECTORS WITHIN ONE LARGE SINGLE BOLT CLAMP.**

Applications include large pressure vessel closures down to pipe connectors used for subsea hook-up. Some of the variety of applications have been shown in detail on pages 06 and 07.

“Destec Connectors - Field proven around the world. An extensive track record subsea with many years of service”

www.destec.co.uk
MATERIALS

<table>
<thead>
<tr>
<th>Description</th>
<th>Material Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLAMP SEGMENTS</td>
<td>- AISI 4140</td>
</tr>
<tr>
<td></td>
<td>- Coating: Epoxy (NORSOK system 7) &amp; Bonded MoS2</td>
</tr>
<tr>
<td>STUDBOLT</td>
<td>- ASTM A193-B7 or B7M, or A320-L7 or L7M</td>
</tr>
<tr>
<td></td>
<td>- Coating: Sermetal</td>
</tr>
<tr>
<td>CLASS 4 TORQUE RECEPTACLE</td>
<td>- Cast Steel A216 WCB</td>
</tr>
<tr>
<td>SEAL RINGS</td>
<td>- Inconel 718 &amp; X750, PTFE</td>
</tr>
<tr>
<td>MOUNTING PLATE</td>
<td>- S355J2</td>
</tr>
<tr>
<td></td>
<td>- Coating: Bonded MoS2</td>
</tr>
<tr>
<td>BELLOWS (not shown see page 2)</td>
<td>- Polyurethane-Grease Filled</td>
</tr>
<tr>
<td>TRUNNION NUTS</td>
<td>- NES 833 Gr.1 (Nickel Bronze)</td>
</tr>
<tr>
<td>HINGE PINS</td>
<td>- ASTM A320-L7M</td>
</tr>
<tr>
<td></td>
<td>- Coating: Bonded MoS2 Epoxy</td>
</tr>
</tbody>
</table>

BW Hubs - A694 F65, 3mm Inconel 625 overlay
22% Cr Duplex and 25% Cr Super Duplex

For Subsea Applications the GSB Connectors are supplied with a combination of Molykote and Epoxy resin coatings.

All materials listed above are Destec standard, however other material grades can be specified as per customers requirements.
Sizes are based on API 6A and AISI 4130 (60k) hub material

<table>
<thead>
<tr>
<th>SIZE</th>
<th>RATING psi</th>
<th>Max Bore</th>
<th>Space Envelope</th>
<th>Mass (excludes hubs &amp; seal)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>X in (mm)</td>
<td>Y in (mm)</td>
</tr>
<tr>
<td>G2SB</td>
<td>15000</td>
<td>1 1/8</td>
<td>9.843  (250)</td>
<td>9.094  (231)</td>
</tr>
<tr>
<td></td>
<td>10000</td>
<td>2 2/3</td>
<td>12.205 (310)</td>
<td>11.024 (280)</td>
</tr>
<tr>
<td></td>
<td>5000</td>
<td>2 1/8</td>
<td>13.386 (340)</td>
<td>13.386 (340)</td>
</tr>
<tr>
<td>G3SB</td>
<td>15000</td>
<td>3 1/8</td>
<td>15.748 (400)</td>
<td>14.961 (380)</td>
</tr>
<tr>
<td></td>
<td>10000</td>
<td>4 1/6</td>
<td>19.685 (500)</td>
<td>18.898 (480)</td>
</tr>
<tr>
<td></td>
<td>5000</td>
<td>5 1/16</td>
<td>20.472 (520)</td>
<td>21.063 (535)</td>
</tr>
<tr>
<td>G4SB</td>
<td>15000</td>
<td>6 1/16</td>
<td>27.559 (700)</td>
<td>25.039 (636)</td>
</tr>
<tr>
<td></td>
<td>10000</td>
<td>7 1/6</td>
<td>30.709 (780)</td>
<td>28.937 (755)</td>
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<tr>
<td></td>
<td>5000</td>
<td>8 1/6</td>
<td>33.465 (850)</td>
<td>32.677 (830)</td>
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<tr>
<td>G5SB</td>
<td>15000</td>
<td>9 1/2</td>
<td>33.228 (844)</td>
<td>33.346 (847)</td>
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<tr>
<td></td>
<td>10000</td>
<td>10 1/4</td>
<td>39.570 (1000)</td>
<td>38.586 (980)</td>
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<tr>
<td></td>
<td>5000</td>
<td>12 1/2</td>
<td>43.701 (1110)</td>
<td>42.913 (1090)</td>
</tr>
</tbody>
</table>
SUBSEA APPLICATIONS

Single Bolt Clamps for Choke Retrieval Subsea.

Destec Single Bolt Clamps are in service in the following fields:

- BP FOINAVEN
- BP SCHIEHALLION
- BP SWIFT
- BP CIRRUS
- NORT HYDRO TROLL
- EXXON MOBIL EPS / KIZOMBA
- BRITISH GAS BLAKE
- BURULLUS GAS SCARAB/SAFFRON
- AMOCO KING
- WOODSIDE ECHO YODEL
- ENTERPRISE COOK / PIERCE
- SHELL MALAMPAYA

Over 1000 Destec Single Bolt Clamps are in use on Retrievable Subsea Chokes. The clamp is an integral part of the bonnet cover and is retrievable to the surface together with the valve trim.

The bolt is fitted with API torque receptacles, to match the particular field standard, for ROV use. Bearings on the bolt ensure smooth even make-up and break.

The clamp mounting plate illustrated is precision bored for additional hydraulic stab connectors and guide pins.

This 10" nominal clamp has API ratings of:

- 15,000 lb/sq.in. at 6" (150mm) diameter
- 10,000 lb/sq.in. at 7" (180mm) diameter
- 7,500 lb/sq.in. at 8" (205mm) diameter
- 5,000 lb/sq.in. at 9" (230mm) diameter

Destec Connector Chosen for First 15,000 psi ROV Hook-up

Destec Engineers worked closely with the Engineers at Sonsub in Houston to perfect the worlds first 15000 psi ROV Hook-up.

The successful installation is on the Gyrfalcon Field, Block 20 in the Gulf of Mexico. The 8" Connectors were supplied complete with a guidance system preventing damage to the hub ends which are also designed to protect and retain the Destec seal ring.

Secondary sealing enables monitoring by the ROV of the connector performance whilst externally preventing the ingress of sea and sand.

The adjacent photograph shows hook-up simulation tests being carried out in the fabricators yard.

The main guidance system also incorporates soft land equipment which can be activated to assist initial pipeline separation.

WWW.TEESING.COM | +31 70 433 07 50
3 Piece Single bolt Subsea Clamps for the Seal Tube Air locks on the Troll Production Platform

A total of seven 32” (813 mm) and 49” (1245 mm) diameter Single Bolt Clamps are installed at the base of the Troll Platform Leg at a depth of 1000 ft (325 m). The units form part of Seal Tube Air Locks and are used for current and future Hook Ups to production wells.

Operation of the Destec Clamp is by ROV and when required a safety link is removed before opening the Single bolt Clamp. The cover together with the stopple equipment cartridge is then removed and brought to the surface.

Design pressure is 508psi (35 bars), with two of Destec’s unique conical seals used for internal and external pressurisation. This system allows for monitoring the sealing integrity.

On the right, the seven Destec closures are in the final position for construction of the concrete support leg of the Troll platform in Norway.

8” Single Bolt Clamps for Kerr McGee Janice Field

On the Kerr McGee Janice Field eleven 8 inch Destec Spool assemblies are used to connect the flowlines to the wellheads.

The units supplied comprise a G8SB Destec hub to 51/8 API 10K 36° fabricated spool clad with Inconel 625, a G8SB Inconel line blind and a Destec single bolt clamps. They form part of the wellhead assembly and are pressure tested to 15000 lb/in2 (1034 bars), and comply with API 6A 75K, PSL3 material class HH, Temperature class X and NACE MR 01-75.

In service the blind is removed and the flexible flowline connected by ROV.

Single Bolt Clamps for the South Arne Gravity Based Structure

Destec’s Single Bolt Connectors are used in three separate applications on the South Arne GBS.

The photograph to the right is a 36” (915 mm) bore roof access hatch on the buffer cell.

The hatch is submerged and diver operated. Contained fluid is either product or sea water. Two 24” (600 mm) Destec Single Bolt hatches together with debris guards are installed on the cells of the GSB and fitted with torque receptacles for ROV operation.

Four 18” (457 mm) seawater hatches shown below are fitted with 8” valves. Both the Destec Single Bolt Clamp and the valve are ROV operated. These seawater port closures are fitted to the GBS tower.
Alignment capability is dictated to some degree by the method of deployment and the supporting structure.

We utilise guide cones to accommodate initial offsets of up to 50mm and 5 degrees, however all connectors of this type need the hub faces to be positioned such that the clamp segments will engage the hub shoulders for tightening of the main studbolt to make up the connection.

- Male-Female configuration controls mis-alignment
- Radial mis-alignment varies with hub size
- Coarse mis-alignment provided by pull-in system
- Fine mis-alignment provided by male/female spigot system
- Radial profile to male spigot avoids snagging
- Guide Bars provide precise entry
- Angular & radial mis-alignment controlled to stop any damage to sealing surfaces during make-up

1. Guide Cone Provides 1st Take up of Misalignment
   Male hub shown at 58mm radial offset. First contact occurs when 30° lead in on male hub shoulder touches the guide cone.

2. Guide Cone ‘Funnels’ Male Hub on Approach
   Male hub shown at 5.6mm radial offset. Hub o/dia. channeled down bore of cone.

3. Step in Bore of Cone Further Reduces Misalignment
   Male hub shown at 3.6mm radial offset.

4. Guide Bars Provide More Precise Entry Into Clamp
   Male hub shown at 1mm radial offset.

5. Male Spigot Provides Final Alignment
   Connection shown with maximum gap at hub faces prior to bolt tightening. Constriction in cone bore and raised lip around hub o/dia. ensure hubs are square as well as concentric when the connection is to be made up.

6. Fully Assembled Connection

Above alignment sequence refers to G10SB only. Other sizes available on request.

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A soft landing system for retrieval and installation is provided to minimize impact loads.

- Be integral part of the connector or running tool
- Designed to absorb impact loads while landing onto the hub
- Maintain separation between sealing surfaces
- Support the weight of the jumper (isolate from vessel motion)
- Lower or raise the connector from the hub in a controlled manner
- Have mechanical indicators readable by ROV
- Allow each end of the jumper to be lowered or raised independently of each other

Connector Insulation System - Doghouse Closure.

Bespoke Insulation Systems available for deep and ultra deepwater field developments. The thermal insulation of subsea connectors is essential to overcome flow assurance issues in order to maintain flow rates, reduce production costs and provide defence against wax and hydrate formations.
BENEFITS OF DESTEC GSB SUBSEA CONNECTORS

- Engineered for remote operation in deep water
- Provides first time connection
- Greater operational efficiency
- Utilises Destec Metal Seal Ring Technology
- Adapted into customers own specification
- Quick connect & disconnect
- Compatible with ROV and sled pull-in systems
- Minimises mass and space envelope
- Design life in excess of 25 years

Other features and optional extras include:

- Destec Seal Ring is a multi-use design when specified in high strength materials. (Inconel 718 or X750)
- Seal Ring completely flush with the bore
- Bellows to protect Stud bolt from marine growth
- Tappings provided for mounting Anodes
- Cathodic protection
- Electrical continuity straps fitted as standard
- Hubs have tongue & groove features to assure alignment before seal ring contact
- Joint make-up is on a basis of torque value and target number of turns. (Open/Close indicator)
- Supplied over 1500 subsea clamp connectors
- Designed for depths in excess of 3,000m
Destec door closures provide quick access to pressure vessels and can be operated safely at speed. Applications include Industrial Waste Treatment closures, Pig traps, Separator vessels, Subsea Access Hatches and Medical Waste treatment vessels. Sizes ranging from 0.5m to 2m diameter. Please consult Destec Engineering Ltd for sizes outside this range.

Designed to meet ASME and other pressure vessel requirements for quick release connectors. Destec Engineering offer front end design studies to determine cost effective solutions and provide manufacture and project management with our own in-house technical expertise.

A range of doors has been developed for domestic waste treatment plants designed for continuous and remote operation.

Contact Destec for full user list.

**Destec Types**

**Doors**

**Liquid**

**Gas**

**Vacuum**

**Flange**

** flange**

**Connection**

**Application**

**Pressure**

**Temperature**

**Design**

**Material**

**Contact**

**Destec**

**Doors**

**Connection**

**Application**

**Pressure**

**Temperature**

**Design**

**Material**

**Contact**

Destec Engineering offer front end design studies to determine cost effective solutions and provide manufacture and project management with our own in-house technical expertise.

**Contact Destec for full user list.**

### Project examples of typical connection applications:

<table>
<thead>
<tr>
<th>CONTRACTOR</th>
<th>SIZE</th>
<th>PROJECT</th>
<th>APPLICATIONS</th>
<th>DEPTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB Offshore Systems AS</td>
<td>5&quot;, 6&quot;</td>
<td>ENTERPRISE</td>
<td>Structural Connection at 1.40 ft, Kicking Line</td>
<td>355m</td>
</tr>
<tr>
<td>ABB Offshore Systems AS</td>
<td>4&quot;</td>
<td>SHELL</td>
<td>Subsea Riser Gas Lift System</td>
<td>1200m</td>
</tr>
<tr>
<td>ABB Offshore Systems AS</td>
<td>8&quot;, 10&quot;, 12&quot;</td>
<td>STATOIL</td>
<td>Multibore Connection for Umbilical (CARIUS) &amp; Choke Module</td>
<td>350m</td>
</tr>
<tr>
<td>Cameron Ireland Limited</td>
<td>10&quot;</td>
<td>SUPPLIED OVER 1,000 TO MANY PROJECTS</td>
<td>7.1/16&quot; 10K &amp; 15K Subsea Choke Valves</td>
<td>Down to 2,000m</td>
</tr>
<tr>
<td>Cooper Cameron (UK) Limited</td>
<td>8&quot;</td>
<td>KERR MCgee</td>
<td>5.1/8&quot; 10K Subsea Riser / Tree Connection</td>
<td>80m</td>
</tr>
<tr>
<td>Cooper Cameron (UK) Limited</td>
<td>16&quot;</td>
<td>BP</td>
<td>Twin Bore Tree Connection</td>
<td>1200m</td>
</tr>
<tr>
<td>DES Operations Ltd</td>
<td>2&quot;, 6&quot;, 8&quot;</td>
<td>BP TOTAL, SHELL, CHEVRON</td>
<td>MARS-Multiple Application Re-injection System</td>
<td>2000m</td>
</tr>
<tr>
<td>EMH Limited</td>
<td>20&quot;</td>
<td>MOBIL</td>
<td>Flexible Pipe on Riser to Sea Bed Achorage</td>
<td>112m</td>
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<tr>
<td>Estech Europe Ltd</td>
<td>36&quot;</td>
<td>DEMONSTRATOR</td>
<td>Vessel Closure for Recycling Municipal Waste</td>
<td>On Shore</td>
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<tr>
<td>Framo Engineering AS</td>
<td>4&quot;, 8&quot;, 14&quot;</td>
<td>BHP BG, SANTOS, PETROBRAS</td>
<td>Subsea Multiphase Flow Meters &amp; Pumps</td>
<td>Down to 2,500m</td>
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<tr>
<td>3 Phase Measurements AS</td>
<td>6&quot;, 10&quot;</td>
<td>BP ATP TOTAL, SHELL, BHP</td>
<td>Subsea Multiphase Flow Meters &amp; Pumps</td>
<td>400m</td>
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<tr>
<td>Frank Mohn Flatoys AS</td>
<td>2&quot;, 6&quot;, 8&quot;, 10&quot;</td>
<td>MARATHON, CNT, SHELL, TOTAL, WOODSIDE</td>
<td>Subsea Multiphase Pumps</td>
<td>Down to 2,500m</td>
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<tr>
<td>Halliburton Brown &amp; Root</td>
<td>12&quot;</td>
<td>STATOIL</td>
<td>Pig Launcher / Receiver</td>
<td>Topside</td>
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<tr>
<td>JP Kenny Inc</td>
<td>8&quot;</td>
<td>CALLON ENTRADE</td>
<td>In-Field Flowlines</td>
<td>1,500m</td>
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<tr>
<td>Kaarner Oilfield Products Ltd</td>
<td>10&quot;</td>
<td>PETRO CANADA</td>
<td>Subsea Multiphase Flowmeter (2 x 4&quot; Bore)</td>
<td>130m</td>
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<td>MOFFAT 2000</td>
<td>3&quot;</td>
<td>EXXON MOBIL</td>
<td>Pipe Spool Connections – Riser Cabinet</td>
<td>1100m</td>
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<td>Oceaneering Inc</td>
<td>14&quot;</td>
<td>SHELL</td>
<td>Subsea Pig Launcher</td>
<td>1030m</td>
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<tr>
<td>OMV (Australia)</td>
<td>6&quot;</td>
<td>OMV / SANTOS</td>
<td>Wellhead to Pipeline Connection</td>
<td>55m</td>
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<tr>
<td>Sonsub International Inc</td>
<td>8&quot;</td>
<td>SHELL</td>
<td>5.1/8&quot; 15K Subsea Riser / Tree Connection</td>
<td>289m</td>
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<td>Statoil</td>
<td>4&quot;</td>
<td>STATOIL</td>
<td>Automated Closure for Gas Weigh Vessel</td>
<td>Topside</td>
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<tr>
<td>Taylor Woodrow M &amp; E Ltd</td>
<td>18&quot;, 24&quot;, 36&quot;</td>
<td>AMARADA HESS</td>
<td>Subsea Access Hatch</td>
<td>60m</td>
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<tr>
<td>Technip AS</td>
<td>8&quot;, 10&quot;, 12&quot;</td>
<td>BP / ESSO</td>
<td>Flexible / Rigid Line / Subsea Pigging Structure Connectors</td>
<td>128m</td>
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<td>Technip UK Ltd</td>
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<td>BURULLUS GAS</td>
<td>Jumper Connection System</td>
<td>500m</td>
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<tr>
<td>Technomarine</td>
<td>31&quot;, 49&quot;</td>
<td>SHELL</td>
<td>Subsea Seal Tube Closures</td>
<td>303m</td>
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<td>UHDE GmbH</td>
<td>60&quot;</td>
<td>HENKEL</td>
<td>Closure- Multi Tube Hydrogenation Vessel</td>
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<tr>
<td>Wilson Systems</td>
<td>79&quot;</td>
<td>Re3</td>
<td>Door Closures - Recycling Vessels</td>
<td>On Shore</td>
</tr>
</tbody>
</table>

Contact Destec for full user list.
Connector Applications.

Connector Applications include:

- RISER / TREE CONNECTIONS
- SUBSEA CHOKE VALVES
- MULTIPHASE FLOW METERS
- FLEXIBLE FLOWLINES & UMBILICALS
- RIGID JUMPERS & TIE-IN SPOOLs
- PIG LAUNCHER SYSTEMS
- WELLHEAD PIPELINE CONNECTIONS
- SUBSEA TIE-IN CONNECTION SYSTEMS
- HORIZONTAL & VERTICAL CONFIGURATION
- SINGLEBORE & MULTIBORE HUBS

Ordering Procedure.

If standard pipe is being used select connection size from integrated specification table.

Check pressure/temperature ratings for the materials required from tables.

Destec Engineering manufacture an extensive range of connections and should sizing be required, please supply the following information:

- DESIGN PRESSURE AND TEMPERATURE
- EXTERNAL PIPE FORCES
- PIPE MATERIALS AND CONTAINED FLUID
- PIPE OR PRESSURE VESSEL CODE
- PIPE BORE AND OUTSIDE DIAMETER
- QUANTITY INVOLVED
- ANY OTHER INFORMATION CONSIDERED RELEVANT TO DESIGN eg. CORROSION ALLOWANCE

Our Design Service.

DESTEC ENGINEERING offers the backing of a full team of engineers equipped with Finite Element Analysis and specialised in-house generated computer programmes. Including:

- FEA TO RELEVANT CODES
- 3D CAD (INVENTOR SUITE & PROFESSIONAL)
- 3D MODELS UPLOADED TO CLIENTS
- PROTOTYPE DEVELOPMENT & TESTING

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