Seapower 03
Tubing hanger feedthrough connector

APPLICATIONS
- ESPs

ADVANTAGES
- Pressure-balanced design to minimize stress across seals
- Male and female electrical contacts that are protected from environment
- Crimped cable terminations
- Capability of repeated subsurface mates and de-mates without loss of operational integrity
- Resistance to ingress of sand and silt deposits
- Coatings to prevent risk of galling
- Maintenance-free design
- Partial discharge-free contacts to 6.9 kV AC

The Seapower 03 tubing hanger feedthrough connector allows power to be passed to single or dual ESPs through existing tubing hangers where space is limited.

The tubing hanger feedthrough connector is configured with electron beam-welded contacts to form a gas barrier at the tubing hanger. It is PR2 tested to API 6A requirements. For ESP applications, the downhole power cable terminates to a dry-mate connector at the rear of the tubing hanger wet-mate receptacle.

Design
Protection is provided to the electrical contacts by oil-filled pressure-balanced enclosures. The Seapower 03 connector uses a proprietary wet-mate technology to protect both pin and socket contacts while the connectors are being un-mated, allowing the connectors to be deployed subsea, open-face without the need for expensive dummy connectors.

During mating, the receptacle connector male contact pin wiper establishes a seal with the front face of the female plug connector, forming a continuous insulation system. The receptacle male contact pins first enter the female connectors’ primary and then secondary diaphragms, where they make a connection with the plug socket contacts. This dual protection system graduates the voltage field between the connectors when they are mated and energized, eliminating the earthing effect of seawater.

Metalized insulation system
At high voltages, insulators often experience discharges at the interface to metallic housings where air voids are present, typically around O-ring seals. A proprietary process metalizes polyetheretherketone (PEEK) insulators to reduce the effects of electrical discharge, thereby extending the life of the insulator.

Installation
The use of an external metal seal (proprietary or customer-supplied design) and internal electron beam welding ensures that the feedthrough connector provides a high-integrity gas and fluid barrier within the tubing hanger. The design of the tubing hanger feedthrough connector, with the incorporation of the lower dry-mate plug for terminating to the downhole power cable, eliminates the need to remove the wet-mate receptacle from the tubing hanger after factory installation and SIT testing.

The downhole power cable can be terminated onshore to the lower dry-mate plug in a clean, dry environment several weeks before offshore operations. This termination simplifies the installation and scope of work offshore when the ESP completion is run, saving valuable rig time and significantly reducing the risk of nonproductive time on the rig floor. For offshore cable termination, the procedure for connector/cable termination allows a quick, reliable, and repeatable process using simple mechanical hand tools.
Seapower 03 Connector Specifications

Environmental and Mechanical
- Max. operating depth, ft [m]: 9,843 [3,000]
- Well pressure, psi [MPa]: 5,000 [34.47]
- Service life downhole, y: 10
- Max. operating temperature, degF [degC]: 250 [121]

Electrical
- Voltage rating (Uo/U/Um), kV: 3.5/6/7
- Withstand test voltage, kV AC: 12.1
- Power frequency test voltage, kV AC: 13.9
- Breakdown voltage, kV AC: >27.7
- Operational phase-ground voltage, kV A: 3.5
- Current rating (continuous), A: 200
- Voltage impulse level, kVp: >60
- Insulation resistance, GΩ at 68 degF [20 degC]: >10
- Contact resistance, mΩ at 68 degF [20 degC]: <2
- Storage temperature, degF [degC]: −40 to 158 (−40 to 70)

Materials
- Housing: Superduplex stainless steel
- Contacts: Gold-plated beryllium copper
- Insulation: PEEK
- Diaphragms: Various compounded elastomers

Tubing hanger feedthrough upper plug details.

Feedthrough details.