Controls and Communications Connectors
Diamould electrical connectors
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The controls and communications connector range in our portfolio of Diamould* electrical connectors satisfies the increasing demands from the subsea industry to provide a highly reliable subsea connection system for subsea controls, distribution, and instrumentation applications. There are multiple product variants within the range that are configurable to suit differing subsea distribution and subsea production system architectures. The portfolio offers all of the functionality expected of an industry standard product but with unique technical differentiation and many additional benefits. Applications include
- umbilical termination to ROV distribution electrical flying leads (EFLs)
- equipment-mounted bulkhead ROV systems
- subsea control module (SCM) to mounting base sensor junction box harness systems
- diver mate and ROV instrumented equipment.

Field-tested subsea connector expertise
The technology principles for the product portfolio have been defined through >100 years of collective subsea connector experience. As a result, the controls and communications connector addresses the most common reliability and service quality performance events associated with complex electrical systems, ensuring a more reliable and robust product.

APPLICATIONS
- Subsea production systems controls
- Connectivity to tree, manifold, choke, and chemical injection metering valve (CIMV)
- Subsea sensors and instruments
- Ethernet harnesses

BENEFITS
- Capex and opex savings
- Improved quality assurance

FEATURES
- No need for expensive long-term protective covers
- Improved electrical performance through extended tracking distances to earth
- Ability for live emergency demating without permanent damage
- Axial stackup capability built into plug (female) connector
- Crimped cable terminations that eliminates quality issues associated with soldering
- Dual-barrier pressure-balanced design that minimizes stress across seals
- Capability of repeated subsurface mates and demates without loss of operational integrity
- Resistance to ingress of sand and silt
- Qualification to 14,750 ft [4,500 m]
- Maintenance-free design
- Qualification compliance
  - ISO 13628-6 certification
  - Petrobras I-ET-3000.00-1500-823-PEK-001
  - API Spec 17F SEAFOM TSD-02 (connectors, 13- and 18-mm bore hoses, and jumpers)
  - Subsea Instrumentation Interface Standardization (SIIS) Level 3
  - Statoil TR-2390 Rev. 2
Based on unique and patented technology, wet-mateable controls and communications connectors in the Diamould connectors portfolio provide the most advanced solution for subsea distribution and controls connectivity on the market today.

Protected male contact pins
To provide additional protection subsea, conventional ROV connectors require full electrical dummy connections, which add both increased expense and additional ROV intervention subsea. The controls and communications connector has a unique protected male pin system that provides immediate corrosion protection as soon as the connector demates, thus eliminating the need altogether.

Crimp termination
Traditional methods for cable termination involve soldering into back of the wet-mateable connectors. To mitigate any potential service quality concerns, OneSubsea developed a mechanical crimp and latch boot system to provide a more repeatable alternative.

Acetal liners
A unique acetal liner system within the ROV connector construction addresses concerns over the long-term effects of biofouling subsea, especially in warmer waters. The fixed volume and debris seal system ensure the mitigation of conditions that accelerate the growth of marine life and calcareous deposits.
Technology Overview—Wet-Mateable Connector

Developed and patented in 2002, the wet-mate Diamould connector range is based on field-proven, patented techniques that optimize performance. The wet-mateable function is achieved through the dual-barrier sealing systems in the plug (electrically female) units, providing independent mechanical and electrical sealing. The Diamould connector is unique in that the receptacle (electrically male) connector also has contact protection by means of a dielectric-filled compensated wiper system. OneSubsea included additional technological elements in the connector design to mitigate quality events that can impact system performance and reliability.

Protected male pins—dielectric-filled wiper
- Long-term corrosion protection to male contact pins in the demated position
- Reduced number of long-term dummy protective covers and parking connectors required
- Protection of male contacts in the event of accidental demating under power
- Reduced intervention time
- Increased electrical tracking distance to earth
- Mitigation of potential accelerated corrosion of pins when residual power exists on a demated connector

Axial stackup capability
The connector uses a secondary spring system within the electrically female plug connector, providing an increased axial stackup capability (±0.20 in) and ensuring the highest electrical integrity and reliability, even in severe equipment stackup scenarios.

Live demate capability
As the dielectric-filled wiper increases the electrical tracking distance to earth in the mated position, it mitigates the potential tracking or arcing that can lead to permanent connector electrical damage during emergency disconnect scenarios.

Antisnag protection
Employing a unique double latch mechanism, the ROV flying connectors are protected from accidental demating—that is, force must be applied to the ROV handle to achieve demating.

Acetal liners
These advanced liners reduce friction, ensuring smooth connector engagement during the mating process. The liners also eliminate close-proximity metal-to-metal contact between connector bodies in the mated condition, which mitigates the possibility of marine growth and calcareous deposits.
Portfolio Overview

The product variants within the range offer an equivalent to typical industry standards with additional technical and commercial benefits while remaining configurable to satisfy project-specific requirements.

Connector-level assemblies
Connector-level assemblies are available in 4-, 7-, and 12-contact configurations for
- flying ROV plug and receptacle
- compliant ROV-mounted plug and receptacle
- bulkhead-mounted ROV plug and receptacle
- stabplate plug and receptacle
- diver mate plug and receptacle
- parking and test connectors.

Junction boxes
The junction box is available in two variants (one in and up to 7 out)
- Open oil communication between junction box and hose (hose compensated)
- Individually sealed hoses with additional water-blocking feature (bladder compensated)

EFLs
Our fully factory-tested connector and oil-filled hose assemblies are built to meet customer requirements and pressurized internally to 145 psi [10 bar]. All EFLs are then subsequently pressure and factory-acceptance tested prior to dispatch. Hoses are supplied in 13- and 18-mm bore options to accommodate different project wiring configurations. For longer EFL needs, a qualified hose splice is used with continuous lengths of cable up to 650 ft [200 m].

Ethernet flying leads
Developed and qualified to SIIS Level 3 specification, the 12-way Ethernet cable solution uses a unique termination method to ensure dual-redundant 100-Mbps Ethernet with minimal crosstalk. The system incorporates four power lines and two screened Ethernet channels, accommodating both distribution and instrumentation applications with a maximum length of 300 ft [90 m].

Instrument harness assemblies
To enable the use of equipment-mounted instruments, the connector-level assemblies can be configured as necessary with oil-filled hoses. Termination and validation of pressure and temperature transducers are performed using a calibrated test unit before and after hydrostatic testing. Depending on the configuration of the harness, a junction or marshalling box may be required.
Termination Methodologies

At the core of the technology portfolio is the ability to repeatedly terminate cables to the same standard and quality. Because of the potential quality issues relating to soldering, OneSubsea has used a bespoke crimp-and-latch boot system since 2002, with several thousand successfully deployed and working.

Crimp termination technology
The technology provides a clean and repeatable means of terminating conductors.

- Calibrated crimp tooling for consistent crimp strength
- Installation flexibility—ability to disconnect and reconnect cables during assembly without retermination
- >15-year track record

It eliminates soldering and its associated quality issues:

- dendrites
- use of conductive media for solder joint cleaning
- solder spikes, dry joints, and cable pullout.

Additionally, the technology speeds up the cable termination process by eliminating the need for photographic evidence, X-ray evidence, or both.

Oil-filled hoses
OneSubsea has developed a range of oil-filled hoses to conduit cables in sensor harnesses and EFLs in accordance with a wide range of wiring configurations. The hoses and EFLs have been fully qualified to API Spec 17F SEAFOM TSD-02, and the hose material construction has been and validated for 30 years design life.

<table>
<thead>
<tr>
<th>Hose Configuration</th>
<th>13-mm Bore</th>
<th>18-mm Bore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall diameter, in [mm]</td>
<td>0.99 [25.2]</td>
<td>1.18 [30]</td>
</tr>
<tr>
<td>Minimum bend radius, in [mm]</td>
<td>4.92 [125]</td>
<td>6.89 [175]</td>
</tr>
<tr>
<td>Design life, yr</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Hose construction</td>
<td>Ozone-resistant HNBR</td>
<td>NBR</td>
</tr>
<tr>
<td>Strain relief</td>
<td>Aramid and polyester weave</td>
<td></td>
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</table>
Electrical testing ROV flying leads—plug and receptacle oil-filled harness.

**Mechanical and Environmental Specifications**
- Operating temperature range, degF [degC]: 23 to 140 [–5 to 60]
- Storage temperature range, degF [degC]: –40 to 158 [–40 to 70]
- Maximum operating depth, ft [m]: 13,000 [4,000]
- Design life (subsea), yr: 30
- Number of mate and demate cycles
  - Dry: 1,000
  - Wet: 250
- Maximum connector mating and demating force (4-, 7-, and 12-way ROV), lbf [N]: <100 [<450]
- Maximum ROV load without damage (4-, 7-, and 12-way ROV), lbf [N]: >1,124 (>5,000)

**Electrical Specifications**
- Voltage rating, V AC
  - Phase to ground: 1,000 (or 1,500 V DC)
  - Phase to phase: 2,000 (or 3,000 V DC)
- Long-term DC potential (phase to ground), V DC: 1,200
- Insulation resistance at 68 degF [20 degC], Gohm: >100
- Maximum working current, A
  - 4- and 7-way ROV: 30
  - 12-way ROV: 20

**Ethernet Specifications**
- Insulation resistance (pin to pin), Gohm: >100
- Data rate (300-ft [90-m] harness), Mb: 100

**Materials (Norsok Compliant)**
- Connector housings
  - ROV: INCONEL® alloy 625
  - Stab and diver: 316L or super duplex stainless steel
- Contacts: Gold-plated beryllium copper
- Insulation: PEEK®
- Sealing systems: Bespoke elastomers

**Pin Configurations**

<table>
<thead>
<tr>
<th>12-Way Plug—Front Face</th>
<th>7-Way Plug—Front Face</th>
<th>4-Way Plug—Front Face</th>
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<tr>
<td>![12-Way Plug Diagram](12-Way Plug Diagram.png)</td>
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