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**CONNECTORS/CABLES/WINCHES;
OFFSHORE RENEWABLES/OFFSHORE TECHNOLOGY**



SEA CON[®]'s Metal Shell Series connectors

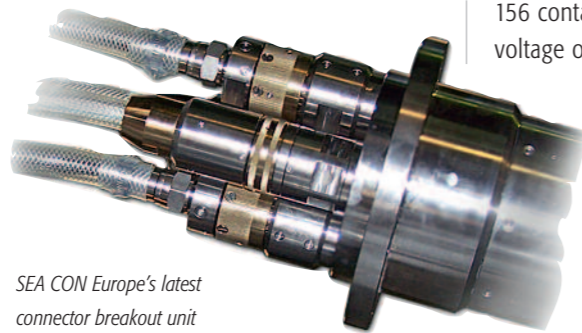
By Michael Mulcahy, Michael Mulcahy & Associates, Inc., Virginia, USA

The Metal Shell Series of connectors from SEA CON[®] have been delivering power underwater for 45 years

The SEA CON Group has been a leader in providing system and connector solutions to the underwater business for more than 40 years, supporting the offshore oil and gas, undersea research and defence communities' subsea power and data needs. By the late 1960s the company was manufacturing the established Marsh and Marine electrical connector, as well as specialised connectors for classified military uses, at its California facility. Since that time, SEA CON has expanded to its current 800 employees in nine offices in five countries.

Two previous articles, in the 2010 and 2011 May/June issues of *International Ocean Systems*, traced SEA CON's history and overall product lines, respectively.

Throughout its history, SEA CON has earned the respect of customers and competitors alike for its willingness to respond to operator feedback by modifying its connector characteristics when practical and economically viable. The company has made technology advancement a major corporate commitment across its product line of more than 25 product ranges, 30,000 discrete connector types and configurations in its standard range, and thousands of custom connectors, distributed among electrical, electro-



SEA CON Europe's latest connector breakout unit

optical hybrid, wet-mate and dry-mate connectors.

As it has developed and implemented technical advances to improve its connectors' performance in progressively harsher operating environments, SEA CON has also continued to support the products it has offered since its earliest days, including its Metal Shell Series (MSS), which provides high contact density and extensive power and signal configurations. This article focuses on the MSS connector line's history and variants within the product range.

SEA CON has manufactured the MSS line for 45 years. The connectors are designed to withstand pressure to full ocean depth and harsh operating environments that include offshore oil and gas, exploration and military applications. The connector range is manufactured with 316 stainless steel as standard, with glass reinforced epoxy (GRE) inserts moulded around gold-plated electrical contacts. Optional materials available include Monel, titanium and aluminium.

MSS contact configurations are available in shell sizes ranging from a single electrical contact or coax to as many as

156 contacts, with fibre optic and high-voltage options.

Applications for the MSS series are varied and include power for motors, submersible pumps and single communications, including Ethernet. The versatility of the connector series makes it ideally suited for systems requiring multiple applications through a single interface (e.g., power, signal and optic).

MSS HISTORY

The MSS product line began life in the early 1960s, moulded to cables, and in the late 1960s SEA CON pioneered the early pressure-balanced oil-filled (PBOF) type connectors which included a valve in the cable connector plug (CCP) PBOF insert. Several hose termination designs have been produced for clamping over polyurethane tubing, including standard hose clamp and SEA CON's Version 3 that utilises a collet style termination, together with the MK2 interface used for coupling to SEA CON Precision hose conduit used on production control systems, in addition to customer-specified special versions.

While stainless steel is still the most common material for the MSS product line, over time, SEA CON developed many alternative connector materials, ranging from anodised 6061 aluminium to titanium, Nitronic 50, 15-5 PH and

MSS pressure-balanced oil-filled (PBOF) connectors



other materials. The middle and upper ranges of this product line are excellent candidates for adapting to high-tensile-load cable terminations. Predominantly titanium connectors are used as a compromise between the comparatively heavy stainless steel and the more easily damaged anodised aluminium, while offering superior corrosion resistance to both of the earlier materials.

MINI-CON

The MINI-CON range was conceived in the early 1980s with an eye toward miniaturising the MSS series for small-diameter, high-density, high-pressure connector requirements. The materials of the two lines are the same, but the size of the connectors, and the electrical pins within them, are scaled down in the MINI-CON. The MINI-CON comes in 13 shell sizes and as many as 203 contacts, including coax. Typical applications include drilling systems, umbilical links and submarines.



SEA CON's MINI-CON Series

MULTIPLEX (MUX)

The MUX connector originated in the 1980s in response to industry demand for a robust, field-installable connector with all the individual cable elements sealed independently and test ports to ensure that all O-rings are in position and working, prior to system deployment. The MSS

connector provided an appropriate baseline to allow the required features to be implemented. The CCP was modified to enable termination onto an armoured cable and sealing to all the various cable jackets, all housed within a one-atmosphere or pressure-balanced chamber and CCP/FCR to include the required test ports. Over the years this base design has evolved, mainly due to the effects of increased drilling depths on the cable, and new solutions have been developed by all SEA CON divisions.

SEA CON Advanced Products' latest baseline is a modular termination that enables new cables to be designed into the connector, with limited impact on components. It uses positive pressure compensation on the cable termination section and features either an integral armour termination and flanged MSS-type connector or a separate armour termination and standard MSS-type connector interface.

SEA CON Europe's latest addition is the cable termination and connector breakout unit for SAIPEM's ultra-deepwater semi-submersible drill rig Scarabeo 8. The connector implements the SEA CON MUX field termination design and incorporates a compensated cable termination section, cable and fibre splice management housing and front end with four individual bulkhead connectors.

API CONNECTOR SERIES

While SEA CON has included test ports for many years, in recent years

customers have frequently requested American Petroleum Institute (API) compliance. SEA CON offers its standard MSS connector, with additional features to comply with the following API specifications:

- 6A (wellhead and christmas tree equipment).
- 16D (control systems for drilling well control equipment and control systems for diverter equipment).
- 17E (subsea umbilicals).

SEA CON has found it critical to work with its customers on their specific API compliance requirements and this has led to the SEA CON API series, now meeting or exceeding API performance specifications. Key areas include:

- Multiple test ports on the flanged connector receptacle (FCR) [aka bulkhead receptacle] connector, allowing in-field O-ring seal verification.
- FCR connectors have inboard water-blocking boots over the electrical termination to eliminate the risk of failure in the case of a flooded housing scenario.
- PBOF cables which operate fully in the event of a breached hose/water ingress with full-pressure water-blocking on the solder



American Petroleum Institute (API) compliant connectors

cup side of the connectors.

- Oil-filled cable connectors without valves. This eliminates a direct path for water to reach the face of the bulkhead connector in the case of hose flooding.

SEA CON performs all necessary design and in-house testing to demonstrate full compliance with the API guidelines, and also offers additional modifications, including a glass-to-metal seal insert, to allow the product to achieve greater ocean-depth rating.

FIELD SERVICES

Fabricating a product is only one step in ensuring reliable performance throughout its service life. A manufacturer's unsung heroes are often the technicians who deploy to worldwide operating locations to terminate connectors to heavy cables and resolve local connector issues so that expensive projects can continue with minimal interruption.

Based in Bellville, Texas, the SEA CON Field Services Department operates at a breakneck pace (24/7/365) and services the whole world. Global Service and Support manager Karen Lewis oversees a staff of 14 mobile technicians who perform field service cable/connector terminations for all of SEA CON's deepwater (up to 5000psi) MUX connectors and shallower water connectors which are typically potted and require different termination techniques.

The Field Service Department has grown at an average rate of nearly 50% per year

since 2008. All technicians hold current passports, visas, medical certificates and training certificates allowing them to be deployed as soon as an emergency call is received. The group's best time (from receiving an emergency call to arrival at the gateway airport) is four hours. The Field Services group performs installations either in Bellville, on the drill rig or at the customer's facility. Connectors can be either all-electric or electro-optical hybrids.

SEA CON takes a proactive approach to its service of this market. Two examples follow.

In 2008 SEA CON established RigLog, a listing of every drill rig with SEA CON MUX connectors installed and associated historical records, including sales, service reports, notes and photos. Before a technician travels to a job, he reviews the historical timeline of that particular rig from the RigLog.

In addition, SEA CON collects cable samples from every field service job, in a long-term study on the effects of pressure and temperature on MUX cables used in subsea applications. Maintaining several chronological cable samples from each rig that SEA CON services enables measurement of each individual conductor and individual wires to quantify changes due to extended deployment or multiple deployments over several years. Understanding cable geometry changes is critical to ensuring functional sealing, since many seals are matched to cable specifications.

CUSTOMER SATISFACTION

Customer satisfaction with the MSS series and all of its connector product lines is paramount to SEA CON, from the factory assembly bay to the drill rig deck – a fact reflected in customer surveys. Industry has come to expect the extra effort offered by SEA CON personnel at every step along the way, which often makes the difference between a costly offshore or undersea operation being interrupted or continuing smoothly. SEA CON's 45-year record of success speaks for itself. ■

For more information, please visit
www.seaconworldwide.com

Michael Mulcahy is a former US Navy officer and former *Sea Technology* magazine managing editor. He has written more than 100 ocean science and engineering articles. His interests include undersea connectors and cables, marine engineering, naval architecture, commercial diving, ROV operations and ship salvage engineering. He is a graduate of the University of North Carolina at Chapel Hill, USA.



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