

Subsea Connectors & Sensor Systems







1" Subsea Vertical Electrical Connector - V1

The Vertical Instrument Wet Mateable Electrical Connector is designed to provide continuous electrical connection between the THRT Top, JRC & DPR Adaptor. The purpose of the Vertical Single Contact Mated Connector is to provide a long term reliable electrical connection for DHPT Applications.

25 years

10,000 Psi 15,000 Psi

± 3.5mm

± 0.5°

± lmm

-20°C to 155°C -18°C Min

Subsea Vertical X-Tree

As per Customer Specifications

Half sine period at 6g

Operational Requirements

Design Life:

Location within Completion:

Rated Pressure:

Test Pressure:

Working Temperature Range: Storage Temperature Range:

Number of Mating Cycles:

Mechanical Requirements

Envelope Diameter: Stack up Tolerance:

Mechanical Shock:

Angular Misalignment:

Radial Misalignment:

Electrical Specification

Number of Contacts:

Contact Method: Multi-contact Working Voltage: 500 Vdc
Test Voltage (to Earth): 1000Vdc

Material Specification

Ampacity:

Housing: Inconel 625/Superduplex to ISO 15156-3

Contact: Gold Plated Beryllium Copper

Insulation: PEEK HT

Design Philosophy

Main Dielectric Filled Body: Pressure Balanced

Seal Philosophy: Dual Electrical and Mechanical Barriers
Electrical Insulation: Primary Thermoplastic or Elastomer

Secondary Dielectric Fluid

Cable

Plug Termination 1/8" Metal Tube with Alpha Cable Receptacle Termination 1/4" Metal Clad Monocable

Qualification Testing

Proof Voltage Insulation Resistance

Contact Resistance Unique Oil Flow Design to Flush the Electrical

Key Performance Features

Pressure Test Connection during Mating

Long Term & Life Test Protective Contact on Male/Female Halves

Temperature Limit HPHT Application Materials

Vibration Test Energised Seals
Shock (Drop) Test Metal to Metal Sealing
Gas Seal (Helium) Test Gold-plated Contacts
Misalignment Test Crimp Technology







1" Subsea Vertical Electrical Connector - V2

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 Electrical 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: Location within Completion: Rated Pressure: Test Pressure:

Working Temperature Range: Storage Temperature Range: Number of Mating Cycles: 25 years Subsea Vertical X-Tree 15,000 Psi 22,500 Psi -20°C to 165°C

100

Mechanical Requirements

Envelope Diameter: Stack up Tolerance: Mechanical Shock: Angular Misalignment: Radial Misalignment:

Electrical Specification

Number of Contacts: Contact Method: Working Voltage: Test Voltage (to Earth): Ampacity:

Material Specification

Housing: Contact: Insulation:

Design Philosophy

Main Dielectric Filled Body: Seal Philosophy: Electrical Insulation:

Independent Design Review Validation

Qualification Testing

Proof Voltage
Insulation Resistance
Contact Resistance
Pressure Test
Pressure & Temperature Cycling
(API 6A)
Long Term & Life Test
Temperature Limit
Vibration Test
Shock (Drop) Test
Gas Seal (Helium) Test
Misalignment Test
Individual Seal Test
Low Temperature Test

As per Customer Specifications

± 3.5mm

-18°C Min

Half sine period at 6g

± 0.5° ± 1mm

1 Multi-contact 500 Vdc 1000Vdc

HS Cupronickel/Superduplex to ISO 15156-3 Gold Plated Beryllium Copper PEEK HT

Pressure Balanced Dual Electrical and Mechanical Barriers Primary Thermoplastic or Elastomer Secondary Dielectric Fluid

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







20ksi Subsea Vertical Electrical Connector - V3

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 Electrical 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: Location within Completion: Rated Pressure: Test Pressure:

Working Temperature Range: Storage Temperature Range: Number of Mating Cycles:

Mechanical Requirements

Envelope Diameter: Stack up Tolerance:

Mechanical Shock: Angular Misalignment:

Radial Misalignment:

Electrical Specification

Number of Contacts: Contact Method: Working Voltage: Test Voltage (to Earth):

Ampacity:

Material Specification

Housing: Contact: Insulation:

Design Philosophy

Main Dielectric Filled Body: Seal Philosophy: Electrical Insulation:

Independent Design Review Validation

Qualification Testing

Contact Resistance Test
Shell Continuity Test
Insulation Resistance Test
Proof Voltage Test
Gas Leak (Helium) Test
Misalignment Test
Locking Device Test
Wet Mating (Turbid Tank) Test
Partial Mating (Turbid Tank) Test
Thermal Shock Test
Mechanical Shock Test
Vibration Test
Drop Test
Pressure Test
Pressure Cycling Test

25 Hears

Subsea Vertical X-Tree

20,000 Psi 30,000 Psi -20°C to 155°C -18°C Min

100

As per Customer Specifications

+ 3.5mm

Half sine period at 6g

± 0.5° ± 1mm

> 1 Multi-contact 1000 Vdc 2400Vdc

5A

al Specification

1g: HS Cupronickel to ISO 15156-3, Inconel 718

1t: Gold Plated Beryllium Copper

PEEK HT

Pressure Balanced

Dual Electrical and Mechanical Barriers Primary Thermoplastic or Elastomer

Secondary Dielectric Fluid

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





Pressure & Temperature Cycling Test

Individual Seal Test



1" Subsea Vertical Fibre Optic Connector

The Vertical Instrument Wet Mateable Fibre Optic Connectors are designed to provide a continuous optical connection between the Tubing Hanger (TH) and the X-Tree. The purpose of the Vertical Optical Connectors is to provide a long-term reliable optical connection for DHPT Applications.

Operational Requirements

Design Life:

Location within Completion:

Rated Pressure: Test Pressure:

Working Temperature Range: Storage Temperature Range:

Number of Mating Cycles:

Mechanical Requirements

Envelope Diameter:

Stack up Tolerance: Vibration:

Mechanical Shock:

Angular Misalignment: Radial Misalignment:

Max. Mate/De-Mate Speed:

Optical Specification

Number of Contacts:

Contact Method:

Insertion Loss:

Return Loss:

Max. Optical Crosstalk:

Material Specification

Housing: Contact:

Design Philosophy

Main Pressure Balanced Body: Seal Philosophy:

Optical Contacts:

Optical Fibre:

Qualification TestingNote: All testing to SEAFOM TSD-01

Insertion Loss Test

Insertion Loss Test Return Loss Test

Hydrostatic Pressure Test

Functional Mate / Demate in Turbid Conditions

Functional Mate / Demate in Cold Conditions

Misalignment Test Thermal Shock Test Flooded Termination Test

Individual Seal Pressure Test Mechanical Shock Test

Vibration Test

Cyclical Pressure and Temperature Test

Helium Leak Test Partial Mating Test 15,000 Psi 22,500 Psi

25 uears

-18°C to 150°C (0°F to 302°F) -40°C to 70°C (-40°F to 158°F)

Subsea Vertical X-Tree & TH

25 turbid & 100

As per Customer Specifications

± 3.5mm

Double Sweep 10 Hz to 60 Hz - 69

Half sine, 11ms @ 10g, 30g ± 0.5°

+ 1mm

Mate 0.5 m/s, De-Mate 1.0 m/s

6 - with any combination of single mode

or multimode APC Ferrule

≤ 0.5 dB Single Mode (1310nm, 1550nm & 1625nm)

 \leq 0.5 dB Multimode (850nm & 1300nm)

 \leq -50 dB Single Mode (qualification requirement \leq -35 dB)

 \leq -50 dB Multimode (qualification requirement \leq -35 dB)

≤ -60 dB Single Mode

≤ -60 dB Multimode

Receptacle - HS Cupronickel Alloy

Plug - Stainless Steel 316 (max. 22 HRC)

HT APC Ferrules

Pressure balanced, dual thixotropic gel filled chambers. HTHP Glass-to-Metal optical penetrators, tapered seal,

O-ring with PEEK backup ring Angled Physical Contact ferrules

Mid-temperature, harsh environment G651.1 (MM) and

G.657 and G652D (SM)

Key Performance Features

Both Connector halves are controlled environment pressure balanced. HPHT Application Materials Energised Seals Metal to Metal Sealing APC Optical Ferrules







Subsea Electrical Concentric Connector

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: 100Vdc
Test Voltage: 500Vdc
Maximum Working Current: 100mA

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

Design Philosophy

to application environments.

Seal Philosophy: Elastomeric Wet Mate Seals Electrical Insulation: Thermoplastic or Elastomer

Cable

Tree Connector: 1/8" Hydraulic Tube

TH Connector: 1/4" or 1/8" Permanent Downhole Cable

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 Cucle Test

Turbid Tank Mate/De-mate Cycle Test Thermal Cycle test Vibration Test

Key Performance Features

TH Pressure Barrier API 17D PSL4 No Hydraulic Return utilises Spring Mechanism Crimp Contacts









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: 6,666 Psi
Test Pressure: 10,000 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/De-mate 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:1,000VdcTest Voltage:2,400VdcMaximum Working Current:5A

Maximum Contact Resistance: <30 mohms with 2.0A load

Material Specification

Housing:316 Stainless Steel or SAF 2205Contact:Gold plated Copper AlloyInsulation:PEEK 450G or Equivalent

Chemical / Corrosion Considerations to application environments.

Design Philosophy

Seal Philosophy: Elastomeric Wet Mate Seals Electrical Insulation: Thermoplastic or Elastomer

Cable

Tree Connector: 1/8" Hydraulic Tube

TH Connector: 1/4" or 1/8" Permanent Downhole Cable

Qualification Testing

Hydrostatic Withstand Pressure Test Functional Mate/Demate Test in Turbid Conditions

Maximum Misalignment Test

Thermal Shock Test

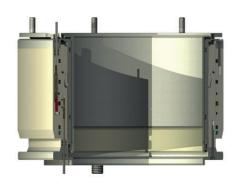
Individual Seal Hydrostatic Pressure Test

Shell Continuity Test

Turbid Tank Mate/De-mate Cycle Test







Key Performance Features

Unique Latch Return Machanism
No Hydraulic Return required, utilises
Latch Mechanism
Cable field Serviceable
High Pressure Application
Shell Continuity
Sealing Elastomeric

Interface Tolerant of Debris During Normal Mating



Horizontal Instrument Wet Mate Electrical Connector

The Horizontal Instrument Wet Mateable Electrical Connector is designed to provide continuous electrical connection between the Tubing Hanger and the X-Tree. The purpose of the Horizontal Single Contact or Multi Pin Mated Connector is to provide a long term reliable electrical connection for DHPT Applications.

Operational Requirements

Design Life: 25 years

Location within Completion: Subsea Horizontal X-Tree

Rated Pressure: 10,000 Psi
Test Pressure: 15,000 Psi
Working Temperature Range: -20°C to 150°C
Water Depth: 3000 Mtrs
Number of Mating Cycles: 100 +

Mechanical Requirements

 $\begin{array}{lll} \mbox{Vertical Misalignment:} & \pm 2\mbox{mm} \\ \mbox{Radial Misalignment:} & \pm 1.68^{\circ} \\ \mbox{No. Turns (Mate/Demate):} & 17 \end{array}$

Envelope Diameter: As per Customer

Specifications

Electrical Specification

Number of Contacts: 1, 2 or 3
Contact Method: Multi-contact
Working Voltage: 500 Vdc
Test Voltage (to Earth): 1000Vdc
Amps: 5A

Material Specification

Housing: HS Cupro Nickel Alloy
Contact: Gold Plated Beryllium Copper

Insulation: PEEK H7

Cable

Plug Termination 1/8" Metal Tube with Alpha Cable Receptacle Termination 1/4" Metal Clad Monocable

Qualification Testing

Proof Voltage Insulation Resistance Contact Resistance Pressure Test

Pressure and Temperature Cycling (API 6A)

100 Mating cycles at pressure

Dry Mate Test Gas Test

Key Performance Features

Turbid Test Unique Oil Flow Design to Flush the Electrical Sealing Systems Connection during Mating

Spheri-Seal Pressure Test HPHT Application Materials
Mating Forces Energised Seals
Internal Seal Metal to Metal Sealing

Misalignment Test Gold-plated Contacts
ROV Actuation Pressure testable



Downhole Electrical Mechanical Splice

The Permanent Downhole Cable Mechanical Splice is designed to join two seperate 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: 5,000 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

 Max Working Current:
 5A

 Max Contact Resistance at 20°C:
 $<2.5 m \Omega$

 Insulative Resistance at 20°C:
 $> 106 \Omega$

 Insulative Resistance at 121°C:
 $> 500 m \Omega$

 Number of Contacts:
 1

imber of Contacts:

Electrical Insulation: Thermoplastic or Elastomer

Material Specification

Housing Options: Stainless Steel 316 or Inconel Alloy Contact: Gold Plated Copper Alloy Insulation: PEEK 450G or Equivalent 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 Cycling Test

Key Performance Features

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





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: 15,000 psi
Test Pressure: 22,500 psi
Working Temperature Range: -20°C to 155°C
Storage Temperature Range: -18°C Min

Mechanical Requirements

Envelope Diameter: As per Customer Specifications

Electrical Specification

Number of Contacts:

Contact Method: Multi-contact
Working Voltage: 500 Vdc
Test Voltage (to Earth): 1000Vdc
Ampacity: 5A

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

Cable

1/4" PDC Cable

Conductor: Wire size range 14 AWG to 26 AWG

Insulation: Max OD 3.5mm Filler: Max OD 5.0mm

Tube: OD 6.35mm (0.25") Nominal

Encapsulation: All sizes compatible (removed locally where terminated into product)

1/8" PDC Cable

Conductor: Wire size range 16 AWG to 26 AWG

Insulation: Max OD 2.0mm

Filler: N/A

Tube: OD 3.175mm (0.125") Nominal
Encapsulation: All sizes compatible (removed locally where terminated into product)

Qualification Testing

Proof Voltage Insulation Resistance Contact Resistance Pressure Test

Pressure and Temperature Cycling (API6 PSL4)

Metal to Metal Sealing Individual Seal Test







Instrumentation Dry Mate Electrical Connector V1 (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: 15,000 psi
Test Pressure: 22,500 psi
Working Temperature Range: -20°C to 155°C
Storage Temperature Range: -18°C Min
Water Depth: 3,000 metres

Mechanical Requirements

Outer Diameter: 30.2mm (1-3/16")

Electrical Specification

Number of Contacts:

Contact Method: Harting Pin Working Voltage: 500 Vdc
Test Voltage (to Earth): 1000Vdc
Ampacity: 5A

Material Specification

Housing: High Strength Cupronickel

Insulation: PEEK 450G

Design Philosophy

Slimline Design

Metal to Metal Sealing - Tubing Hanger Half

Field Attachable Dry Mate Test Port Facilities

Cable

1/4" PDC Cable

Conductor: Wire size range 14 AWG to 26 AWG

Insulation: Max OD 3.5mm Filler: Max OD 5.0mm

Tube: OD 6.35mm (0.25") Nominal

Encapsulation: All sizes compatible (removed locally where terminated into product)

1/8" PDC Cable

Conductor: Wire size range 16 AWG to 26 AWG

Insulation: Max OD 2.0mm

Filler: N/A

Tube: OD 3.175mm (0.125") Nominal
Encapsulation: All sizes compatible (removed locally where terminated into product)

Qualification Testing

Proof Voltage Insulation Resistance Contact Resistance Pressure Test

Pressure and Temperature Cycling (API 6A PSL4)







WellConnectTM 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:

Location within Completion: Subsea Vertical X-Tree Rated Pressure: 10,000 Psi

Rated Pressure: Test Pressure:

15,000 Psi

30 years

Working Temperature Range: Storage Temperature Range:

-20°C to 155°C -18°C Min

Number of Mating Cycles:

100

Mechanical Requirements

Envelope diameter: As per Customer Specifications

Stack up tolerance: ± 0.50

Mechanical Shock: Half sine period at 30g

Angular Misalignment: $\pm 0.5^{\circ}$ Radial Misalignment: 0.1°

Electrical Specification

Number of Contacts:

Contact Method: Multi-contact
Working Voltage: 500 Vdc
Test Voltage (to Earth): 1000Vdc
Ampacity: 5A

Material Specification

Housing: Inconel 625/Superduplex to ISO 15156-3

Key Performance Features

Contact: Gold Plated Beryllium Copper

Insulation: PEEK HT

Design Philosophy

Main Dielectric Filled Body: Pressure Balanced Seal Philosophy: Dual Electrical and Mechanical Barriers Electrical Insulation Primary Thermosplastic or Elastomer Secondary Dielectric Fluid

Cable

Plug Termination 1/8" Metal Tube with Alpha Cable Receptacle Termination 1/4" Metal Clad Monocable

Qualification Testing

Proof Voltage Insulation Resistance Contact Resistance Pressure Test

Pressure Test Unique Dielectric Oil Treatment System
Long Term & Life Test Protective Contact on Male/Female Halves
Temperature Limit HPHT Application Materials

Vibration Test Energised Seals
Shock (Drop) Test Metal to Metal Sealing
Gas Seal (Helium) Test Gold-plated Contacts
Misalignment Test Crimp Technology







Well**Connect™** Subsea WHO Electrical Penetrator

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 the Wellhead equipment. The mating half of the Connector is terminated to an Oil Filled Subsea Jumper via an Omnitec Mk 2 interface or Subsea Connector.

Operational Requirements

Subsea Wellhead Location within Completion: 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) 0-10,000ft (0-3,048m) Deployment Water Depth:

Mechanical Requirements

Crimp Termination Strength: >75% UTS of Cable >1300 lbf (5783N) Cable Pull Out Force: 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: Max Contact Resistance at 20°C: <2.5m Ω Insulation Resistance at 20°C: > 10G Ω Insulation Resistance at 121°C: $> 500M \Omega$ Number of Contacts: Electrical Insulation Thermoplastic,

Material Specification

Elastomer or Dielectric Fluid

Stainless Steel 316 SAF 2205, 17-4PH Housing Options: Stainless Steel or HS Cupronickel in compliance

> with ISO15156/NACE MR0175 Contact Gold Plated Copper Alloy PEEK 450G or Equivalent Hydrogenated Nitrile Rubber, Flurosilicone, Rubber or Silicone

Design Philosophy

Ease of Termination Electrical Contacts: 1+1 (1 live +1 earth) Crimo Termination Pressure Testable Independent Design Review Validation

Interfaces

Insulation:

Seal Options:

WHO Interface API and Grayloc Sealing Flanges, as per customers requirements. Including as minimum; 1-11/16", 2-1/16" - API BX 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 or Subsea Connector

Qualification Testing

Contact Resistance Insulation Resistance Proof Voltage Hudrostatic Pressure Test PR2 Test (Pressure & Thermal Cycle) Vibration Test Gas Test Reverse Pressure Test Individual Seal Test

Key Performance Features

Flexible Design Suiting any Wellhead Prep Ease of termination Earth Continuity 2 Live Contacts





Well**Power**TM Junction Box

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

Material Specification

Housing: 316 Stainless Steel

Duplex Stainless Steel (2205)
Contacts: Gold Plated Beryllium Copper

Insulation: PEEK 450G

Design Philosophy

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

Cable

Various Cable Options

Qualification Testing

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

Key Performance Features

Provides 180° 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





DW (Deep Water) - 4/7/12 Diver-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.

Specifications

20 amps per contact Current Capacity:

Operating Temperature: 0°C to 60°C Working Depth: 4.000 metres Voltage: 1 kV AC Design Life: 25 years

Materials

316 Stainless Steel or Super Duplex Housing:

Insulation:

Silicone, HNBR, Nitrile Flastomers: Electrical Contacts: Gold Plated Copper

Terminal 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

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.

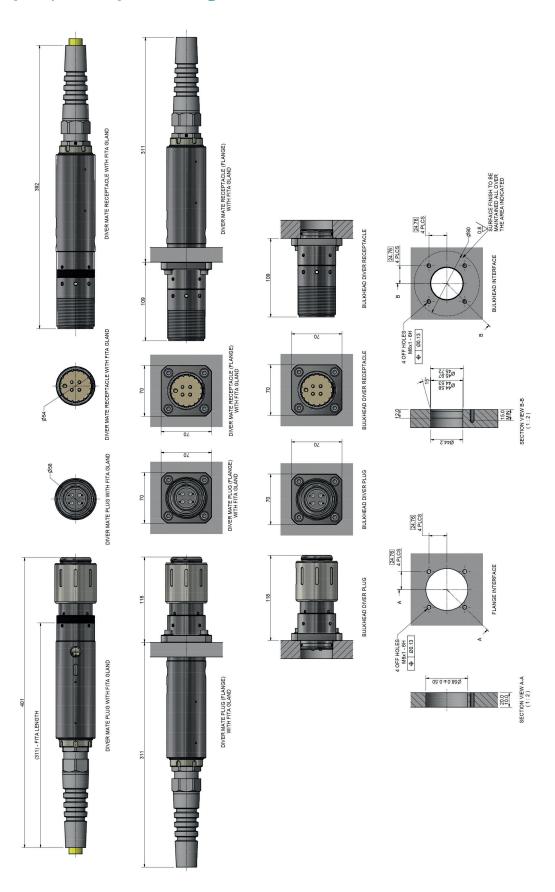
Oil Filled Pressure Balanced Design.





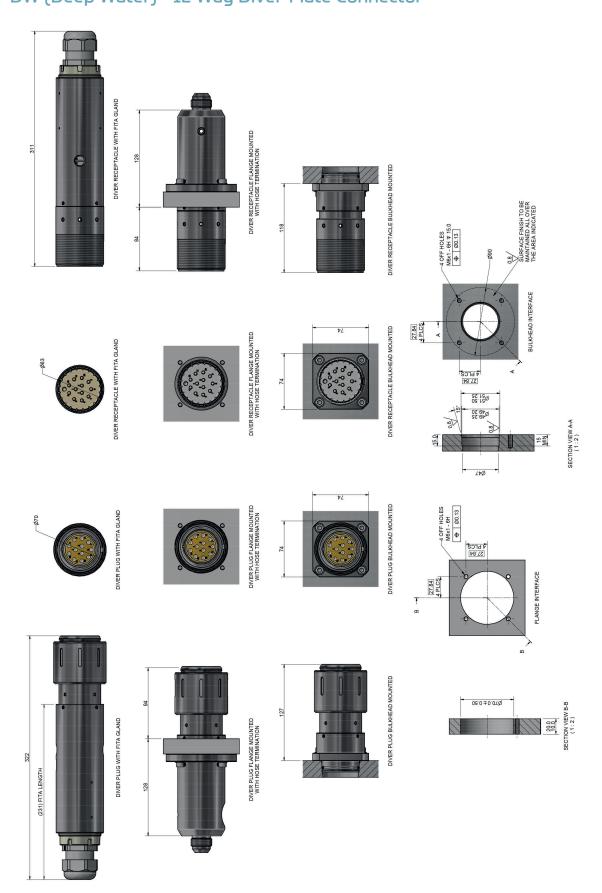


DW (Deep Water) - 4/7/ Way Diver-Mate Connectors





SeaConnectTM DW (Deep Water) - 12 Way Diver-Mate Connector





SW - Shallow Water Wet-Mate Connectors

RMSpumptools field proven SeaConnectTM 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.

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: PE

Elastomers: Silicone, HNBR, Nitrile Electrical Contacts: Gold Plated Copper

Termination Options

Oil-filled Hose

1/2"NB oil filled hose termination. Pressure compensation hose.

Field Installable Termination Assembly (FITA) Gland

Pressure compensating termination assembly onto cable.

Oil-Filled termination chamber.

Can be terminated in customer facilities.

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

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







SeaConnectTM Subsea Junction Box

The RMSpumptools SeaConnectTM 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.

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

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





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.

Specifications

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

Materials

316 Stainless Steel or Super Duplex Housing: Insulation:

Silicone, HNBR, Nitrile Flastomers: Electrical Contacts: Gold Plated Copper

Termination Options

Oil-filled Hose

1/2"NB oil filled hose termination. Pressure compensation hose.

Field Installable Termination Assembly (FITA) Gland

Pressure compensating termination assembly onto cable.

Oil-Filled termination chamber.

Can be terminated in customer facilities.

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 Test Thermal Vibration Test 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

Maxiumum Misalignment

Twisting

Jumper Pull

Jumper Handling Simulation

Oscillating Jumper

Simulated Deployment

ROV Handle Options

Paddle, Fish Tail, T-Bar

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.



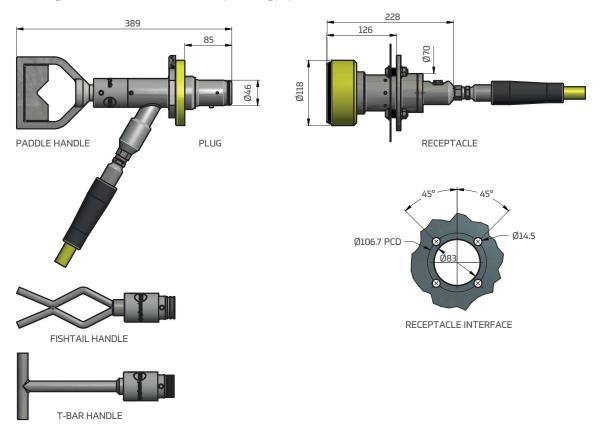




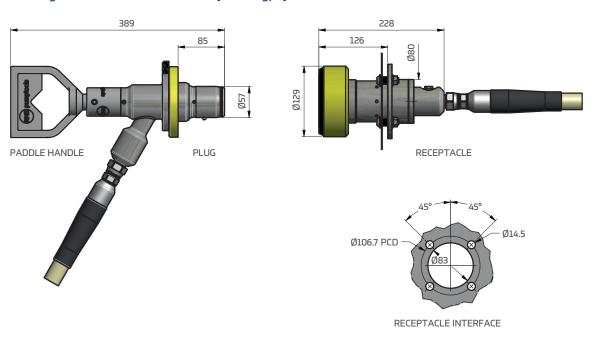
Sea**Connect**™

4/7/12 ROV Wet-Mate Connectors

4/7 Way ROV Wet-Mate Connectors (Hose Type)



4/7 Way ROV Wet-Mate Connectors (Hose Type)





SeaConnectTM 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.

Specifications

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

Materials

316 Stainless Steel or Super Duplex Housing:

Insulation:

Silicone, HNBR, Nitrile Flastomers: Electrical Contacts: Gold Plated Copper

Termination Options

Oil-filled Hose

1/2"NB oil filled hose termination. Pressure compensation hose.

Field Installable Termination Assembly (FITA) Gland

Pressure compensating termination assembly onto cable.

Oil-Filled termination chamber.

Can be terminated in customer facilities.

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 Test

Thermal Vibration Test

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

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

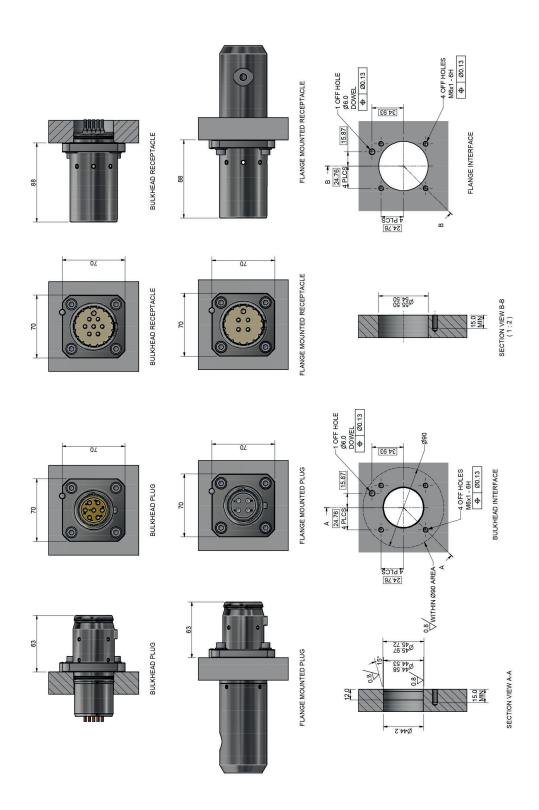






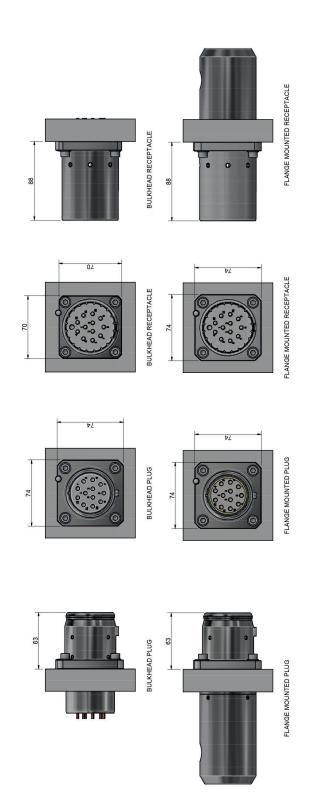
Sea**Connect**™

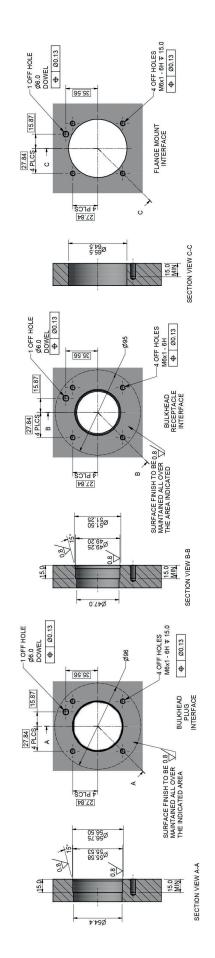
4/7 Way Stab Plate Connector





12 Way Stab Plate Connector







Temperature & Pressure Sensor

The RMSpumptools SeaConnect Temperature & Pressure Sensor performs measurements on completion and production systems in subsea environments to a water depth of 2,500m. 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 or subsea cable

Ring Gasket: BX-151 or BX-152

and 2-239 elastomeric seal

Location of installation: Subsea Tree Valves or at Manifolds

Working Pressure: 0 - 10,000psi
Working Temperature: -10°C - 120°C

Sensor Specification

Pressure

Compensated Temperature: $0-150^{\circ}$ C Calibrated Pressure: 0-10,000psi Resolution: 0.05% FS

Accuracy: ±0.2% FS (Total Error Band)

Long Term Stability: 0.2% FS / year

Temperature

Calibrated Temperature: 0 - 150°C Resolution: 0.05% FS

Accuracy: ±1% FS (Total Error Band)

Electrical Specification

Power Supply: 12-36VDC

Signal Output: 4-20mA current loop

 $\begin{tabular}{ll} The output is made via electrical penetrators \\ Insulation: & 10M\Omega / 50VAC (temperature and pressure) \\ \end{tabular}$

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)

Qualification Testing

Qualified Pressure: 3,800psi

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.

Key Performance 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)





Temperature & Pressure Sensor - CAN Bus

The RMSpumptools SeaConnect™ Temperature & Pressure Sensor performs measurements on completion and production systems in subsea environments to a water depth of 2,500m. 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

API 6BX 1.13/16" 10ksi flange Process Connection:

Electrical Connection: JIC 8 with oil filled hose or subsea cable

Ring Gasket: BX-151 or BX-152

and 2-239 elastomeric seal

Location of installation: Subsea Tree Valves or at Manifolds

Working Pressure: 0 - 10,000psi Working Temperature: -10°C - 120°C

Sensor Specification

Pressure

Compensated Temperature: 0 - 150°C Calibrated Pressure: 0 - 10,000psi Resolution: 0.05% FS

±0.2% FS (Total Error Band) Accuracy: Long Term Stability:

0.2% FS / year

Temperature

0 - 150°C Calibrated Temperature: Resolution: 0.05% FS

Accuracy: ±1% FS (Total Error Band)

Electrical Specification

CANopen (according to SIIS recommended Protocol:

practice and CiA-443) 24 Vdc ±20% (19 to 29 Vdc)

Power Supply: Power Consumption (nominal): < 1 Watt under normal operation

Qualification Testing

Qualified Pressure: 3,800psi

Vibration Test:

Thermal cycling at 4°C, 25°C, 50°C and 60°C with 2 hours on each temperature for 5 days.

12-300Hz at 5g on the 3 axis

Key Performance Features

Reduced Size

40cm total length, from the flush to the JIC

Reduced Weight

15kg. Easy handling and installation

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)



Temperature & Pressure Sensor - RS-485 MODBUS RTU

The RMSpumptools SeaConnect[™] Temperature & Pressure Sensor performs measurements on completion and production systems in subsea environments to a water depth of 2,500m. It is typically used for Subsea Christmas Trees and are mandatory to monitor these variables during production.

Operational Requirements

Design Life:25 yearsRecalibration:10 yearsProcess Connection:On request

Electrical Connection: JIC 8 with oil filled hose or subsea cable

Ring Gasket: On request

Location of installation: Subsea Tree Valves or at Manifolds

Working Pressure: 0 - 10,000psi Working Temperature: $-20^{\circ}\text{C} - 120^{\circ}\text{C}$

Sensor Specification

Pressure

Compensated Temperature: -20°C - 120°C

Calibrated Pressure: 0 - 10,000psi (other ranges on request)

Resolution: 0.001% FS

Accuracy: ±0.025% FS (Total Error Band)

Long Term Stability: 0.1% FS / year

Temperature

Calibrated Temperature: -20°C - 150°C Resolution: 0.05% FS

Accuracy: ±1% FS (Total Error Band)

Electrical Specification

Protocol: RS-485 MODBUS RTU
Power Supply: 24 Vdc ±20% (19 to 29 Vdc)
Power Consumption (nominal): <1 Watt under normal operation

Qualification Testing

Qualified Pressure: 3,800psi

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.

Key Performance Features

Reduced Size

40cm total length, from the flush to the JIC (others on request)

Reduced Weight

15kg. Easy handling and installation

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)





SeaConnectTM Valve Position Sensor

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.



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.







SeaConnectTM Valve Position Sensor

Design Specifications (all models)

Angle of Operation: 0° to 360° (to customer specification) Accuracy: Better than \pm 0.6% (0.4% optional)

Resolution: Better than ± 0.05% Input Voltage: 14 to 28 VDC

Output Current: 4 to 20 mA (normal range)

Update Rate: 3Hz

Operating Temperature: -20°C to 40°C

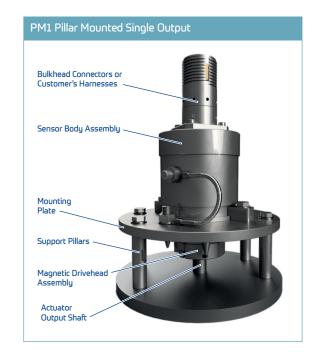
Max. Operating Depth: 1500 metres standard

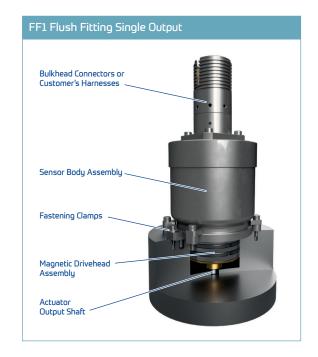
(3000 metres optional)

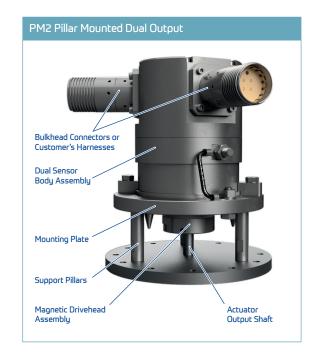
Test Pressure: To Customer Specification

Customer Options

- · Standard or Ultra Deep Water
- · Single or Dual Output
- · Pillar mounted of Flush Fitting design
- Standard or high accuracy (0.6% or 0.4% of full scale deflection)
- Angle of operation programmed to customer specification (up to 360°)
- Clockwise or Counter Clockwise direction of operation
- · Fitted with subsea electrical connector of choice
- Dual Output models fitted with one or two connectors
- Pressure testing to suit customer specifications









Valve Position Sensor - CAN Bus

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 4 wire, CAN Bus 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 CANopen output (according to SIIS recommended practice and CiA-443).

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.







Valve Position Sensor - CAN Bus

Design Specifications (all models)

0° to 360° (to customer specification) Angle of Operation: Accuracu: Better than ± 0.6% (0.4% optional) Resolution: Better than ± 0.05%

Protocol: CANopen (according to SIIS recommended practice and CiA-443)

24 Vdc ±20% (19 to 29 Vdc)

Power Supply: Operating Temperature: -20°C to 40°C

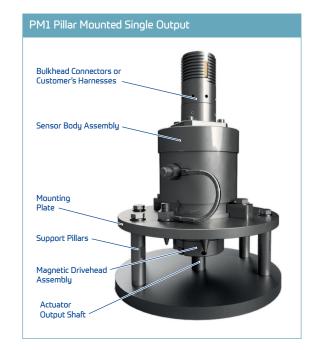
Max. Operating Depth: 1500 metres standard

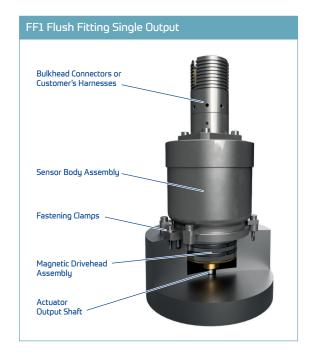
(3000 metres optional)

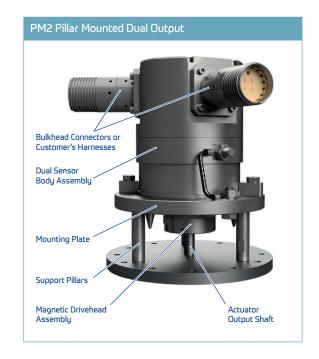
Test Pressure: To Customer Specification

Customer Options

- · Standard or Ultra Deep Water
- Single or Dual Output
- · Pillar mounted of Flush Fitting design
- Standard or high accuracy (0.6% or 0.4% of full scale deflection)
- Angle of operation programmed to customer specification (up to 360°)
- Clockwise or Counter Clockwise direction of operation
- · Fitted with subsea electrical connector of choice
- Dual Output models fitted with one or two connectors
- Pressure testing to suit customer specifications









WellPowerTM 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: -18°C to 150°C (0°F to 302°F)
Storage Temperature Range: -30°C to 40°C (-22°F to 104°F)

Number of Cycles: 100

Mechanical Requirements

 Diameter:
 1.250"

 Length:
 <12.000"</td>

 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

Material Specification

Housing: 316 Stainless Steel, Inconel 625 (nipple)

HS Cupro Nickel Alloy

Contacts: Gold Plated Beryllium Copper

Insulation: PEEK 450G

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

Qualification Testing

Temperature Rise (current)

High Voltage

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

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







WellPowerTM Split-Phase Vertical Electrical Connector V1

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: 10,000 Psi Test Pressure: 15,000 Psi

Working Temperature Range: -18°C to 93°C (0°F to 200°F)
Storage Temperature Range: -30°C to 40°C (-22°F to 104°F)

Number of Cycles: 100

Mechanical Requirements

 Diameter:
 1.250"

 Length:
 <12.000"</td>

 Stack up Tolerance:
 ± 0.25"

Electrical Specification

 Rated Voltage:
 2.89 / 5.0 kVAC (Uo/U)

 Breakdown Voltage:
 > 8Uo (23.1 kV)

 Ampacity:
 150 A

 Frequency Range:
 30 - 85 HZ

Material Specification

Housing: 316 Stainless Steel, Inconel 625 (nipple)

HS Cupro Nickel Alloy

Contacts: Gold Plated Beryllium Copper

Insulation: PEEK 450G

Design Philosophy

Main Dielectric Filled Body: Pressure Balanced

Sealing: Dual Electrical and Mechanical Barriers

Electrical insulation Primary: Thermoplastic or Elastomer

Cable

Various Cable Options

Lower Connector Pressure Barrier

Qualification TestingStandard Electrical Integrity Tests

High Voltage

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)

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







Well**Power**TM

Split-Phase Vertical Electrical Connector V2

The High Pressure ESP connector system is used in Subsea Tree, TH, THRT & Downhole environments and consists of three single phase Wet-Mate Power Connectors spaced around the production bore. The female Plug Connector halves are in the upper retrievable section, while the male Receptacle 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: 10,000 Psi
Test Pressure: 15,000 Psi
Design Pressure: 19,500 Psi

Working Temperature Range: -18°C to 93°C (0°F to 200°F)
Storage Temperature Range: -30°C to 40°C (-22°F to 104°F)

Number of Cycles:

Mechanical Requirements

Plug
Diameter: 1.250" (Front Body)
Rear to suit application

Length: To suit application

Receptacle

Diameter: 1.653" (Lock Nut)

1.250" (Body in TH) 13.850"

 Length:
 13.850"

 Lock Nut Thread:
 1.5"-20 UN 2A

 Stack-up Tolerance:
 ± 0.25"

 Misalignment Tolerance:
 ± 0.012"

Electrical Specification

 Rated Voltage:
 2.89 / 5.0 kVAC (Uo/U)

 Breakdown Voltage:
 > 8Uo (23.1 kV)

 Ampacity:
 150 A

 Frequency Range:
 30 - 85 HZ

Material Specification

Housing: 316 Stainless Steel, Inconel 625 (nipple)

HS Cupro Nickel Alloy

Contacts: Gold Plated Beryllium Copper

Insulation: PEEK 450G

Design Philosophy

Main Dielectric Filled Body: Pressure Balanced

Sealing: Dual Electrical and Mechanical Barriers

Electrical Insulation Primary: Thermoplastic or Elastomer Lower Connector Pressure Barrier

Qualification Testing

Standard Electrical Integrity Tests
Dry Mated Test
Mains Water Mate / Demate Curle

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 Vibration

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







Well**Power**TM

Diver-Mate Single Mandrel

The 3-Phase Diver-Mate Connector System is used in Subsea Tree, TH, THRT & Downhole environments and consists of two connectors, a Male Plug Connector as the termination of the EFL and a Female Receptacle Connector for connection to the Tree. The connectors provide a 3 phase wet-mateable connection held together by diver installed locknut connection. Each connector contains three WellPower Split-Phase Connectors providing a reliable long-term electrical connection which can be mated and de-mated as required. The EFL is protected within an oil-filled pressure compensated hose.





Operational Requirements

Design Life: Rated Pressure: Connector Test Pressure: Connector Design Pressure: Working Temperature Range: Storage Temperature Range: Number of Cycles:

Permanently Installed Connector 10 years 5,000 Psi (3,500m) 7.500 Psi 9,000 Psi -18°C to 93°C (0°F to 200°F) -30°C to 40°C (-22°F to 104°F)

Mechanical Requirements

Diver-Mate Plug

Diameter: Length: Hose Length:

Diver-Mate Receptacle Diameter:

Length: Bolt Circle: 122mm (Lock Nut) 610mm (Connector Body) To suit application

145mm (Mounting Flange)

6 x M8 on 125mm PCD

Electrical Specification (3 Individual Phase Connectors)

Rated Voltage: 2.89 / 5.0 kVAC (Uo/U) Breakdown Voltage: > 8Uo (23.1 kV) Ampacity: 150 A Frequency Range: 30 - 85 HZ

Material Specification

Body

Housing: Lock Nuts:

316 Stainless Steel HS Cupro Nickel Alloy

Connectors

Contacts:

Housing: 316 Stainless Steel, Inconel 625 (nipple),

HS Cupro Nickel Allou

Gold Plated Beryllium Copper

Insulation: PEEK 450G Design Philosophy

Main Dielectric Filled Body: Sealing: Electrical Insulation Primary:

Pressure Balanced Dual Electrical and Mechanical Barriers Thermoplastic or Elastomer Lower Connector Pressure Barrier

Contained within oil-filled pressure compensated hose Various Cable Options

Qualification Testing (Phase Connectors)

Standard Electrical Integrity Tests

Dru 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 Cucle Test Simulated Environment Material Compatibility Test

Rapid Mate / Demate Cycle Test Temperature Rise (current)

High Voltage Vibration

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



WellPowerTM Junction Box

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 (32°F to 302°F) Storage Temperature Range: -30°C to 40°C (-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

Material Specification

Housing: 316 Stainless Steel

Duplex Stainless Steel (2205)
Contacts: Gold Plated Beryllium Copper

Insulation: PEEK 450G

Design Philosophy

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

Cable

Various Cable Options

Qualification Testing

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

Key Performance Features

Provides 180° 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





Ocean**Power**TM 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: 1,500 psi
Test Pressure: 7,500 psi
Design Pressure: 9,000 psi

Working Temperature Range: 0°C to 120°C (32°F to 300°F)
Storage Temperature Range: -30°C to 40°C (-22°F to 104°F)

Number of Cycles: 100

Mechanical Requirements

 Diameter:
 1.250"

 Length:
 <12.000"</td>

 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

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

etallic Material Specification: Norsok M710 H2S Levels Norsok M710 compliant

CO2 Levels Norsok M710 compliant

Design Philosophy

Main Dielectric Filled Body: Pressure Balanced

Sealing: Dual Electrical and Mechanical Barriers

Electrical insulation Primary: Thermoplastic or Elastomer

Cable

Various Types

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

Key Performance Features

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





Ocean PowerTM 10kV dc Single Phase System

The RMSpumptools 10kV dc Single Phase System consists of two Wet-Mate Connectors mounted on a Stab Plate system. Both Wet-Mate Connectors are terminated by Pressure Balanced Oil-Fill (PBOF) Hoses and cable to identical Penetrators which are mounted to the customer's Pressure Vessels (PV) with cable terminated to their equipment. The female (Wet-Mate Plug) Connector is mounted to the Upper (retrievable) Stab Plate via a Compliant Mount. The male (Wet-Mate Receptacle) Connector is mounted to the Lower Stab Plate and remains permanently installed.

Operational Requirements

Design Life: Rated Pressure: Working Temperature Range: Storage Temperature Range: Deployment Water Depth:

4,500 Psi (3,000m depth pressure) 0°C to 149°C (32°F to 300°F) -30°C to 40°C (-22°F to 104°F)

Mechanical Requirements

Sealing:

Interface Drawings: Max Misalignment (x & y axis): Max Angular Misalignment (x & y axis):

Metallic Primary and Elastomeric Backup or Dual Elastomeric

As per drawings 247-36-021, 022, 023 + 3mm

± 10

Electrical Specification

Insulative Resistance:

Rated Voltage U: 10 kV dc Maximum Voltage: 10 kV dc Maximum Working Current: ~20 A

Maximum Contact Resistance: ≤ 2.5 mohms (per contact, less conductor

& cable resistance) ≥ 10 Gohms @ 20°C

Chemical/Corrosion Considerations

External Environment Media: PV1 Internal Environment Media: PV2 Internal Environment Media: Stab Plate / PV Material: Stab Plate / PV Fixings:

Seawater Nitrogen Gas at latm Silicon Dielectric Oil at latm Titanium

Titanium size M8 (Customer supply)

Material Specification

Stainless Steel (Superduplex) Housing:

HS Cupronickel Alloy

Gold Plated Beryllium Copper / Copper Silver

PEEK 450G, Silicon Rubber

Dielectric Oil: Midel 7131

3/4" ID with 2507 JIC Fittings Hoses. Elastomers: HNBR/FKM or equivalent

Design Philosophy

Elastomeric Seals and Mechanical Barrier Seal Philosophy: Electrical Insulation: Thermoplastic or Elastomer2507

Contacts:

Insulation:

Wet-Mate Connector to Penetrator: 1 x 16mm² 13.8/15kV Class 5 Conductors Penetrator to PV Termination:

1 x PTFF Cable

Testing

Factory Acceptance Test (FAT) Qualification Testing





Ocean **Power**TM **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 1500 osi

Rated Pressure: -20°C to 60°C (-4°F to 140°F) Working Temperature Range: Storage Temperature Range: -30°C to 40°C (-22°F to 104°F)

Mechanical Requirements

Option 1 Bore Sealing: Flange:

Option 2 Bore Sealing: Flange:

Envelope Diameter:

Electrical Specification

Number of Contacts: Contact Method: Working Voltage: Test Voltage (to Earth):

Ampacity: Frequency Range:

Material Specification

Housing: Insulation:

Design Philosophy

IEC:

Cable and Hose

Siwo-kul 35mm² Cable Goodyear Gorilla Hose via Hose Fittings Connection Oil-filled & Pressure Balanced Other Cables & Hoses are available

Qualification Testing

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

Key Performance Features

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

Ø76.5mm = 50sqmm Cable Ø130mm = 50sqmm Cable

Ø82.7mm = 70sqmm Cable Ø130mm = 70sgmm Cable As per Customer Specification

Crimped Terminations 3.6/6(7.2) kV

250 A (cable limiting factor)

SS 316 / High Strength CuproNickel

60502-2, 60502-4, 60228





Ocean**Power**TM 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 (-4°F to 140°F)
Storage Temperature Range: -30°C to 40°C (-22°F to 104°F)

Mechanical Requirements

Profile: <90mm

Envelope Diameter: As per Customer Specification

Electrical Specification

Number of Contacts:

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

Material Specification

Housing: SS 316 / High Strength CuproNickel

Insulation: PEEK, EPDM

Design Philosophy

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

Qualification Testing

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

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







Ocean**Power**TM V1 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: -20°C to 45°C (-4°F to 113°F)
Storage Temperature Range: -30°C to 40°C (-22°F to 104°F)

Mechanical Requirements

Fully Compliant Mounting System

 $\begin{array}{ll} \mbox{Misalignment Limits:} & \mbox{Radial +/- 3mm, Angular +/- } 1^{o} \\ \mbox{Envelope Diameter:} & \mbox{As per Customer Specification} \end{array}$

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

Material Specification

Housing: SAF / High Strength CuproNickel

Insulation: PEEK

Design Philosophy

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

Testing

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

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



