

# Ocean Systems

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



# Investments in advanced quality and manufacturing protocols for high-performance connectors

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BIRNS, Inc. invests in new certifications, groundbreaking testing equipment and advanced manufacturing techniques to deliver industry's most sophisticated high-performance connectors and cable assemblies

A range of new quality and manufacturing enhancements are key to developing and testing the industry's most sophisticated high-performance connectors and cable assemblies. The most important investments include new training and certifications covering advanced manufacturing techniques from soldering to overmoulding and groundbreaking testing equipment – to successfully deliver cutting-edge connector solutions for extreme depth applications. BIRNS, Inc. has long been at the forefront of cutting-edge connector technology, leading the



J-STD-001 revision G Class 3 has even more stringent requirements for training and certification for soldering than the previous iteration



BIRNS moulding facility is NAVSEA PRO-020 certified by the US Navy, as an approved supplier for submarine outboard cables; shown here is a BIRNS Millennium 3P-2C6 (with two coax contacts and six electrical pins)

marine industry with advanced, custom products since 1957, and soon went on to specialise in connectors and custom cable assemblies. From connectivity at six kilometres, to coax inserts that provide open face pressure resistance and incredibly low insertion losses, to electro-opto-mechanical and electro-opto-coax hybrids providing immense data speed and accuracy, BIRNS has been investing in advanced protocols to ensure that these high-performance connectivity solutions are made well, and perform seamlessly.

With products that perform at such peak levels at such great depths, and projects in which lives and millions of dollars are often at stake, BIRNS has a commitment to

identifying and implementing the highest levels of quality assurance and manufacturing technology in the development and testing of these connectors. Quality underlies the commitment to excellence that the company has had for more than six decades, which has allowed BIRNS to serve the US Navy continuously since 1960, and go on to supply connector and cable assembly and lighting products to other navies across the globe.

## QUALITY

The ISO 9001 standard is recognised internationally as a benchmark of quality management systems. Organisations use the standard as a foundation to develop their quality management system (QMS)

and demonstrate the ability to consistently provide products and services that meet customer and regulatory requirements. BIRNS achieved ISO 9001:2008 certification in 2009, and has successfully maintained its certification ever since. BIRNS is renowned for developing solutions tailored for exceptionally rigorous applications, including nuclear reactors, oceanic deep submergence and diving decompression usage. Since its inception more than 60 years ago, BIRNS has adhered to both its own painstaking internal standards of testing, and complied with the requisite auditing and individual certifications for major entities in the nuclear, armed forces and hazardous environment markets.

BIRNS is currently transitioning to the new ISO 9001:2015, which has been restructured to be more closely aligned with the structure of other ISO standards. There is now a much greater emphasis of leadership involvement and demonstrated commitment to understanding the needs and expectations of interested parties, customer focus and the wide-ranging associated risks that may have an impact on the organisation's ability to deliver products or services on time, meeting customer expectations. There is a commitment required from all management to achieve and maintain the



Specialised test equipment like CAMI Research high-voltage test systems allow technicians to perform complex high-voltage tests quickly and efficiently

and outputs and how all of the processes are interrelated to achieve an end result that assures customers of the highest levels of quality and consistency. This helps us better meet their needs, while helping BIRNS effect positive changes throughout every step of the manufacturing process, and increase profitability."

## ELECTRICAL TERMINATION

Today's high-performance, deep-submergence connectors and cable assemblies require meticulous care in design, and equally meticulous protocols for development and termination. The continuing engineering trend in vehicles and other subsea systems is focused on smaller, better and

new standard, versus having the lion's share of responsibility rest with the quality leadership. "The standard has removed the requirement to have a designated 'management representative' to serve as the primary contact point; now there must be demonstrated involvement and participation from the entire leadership team," says Paul Ross, BIRNS quality assurance manager. "Plus, the process approach emphasised in the standard helps establish the structure to thoroughly understand the input, process

faster solutions. This means that designers of such systems seek connectivity options that provide immense performance characteristics, all in a diminutive footprint. Single advanced hybrid connectors can now take the place of what would have required two or more connectors in just the past decade. Manufacturing connectors with huge numbers of contacts in a connector diameter of less than two inches (5cm) demands finesse, and controlled processes and procedures that offer consistent, excellent results.

BIRNS has invested in the industry's highest calibre of training and certification for the termination of its complex connectors and cable assemblies. BIRNS expert electrical technicians, assembly and inspection personnel hold J-STD-001 Class 3 certification for soldering – Class 3 is for high performance/harsh environment electrical products, where performance on demand is critical, equipment downtime cannot be tolerated, the environment may be unusually harsh and the equipment must function when required. The team also holds WHMA-A-620 C certification, for producing crimped, mechanically secured, or soldered interconnections and the associated lacing/restraining criteria associated with cable and harness assemblies.

The Association Connecting Electronics Industries (IPC) recently released a new J-STD-001 revision, so in early 2018, BIRNS sent Maria Salinas, a highly qualified quality inspector from its team, who first became J-STD certified in 2008 and has been in the industry ever since, to become a certified IPC trainer. She attended two different four-day class segments from the IPC, and successfully completed the new training. She returned qualified to train, test and certify all relevant BIRNS personnel in the WHMA standard as well as the new revision (G) of the J-STD, which describes materials, methods and verification criteria for producing high quality soldered interconnections. The new J-STD emphasises process control and sets industry-consensus requirements for a broad range of electronic products. Team members go through five different training modules to become certified IPC specialists (CIS) to the new standard, with highly specific and rigorous training and testing. The new standard is even more stringent in its compliance and training methodologies. Some changes include the addition of MIL-STD-1686 for control of electrostatic discharge, as well as more rigorous requirements for specifics of overall workmanship of soldered parts. "There are many advantages of certification to J-STD, and the newest revision even more so," says Salinas. "Number one is customer

confidence; our national and international customers will feel even more confident about our capabilities of performing per the standard requirement. It's always been an extremely strict, exacting standard, and for good reason, since it applies to aerospace, defence and marine applications, and was adopted by the US Department of Defense."

In addition to the BIRNS team's high level of termination training, the BIRNS CableEye testing now permits real-time in-process testing of terminations with automated quality reports which can be uploaded to the company's server network to become a permanent part of the production job record.

### NAVSEA PRO-020 AND OTHER OVERMOULDING

Overmoulding the wire terminations in the connector shell to a cable jacket is a key process for cable assemblies to withstand the demanding subsea environment and extreme depths in which BIRNS connectors operate. Great care must be taken to ensure that the process is done properly, and provide the requisite sealing, strain relief on the cable, and mechanical strength to the junction. BIRNS moulding technicians use an EXACT Dispensing, USA, MMD-9450D-ENC meter/mix dispense system for accurate control of polyurethane mixing and dispensing during this process.

As part of its ongoing commitment to excellence, BIRNS' moulding facility was NAVSEA S9320-AM-PRO-020 certified in 2012. The US Navy's Submarine Maintenance Engineering, Planning and



software. The system includes a 254mm lens which provides a seven-inch (17.8cm) square marking field. For precise, consistent wire lengths and strips, BIRNS uses automated

A BIRNS quality team member inspects a connector insert with a digital video comparator, which combines the capabilities of a horizontal optical comparator and a vision metrology system

Procurement (SUBMEPP) department awarded the certification to BIRNS for Moulding and Inspection Procedures for Fabricating Connector Plugs for Submarine Outboard Cables. As a result, BIRNS is an approved vendor to fabricate, mould and inspect outboard cable assemblies and components for the Navy. This certification was granted after an extensive audit by Naval Sea Systems Command (NAVSEA) personnel, during which the BIRNS cable assembly, termination and quality assurance teams demonstrated absolute adherence to the exacting procedure of the NAVSEA Technical Manual.

The certification requires strict adherence to the use of specific materials, primers and clear/amber military-grade MIL-M-24041C chemically cured polyurethane, which has an extremely high tear strength, and is highly resistant to oils, gasoline and seawater, while providing outstanding protection against corrosion. In addition to the strict material requirements, NAVSEA PRO-020 certification requires meticulous record keeping and documentation during the overmoulding process, for absolute traceability for the Navy, for protocols from precise temperatures to exact cure times.

### TESTING AND MANUFACTURING EQUIPMENT

To further provide traceability, BIRNS inserts and connector shells are uniquely and permanently marked at the source using a hybrid fibre laser marking system incorporating a 30W pulsed fibre laser, ScanLab, Germany, RTC-4 control board and LeopardMark, USA, laser marking



High-frequency RF testing is conducted with an ENA series network analyser

Schleuniger, Switzerland, wire processing machines for dispensing, cutting and stripping wire to tight tolerances. BIRNS utilises automated vertical wire carousels for traceability and material control of all wire and cable products.

The BIRNS quality team utilises advanced equipment and procedures for the rigorous testing of connectors and custom cable assemblies. This cutting-edge digital inspection equipment includes a Mitutoyo, Japan, Bright 504 DCC CMM (coordinate measuring machine), a Starrett, USA, HDV300 video measuring system (new technology that combines the power of an optical comparator with digital video, hi-res cameras, telecentric optics and LED illumination), Mantis 3D binocular scopes with digital imaging and all-digital precision measuring instruments.

Advanced deep-submergence connectors, penetrators and cable assemblies undergo a wide range of electrical tests. The company's main electrical test system was custom-made for BIRNS in Japan by Kikusui. It permits the simultaneous testing of up to 16 electrical circuits with up to 99 different programmable test sequences, at voltages up to 10kV. High-voltage testing is done per IAW MIL-STD-1344A, 'Test Methods for Electrical Connectors', Test Method 3001.1, 'Dielectric Withstanding Voltage'. Technicians also use a CAMI

Research, USA, high-voltage test system (DC/AC, 128 TP with expansion module), at voltages up to 2100VDC and 1200VAC, meeting all electrical testing requirements of the IPC/WHMA-A-620B guidelines. "The CAMI system drastically decreases time for such testing, particularly for wire harness insulation resistance (IR) testing – testing sequences which would have previously taken an hour can now be done in three minutes," says Garrett Kirby, manufacturing and engineering technician at BIRNS. "The system is also highly configurable, so we can tailor it to specific processes for our most complex custom assemblies."

Voltage standing wave ratio (VSWR) is a measure of how capably radio frequency (RF) power is transmitted, and in the case of connectors, measuring the amount of input signal that is reflected back toward the source. For high-frequency VSWR testing, BIRNS uses an ENA series network

analyser with E5063A-2H5 two-port testset (100kHz to 18GHz) and N4691B 3.5mm two-port ECal module (36.5GHz). BIRNS' proprietary, revolutionary coax contacts, which can withstand open face pressure, have a maximum insertion loss of 0.7dB at signal frequencies to 3GHz, with an associated maximum SWR of 1.7:1.

BIRNS is well known for its precision optical connectors and cable assemblies, like a system recently developed for a military customer for custom electro-optical hybrid connectors and cable assemblies that required zero magnetic signature. These types of hybrid configurations can deliver advanced subsea connectivity for demanding applications that require massive data rates in a small footprint – capable of transmitting gigabits of data per second. They provide combinations of single-mode or multi-mode fibres, and can be paired in hybrid configurations with both high- and low-voltage contacts and mechanical load bearing > 50,000 pounds (22,700kg). Typical insertion losses (per ANSI/TIA/EIA-455) for single-mode are 0.1dB and 0.25dB for multi-mode, with return losses 35dB min. BIRNS technicians perform optical testing with equipment such as Opto-Test OP940-SM-13/15 Single-mode Return Loss Meters, Dual Wavelength (1310/1550nm) 1mm InGaAs detector with universal adapter interface.

The subsea industry is continually changing, and connector technology accelerating. BIRNS customers know that they can rely on the company to continue to invest in the most advanced protocols and equipment available, to provide critically important connectivity products with proven track records in the field. ■



A six-kilometre rated BIRNS Millennium 30-2F2-CP-TI-CA (with two optical fibres and two electrical pins) custom cable assembly with zero magnetic signature, constructed with Delrin and titanium components