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Roadmap for the Subsea Connector Market

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The SEA CON® Roadmap for the Subsea Connector Market

By Michael Mulcahy
Michael Mulcahy & Associates, Inc.

Where We've Been

Most people in the subsea industry consider underwater engineering to be the most technically challenging aspect of the offshore petroleum industry. In the unique environment of deepwater operations, subsea engineers must particularly consider extremes in temperature, pressure, and corrosion when choosing equipment and tools, including subsea connectors.

The SEA CON Group has been perfecting underwater connection technology for 45 years. From the introduction of its ALL-WET connector range, which provides the ability to mate electrical connectors "wet" along with the flexibility of connecting multiple instruments, lights, and other equipment into a single interface on a control pod, to the Metal Shell Series (MSS) range, which provides high contact density and a variety of power and signal configurations as well as meeting the requirements of API-16D standards, to being the first to provide a multi-channel (six-channel) wet-mate down-hole fiber optic connector, SEA CON has helped conquer harsh environments with some of the most advanced solutions in the market.

The organization designs, prototypes, tests, manufactures, and services this technology, and this all-inclusive approach means we have the flexibility to offer an extensive range of electrical, optical, and hybrid connectors, cable systems, and complex distribution harness systems for the subsea markets. From our 1968 start as a small San Diego, California electrical connector manufacturer, SEA CON has become a global player with 800 employees in five countries. But perhaps even more importantly, we supply some of the most cutting-edge equipment available to the subsea connector market. This article looks at some of the products and services the company offers in light of the unique challenges and opportunities the subsea industry faces.

The SEA CON Group constantly invests in and refines our manufacturing capabilities, which is how we can produce high-volume connectors in a vast range of specifications and materials. We produce parts in large numbers with exceedingly high levels of accuracy using advanced materials science to make use of everything from highly durable

metals and plastics to the most advanced alloys. For example, we have a specialized facility that allows us to manufacture a wide range of glass-to-metal sealed, MIL-SPEC harsh-environment connectors.

We have also made a significant investment in testing and prototyping, which has built our reputation and ensured confidence in the safety and reliability of our products. It is not enough, though, to just manufacture a product, sell it, and then walk away. Not in this business, where so much is at stake.

That is why SEA CON provides customers with critical field support, all the way from matching specs to providing highly qualified and trained technicians for immediate and professional responses to any service requirement in any location.

SEA CON has the global reach to apply our core values to support systems and solutions that match the needs of our customers, whether that means tailoring an existing connector or developing an entirely new connector to meet a technology gap and providing a durable, specific, and supported solution. We have always done this, from our standard range of products to the constant innovation in response to evolving customer requirements. Each division within SEA CON has a specific product focus, but we also pool resources across the divisions to explore new solutions.

In the design phase of a given connector, SEA CON considers many variables regarding its functionality and anticipated use to eliminate surprises when it becomes operational. The more specifics the customer can provide about the planned use of the product, the more precisely we can match the product to the requirement. In addition to the corporate memory represented by SEA CON staff's decades of professional experience, two additional resources bolster the design of a connector. Since 2008, the company has maintained a database documenting every field service connector and cable termination action by location and platform (e.g., drill rig and drillship). This database is available company-wide, and each entry contains the following information:

- Date/platform/location;
- Connector model/condition photos;
- Cable type/history/condition photos;
- Issues encountered;
- Operational details (drilling history/depth/time connector deployed);
- Spares on rig/parts needed; and
- Training given/needed.

Secondly, senior engineering managers from all SEA CON divisions meet on a regular basis to discuss, share, and document lessons learned in their respective connector specialties. Recent issues identified for further study have included the following:

- Termination durability in view of working conditions;
- Cathodic delamination;
- Corrosion due to dissimilar metals or other causes;
- Consistency of cable construction and the need for components designed for the exact cable being used;
- How temperature extremes affect connectors and terminations;
- Pressure-related issues (e.g., insulation resistance and optical attenuation); and
- Deployment stresses on terminations (e.g., straight, off-angle loading).

This cross-fertilization means that SEA CON invests its connectors with generations of empirical data, augmented with hard

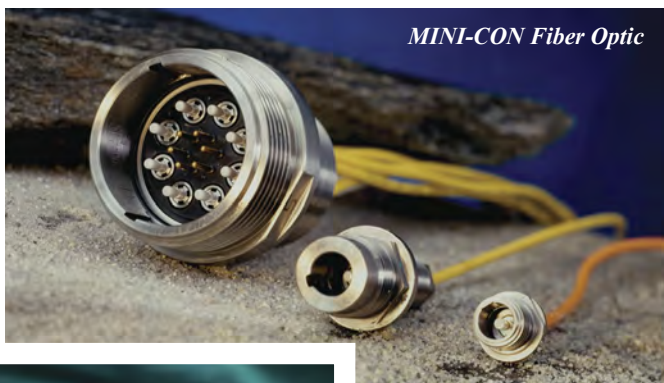


American Petroleum Institute (API) Compliant Connectors

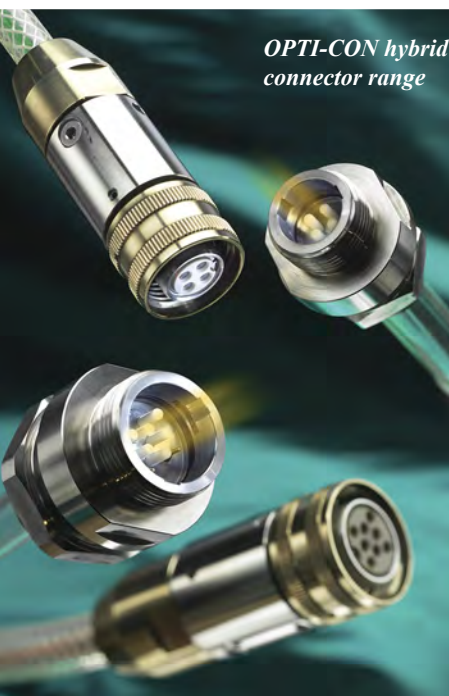
field statistics and customer feedback and supported by field technicians so that the user is considered at every step along the way from design through production and field modification when appropriate.

Where We're Headed

Right now, SEA CON is making major investments in fiber optics. A prime example of this is our commitment to fiber optics within the Oil & Gas industry through the development of dry-mate optical products, including the MINI-CON and OPTI-CON connector series, the underwater mateable HYDRALIGHT connector, and the down-hole, multi-channel fiber-optic G3 connector series.



MINI-CON Fiber Optic



OPTI-CON hybrid connector range

Speaking of OPTI-CON, with our Precision MKII hose conduit and the development of a Subsea Umbilical Termination Assembly (SUTA), SEA CON now supplies complete systems solutions for the subsea control market. SEA CON is also expanding the capabilities of the HYDRALIGHT connector series, with the release of the APC version, which improves back reflection performance and a high-fiber-count version providing up to 48 fiber optic channels within the same basic envelope of the standard HYDRALIGHT connector.

SEA CON has also introduced numerous high-specification connectors developed to meet the always-expanding technical requirements of OEM manufacturers — one of the challenges being to provide these capabilities within the smallest possible connector diameter.

SEA CON also anticipates a need for high-power connection systems for subsea processing in addition to renewable energy projects utilizing our standard connector series as well as underwater-mateable fiber optics and for high-power applications for which we are already exploring a range of innovative solutions. After all, with a history of being on the leading edge, wouldn't you expect SEA CON to be at the forefront of this new challenge?

Recent SEA CON Advancements

- SEA CON continues to expand its range of options, including the API-compliant Metal Shell Series of dry-mate connectors.
- Historically, SEA CON's optical connectors have used Ultra Polish Contacts (UPC). As use of optical connectors has increased in sensing systems, the need for improved back reflection performance has prompted SEA CON to develop connectors with Angled Polish Contacts (APC), now available in the fiber optic dry-mate series.
- SEA CON is applying V-3 Pressure Balanced Oil-Filled (PBOF) terminations to many products. SEA CON Europe pioneered this development with SEA-MATE and OPTI-CON connectors, and SEA CON has taken advantage of its shared engineering philosophy to enhance both earlier and more recent product lines, including MINI-CON and MSS. This design eliminates the hose clamps in PBOF terminations, enabling connector and termination components to be manufactured from a wider range of subsea materials and decreasing the chances of corrosion.
- The HYDRALIGHT underwater-mateable connector family has expanded.
 - Channels have increased from 1-8 to 1-48.
 - APC contact – Designed for sensing system requiring greater back reflection performance.
 - Hybrid optical and electrical connector, combining qualified and field-proven technologies of the HYDRALIGHT and CM2000.
- Complete product suite for umbilical cables, including optical and electrical umbilical cable termination (breakout of umbilical cable elements to single or multiple wet-mate connectors), umbilical cable abandonment caps (for secure sealing of topside during abandonment), and umbilical optical and electrical repair splices (for repair of damaged umbilical elements).
- Modular field-installable multiplex (MUX) connectors – Resulting from the need to adapt the highly successful and field-proven MUX connectors onto an ever-increasing range of cables, the modular design approach on the MUX connectors enables faster design implementation of alternate cable designs.

Conclusion

Every year marks increased capabilities and new product options across the SEA CON Group's product line that includes dozens of connector products with thousands of variations. Often, a custom-developed variation of a core product spawns a new, unplanned product line as was the case with the AWQ 4/24 ALL-WET connector. Similarly, variations of the basic MSS and MINI-CON contact patterns remain in the product catalog after being developed to meet emerging customer requirements. The company's strong focus on quality, in both products and services, continues to enhance SEA CON's status in the industry. With the California SEA CON factory's February 2012 ISO 9001-2008 certification, all SEA CON factories are now ISO-certified. The company continues to push the technology envelope in many key areas, such as miniaturizing fiber optic connectors with no degradation of performance. SEA CON's four-decade track record of responsiveness to operator feedback and reasonable customer requests has been a significant contributing factor in achieving the company's enviable reputation in the industry and its ultimate staying power.

For further information, visit the SEA CON website at <http://seaconworldwide.com>.

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