Subsea Wet-Mate & Dry-Mate Connector Systems

performance with reliability
SeaConnect™ 4/7/12 ROV Wet-Mate Connectors

RMSpumptools field proven SeaConnect™ electrical connectors provide a wet-mate connection for all subsea monitoring and control requirements including Subsea Trees, production control systems and distribution units. The product utilises RMSpumptools highly reliable proven connection technology. Jumper harnesses, splitter boxes, transducers are offered as part of the configurable system.

Key Performance Features
- Patented Latching Device
- Flexibly Mounted ROV Handle
- Seawater Protected Contacts on both Male & Female
- No Dummy Connectors required for protection when unmated in Subsea Environments
- Oil Filled Pressure Balanced Design

Specifications
- Current Capacity: 20 amps per contact
- Operating Temperature: 0°C to 60°C
- Working Depth: 4,000 metres
- Voltage: 1 kV AC
- Design Life: 25 years

Materials
- Housing: 316 Stainless Steel or Super Duplex
- Insulation: PEEK
- Elastomers: Silicone, HNBR, Nitrile
- Electrical Contacts: Gold Plated Copper

Termination Options
- Oil-filled Hose
  - 1/2”NB oil filled hose termination.
  - Pressure compensation hose.
  - Simpler and less expensive than cable terminations.

ROV Handle Options
- Paddle, Fish Tail, T-Bar

Qualification Testing
- Contact & Insulation Resistance
- Proof Voltage
- 1000 Mate/De-Mate Cycles
- Functional Mate / de-mate
- Turbid Tank Partial Mate
- Pressure Burst
- Flooded Devices
- Flooded Front End
- Endurance
- Thermal Cycles
- Shell Continuity
- Voltage Withstand
- Shock (Drop Test)
- Thermal Shock & Vibration
- Temperature Rise
- Connect / disconnect force testing
- Short Circuit
- High Voltage Breakdown
- Flooded Back End
- Flooded Back End Long term
- Partial Discharge Testing
- Bulk Head test
- Compliant Flange Test
- Handle Test: Bending & Twisting
- Helium Leak
- Maximum Misalignment
- Twisting
- Jumper Pull
- Jumper Handling Simulation
- Oscillating Jumper
- Simulated Deployment
SeaConnect™ 4/7 Way ROV Wet-Mate Connectors (Hose Type)

FOR INFORMATION ONLY
NOT TO BE USED FOR PRODUCTION

SeaConnect™ 12 Way ROV Wet-Mate Connectors (Hose Type)
RMSpumptools field proven SeaConnect™ electrical connectors provide a wet-mate connection for all subsea monitoring and control requirements including Subsea Trees, production control systems and distribution units. The product utilises RMSpumptools highly reliable proven connection technology. Jumper harnesses, splitter boxes, transducers are offered as part of the configurable system.

**SeaConnect™ 4/7/12 Way Stab Plate Connectors**

RMSpumptools field proven SeaConnect™ electrical connectors provide a wet-mate connection for all subsea monitoring and control requirements including Subsea Trees, production control systems and distribution units. The product utilises RMSpumptools highly reliable proven connection technology. Jumper harnesses, splitter boxes, transducers are offered as part of the configurable system.

**Key Performance Features**
- Patented Latching Device
- Flexibly Mounted ROV Handle
- Seawater Protected Contacts on both Male & Female
- No Dummy Connectors required for protection when unmated in Subsea Environments
- Oil Filled Pressure Balanced Design

**Specifications**
- Current Capacity: 20 amps per contact
- Operating Temperature: 0°C to 60°C
- Working Depth: 4,000 metres
- Voltage: 1 kV AC
- Design Life: 25 years

**Materials**
- Housing: 316 Stainless Steel or Super Duplex
- Insulation: PEEK
- Elastomers: Silicone, HNBR, Nitrile
- Electrical Contacts: Gold Plated Copper

**Termination Options**
- Oil-filled Hose
  - 1/2”NB oil filled hose termination.
  - Pressure compensation hose.
  - Simpler and less expensive than cable terminations.

**Qualification Testing**
- Contact & Insulation Resistance
- Proof Voltage
- 1000 Mate/De-Mate Cycles
- Functional Mate / de-mate
- Turbid Tank Partial Mate
- Pressure Burst
- Flooded Devices
- Flooded Front End
- Endurance
- Thermal Cycles
- Shell Continuity
- Voltage Withstand
- Shock (Drop Test)
- Thermal Shock & Vibration
- Temperature Rise
- Connect / disconnect force testing
- Short Circuit
- High Voltage Breakdown
- Flooded Back End
- Flooded Back End Long term
- Partial Discharge Testing
- Bulk Head test
- Compliant Flange Test
- Helium Leak
- Maximum Misalignment
- Twisting
- Jumper Pull
- Jumper Handling Simulation
- Oscillating Jumper
- Simulated Deployment
SeaConnect™ 4/7 Way Stab Plate Connectors

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<thead>
<tr>
<th></th>
<th>BULKHEAD</th>
<th>FLANGE MOUNT</th>
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<tbody>
<tr>
<td>BULKHEAD RECEPTACLE</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>PLUG</td>
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<tr>
<td>RECEPTACLE</td>
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</table>

FOR INFORMATION ONLY
NOT TO BE USED FOR PRODUCTION
SeaConnect™ 12 Way Stab Plate Connectors

FOR INFORMATION ONLY
NOT TO BE USED FOR PRODUCTION
SeaConnect™ SW - Shallow Water Wet-Mate Connectors

RMSpumptools field proven SeaConnect™ electrical connectors provide a wet-mate connection for all subsea monitoring and control requirements including Subsea Trees, production control systems and distribution units. The product utilises RMSpumptools highly reliable proven connection technology. Jumper harnesses, splitter boxes, transducers are offered as part of the configurable system.

Key Performance Features
Patented Latching Device
Flexibly Mounted ROV Handle
Seawater Protected Contacts on both Male & Female
No Dummy Connectors required for protection when unmated in Subsea Environments
Oil Filled Pressure Balanced Design

Specifications
Current Capacity: 20 amps per contact
Operating Temperature: 0°C to 60°C
Working Depth: 4,000 metres
Voltage: 1 kV AC
Design Life: 25 years

Materials
Housing: 316 Stainless Steel or Super Duplex
Insulation: PEEK
Elastomers: Silicone, HNBR, Nitrile
Electrical Contacts: Gold Plated Copper

Termination Options
Oil-filled Hose
1/2”NB oil filled hose termination.
Pressure compensation hose.
Simpler and less expensive than cable terminations.

Qualification Testing
Contact & Insulation Resistance
Proof Voltage
1000 Mate/De-Mate Cycles
Functional Mate / de-mate
Turbid Tank Partial Mate
Pressure Burst
Flooded Devices
Flooded Front End
Endurance
Thermal Cycles
Shell Continuity
Voltage Withstand
Shock (Drop Test)
Thermal Shock & Vibration
Temperature Rise
Connect / disconnect force testing
Short Circuit
High Voltage Breakdown
Flooded Back End
Flooded Back End Long term
Partial Discharge Testing
Bulk Head test
Compliant Flange Test
Helium Leak
Twisting
Jumper Pull
Jumper Handling Simulation
Oscillating Jumper
Simulated Deployment
RMSpumptools field proven SeaConnect™ electrical connectors provide a wet-mate connection for all subsea monitoring and control requirements including Subsea Trees, production control systems and distribution units. The product utilises RMSpumptools highly reliable proven connection technology. Jumper harnesses, splitter boxes, transducers are offered as part of the configurable system.

### Key Performance Features
- Patented Latching Device
- Flexibly Mounted ROV Handle
- Seawater Protected Contacts on both Male & Female
- No Dummy Connectors required for protection when unmated in Subsea Environments
- Oil Filled Pressure Balanced Design

### Specifications
- Current Capacity: 20 amps per contact
- Operating Temperature: 0°C to 60°C
- Working Depth: 4,000 metres
- Voltage: 1 kV AC
- Design Life: 25 years

### Materials
- Housing: 316 Stainless Steel or Super Duplex
- Insulation: PEEK
- Elastomers: Silicone, HNBR, Nitrile
- Electrical Contacts: Gold Plated Copper

### Termination Options
- Oil-filled Hose
- 1/2”NB oil filled hose termination.
- Pressure compensation hose.
- Simpler and less expensive than cable terminations.

### Qualification Testing
- Contact & Insulation Resistance
- Proof Voltage
- 1000 Mate/De-Mate Cycles
- Functional Mate / de-mate
- Turbid Tank Partial Mate
- Pressure Burst
- Flooded Devices
- Flooded Front End
- Endurance
- Thermal Cycles
- Shell Continuity
- Voltage Withstand
- Shock (Drop Test)
- Thermal Shock & Vibration
- Temperature Rise
- Connect / disconnect force testing
- Short Circuit
- High Voltage Breakdown
- Flooded Back End
- Flooded Back End Long term
- Partial Discharge Testing
- Bulk Head test
- Compliant Flange Test
- Helium Leak
- Twisting
- Jumper Pull
- Jumper Handling Simulation
- Oscillating Jumper
- Simulated Deployment

[rsmpumptools.com](http://rsmpumptools.com)
SeaConnect™ DW (Deep Water) - 4/7/12 Diver-Mate Connectors

DIVER MATE PLUG

DIVER MATE RECEPTACLE

BULKHEAD MOUNTED RECEPTACLE

INTERFACE DETAIL

SECTION A-A

FOR INFORMATION ONLY
NOT TO BE USED FOR PRODUCTION
The RMSpumptools SeaConnect™ Junction Box forms part of the electrical distribution system for all Signal and Monitoring requirements. The Junction Boxes are flexible and modular in design with various configurations - assembly for both Subsea Cable and Hose Harnesses can be fully field attachable or factory terminated, depending on system requirements.

**Key Performance Features**
- Modular system with 2:1, 3:1, 4:1 and 5:1 variations
- Fully Pressure Compensated
- Primary Metallic Seals / Secondary Elastomeric
- Fully field attachable with option for factory termination

**Specifications**
- Current Capacity: 5A
- Operating Temperature: 0°C to 60°C
- Working Pressure: 4500psi @ 3000m
- Voltage: 1,000V

**System Qualification**
- Hydrostatic Withstand Pressure Test
- Local Unlinking Test
- Insulation Resistance Test
- Contact Resistance Test
- Proof Voltage Test
- Vibration and Mechanical Shock Test
SeaConnect™ Temperature and Pressure Sensor

The RMSpumptools SeaConnect™ Sensor performs pressure and temperature measurements on completion and production systems in subsea environments to a water depth of 3,000m. It is typically used for Subsea Christmas Trees and are mandatory to monitor these variables during production.

**Operational Requirements**
- Design Life: 25 years
- Recalibration: 10 years
- Process Connection: API 6BX 1.13/16” 10ksi flange
- Electrical Connection: JIC 8 with oil filled hose
- Ring Gasket: BX-151 and 2-239 elastomeric seal
- Location of installation: Subsea Tree Valves or at Manifolds
- Working Pressure: 0 - 10,000psi
- Working Temperature: -10 - 121°C

**Qualification**
- Qualified Pressure: 3,800psi
- Maximum withstand pressure: 8,600psi (body)
- 20,000psi (probe)
- Vibration Test: 12-300Hz at 5g on the 3 axis
- Thermal cycling at 4°C, 25°C, 50°C and 60°C with 2 hours on each temperature for 5 days

**Electronic Specification**
- Power Supply: 12-36VDC
- Signal Output: 4-20mA current loop
- The output is made via electrical penetrators
- Insulation: 10MΩ / 50VAC (temperature and pressure)
- The electronic signal conditioning uses AD/DA converters 16 bits
- The reading of the values of pressure and temperature can be made by HART protocol (temperature) and RS485 Modbus (pressure)

**Sensor Specification**
- Pressure:
  - Compensated Temperature: 0 - 120°C
  - Calibrated Pressure: 0 - 10,000psi
  - Resolution: 0.03% FS
  - Accuracy: 0.2% FS (Total Error Band)
  - Long Term Stability: 0.1% FS / year
- Temperature:
  - Calibrated Temperature: 0 - 120°C
  - Resolution: 0.03% FS
  - Accuracy: 1% FS (Total Error Band)
  - Long Term Stability: 0.5% FS / year

**Key Product Features**
- Reduced Size:
  - 40cm total length, from the flush to the JIC
- Reduced Weight:
  - 15kg. Easy handling and installation
- Facilitated Calibration:
  - Calibration performed by HART and Modbus output
- Materials:
  - All units are manufactured with qualified materials for subsea use and for corrosive environments, according to the HH class on API 6A / NACE MR-0175
- Two Choices of Materials:
  - Can be supplied in 316L SS (UNS S31603) or Super Duplex (UNS 32550)

* The Sensor is offered as part of the SeaConnect System in partnership with Transeletron (ezSensing).
WellConnect™ Subsea Vertical Electrical Connector

The Vertical Instrument Wet Mateable Electrical Connector is designed to provide continuous electrical connection between the Tubing Hanger and the X-Tree. The purpose of the Vertical Single Contact Mated Connector is to provide a long term reliable electrical connection for DHPT Applications. The system also uses a THRT Connection to allow system checks prior to the X-Tree landing.

**Operational Requirements**
- **Design Life:** 30 years
- **Location within completion:** Subsea Vertical X-Tree
- **Rated Pressure:** 10,000 Psi
- **Test Pressure:** 15,000 Psi
- **Working temperature range:** -20ºC to 155ºC
- **Storage temperature range:** -18ºC Min
- **Number of mating cycles:** 100

**Mechanical Requirements**
- **Envelope diameter:** As per Customer Specifications
- **Stack up tolerance:** ± 0.500”
- **Mechanical Shock:** Half sine period at 30g
- **Angular Misalignment:** ± 0.5º
- **Radial Misalignment:** 0.1”

**Electrical Specification**
- **Number of contact:** 1
- **Contact Method:** Multi-contact
- **Working Voltage:** 500 Vdc
- **Test Voltage (to Earth):** 1000Vdc
- **Ampacity:** 5 A

**Key Performance Features**
- Unique Dielectric Oil Treatment System
- Protective Contact on Male/Female Halves
- HPHT Application Materials
- Energised Seals
- Metal to Metal Sealing
- Gold-plated Contacts
- Crimp Technology

**Material Specification**
- **Housing:** Inconel 625/Superduplex to ISO 15156-3
- **Contact:** Gold plated beryllium copper
- **Insulation:** PEEK HT

**Qualification Testing**
- **Proof Voltage**
- **Insulation Resistance**
- **Contact Resistance**
- **Pressure Test**
- **Long Term & Life Test**
- **Temperature Limit**
- **Vibration Test**
- **Shock (Drop) Test**
- **Gas Seal (Helium) Test**
- **Misalignment Test**

**Cable**
- **Plug Termination:** 1/8” Metal Tube with Alpha Cable
- **Receptacle Termination:** 1/4” Metal Clad Monocable

**Design Philosophy**
- Main Dielectric Filled Body: Pressure Balanced
- Seal Philosophy: Dual Electrical and Mechanical Barriers
- Electrical Insulation Primary Thermosplastic or Elastomer
- Secondary Dielectric Fluid
The Vertical Instrument Wet Mateable Electrical Connector is designed to provide continuous electrical connection between the Tubing Hanger and the X-Tree. The purpose of the Vertical Single Contact Mated Connector is to provide a long term reliable electrical connection for DHPT Applications. The system also uses a THRT Connection to allow system checks prior to the X-Tree landing. The design is a smaller bore design with lower receptacle 27.9mm in diameter.

**Operational Requirements**
- Design Life: 25 years
- Location within Completion: Subsea Vertical X-Tree
- Rated Pressure: 10,000 Psi
- Test Pressure: 15,000 Psi
- Working Temperature Range: -20ºC to 155ºC
- Storage Temperature Range: -18ºC Min
- Number of Mating Cycles: 100

**Mechanical Requirements**
- Envelope Diameter: As per Customer Specifications
- Stack up Tolerance: ± 3.5mm
- Mechanical Shock: Half sine period at 6g
- Angular Misalignment: ± 0.5º
- Radial Misalignment: ± 1mm

**Electrical Specification**
- Number of Contact: 1
- Contact Method: Multi-contact
- Working Voltage: 500 Vdc
- Test Voltage (to Earth): 1000Vdc
- Ampacity: 5 A

**Design Philosophy**
- Main Dielectric Filled Body: Pressure Balanced
- Seal Philosophy: Dual Electrical and Mechanical Barriers
- Electrical Insulation Primary Thermosplastic or Elastomer
- Secondary Dielectric Fluid
- Independent Design Review Validation

**Key Performance Features**
- Unique Oil Flow Design to Flush the Electrical Connection during Mating
- Protective Contact on Male/Female Halves
- HPHT Application Materials
- Energised Seals
- Metal to Metal Sealing
- Gold-plated Contacts
- Crimp Technology

**Material Specification**
- Housing: Inconel 625/Superduplex to ISO 15156-3
- Contact: Gold plated beryllium copper
- Insulation: PEEK HT

**Qualification Testing**
- Proof Voltage
- Insulation Resistance
- Contact Resistance
- Pressure Test
- Pressure and Temperature Cycling (API64)
- Long Term & Life Test
- Temperature Limit
- Vibration Test
- Shock (Drop) Test
- Gas Seal (Helium) Test
- Misalignment Test
- Individual Seal Test
- Low Temperature Test

**Cable**
- Plug Termination 1/8” Metal Tube with Alpha Cable
- Receptacle Termination 1/4” Metal Clad Monocable
Bonnet Actuator Plug Assembly
- Single or multiple electrical connectors available
- Inconel clad M-M sealing provides reliable final leak path barrier protection
- Extended type testing in a range of completion fluids enables the actuator to work in all harsh environments
- Pressure and mate/break cycle tested by RMSpumptools before delivery ensuring working life durability
- Variety of electrical connectors for subsea outlet
- Positive internal pressure repels the external environment and ensures electrical integrity is maximised
- Lloyds witnessed and approved pressure, temperature and mate/break test regime

Tubing Hanger Receptacle Assembly
- Single or multiple electrical connectors available
- Spring energised conductor wand assembly enables simple installation and in-field change-out
- Whole life sealing system reliability is ensured with M-M sealing in upper and lower Tubing Hanger pockets
- Proven RMSpumptools wellhead instrumentation pressure barrier technology incorporated
- Pressure and temperature cycle test regime witnessed and approved by Lloyds

Lower Tubing Hanger Dry Mate Connector
- Single or multiple electrical connectors available
- Easy field installation of downhole cables
- Optimised to fit into Orientation Sleeve pocket
- Lloyds witnessed and approved pressure as well as temperature cycle test regime
- Industry standard ferrule assembly onto 1/4” downhole instrument cable
- Pressure testable metal sealing

Specification - Standard Range

<table>
<thead>
<tr>
<th>RMS Ref</th>
<th>Pressure Rating (psi)</th>
<th>Number of Conductors</th>
<th>Temperature Rating</th>
<th>Water Depth</th>
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<tbody>
<tr>
<td>234/12/022</td>
<td>10,000</td>
<td>1 + Earth</td>
<td>0 - 250°F</td>
<td>5,000ft (1500m)</td>
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<tr>
<td>234/12/081</td>
<td>10,000</td>
<td>3 + Common Earth</td>
<td>0 - 250°F</td>
<td>5,000ft (1500m)</td>
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<td>234/12/149</td>
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<td>1 + Earth</td>
<td>0 - 300°F</td>
<td>10,000ft (3000m)</td>
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<tr>
<td>234/12/150</td>
<td>10,000</td>
<td>3 + Common Earth</td>
<td>0 - 300°F</td>
<td>10,000ft (3000m)</td>
</tr>
</tbody>
</table>

All Types
- Misalignment: +/- 1.5 mm Vertical
- +/- 1.5º Radially
- 17 Tuns
- ROV Torque: 30 ft-lb (40 Nm) @ 6,000 ft (1900m)
- Power Rating: 5 Amps, 500 V d.c.
- ROV Shaft Rating Speed: 60 - 240 rpm
The Concentric Instrument Wet Mateable Electrical Connector is designed to provide continuous electrical connection between the Tubing Hanger and the X-Tree and power DHPT. The connector is designed to fit a non-orientated Tree and provide electrical connection in all feasible orientation arrangements. The system also uses a THRT Connection to allow system checks prior to the X-Tree landing.

**Operational Requirements**
- Design Life: 25 years
- Location within completion: Vertical X-Tree TH, THRT
- Rated Pressure: 6,500 Psi
- Test Pressure: 9,750 Psi
- Working temperature range: 0°F to 250°F (-18°C to 121°C)
- Storage temperature range: -40°F to 158°F (-40°C to 70°C)
- Deployment Water Depth: 0-6,000ft (0-1,803m)

**Mechanical Requirements**
- Sealing Elastomeric and M-M
- Non orientated design
- Interface Tolerant of debris during normal mating
- Maximum Radial Misalignment: ±0.04” (1.0mm)
- Maximum Axial Misalignment: ±0.19” (4.9mm)
- Maximum Mating Speed: 0.3m/sec

**Electrical Specification**
- Working Voltage: 1,000Vdc
- Test Voltage: 2,400Vdc
- Maximum Working Current: 5A
- Maximum contact resistance: <30 mohms with 2.0A load

**Material Specification**
- Housing: 316 Stainless Steel, SAF 2205, High Strength CuproNickel
- Contact: Gold Plated Copper Alloy, Nickel
- Insulation: PEEK 450G or Equivalent
- Chemical/Corrosion Considerations to application environments

**Design Philosophy**
- Seal Philosophy: Elastomeric Wet Mate Seals
- Electrical Insulation: Thermosplastic or Elastomer

**Cable**
- Tree Connector: 1/8” Hydraulic Tube
- TH Connector: 1/4” or 1/8” Permanent Downhole Cable

**Key Performance Features**
- TH Pressure Barrier API 17D PSL4
- No Hydraulic Return utilizes Spring Mechanism
- Crimp Contacts

**Qualification Testing**
- Standard Electrical Integrity Test
- Dry Unmated Test
- Hydrostatic Withstand Low Pressure Test
- Hydrostatic Withstand High Pressure Test
- Individual Seal Hydrostatic Pressure Test
- Air Mate/Demate Cycle Test
- Wet Mate/Demate Cycle Test
- Turbid Tank Mate/De-mate Cycle Test
- Thermal Cycle test Vibration Test

**WellConnect™ Subsea Electrical Concentric Connector**
**WellConnect™ Subsea Electrical Concentric Connector - HP Series**

The Concentric Instrument Wet Mateable Electrical Connector is designed to provide continuous electrical connection between the Tubing Hanger and the X-Tree, providing long term electrical connection for DHPT applications. The connector is designed to fit a non-orientated Tree and provide electrical connection in all feasible orientation arrangements. The system also uses a THRT Connection to allow checks prior to the X-Tree landing.

### Operational Requirements
- **Design Life:** 15 years
- **Location within completion:** Vertical X-Tree TH, THRT
- **Rated Pressure:** 10,000 Psi
- **Test Pressure:** 15,000 Psi
- **Working temperature range:** 0°F to 250°F (-18°C to 121°C)
- **Storage temperature range:** -40°F to 158°F (-40°C to 70°C)
- **Deployment Water Depth:** 0-6,000ft (0-1,803m)

### Mechanical Requirements
- **Mate/demate cycle life:** 100 mates (turbid sand, salt and water)
- **Sealing Elastomeric and M-M**
- **Non orientated design**
- **Interface Tolerant of debris during normal mating**
- **Maximum Radial Misalignment:** +/- 0.04” (1.0mm)
- **Maximum Axial Misalignment:** +/- 0.2” (5.1mm)
- **Maximum Mating Speed:** 0.3m/sec

### Electrical Specification
- **Maximum Working Voltage:** 1,000Vdc
- **Test Voltage:** 2,400Vdc
- **Maximum Working Current:** 5A
- **Maximum contact resistance:** <30 mohms with 2.0A load

### Material Specification
- **Housing:** 316 Stainless Steel or SAF 2205
- **Contact:** Gold plated Copper Alloy
- **Insulation:** PEEK 450G or Equivalent

### Key Performance Features
- **Unique Latch Return Mechanism**
- **No Hydraulic Return required, utilises**
- **Latch Mechanism**
- **Cable field Serviceable**
- **High Pressure Application**
- **Shell Continuity**
- **Sealing Elastomeric and M-M**
- **Interface Tolerant of Debris During Normal Mating**

### Qualification Testing (to IWIS specification)
- **Hydrostatic Withstand Pressure Test**
- **Functional Mate/Demate Test in Turbid Conditions**
- **Maximum misalignment Test Specification**
- **Thermal Shock Test**
- **Individual Seal Hydrostatic Pressure Test**
- **Shell Continuity Test**
- **Wet Mate/Demate Cycle Test**
- **Turbid Tank Mate/De-mate Cycle Test**
- **Thermal Cycle test Vibration Test**

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**Operational Requirements**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
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<tbody>
<tr>
<td><strong>Design Life</strong></td>
<td>15 years</td>
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<tr>
<td><strong>Location within completion</strong></td>
<td>Vertical X-Tree TH, THRT</td>
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<tr>
<td><strong>Rated Pressure</strong></td>
<td>10,000 Psi</td>
</tr>
<tr>
<td><strong>Test Pressure</strong></td>
<td>15,000 Psi</td>
</tr>
<tr>
<td><strong>Working temperature range</strong></td>
<td>0°F to 250°F (-18°C to 121°C)</td>
</tr>
<tr>
<td><strong>Storage temperature range</strong></td>
<td>-40°F to 158°F (-40°C to 70°C)</td>
</tr>
<tr>
<td><strong>Deployment Water Depth</strong></td>
<td>0-6,000ft (0-1,803m)</td>
</tr>
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**Mechanical Requirements**

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<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
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<tr>
<td><strong>Mate/demate cycle life</strong></td>
<td>100 mates (turbid sand, salt and water)</td>
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<tr>
<td><strong>Sealing Elastomeric and M-M</strong></td>
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<tr>
<td><strong>Non orientated design</strong></td>
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<tr>
<td><strong>Interface Tolerant of debris</strong></td>
<td>During normal mating</td>
</tr>
<tr>
<td><strong>Maximum Radial Misalignment</strong></td>
<td>+/- 0.04” (1.0mm)</td>
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<tr>
<td><strong>Maximum Axial Misalignment</strong></td>
<td>+/- 0.2” (5.1mm)</td>
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<tr>
<td><strong>Maximum Mating Speed</strong></td>
<td>0.3m/sec</td>
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**Electrical Specification**

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<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
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<tbody>
<tr>
<td><strong>Maximum Working Voltage</strong></td>
<td>1,000Vdc</td>
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<tr>
<td><strong>Test Voltage</strong></td>
<td>2,400Vdc</td>
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<tr>
<td><strong>Maximum Working Current</strong></td>
<td>5A</td>
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<tr>
<td><strong>Maximum contact resistance</strong></td>
<td>&lt;30 mohms with 2.0A load</td>
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**Material Specification**

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<th>Requirement</th>
<th>Specification</th>
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<tbody>
<tr>
<td><strong>Housing</strong></td>
<td>316 Stainless Steel or SAF 2205</td>
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<tr>
<td><strong>Contact</strong></td>
<td>Gold plated Copper Alloy</td>
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<tr>
<td><strong>Insulation</strong></td>
<td>PEEK 450G or Equivalent</td>
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**Design Philosophy**

<table>
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<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Seal Philosophy</strong></td>
<td>Elastomeric Wet Mate Seals</td>
</tr>
<tr>
<td><strong>Electrical insulation</strong></td>
<td>Thermoplastic or Elastomer</td>
</tr>
</tbody>
</table>

**Cable**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
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<tbody>
<tr>
<td><strong>Tree Connector</strong></td>
<td>1/8” Hydraulic Tube</td>
</tr>
<tr>
<td><strong>TH Connector</strong></td>
<td>1/4” or 1/8” Permanent Downhole Cable</td>
</tr>
</tbody>
</table>
The Wellhead Outlet (WHO) Penetrator is a Dry Mateable Subsea Electrical Connector designed to provide continuous electrical connection through Wellhead equipment. Typically this will be from a Tree mounted Wet mateable Connector to a Diver/ROV Connector situated at the Junction Box. The connector is mounted to a Flange which is then mounted to a pre-machined face on Wellhead equipment. The mating half of the Connector is terminated to an Oil Filled Subsea Jumper via an Omnitec Mk 2 interface.

**Operational Requirements**
- Location within completion: Subsea, Wellhead
- Rated Pressure: 15,000 Psi
- Test Pressure: 22,500 Psi
- Working Temperature range: 0°F to 300°F (-18°C to 150°C)
- Storage Temperature range: -40°F to 158°F (-40°C to 70°C)
- Deployment Water Depth: 0-10,000ft (0-3,048m)

**Mechanical Requirements**
- Crimp Termination Strength: >75% UTS of Cable
- Cable Pull Out Force: >1300 lbf (5783N)
- Connection Cycle Life: >100
- Sealing: M-M Primary, Elastomeric Secondary
- Orientation: Keyed interfaces

**Electrical Specification**
- Maximum Working Voltage: 1000 Vdc
- Test Voltage: 2500 Vdc
- Maximum Working Current: 5 A
- Maximim contact resistance at 20°C: <2.5mΩ
- Insulative Resistance at 20°C: > 10G Ω
- Insulative Resistance at 121°C: > 500M Ω
- Number of Contacts: 2/3
- Electrical Insulation Thermoplastic, Elastomer or Dielectric Fluid

**Material Specification**
- Housing Options: Stainless Steel 316 SAF 2205, 17-4PH
- Stainless Steel or HS Cupronickel in compliance with ISO15156/NACE MR0175
- Contact Gold Plated Copper Alloy
- Insulation: PEEK 450G or Equivalent
- Seal Options: Hydrogenated Nitrile Rubber, Fluorsilicone, Rubber or Silicone

**Design Philosophy**
- Ease of Termination
- Electrical Contacts: 2+1 or 1+1 (2 lives +1 Earth)
- Crimp Termination
- Pressure Testable
- Independent Design Review Validation

**Interfaces**
- WHO Interface API and Grayloc Sealing Flanges, as per customers requirements.
- Including as minimum; 1-1/16”, 2-1/16” - APIBX 150, 152 Ring
- Tree Cable Termination 1/8” Encapsulated/Hydraulic Tube or 1/4” Encapsulated/Hydraulic Tube
- Oil Filled Jumper/Hose Termination Omnitec Mk 2 Fitting
WellConnect™ Instrumentation Dry Mate Electrical Connector (Field Attachable)

The dry mate consists of two halves Male and female. The male half has metal to metal sealing whilst the female is a field attachable connector, eradicating the need for offshore splicing. The connectors are used for Subsea equipment including Tubing Hanger & Tubing Hanger Running Tools.

**Operational Requirements**
- Design Life: 25 years
- Location within Completion: Subsea TH & THRT
- Rated Pressure: 10,000 psi
- Test Pressure: 15,000 psi
- Working Temperature Range: -20°C to 155°C
- Storage Temperature Range: -18°C Min

**Material Specification**
- Housing: High strength CuproNickel
- Insulation: PEEK HT

**Design Philosophy**
- Independent Design Review Validation
- Metal to Metal Sealing
- Field Attachable Dry Mate
- Test Port Facilities

**Mechanical Requirements**
- Envelope Diameter: As per Customer Specifications

**Electrical Specification**
- Number of Contacts: 1
- Contact Method: Multi-contact
- Working Voltage: 500 Vdc
- Test Voltage (to Earth): 1000Vdc
- Ampacity: 5 A

**Cable**
- 1/4” or 1/8” Metal Type Termination
  (or client specific)

**Qualification Testing**
- Proof Voltage
- Insulation Resistance
- Contact Resistance
- Pressure Test
- Pressure and Temperature Cycling (API6 PSL4)
- Metal to Metal Sealing
- Individual Seal Test
WellConnect™ Downhole Electrical Mechanical Splice

The Permanent Downhole Cable Mechanical Splice is designed to join two separate cables providing a continuous electrical connection. The Splice is sealed against the environment in an outer Metallic body and is mechanically joined to both ends of the PDC which provides a metal to metal seal. It is also fully insulated against electrical tracking through thermoplastic and elastomeric sleeves.

**Operational Requirements**
- Design Life: 10 years
- Location within Completion: Downhole
- Rated Pressure: 10,000 Psi
- Test Pressure: 15,000 Psi
- Operating Temperature Range: -18°C to 121°C (0°F to 250°F)
- Storage Temperature Range: -40°C to 70°C (-40°F to 158°F)

**Mechanical Requirements**
- Crimp Termination Strength: >75% UTS of Cable
- Cable Pull Out Force: >1300 lbf (5783N)
- Sealing: M-M Primary, Elastomeric Secondary
- Orientation: Keyed Interfaces if Required

**Electrical Specification**
- Maximum Working Voltage: 1000 Vdc
- Test Voltage: 2500 Vdc
- Maximum Working Current: 5 A
- Maximum Contact Resistance at 20°C: <2.5m Ω
- Insulative Resistance at 20°C: > 10G Ω
- Insulative Resistance at 121°C: > 200M Ω
- Number of Contacts: 1
- Electrical Insulation Thermoplastic or Elastomer

**Key Performance Features**
- Metal to Metal Sealing
- Elastomeric Back-up
- 1/4 & 1/8 Cables
- Test Port for Onsite Verification

**Material Specification**
- Housing Options: Stainless Steel 316 or Inconel Alloy
- Contact: Gold Plated Copper Alloy
- Insulation: PEEK 450G or Equivalent
- Seal Options: Hydrogenated Nitrile Rubber, Flurosilicone, Silicone

**Design Philosophy**
- Ease of termination
- Pressure testable
- Metal/Metal Primary seal
- Suitable for 1/8” and 1/4” PDC

**Cable**
- Cable Option 1: 1/8” Encapsulated Cable/Hydraulic Tube to 1/4” Encapsulated Cable/Hydraulic Tube - 16 & 18 AWG
- Cable Option 2: 1/4” Encapsulated Cable/Hydraulic Tube to 1/4” Encapsulated Cable/Hydraulic Tube - 16 & 18 AWG

**Qualification Testing**
- Standard Electrical Integrity Test
- Hydrostatic Pressure Test
- Thermal Test
RMSpumptools is the industry’s technology leader for ESP Power Connectors and extends our ethos of design for reliability to Subsea Electrical Wetmateable Connectors for Power and Instrument Lines, bringing a step-change to ESP Subsea System reliability.

**Key Features**

**Dielectric Oil Treatment Technology**
Unique formula treatment that neutralises moisture and maintains insulation integrity, protecting against electrical failure and prolonging life of the system.

**Energised Seals**
Provides reliable long term seal compression in hostile environments, ensuring high levels of mechanical and electrical integrity over the life of the product - delivering maximised reliability.

**Metal to Metal Sealing**
High integrity sealing at critical barriers providing maximum protection against water ingress, resulting in long term reliability.

**Misalignment Compliance System**
Radial, Angular and Axial mechanical compliance is built into the design, eliminating damage during the most severe mating scenarios, avoiding premature failure and recourse to backups.

**Plug & Play Installation Options**
Allows repeatable, efficient installation without critical on-site operations, resulting in superior time and cost savings.

**Crimp Termination Technology**
Repeatable cable termination using pre-set crimp tooling, simplifying installation and eliminating errors during operation.

**ESP Cable Termination Technology**
Field proven repeatable cable termination reliability over years of wide ranging service, simplifying installation and eliminating errors.

**Electrical Specification**
3 Phase System
- Maximum Working Current: 160A
- Maximum Balanced Working Voltage: 5000Va.c
- Frequency: Up to 60Hz
- Maximum Test Voltage: 28Vd.c (11.54kVa.c)
- Insulation Resistance (@20ºC): >10 GΩ @ 5000Vd.c
- Maximum Contact Resistance: <10 mΩ
- Partial Discharge Inception Voltage: > 1.73 Uo

**Mechanical Properties**
- Working Design Life: 20 years
- Body Material: Inconel, Superduplex and Stainless Steel to ISO 15156
- Working Depth: 3400m
- Rated Pressure: 5,000psi (34 Nmm-2, 340 Bar)
- Operating Temperature: -20ºC to 121ºC
- Storage Temperature: -40ºC to 70ºC
- Outer Diameter: 70mm, Female=76mm
- Maximum Demate Speed: 0.5 ms-1
WellPower v1  Split-Phase Vertical Electrical Connector

The ESP connector system consists of three single phase wet-mate power connectors spaced around the production bore. The female connector halves are in the upper section, while the male connector halves are fixed within the lower section. The connector system provides a long term reliable connection in a subsea downhole environment.

Operational Requirements
Design Life: Permanently Installed Connector 10 years
Rated Pressure: 5,000 Psi
Test Pressure: 7,500 Psi
Design Pressure: 9,000 Psi
Working Temperature Range: 0°C to 150°C (300°F)
Storage Temperature Range: -22°F to 104°F
Number of Cycles: 100

Mechanical Requirements
Diameter: 1.250”
Length: <12.000”
Stack up Tolerance: ± 0.25”

Electrical Specification
Rated Voltage: 2.89 / 5.0 kVAC (Uo/U)
Breakdown Voltage > 8Uo (23.1 kV)
Ampacity: 80 - 125 A
Frequency Range: 30 - 85 HZ

Key Performance Features
Unique Dielectric Oil Flow System
Protective Contact on Male/Female Halves
HPHT Application Materials
Energised Seals
Metal to Metal Sealing
Gold-plated Contacts
Crimp Technology

Material Specification
Housing: 316 Stainless Steel, Inconel 625 (nipple)
HS Cupro Nickel Alloy
Contacts: Gold Plated Beryllium Copper
Insulation: PEEK 450G

Qualification Testing
Standard Electrical Integrity Tests
Dry Mated Test
Mains Water Mate / Demate Cycle Test
Seawater Mate / Demate Cycle Test
Turbid Tank Test
Helium Leak Test
Cold Water Mate / Demate Cycle Test
Simulated Environment Mate / Demate Cycle Test
Simulated Environment Material Compatibility Test
Rapid Mate / Demate Cycle Test
Temperature Rise (current)
High Voltage

Design Philosophy
Main dielectric filled body: Pressure balanced
Sealing: Dual electrical and mechanical barriers
Electrical insulation Primary: Thermoplastic or Elastomer
Lower Connector Pressure Barrier

Cable
Various Cable Options
The RMSpumptools Junction Box for power systems distributing Single and Split-Phase ESP Cables provides a long term reliable connection in a subsea downhole environment.

**Operational Requirements**
- Design Life: Permanently Installed Connector 10 years
- Rated Pressure: 5,000 Psi
- Test Pressure: 7,500 Psi
- Design Pressure: 11,250 Psi
- Working Temperature Range: 0°C to 150°C (302°F)
- Storage Temperature Range: -22°F to 104°F

**Mechanical Requirements**
- Outside Diameter: 5” or 5.5”
- Production Tube: 2.9” or 3.56”
- Box Only Length: 13.4”
- Junction Box Min Length: 16”
- System Length with WMEC’s: 32”

**Electrical Specification**
- Rated Voltage: 2.89 / 5.0 kVAC (Uo/U)
- Breakdown Voltage > 8Uo (23.1 kV)
- Ampacity: 80 - 125 A
- Frequency Range: 30 - 85 HZ

**Key Performance Features**
- Provides 180º U-Turn
- Flat MLE to WMEC rear PB
- HPHT Application Materials
- Energised Seals
- Metal to Metal Sealing
- Gold-plated Contacts
- Crimp Technology
- Plug and Play Jumpers to Wet-Mate

**Material Specification**
- Housing: 316 Stainless Steel
- Duplex Stainless Steel (2205)
- Contacts: Gold Plated Beryllium Copper
- Insulation: PEEK 450G

**Qualification Testing**
- Standard Electrical Integrity Tests
- Pre-Epoxy Full Pressure Test
- Endurance Test
- Simulated Environment Material Compatibility Test
- Temperature Rise (current)
- High Voltage

**Design Philosophy**
- Sealing: Dual electrical and mechanical barriers
- Primary Metallic Cone Seal and Elastomeric Back-up
- Electrical insulation Primary: Thermoplastic or Elastomer
- Lower Connector Pressure Barrier

**Cable**
- Various Cable Options
OceanPower™ HV Electrical Wet-Mate Connector

The HV Power 3-phase Wet-Mate system is a single mandrel connector, utilising technology proven in the marine environment ensuring long term reliability. The connectors bring many benefits to tidal stream and wave energy devices, providing innovation to some of the industry’s major challenges.

Operational Requirements
Location within Completion: Subsea Turbine and Hub
Design Life: 25 years
Rated Depth: 1,000+ Metres
Rated Pressure: 1,500 Psi
Working Temperature Range: -20ºC to 45ºC
Storage Temperature Range: -20ºC to 60ºC

Mechanical Requirements
Fully Compliant Mounting System
Misalignment Limits: Radial +/- 3mm, Angular +/- 1º
Envelope Diameter: As per Customer Specification

Electrical Specification
Number of Phases: 3 + 1 earth
Contact Method: Multi-contact
Working Voltage: 3.6/6(7.2) kV
Test Voltage: 14.4 kVdc
Ampacity: 168 A
Frequency Range: 47 - 52 HZ

Key Performance Features
Modular inter-changeable Male and Female Connectors
Plug Connectors can be Energised Unmated
Dual Sealing Barriers
Metal to Metal Sealing
Elastomeric Back-up Sealing
Gold-plated Contacts
Compliant Mount maintains axial pre-load on Mated Connectors

Material Specification
Housing: SAF / High Strength CuproNickel
Insulation: PEEK

Qualification Testing
Shell Continuity
Proof Voltage
Insulation Resistance
Contact Resistance
Partial Discharge (PD)
Pressure Test
Thermal Short Circuit
Temperature Cycles
Pull Test

Design Philosophy and Standards
Protected Male & Female Electrical Contacts
Oil Filled Pressure Balanced Design
Test Port Facilities
Cathodic Protection System Compatible
IEC: 60502-2, 60502-4, 60228

Cable and Hose
35mm² Cable
Goodyear Gorilla Hose via Hose Fittings Connection
Oil-filled & Pressure Balanced
Other Cables & Hoses are available
OceanPower™ HV Split Phase Connector

The HV Power Wet-Mate system is a Split-Phase connector allowing a single or 3-phases to be applied, utilising technology proven in the marine environment ensuring long term reliability. The connectors bring many benefits to tidal stream and wave energy devices, providing innovation to some of the industry’s major challenges.

Operational Requirements
Design Life: 25 years
Rated Pressure: 5,000 Psi
Test Pressure: 7,500 Psi
Design Pressure: 9,000 Psi
Working Temperature Range: 0°C to 120°C (300°F)
Storage Temperature Range: -22°F to 104°F
Number of Cycles: 100

Mechanical Requirements
Diameter: 1.250"
Length: <12.000"
Stack up Tolerance: ± 0.25"

Electrical Specification
Rated Voltage: 2.89 / 5.0 kVAC (Uo/U)
Breakdown Voltage > 8Uo (16.1 kV)
Ampacity: 80 A - 150 A
Frequency Range: 30 - 85 HZ

Key Performance Features
Unique Dielectric Oil Treatment System
Protective Contact on Male/Female Halves
Energyised Seals
Metal to Metal Sealing
Gold-plated Contacts
Crimp Technology

Material Specification
Housing: Stainless Steel, Inconel 625 and Superduplex to ISO15156
Contacts: Gold Plated Beryllium Copper
Insulation: PEEK 450G
Non Metallic Material Specification: Norsok M710
H2S Levels Norsok M710 compliant
CO2 Levels Norsok M710 compliant

Qualification Testing
Standard Electrical Integrity Tests
Dry Mated Test
Mains Water Mate / Demate Cycle Test
Seawater Mate / Demate Cycle Test
Turbid Tank Test
Helium Leak Test
Cold Water Mate / Demate Cycle Test
Simulated Environment Mate / Demate Cycle Test
Simulated Environment Material Compatibility Test
Rapid Mate / Demate Cycle Test

Design Philosophy
Main dielectric filled body: Pressure balanced
Sealing: Dual electrical and mechanical barriers
Electrical insulation Primary: Thermoplastic or Elastomer

Cable
Various types
OceanPower™ HV Electrical Dry-Mate Connector

The HV Power 3-phase Dry-Mate Connector utilises technology proven in the marine environment providing long term reliability. The Dry-Mate connectors brings many benefits to tidal stream and wave energy devices, providing innovation to some of the industry’s major challenges.

Operational Requirements
Location within Completion: Subsea Turbine, Hub & Umbilical
Design Life: 25 years
Rated Depth: 1,000+ Metres
Rated Pressure: 1,500 Psi
Working Temperature Range: -20°C to 60°C
Storage Temperature Range: -18°C Min

Mechanical Requirements
Profile: <90mm
Envelope Diameter: As per Customer Specification

Electrical Specification
Number of Contacts: 3
Contact Method: Multi-contact
Working Voltage: 3.6/6(7.2) kV
Test Voltage (to Earth): 14.4 kVdc
Ampacity: 250 A (cable limiting factor)
Frequency Range: 47 - 52 Hz

Key Performance Features
Energised Seals
Elastomeric Back-up Sealing
Security Screw to prevent lock ring rotation and Demating
Gold-plated Contacts
Design suits a range of Cables

Material Specification
Housing: SS 316 / High Strength CuproNickel
Insulation: PEEK, EPDM

Qualification Testing
Shell Continuity
Proof Voltage
Insulation Resistance
Contact Resistance
Partial Discharge (PD)
Pressure Test
Thermal Short Circuit
Temperature Cycles

Design Philosophy and Standards
IEC: 60502-2, 60502-4, 60228

Cable and Hose
Siwo-kul 35mm² Cable
Goodyear Gorilla Hose via Hose Fittings Connection
Oil-filled & Pressure Balanced
Other Cables & Hoses are available
OceanPower™ HV Electrical Penetrator

The HV Power 3-phase Penetrator utilises technology proven in the marine environment providing long term reliability. The Penetrator brings many benefits to tidal stream and wave energy devices, providing innovation to some of the industry’s major challenges.

**Operational Requirements**
Location within Completion: Subsea Turbine, Hub & Umbilical
Design Life: 25 years
Rated Depth: 1,000+ Metres
Rated Pressure: 1,500 Psi
Working Temperature Range: -20°C to 60°C
Storage Temperature Range: -18°C Min

**Mechanical Requirements**
Option 1
Bore Sealing: Ø76.5mm = 50sqmm Cable
Flange: Ø130mm = 50sqmm Cable
Option 2
Bore Sealing: Ø82.7mm = 70sqmm Cable
Flange: Ø130mm = 70sqmm Cable
Envelope Diameter: As per Customer Specification

**Electrical Specification**
Number of Contacts: 3
Contact Method: Crimped Terminations
Working Voltage: 3.6/6(7.2) kV
Test Voltage (to Earth): 14.4 kVdc
Ampacity: 250 A (cable limiting factor)
Frequency Range: 47 - 52 HZ

**Key Performance Features**
Energised Seals
Elastomeric Back-up Sealing
Design suits a range of Cables
Flange Seal Test Port

**Design Philosophy and Standards**
IEC: 60502-2, 60502-4, 60228

**Material Specification**
Housing: SS 316 / High Strength CuproNickel
Insulation: PEEK, EPDM

**Qualification Testing**
Shell Continuity
Proof Voltage
Insulation Resistance
Contact Resistance
Partial Discharge (PD)
Pressure Test
Thermal Short Circuit
Temperature Cycles
Pull Test
Subsea Valve Position Sensors

RMSpumptools Subsea Valve Sensor provides the exact position of the subsea valve. The Subsea Valve Position Sensor can be used on a variety of valve applications including Choke and HIPPS. The 2 wire, 4-20mA current loop output, non-contacting magnetic Subsea Valve Position Sensors are available in various styles and configuration to harness/mate with subsea connectors as a package supply.

Operating Principle

The Subsea Valve Position Sensor measures the direction of the magnetic field generated by external magnets. The system can be divided into two main mechanical components, the magnetic drivehead assembly and the sensor body assembly.

The magnetic drivehead assembly is attached to the output shaft of the valve actuator. When the valve moves, the magnetic drivehead assembly rotates around four magnetic sensors built inside the nose of the sensor body assembly. The angle of the magnetic field relative to the sensor body assembly is determined by measuring two components of the field at right angles to each other.

These magnetic resolutes are processed by the electronics inside the magnetic sensor assembly, resulting in a closed loop signal of between 4mA and 20mA.

Key Performance Features

Ultra Deep Water Capability
Sensors suitable for depths of up to 3,000 metres

Non-Contacting
No moving parts or dynamic seals to wear

Solid-State Electronic Components
Ensures superb levels of reliability and accuracy with low drift characteristics

Extensive Shock and Vibration Tested
M.T. failure analysis calculated at 67 years

Manufactured to ISO 9001 Standards
Designed, manufactured, assembled and rigorously tested to ISO 9001 approved quality standards

Interchangeable in the Field
Each sensor is programmed and calibrated on master rig, then pressure tested as per customer requirements

Bespoke Solutions
To meet specific customer applications

Experience
Since their North Sea debut in 1992, over 550 Subsea Valve Position Sensors have been installed to date. The Sensors have been proven using extensive shock and vibration tests.
Subsea Valve Position Sensors

<table>
<thead>
<tr>
<th>Design Specifications - All Models</th>
<th>Customer Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle of Operation: 0° to 360°</td>
<td>• Standard or Ultra Deep Water</td>
</tr>
<tr>
<td>(to customer specification)</td>
<td>• Single or Dual Output</td>
</tr>
<tr>
<td>Accuracy: Better than ± 0.6% (0.4% optional)</td>
<td>• Pillar mounted of Flush Fitting design</td>
</tr>
<tr>
<td>Resolution: Better than ± 0.05%</td>
<td>• Standard or high accuracy (0.6% or 0.4% of full scale deflection)</td>
</tr>
<tr>
<td>Input Voltage: 14 to 28 VDC</td>
<td>• Angle of operation programmed to customer specification (up to 360°)</td>
</tr>
<tr>
<td>Output Current: 4 to 20 mA (normal range)</td>
<td>• Clockwise or Counter Clockwise direction of operation</td>
</tr>
<tr>
<td>Update Rate: 3Hz</td>
<td>• Fitted with subsea electrical connector of choice</td>
</tr>
<tr>
<td>Operating Temperature: -20°C to 40°C</td>
<td>• Dual Output models fitted with one or two connectors</td>
</tr>
<tr>
<td>Max. Operating Depth: 1500 metres standard (3000 metres optional)</td>
<td>• Pressure testing to suit customer specifications</td>
</tr>
<tr>
<td>Test Pressure: To Customer Specification</td>
<td></td>
</tr>
</tbody>
</table>

PM1 Pillar Mounted Single Output

1. Sensor Body Assembly
2. Magnetic Drivehead Assembly
3. Mounting Plate
4. Support Pillars
5. Actuator Output Shaft
6. Bulkhead Connectors or Harnesses of Customer’s choice

PM2 Pillar Mounted Dual Output

1. Dual Sensor Body Assembly
2. Magnetic Drivehead Assembly
3. Mounting Plate
4. Support Pillars
5. Actuator Output Shaft
6. Bulkhead Connectors or Harnesses of Customer’s choice

FF1 Flush Fitting Single Output

1. Sensor Body Assembly
2. Magnetic Drivehead Assembly
3. Fastening Clamps
4. Actuator Output Shaft
5. Bulkhead Connectors or Harnesses of Customer’s choice
SeaConnect™ Temperature and Pressure Sensor

The RMSpumptools SeaConnect™ Sensor performs pressure and temperature measurements on completion and production systems in subsea environments to a water depth of 3,000m. It is typically used for Subsea Christmas Trees and are mandatory to monitor these variables during production.

**Operational Requirements**
- Design Life: 25 years
- Recalibration: 10 years
- Process Connection: API 6BX 1.13/16” 10ksi flange
- Electrical Connection: JIC 8 with oil filled hose
- Ring Gasket: BX-151 and 2-239 elastomeric seal
- Location of installation: Subsea Tree Valves or at Manifolds
- Working Pressure: 0 - 10,000psi
- Working Temperature: -10 - 121°C

**Qualification**
- Qualified Pressure: 3,800psi
- Maximum withstand pressure: 8,600psi (body) 20,000psi (probe)
- Vibration Test: 12-300Hz at 5g on the 3 axis
- Thermal cycling at 4°C, 25°C, 50°C and 60°C with 2 hours on each temperature for 5 days

**Electronic Specification**
- Power Supply: 12-36VDC
- Signal Output: 4-20mA current loop
- Insulation: 10MΩ / 50VAC (temperature and pressure)
- The electronic signal conditioning uses AD/DA converters 16 bits
- The reading of the values of pressure and temperature can be made by HART protocol (temperature) and RS485 Modbus (pressure)

**Sensor Specification**
- Pressure:
  - Compensated Temperature: 0 - 120°C
  - Calibrated Pressure: 0 - 10,000psi
  - Resolution: 0.03% FS
  - Accuracy: 0.2% FS (Total Error Band)
  - Long Term Stability: 0.1% FS / year
- Temperature:
  - Calibrated Temperature: 0 - 120°C
  - Resolution: 0.03% FS
  - Accuracy: 1% FS (Total Error Band)
  - Long Term Stability: 0.5% FS / year

**Key Product Features**
- Reduced Size:
  - 40cm total length, from the flush to the JIC
- Reduced Weight:
  - 15kg. Easy handling and installation
- Facilitated Calibration:
  - Calibration performed by HART and Modbus output
- Materials:
  - All units are manufactured with qualified materials for subsea use and for corrosive environments, accordingly to the HH class on API 6A / NACE MR-0175

**Two Choices of Materials:**
- Can be supplied in 316L SS (UNS S31603) or Super Duplex (UNS 32550)

* The Sensor is offered as part of the SeaConnect System in partnership with Transeletron (ezSensing).