

# SEACON<sup>®</sup>

UNDERWATER ELECTRICAL AND FIBER OPTIC CONNECTORS



## DOWNHOLE

UNDERWATER ELECTRICAL, OPTICAL & HYBRID CONNECTORS

## PRODUCT DATASHEET

### **G3** OPTICAL WET-MATE CONNECTOR



*New G3 Optical Wet-Mate Connector*

#### DESCRIPTION

One of **SEA CON**®'s latest fiber optic developments is the **G3** optical wet-mate connector. Manufactured by **SEA CON** Advanced Products, LLC in Bellville, Texas, this new, third generation connector utilizes existing **HYDRALIGHT** technology and is available in 6 channels with either single-mode or multi-mode optical fibers. The **G3** offers low profile optical connectivity combined with simplicity of operation and is ideally suited for tight interfaces requiring low loss optical performance. This connector can incorporate flat or angle polished contacts making it ideal for either signal communication systems or optical measurement and sensing systems such as tubing hanger connections, tree connections, riser monitoring systems and life of field seismic systems (LoFS).

#### KEY FEATURES

- Very small form factor, with low loss optical performance
- Matched pairs not required
- Internal pressure compensated
- 15,000 psi, 150°C operating
- Footprint < 1.5 x 0.875"
- 6 channels, single-mode or multi-mode
- Few internal moving parts
- Simplicity of operation
- Elastomers suited for harsh chemical environments
- Patented "Joined Chamber" concept
- Suitable for ROV, Diver, or Stab Plate operation

#### QUALITY

- **SEA CON** Advanced Products, LLC operate a Quality Management System certified to ISO 9001:2008.



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**G3**

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## PRODUCT DATASHEET

# HIGH PRESSURE, HIGH TEMPERATURE (HPHT) DOWN-HOLE, DRY-MATE CONNECTOR SERIES



*HPHT down-hole connector series*

### KEY FEATURES

- Over 70 units sold
- Optical, Electrical and Hybrid (electro/optical) versions available
- 2-channel optical only version
- 2-channel electrical only version
- 4-channel hybrid (2 optical, 2 electrical)
- Maximum operating pressure: 10,000psi
- Maximum operating temperature: +125°C
- Primary metal-to-metal sealing
- Inconel® 625 body material
- All less than 1" in diameter
- 1/4" OD, 10,000psi WP 316LSS tube
- Field installable termination
- Linear splice box to facilitate field installation
- Maximum optical attenuation: 0.3dB
- Maximum optical back-reflection: -50dB
- Maximum voltage: 600 VAC
- Maximum current: 2.5 amps

### DESIGN RATINGS

- Design life: 25 years
- Maximum operating pressure: 10,000 psi
- Maximum test pressure: 16,500 psi
- Minimum operating temperature: 0°C
- Maximum operating temperature: +125°C
- Minimum storage temperature: -40°C
- Maximum storage temperature: +85°C
- Maximum optical attenuation: 0.3dB
- Maximum back reflection: -50dB
- Maximum voltage: 600 VAC
- Maximum test voltage: 2,500 VDC
- Maximum current: 2.5 amps

### QUALITY

- **SEACON** Advanced Products, LLC operate a Quality Management System certified to ISO 9001:2008.



Certificate No. 6936

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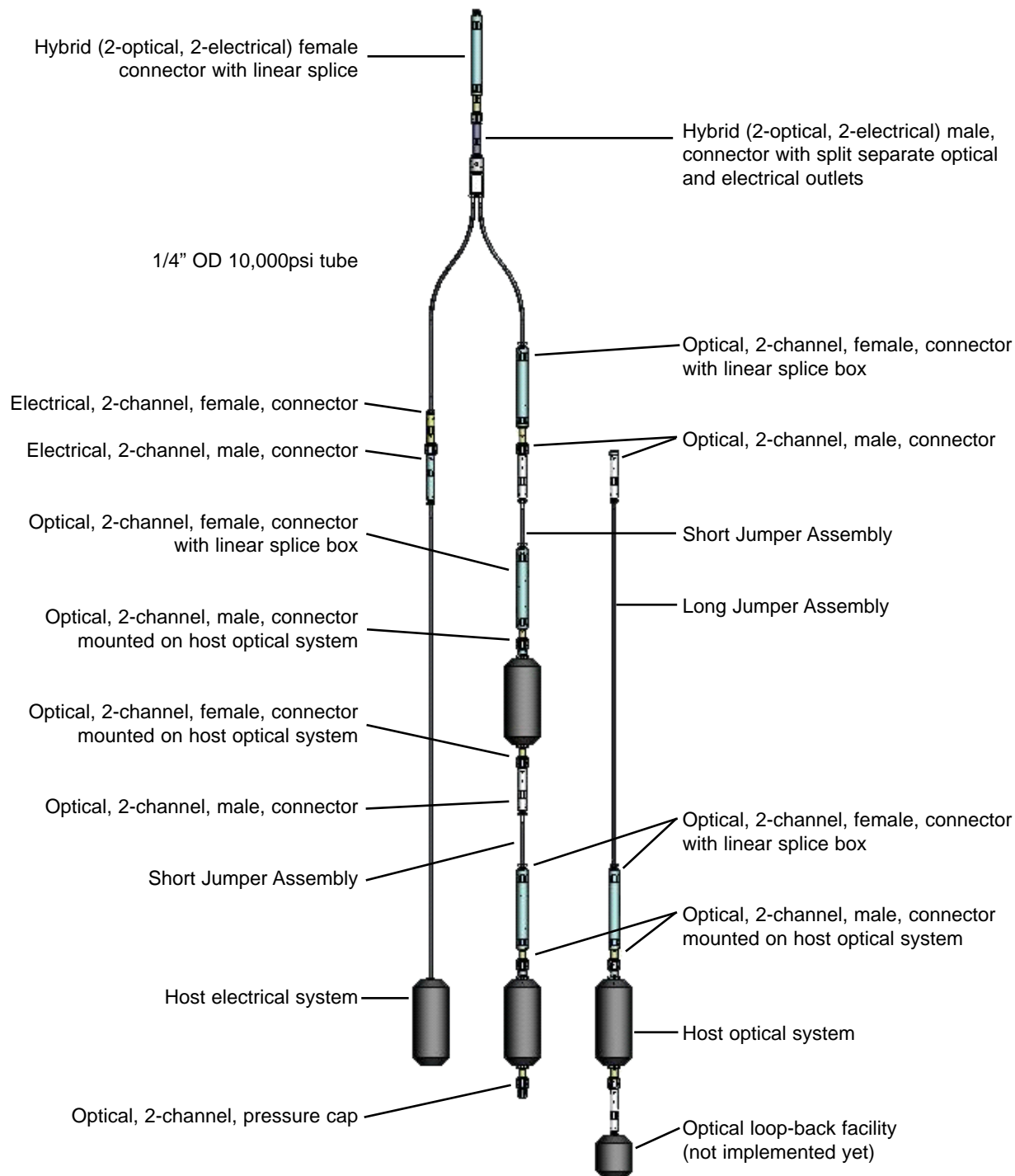
HPHT

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## PRODUCT DATASHEET

### TYPICAL SYSTEM LAYOUT



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## PRODUCT DATASHEET

### CONNECTOR CONFIGURATIONS

The list of connectors configurations are as follows:

#### Hybrid - 2 Electrical and 2 Optical Channels

- 7938-101 - HPHT, hybrid, 2E, 2F, down-hole, male connector with split separate optical and electrical outlets
- 7938-102 - HPHT, hybrid, 2E, 2F, down-hole female connectors with pressure barrier and linear splice box

#### Optical Connectors - 2 channel

- 7936-101 - HPHT, 2-channel, optical, bulkhead mounted, down-hole, male connector, with pressure barrier
- 7936-102 - HPHT, 2-channel, optical, bulkhead mounted, down-hole female connector with pressure barrier
- 7936-103 - HPHT, 2-channel, optical, down-hole, male in-line connector
- 7936-104 - HPHT, 2-channel, optical, down-hole female in-line connector with linear splice box
- 7938-105 - HPHT, 2-channel, optical, down-hole, male pressure cap (for female connector)
- 7938-106 - HPHT, 2-channel, optical, down-hole female in-line connectors with pressure barrier and linear splice box

#### Hybrid - 2 Electrical and 2 Optical Channels

- 7937-101 - HPHT, 2-channel, electrical, down-hole, female connector with glass-to-metal seal pressure barrier
- 7937-102 - HPHT, 2-channel, electrical, down-hole male connector with glass-to-metal seal pressure barrier

### FIELD MAINTENANCE

- The HPHT Connectors are designed for field installation and maintenance
- The Linear Splice Box is a unique feature designed to facilitate the final optical fiber length adjustment required for field installation
- Connectors are design for rear-termination of fiber, wires and tube
- Primary seals are metal-to-metal that can be easily energized on site

### BENCH & PRODUCTION TESTING SUMMARY

- Optical insertion loss
- Optical back-reflection
- Electrical insulation resistance
- Electrical continuity
- Shell continuity
- Proof voltage test, 2000 VDC for 5 minutes
- Production Hyperbaric 10,000 psi (as required)

## PRODUCT DATASHEET

### QUALIFICATION TESTING SUMMARY

- Pressure Testing - 15,000 psi, 5-cycles and 1 hour hold, Optical and electrical performance monitored during test
- Optical insertion loss and back-reflection
- Electrical insulation resistance and contact resistance
- Proof voltage
- Shock (single axis)
  - 3 shocks in a horizontal direction
  - 3 shocks in a vertical direction
  - Shock profile is a half-sine period of 11ms at 30g.
- Vibration (3-axis) - Vibrate in x-axis, y-axis and z-axis, vibration profile:
  - A double sweep from 5 Hz to 150 Hz and back to 5 Hz
  - 5 Hz to 25 Hz:  $\pm 2$ mm displacement
  - 25 Hz to 150 Hz: 5g acceleration
  - Sweep rate maximum 1 octave/minute
  - Optical and electrical performance monitoring during the vibration and verified after completion of the vibration
- High-temperature testing
  - 2 weeks at 125°C and then 5-cycles between ambient, monitoring optical and electrical performance
- Low-temperature testing
  - 20°C to ambient, verify functioning afterwards
- Outside 50-mate test, monitoring optical and electrical performance to monitor degradation

### TRACK RECORD & RELIABILITY DATA

Connectors have been delivered to customers but the operational sample population is still too small to extrapolate any significant statistical data for reliability.

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## PRODUCT DATASHEET

# CM2001

## HIGH INTEGRITY, SINGLE PIN, WET-MATE, ELECTRICAL CONNECTOR



CM2001/2mm single pin connector set

### DESCRIPTION

The **CM2001** is a very small, single pin underwater mateable electrical connector which is a simple yet robust design with very few moving parts. It is designed for high pressure applications and is available in a high temperature version.

### KEY FEATURES

- Very small single pin connector
  - Diameter: Less than 1" (25mm)
  - Receptacle length: Less than 3" (75mm)
  - Plug length: Less than 2.7" (69mm)
- CM2000 series of connectors have:
  - A field proven track record of over 20 million accumulated operating hours
  - Mean Time Between Failure (MTBF) of better than 4.4 million hours
- Oil-filled pressure balanced socket contacts
- Extensive qualification testing data available
- Successful completion of long-term testing (3 years) by an independent body
- Voltage rating to 1,000 VAC
- Current rating to 10 amps
- Rated to 23,000 feet (7,000m)
- Simple and robust with few moving parts
- Redundant sealing barriers for contacts
- No single point failures
- Wide operational temperature rating to +65°C (+149°F)
- Elastomers have over 20 years of use underwater
- Alternative range of terminations available

### QUALITY

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## PRODUCT DATASHEET

### CONFIGURATIONS

- Stab configuration as standard
- Diver or ROV configurations available
- Ø2mm electrical contact size
- Oil filled pressure balanced socket contacts
- Redundant sealing barriers for each contact
- Terminations:
  - Oil-filled
  - Molded cable
  - Customer specific
- Easily configured into many different configurations:
  - Flying lead
  - Bulkhead mounted, flange mounted
  - Straight terminations, 90° terminations
  - Omnitec MKII interface
  - Molded terminations
  - Parking places
  - Long-term protective caps
  - Short-term protective caps

### DESIGN RATINGS

- Ø2mm contacts: 1,000 VAC, 10 amps
- Depth Rating: Ø2mm contact is an ultra-deepwater configuration, rated to 690 bar (10,000psi), equates to over 7,000m (23,000 feet)
- Socket contacts never see the outside environment, always contained in dual nested oil-filled bladders
- Design life: 25 years
- Minimum Life-Cycle: 100 mate/de-mates
- Maintenance-free over design life (within number of mate/de-mate cycles)
- Operating Temperature: -5°C to +65°C (23°F to +149°F)
- Storage Temperature: -20°C to +65°C (-4°F to +149°F)

### OPERATION

- Typical mate force: 3 to 6 lbs (1.36 to 2.72kg)
- De-mate force: 25% of mating force
- Force to maintain: 0 lbs
- Typical mating stroke length: 1.7" (43mm)
- Maximum angular misalignment: 0.5°
- Maximum axial separation: 2.5mm (0.1 inches)

### MATERIALS

- Housing of choice: Titanium, 17-4 PH, Nitronic 50, Inconel, Ferralium, 316, Al Ni Bronze, Beryllium copper and PEEK)
- Insulator: PEEK
- Compensation bladders: Natural rubber (Alternative elastomers available for special fluid compatibility requirements)
- O-rings: Nitrile

### TRACK RECORD AND RELIABILITY DATA

- Deepest recorded actual operating depth to 15,420 feet (4,700m)
- The CM2000's currently in service have now reached accumulated operating hours in excess of 26 million hours with a Mean Time Between Failure of better than 6.1 million hours

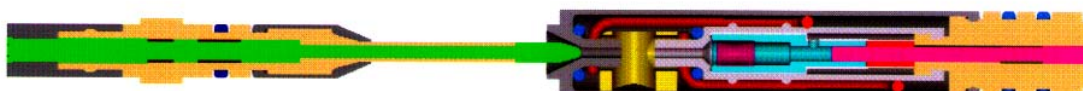


## PRODUCT DATASHEET

### PRINCIPLE OF OPERATION

The critical electrical contact is made without exposure to external contamination in a harsh subsea environment. This is achieved as described by the following mating sequence:

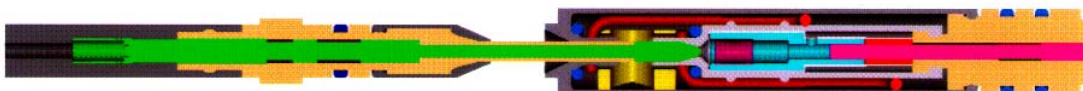
Step 1: The contact pin enters the outer bladder entry of the receptacle contact.



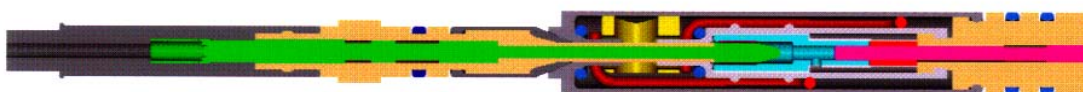
Step 2: The contact pin is wiped and bathed in dielectric fluid as the entry throat maintains a force around the pin ensuring a secure seal.



Step 3: The contact pin continues and enters a second inner bladder entry and is wiped and bathed in dielectric fluid again.



Step 4: The pin engages with the mating socket within the dielectric filled inner bladder enclosure.



Mated Contact: During and after the mating activity, two seals are created and maintained around the pin contact within the oil-filled and pressure-compensated bladders

### QUALIFICATION TESTING

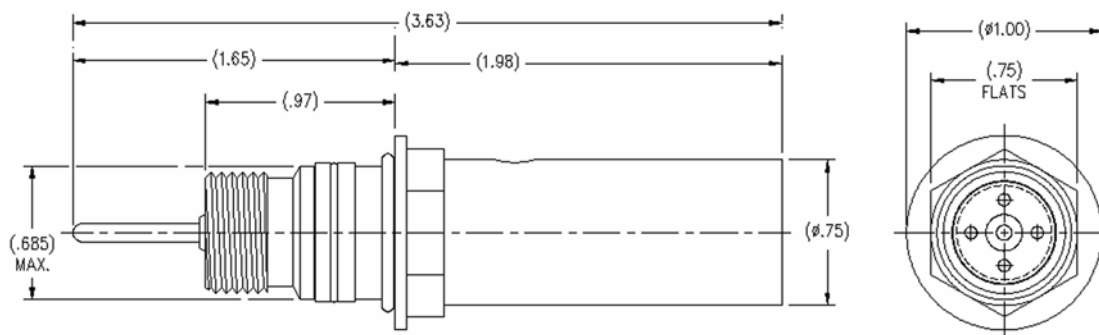
In addition to the full range of testing highlighted in **SEA CON**® document SC-ENG-1011. The following was specifically additionally completed for the **CM2001** / 2mm connector:

- Deepwater Testing - Performed by **SEA CON**® - Mated connector to 10,000 psi (690 bar), open face to 10,000 psi (690 bar)

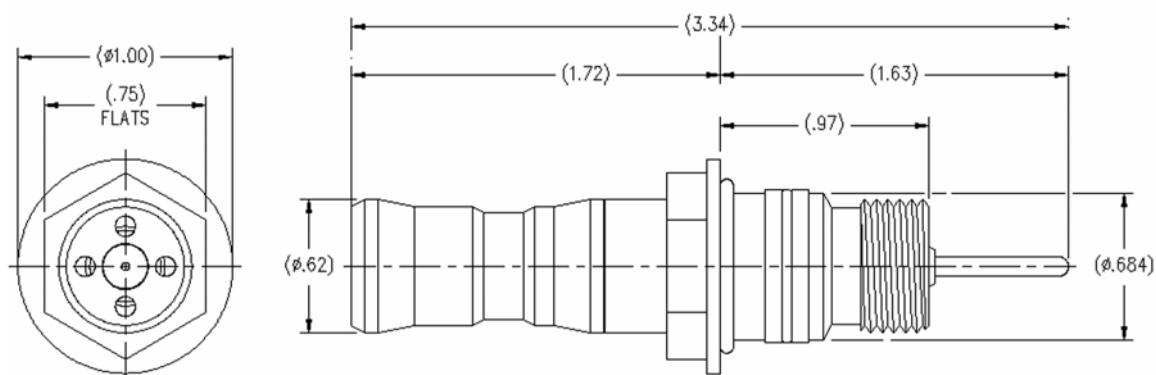
## PRODUCT DATASHEET

### KEY INTERFACE DIMENSIONS

#### CM2001 / 2mm Receptacle (with pin) (Dimensions are in inches)



#### CM2001 / 2mm Plug (with socket) (Dimensions are in inches)



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## PRODUCT DATASHEET

# MICROSTAR

## 4-CHANNEL, WET-MATE, OPTICAL CONNECTOR

(CURRENTLY UNDER DEVELOPMENT)



*MICROSTAR plug and receptacle*

### DESCRIPTION

The **MICROSTAR** is a slimline (<1.8" diameter) underwater mateable, high integrity, fiber optic connector. It is a 4 channel device that facilitates underwater connection of optical fibers. The principle of operation is exactly the same as the successful **HYDRASTAR** and **HYDRALIGHT** series of wetmate optical connectors but it is smaller in size and has a number of additional features.

### KEY FEATURES

- Modular optical contacts up to 4 channels
- Field proven sealing mechanisms
- Oil filled and pressure balanced
- Optical coupling within "joined chamber"
- Slim-line less than 1.8" in diameter
- Seawater compatible internals
- Sealing mechanisms developed from field proven **HYDRASTAR** & **HYDRALIGHT** optical wet-mate products
- 2nd-Generation optical wet-mate connector
- Insertion loss of better than -0.5dB
- Back reflection of better than -30dB
- Design to +121°C (+250°F)
- Rated to 690 bar (10,000 psi)
- Interface drawing, bulkhead plug connector, drawing number 7849-101
- Interface drawing, bulkhead receptacle connector, drawing number 7850-101

### CONFIGURATIONS

- Initially designed for "tubing hanger / master valve block" interface associated with a conventional subsea-tree
- Plug and Receptacle configurations:
  - Bulkhead mounted
  - Stab-plate interface
  - Straight terminations
- Modular contacts with up to 4 optical channels
- Oil-filled and pressure balanced
- Suitable for any type of optical fiber
- Terminations:
  - Standard compression fittings
  - Customer specific

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## PRODUCT DATASHEET

### DESIGN RATINGS

- Design life: 25 years
- Maximum Life-Cycle: 25 mate/de-mate cycles
- Maintenance-free over design life (within number of mate/de-mate cycles)
- Insertion loss of better than -0.5dB
- Back reflection of better than -30dB
- To be qualified to 7,000m (23,000 feet)
- Operating Temperature: -5°C to +121°C (23°F to +250°F)

### OPERATION

- Linear stab-plate interface
- Maximum mate/de-mate speed: TBA
- Typical mate force: TBA Kg
- Typical mate stroke length: TBA mm
- Maximum rotational misalignment: TBA°
- Maximum angular misalignment: TBA°
- Maximum radial misalignment: TBA mm

### MATERIALS

- Seawater-wetted parts: Super Duplex Stainless Steel (NACE MR0175)
- Elastomeric seals, O-rings: A compound of Hydrogenated Nitrile (HNBR)
- Pressure compensation fluid: Synthetic oil

### RECOMMENDED QUALIFICATION TESTING

- Optical Tests - Optical Attenuation, Optical Back-Reflection
- Mechanical Tests - Helium Leak, Mating Force, Mating Force (misalignment)
- Hyperbaric testing and pressure cycling
- Elevated temperature testing
- Host system interface testing
- Environmental Stress Screening - shock and vibration

### PRINCIPLE OF OPERATION

The critical fiber-to-fiber joint is made without exposure to the external contamination of a harsh subsea environment. This is achieved as both ends of the optical termination are protected from seawater, sand and silt by being enclosed within separate oil-filled and pressure compensated chambers.

### TRACK RECORD & RELIABILITY DATA

The **MICROSTAR** Optical Connector Systems are currently being developed and qualified for use.

### QUALITY

- **SEACON** Advanced Products, LLC operate a Quality Management System certified to ISO 9001:2008.



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## PRODUCT DATASHEET

# 4 CHANNEL DRY-MATE FIBRE OPTIC CONNECTOR



*4 Channel Dry-Mate Fibre Optic Connector*

## DESCRIPTION

Small compact connector originally designed and developed for the demanding downhole environment. The materials and design chosen are specific for these arduous conditions. The compact nature of this connector lends itself to many applications where overall size needs to be kept to a minimum.

## KEY FEATURES

- Based around proven optical connector designs
- Small in size (see following drawings)
- Wide temperature rating
- Single or multi-mode fibre accommodated
- Available in different materials and terminations to suit the requirement
- Dual "O" seals
- Field installable (in certain environments)

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### DESIGN SPECIFICATION

- Max Working Pressure: 10,000 psi (mated)
- Temperature Rating: -20 to +150°C (-4 to +300°F)
- Optical Insertion Loss: <0.5db typically <0.3 db single or multi-mode
- Typical Optical Return Loss: <-25 db

### MATERIALS

- Connector Shell: Titanium or 17-4 PH (Alternatives available to meet different specifications and/or special fluid compatibility requirements)
- Elastomer: Nitrile (Alternatives available to meet different specifications and/or special fluid compatibility requirements)

### CONFIGURATION

- Bulkhead mounted receptacle
- Flange mounted receptacle
- PBOF
- Over mouldable backshell
- Right Angle

### INTERFACE DATA

- For customer specific requirements and specific interface detail contact **SEACON** (europe) Ltd
- Examples shown on the following drawings

### QUALITY

- **SEACON** (europe) Ltd operate a Quality Management System accredited to ISO 9001.



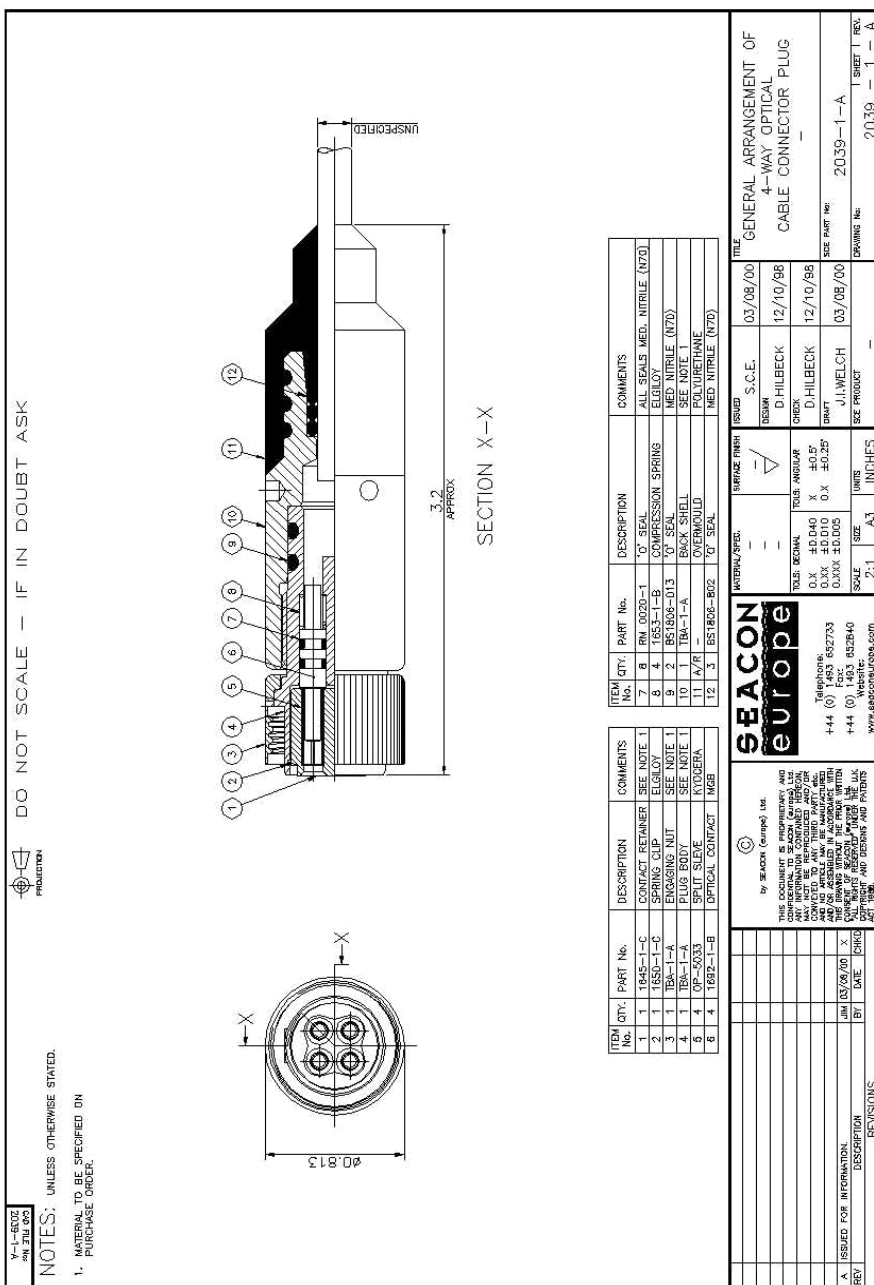
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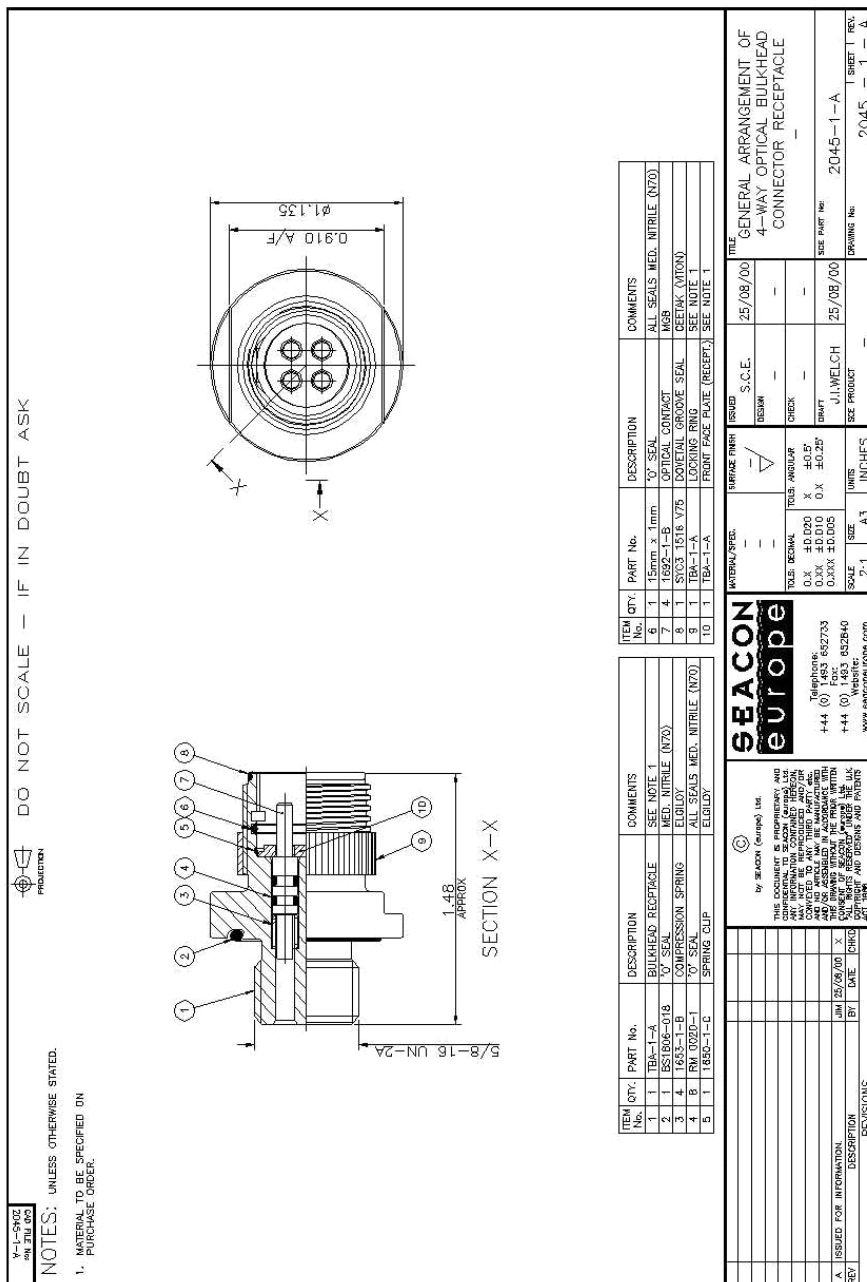
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August 2004

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## PRODUCT DATASHEET

VITON® SERIES  
CONNECTOR

VS-8#22-ILMP-FI &amp; VS-8#22-ILFS-FI

## DESCRIPTION

This 8 way connector pair was designed for a wire line tool which is fitted within an arm leading to a sensing pad. This meant that when the tool was retrieved the sensing pad could be changed out quickly and easily without tooling or special training. As the connector would directly see wellbore fluids at high pressures and temperatures the connector is moulded in VITON®. The cable has an outer jacket of ETFE so a booting technique has been used to seal to the cable jacket. This gives the benefit that the free half connectors are field installable, but soldering is required.

The connection philosophy is based around our standard WET-CON connector range. The pin contact has a sealing diameter and when this is connected into the socket bore two integrally moulded o-rings impinge onto this diameter. This means that there are two o-ring seals between contact and earth and four o-ring seals between different contacts. As there are no pressure differentials in the design the connector pair are pressure tolerant.

## KEY FEATURES

- High temperature rating
- High pressure rating
- Excellent electrical properties
- Eight electrical contacts
- Harsh environment compatible
- Positive external grip for disconnection
- Small size and weight
- Field installable free halves
- Push-on pull-off design (sealing retention retains connectors)
- Keying achieved by contact face pattern
- Wet mateable

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### DESIGN SPECIFICATION

- Max working pressure: 1380 bar (20,000 psi) mated or unmated
- Max continuous working temperature: +200°C (392°F)
- Min continuous working temperature: -17°C (1.4°F)
- Min storage temperature: -40°C (-40°F)
- Voltage: 600 VDC/440 VAC
- Current (max): 2.5 amps

### MATERIALS

- Pin & socket contact: 22AWG Copper alloy, Gold plated. Socket incorporates a Multilam™ for positive electrical contact
- Connector body: Moulded in 100% DuPont VITON® fluoroelastomer grade 'A'. It has a continuous temperature rating of -17°C to 250°C (1.4°F to 482°F)
- Cable: Raychem Spec 55. 22AWG with cross linked ETFE polymer jacket. It has a continuous temperature rating of -65°C to 200°C (149°F to 392°F) and short periods at 400°C (752°F) and combines the easy handling of a flexible wire with excellent scrape, abrasion and cut through characteristics
- Solder: High temperature solder is used to solder the wire to the contact

### CONFIGURATION

- See Page 3

### QUALIFICATION

- A pair of connectors has successfully been laboratory tested to 1725 bar (25,000 psi) and 200°C (392°F)
- A pair of connectors has successfully been installed in a wire line tool within a test well at a depth of 360m (1,200 ft)

### QUALITY

- SEACON (europe) Ltd operate a Quality Management System accredited to ISO 9001.



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## PRODUCT DATASHEET

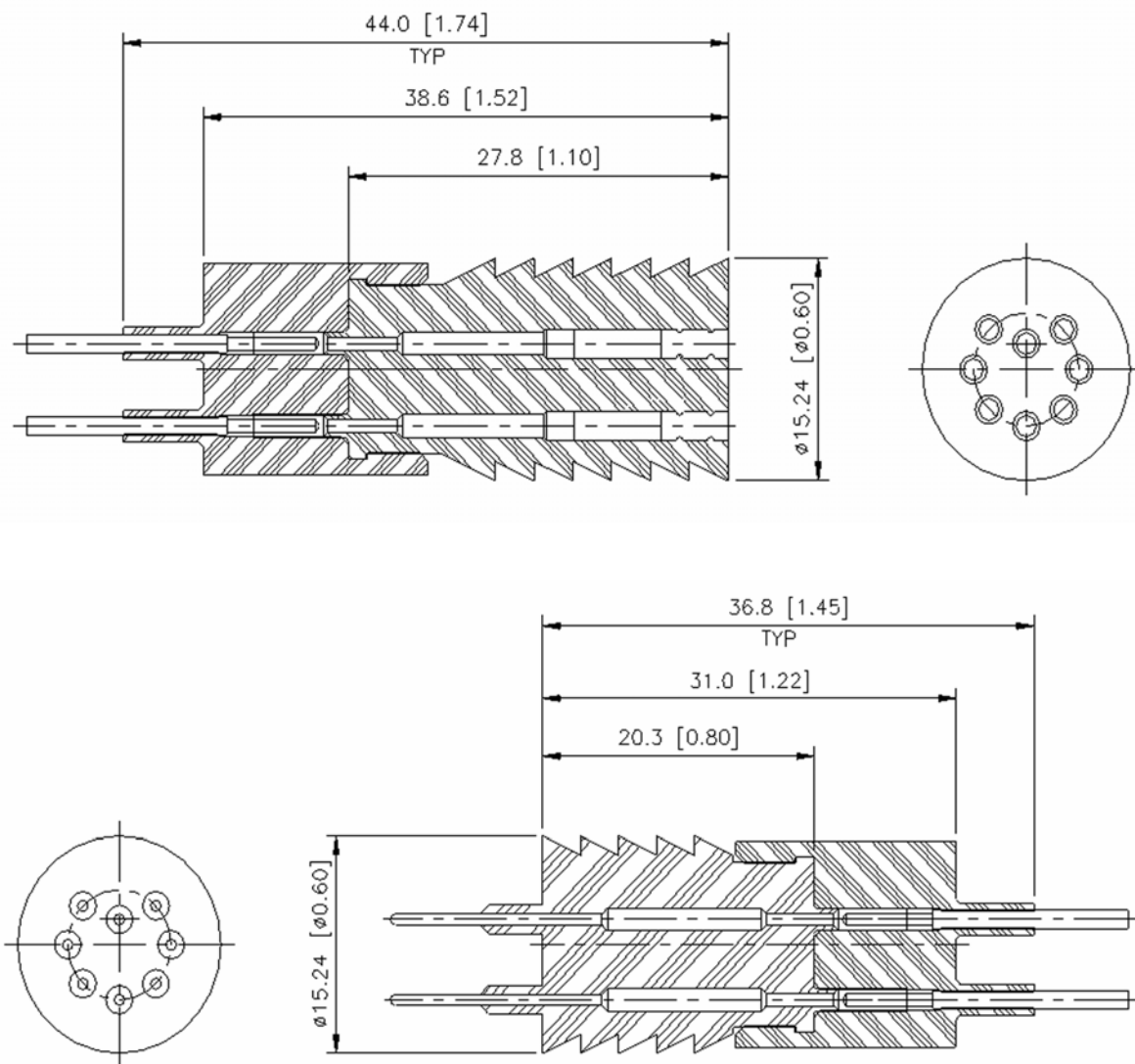


Figure 2 - VS-8#22-ILFS-FI & VS-8#22-ILMP-FI

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