BIRNS Millennium[™] Connector Series







High Performance . . . Under Pressure®

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Company Overview

Established in 1954, BIRNS is a global leader in the design and manufacturing of high performance connectors, penetrators and cable assemblies for deep ocean vehicles (manned and unmanned), subsea electronics, commercial diving and security applications. Thus, our quality certifications and manufacturing capabilities meet or exceed the most exacting requirements. Our world-class cable facility is SUBMEPP-certified to NAVSEA S9320-AM-PRO-020, only one of seven such commercial organizations in the U.S. All BIRNS QA personnel and production technicians are certified to both J-STD-001 and WHMA-A-620-A Class 3^[11], and we hold ABS Product Design Assessment Certification for all of our man-rated submarine and SAT-system penetrators.

Our dedicated engineers have deep in-field experience and use the latest 3D parametric solid modeling software to deliver outstanding solutions with precision and speed. All designs are performed in model space. BIRNS designs and performs mechanical termination of load-bearing cables with central or coaxial stress members of Aramid fiber or steel, and performs in-house molding of epoxy, polyurethane, polychloroprene and other materials. We can produce items designed for a diverse range of highly specific needs, or modify items tailored to customers' specifications.

Our ongoing investments in our processes, equipment and protocols continue to increase our capabilities—while reducing costs and lead times—to effectively meet the changing needs of our customers.



^[1] Class 3 is for products where continued high performance or performance-on-demand is critical, equipment downtime cannot be tolerated, end-use environment may be uncommonly harsh, and the equipment must function when required, such as life support or other critical systems.

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Our emphasis is always to provide the ultimate in product quality and performance. Thus, our comprehensive quality program is fully integrated throughout every department, from sales, design, and production; to detailed receiving, in-process and final inspection; and ultimately through delivery and customer service. As part of our ongoing commitment to our customers, our Quality Management System is certified to ISO 9001:2008 by DNV and complies with 10CFR50 App. B (NQA-1). Our attention to detail is unmatched, with consistent, extensive employee training and cross training, and internal oversight. The entire QMS is process based and dedicated to continual process improvement.

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We utilize advanced digital inspection equipment, including a Mitutoyo DCC CMM (Coordinate Measuring Machine) and a Starrett 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. Additionally, we use Mantis 3D binocular scopes with digital imaging, and all digital precision measuring instruments.

BIRNS has provided industry-leading testing, exceeding stringent ABS/DNV requirements, for man-rated electrical penetrators and complex connector solutions since 1995. By adding saltwater testing in 2006, BIRNS now affords the industry's greatest volume of cost-effective hydrostatic and helium pressure testing. Our custom-engineered hydrostatic pressure testing system has digital data recording capabilities and can be controlled remotely or via automatic programming. In it, our technicians can simultaneously test three independent pressure circuits in six chambers at pressures up to 20,000 PSI (138 MPa), in fresh or salt water.





Our electrical test system was custom-designed and made for us by Kikusui and permits the simultaneous testing of up to 16 electrical circuits, automatically, with up to 99 different programmable test sequences, at voltages up to 10kV, while subjected to hydrostatic/hydrodynamic pressure.



Product Overview

Introduction/General Features

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The BIRNS Millennium series is a high performance, high density dry-mate connector range suitable for deep submergence applications to 6km depth. This series can be used with solid (molded) or oil-filled cables in straight or 90° configurations. Both Plugs and Receptacles have replaceable inserts, are available in high and low voltage, coax, fiber-optic, and hybrids of electro-coax, electro-optical and electro-opto-mechanical configurations.

BIRNS Millennium connectors are open-face rated to 6,000 meters and preclude pressure vessel flooding without need for glass-sealing. Although many manufacturers' connectors cannot resist more than 2,000-3,000 PSI (1,300m-2,000m) while mated to oil-filled cables, BIRNS Millennium connectors are rated to 6,000m when used with PBOF or molded cables.

- **User-friendly**: Replaceable electrical inserts (for Receptacles and Plugs); insulated solder pots, and user-friendly termination with thick gold plating (50 microns) on all contacts
- **Rugged**: Positive stainless steel stops obviate over-tightening; square Acme threads resist mechanical damage; redundant O-ring seals; integral, square stainless CP keys; 15° lead-in O-ring chamfers; oil-filled adapters incorporate double-ferrule hydraulic fittings
- **Durable**: Hard phosphor bronze coupling rings, with special Higbee threads and anti-vibration locking mechanism; Heat-treated BeCu sockets keep spring strength
- Adaptable: Receptacles available in 316-SS or Titanium; Available Receptacle Types: FR, OR, BR, and CR; conductor sizes 22-, 20-, 16-, 14-, and 10-AWG are available without incompatible regular and long shells; can be used with solid (molded) or oil-filled cables; three key options available for purposeful incompatibility



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Specific Benefits

Design/Construction

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- Replaceable GRE inserts in Plugs and Receptacles
- Dual redundant O-ring seals—with 15° lead-in angles—assure long-term sealing reliability
- Dual integral (machined from solid bar) long, square keys provide positive indexing
- Square Acme threads resist mechanical damage

Mechanical Performance

- 6 km rating standard (non-coax)
- Connectors are compatible with molded or oil-filled cables
- Anti-vibration locking mechanism precludes inadvertent connector loosening
- Stainless steel positive stops preclude over-tightening
- Rugged, sturdy coupling rings resist mechanical damage

User-friendly Termination

- No wings or other obstructions limit soldering access
- All solder pots are scalloped and face outward
- Inserts can be terminated outside the shell
- Solder pots accept the largest stranding of any wire size per MIL-STD-39029D
- Insulated solder pots are easy to cover with heat-shrink tubing



Pin Configurations



*Requires BIRNS' mechanical termination

BARANA

Graphical Overview



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OR-CA: Dual O-ring Receptacle-Cable Assembly

RCH-Ti: Receptacle Cap, High Pressure-Titanium

FR-CA: Flanged Receptacle-Cable Assembly

CP-OF: Cable Plug-Oil Filled

PCH: Plug Cap High Pressure

DSP: Dummy Sealing Plug

CP-OF-CA: Cable Plug-Oil-Filled-Cable Assembly

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Part Numbering

3<u>M-13-CP-TI-K2-OF-RA-13-CA</u>

SHELL SIZE F G K L M O P R T	TERMINATION (blank): no termination CA: terminated, assembled, and overmolded if applicable TUBING SIZE 13: ½" OD tube 19: ¾" OD tube 25: 1" OD tube 32: 1¼" OD tube
	CABLE ANGLE
CONTACTS SHELL TYPE CP: Cable Plug FR: Flanged Receptacle OR: Dual O-ring Receptacle BR: Bulkhead Receptacle CR: Cable Receptacle SHELL MATERIALS (blank): 316 SS TI: Ti 4A16V	(blank): 180° RA: 90° CABLE ATTACHMENT (blank): molded, solid cable OF: oil-filled, double-ferrule swage-style hydraulic fitting OH: oil-filled, hose-clamp KEY OPTIONS (blank): standard key K2 (240°) K3 (210°) K4 (180°)
Pressure Caps	
3 <u>M-13-DSP</u>	3 <u>M-RC H-TI</u>

Shell Size

Contacts -

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Dummy Sealing Plug Special Cap for 3_-_-CR-OF

Shell Size → RC: Receptacle Cap → PC: Plug Cap

L: IP56 H: 1,000m H-TI: 6,000m

Tabulated Dimensions



R

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Canout	Description	3F	3G	ЗК	3L	3M	30	3P	3R	3T
А	BR Mounting Thread	1/2-20 UNF-2B	5/8-24 UNEF-2B	3/4-20 UNEF-2B	7/8-20 UNEF-2B	1-20 UNEF-2B	1 1/8-16 UN-2B	1 1/4-16 UN-2B	1 1/2-16 UN-2B	2-16 UN-2B
В	O-Ring Spot Face	0.88	1.13	1.13	1.38	1.38	1.50	1.88	2.07	2.38
С	BR Face O-Ring	2-015	2-017	2-020	2-021	2-024	2-026	2-028	2-031	2-034
D	BR Wrench Flats	3/4	7/8	1	1 1/8	1 3/8	1 1/2	1 5/8	2	N/A
E	BR Thread Length	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.25	1.00
F	BR Body Height	0.88	1.00	1.40	1.34	1.13	1.33	1.34	1.57	1.34
G	BR Body Diameter	0.82	1.00	1.13	1.25	1.50	1.62	1.75	2.25	2.50
н	BR Vessel Thickness, Drilled	0.50	.56 max	.44 max	.44 max	.48 max	.44 max	.44 max	.69 max	.44 max
1	BR Nut/Washer Assy P/N	241-120	241-625	241-075	241-088	241-102	241-350	241-125	241-150	241-200
J	BR Drilled Hole Diameter	0.52	0.64	0.77	0.89	1.02	1.14	1.27	1.52	2.02
К	BR/OR Nut and Washer Height	0.56	0.36	0.56	0.56	0.52	0.56	0.56	0.56	0.56
L	BR/RCH Combined Height	1.33	1.63	2.06	2.05	1.83	2.05	2.06	2.29	2.04
М	RCH Height	0.86	0.98	1.24	1.23	1.25	1.24	1.23	1.24	1.28
N	Engaging Nut Diameter	0.75	1.06	1.32	1.44	1.56	1.69	1.94	2.25	2.63
0	BR/CP-RA Combined Height	N/A	2.56	3.43	3.36	3.48	3.66	3.12	3.69	3.52
Р	CP to Face Distance, on BR	0.45	0.65	0.89	0.82	0.61	0.79	0.48	1.05	0.59
Q	Engaging Nut Height	0.75	0.78	1.05	1.05	1.05	1.05	1.05	1.05	1.03
R	RA Overmold Height	N/A	1.13	1.49	1.49	1.82	1.82	1.59	1.59	1.90
S	RA Overmold Length	N/A	2.24	3.78	3.78	4.50	4.50	4.49	4.49	5.79
Т	OR Mounting Thread	1/2-20 UNF-2B	9/16-20 UN-2B	11/16-20 UNEF-2B	7/8-20 UNEF-2B	1-20 UNEF-2B	1 1/16-20 UNEF-2B	1 1/4-16 UN-2B	1 1/2-16 UN-2B	2-16 UN-2B
U	OR Shaft Seal Diameter (+.002/000)	0.562	0.625	0.750	0.937	1.000	1.125	1.250	1.625	2.000
V	OR Shaft Seal Depth	0.38	0.43	0.43	0.40	0.40	0.43	0.42	0.43	0.40
W	OR Shaft Seal O-Ring	2-013	2-014	2-016	2-019	2-020	2-022	2-024	2-029	2-032
Х	OR Face Seal O-Ring	2-016	2-017	2-026	2-022	2-024	2-026	2-028	2-132	2-034
Y	OR Wrench Flats	0.75	0.88	1.00	1.30	1.30	1.50	1.62	1.92	N/A
Z	OR Thread Length	1.00	1.00	1.13	1.00	1.00	1.00	1.00	1.25	1.03
BB	OR Body Height	0.88	1.00	1.40	1.34	1.12	1.32	1.29	1.85	1.37
CC	OR Body Diameter	0.93	1.00	1.38	1.38	1.50	1.63	1.75	2.19	2.50
DD	OR Vessel Thickness, Drilled	0.88	.90 max	.95 max	.82 max	.86 max	.82 max	.82 max	1.06 max	.82 max
EE	OR Nut/Washer Assy P/N	241-120	241-562	241-069	241-088	241-102	24I-113	241-125	241-150	241-200
FF	OR/RCL Combined Height	1.07	1.15	1.73	1.62	1.52	1.72	1.75	1.75	1.75
GG	RCL Height	0.60	0.60	1.00	1.00	1.00	1.00	1.05	1.05	1.06
HH	Engaging Nut/PCH Comb. Height	1.07	1.18	1.34	1.53	1.53	1.51	1.63	1.91	1.74
11	Straight Overmold Diameter	0.75	1.11	1.50	1.50	1.50	1.63	1.82	2.02	2.50
IJ	Straight Overmold Length	1.05	2.20	3.39	3.75	3.39	4.43	4.50	5.25	5.75
KK	FR Shaft Seal Diameter (+.002/000)	0.500	0.687	0.750	1.000	1.000	1.000	1.500	1.500	2.000
LL	FR Mounting Screw Size	#4	#4	#6	#6	#8	#10	#10	1/4	1/4
MM	FR Mounting Screw Pattern	0.780	0.906	1.020	1.188	1.186	1.446	1.850	1.768	2.086
NN	FR Shaft Seal Depth	0.50	0.50	0.50	0.50	0.50	0.60	0.50	0.50	0.50
00	FR Shaft Seal O-Ring	2-012	2-015	2-016	2-020	2-020	2-020	2-028	2-028	2-032
PP	FR Face Seal O-Ring	2-016	2-019	2-020	2-024	2-024	2-024	2-030	2-031	2-034
QQ	FR Flange Thickness	0.19	0.19	0.30	0.20	0.15	0.20	0.30	0.25	0.30
RR	FR Body Height	0.68	0.81	1.15	1.20	1.10	1.20	1.16	1.22	1.24
SS	FR Flange Dimension	1.00	1.13	1.25	1.50	1.50	1.75	2.36	2.25	2.62
TT	CP-OF Body Diameter	0.75	1.05	1.05	1.32	1.32	1.50	1.62	2.13	N/A
UU	Oil-Filled Tubing Diameter	1/2	1/2 or 3/4	1/2 or 3/4 or 1	3/4 or 1	3/4 or 1	1	1	1	N/A
VV	CP-OF Overall Length	2.40	2.82	3.17	3.18	3.18	3.54	3.52	3.72	N/A
WW	CP-OF-RA Height	N/A	2.66	3.05	3.19	3.72	3.42	3.42	3.83	N/A
XX	FR/CP-OF-RA Clearance Height	N/A	3.10	3.97	3.94	4.28	4.28	4.05	4.48	N/A
YY	Mating Axial Seal O-ring	2-011	2-014	2-016	2-018	2-019	2-023	2-025	2-029	2-031
ZZ	Receptacle Insert Seal O-ring	2-006	2-014	2-016	2-018	2-019	2-023	2-025	2-029	2-031
AAA	Plug Insert Seal O-ring	2-006	2-012	2-014	2-015	2-016	2-018	2-119	2-026	2-028
BBB	Mating Face Seal O-ring	2-012	2-015	2-018	2-020	2-023	2-025	2-028	2-030	2-033
CCC	OF Adapter Seal O-ring	2-013	2-016	2-018	2-020	2-021	2-023	2-026	2-030	N/A
Note	Note: The face seal O-rings for the Millennium CP shells in sizes 3M, 3O, and 3P have changed with an improved shell design. The improved shells may be identified by their rectangular, machined-in keys. Old style CP shells have round, pressed in									

keys. The face seal O-rings for the old style shells are: 3M: 2-021 30:2-024 3P:2-026

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Materials

- Cable Plug shell: 316 SS, passivated per ASTM A967
- Receptacle shell: 316 SS, passivated per ASTM A967 (standard)
- Titanium Grade 5 (Ti6Al4V) passivated per ASTM B600 also available
- Coupling ring: C54400 Phosphor Bronze per ASTM B139, hard temper H04
- Hardware: 300-series SS

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- Insert: GRE (glass-reinforced epoxy)
- Pins: C36000 Copper
- Sockets: heat-treated C17300H Beryllium-Copper
- Optical Ferrules and alignment sleeves: Zirconia ceramic
- Contact plating: 50µ Au over 50µ Ni per MIL-G-45204 Type II Grade D Class 1
- O-rings: NBR (Nitrile rubber) standard

Temperature Range

- -30°F to +250F° (-34°C to +121C°) with NBR Nitrile O-rings
- -15°F to +329F° (-26°C to +165C°) with optional FKM Viton™ O-rings





Electrical Performance

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BIRNS Millennium electrical connectors are ideal for any high performance subsea system requiring power and fast data transfer. Inserts are available with both high (\leq 3.6 kV) and low (\leq 600V) contact combinations. They provide excellent contact engagement per MIL-STD-39029D, and have insulated solder pots to minimize EMI, noise and cross-talk. Each socket is engineered with heat-treated BeCu for longevity and superior electrical contact, and all contacts have 50µ of hard gold plating for superior data transmission.





As there is not a true "standard" AWG, actual measurements of AWG sizes can vary from manufacturer to manufacturer. The conductors in BIRNS connectors are slightly larger than some standard sizes—we use larger conductors to give more flexibility to the electrical systems of our customers.

Contact	Actual BIRNS Size			Current	Voltage	Max. Wire Ø	
("AWG")	Ø (mm)	Ø (in.)	A (mm ²)	I _{max} (A)	(Max. V)	(mm)	(inches)
22	.76	.030″	.45	2	700	.91	.036″
20	1.02	.040"	.81	4	700	1.02	.040"
16	1.59	.063″	1.98	12	700	1.78	.070″
14	1.98	.078″	3.08	15	700	2.36	.093″
10	3.18	.125″	7.92	33	700	3.18	.125″

Optical Performance

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The series' optical configurations deliver advanced subsea connectivity for demanding applications that require massive data rates—often in a small footprint. They provide combinations of single-mode or multimode fibers, and can be paired in hybrid configurations with both high and low voltage contacts and mechanical load bearing > 50,000 lbs.

- Insertion Loss (per ANSI/TIA/EIA-455)
 Single-mode: .5dB max [typical: .1dB]
 Multi-mode: 1dB max [typical: .25dB]
- Return Loss 35 dB min





Coaxial Performance

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BIRNS Millennium coax connectors feature a superior polyethylene dielectric, making them ideal for GPS-frequency systems, large data and HD video signal applications. A number of shell sizes are available with impedance of 50 or 75Ω and most can be hybridized with electrical contacts and/or optical ferrules.



We've been successfully getting some exciting, groundbreaking testing results on our new coax contacts, which demonstrate open face pressure resistance to 1433m, and a maximum insertion loss of 0.7 dB to 3GHz, with an associated maximum SWR of 1.7:1



3P-1C



3P-2C6

Receptacle Caps

DESTRACT

There are four versions of BIRNS Millennium Receptacle Caps:

- 1. RCL: "Receptacle Cap, Low pressure"—made of Delrin, splash-proof only
- 2. RCH: "Receptacle Cap, High pressure"—made of Brass, proof to 1,000m
- 3. RCH-Ti: "Receptacle Cap, High pressure, Titanium"—made of Titanium, proof to 6,000m
- 4. DSP: "Dummy Sealing Plug"—a modified version of a CP, used for reverse pressure



Reverse Pressure

Receptacle

The BIRNS Millennium Receptacle is front-loaded and designed to withstand the high face pressure it experiences in its standard configuration (BR, OR or FR mounted into a 1-atmosphere pressure vessel). However, in two configurations the Receptacle insert can experience reverse (rear) pressure:

- When the Receptacle is part of an oil-filled cable (CR-OF)
- When the Receptacle is installed on an oil-filled pressure-compensated canister

In these configurations, the Receptacle must not be capped with a RCH. Rather, it must:

- Be mated to a CP or CP-OF
- Remain unmated (open to seawater)
- Be capped with a SPECIAL cap, the "DSP" (Dummy Sealing Plug) which is a special high-pressure cap for the CR-OF. The DSP mimics a CP: when mated to the Receptacle the DSP minimizes the air gap and supports the Receptacle insert.

The DSP is specific to each CR-OF: a 3L-25-DSP mates to a 3L-25-CR-OF, a 3L-7-DSP mates to a 3L-7-CR-OF, etc.

Plug

The BIRNS Millennium Plug is designed to withstand high 'rear' pressure because it is usually in a standard configuration (CP or CP-OF) and is mated to a receptacle. To withstand high rear pressure, the Plug insert is rear-loaded. When installed in an oil-filled cable assembly, the CP-OF can withstand 100 bar while capped with the PCH.

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Key Options

As the BIRNS Millennium series is specifically engineered for challenging power and signal applications and systems requiring electro-opto-mechanical solutions, keys for the series are designed to meet these demands while providing ease of use. The keys are fully machined, as opposed to commercially available press fit versions, and feature a squared silhouette, providing maximum strength and making the keying process more seamless, secure and user-friendly. Users have the option of a third key, providing purposeful incompatibility of different positions between the same connector with different circuits. This precludes inadvertent mis-connection in the field when more than one of the same connector—with the same pin configurations but different circuits, for example—are being used in a subsea system. The optional third key can be specified in one of three positions, which are designated by part number nomenclature: K2, K3, or K4.

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Standard Key (<u>Not</u> Key Option 1)



Key Option 3

Note: Face of cable plug shown. Receptacles are mirror image.





Key Option 2



Key Option 4

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EOM Terminations

BIRNS' Electro-Opto-Mechanical (EOM) cable assemblies provide immense performance capabilities and are developed with precision to preserve the integrity of the delicate optical fibers. They deliver huge levels of power, signal and data and withstand extreme environments, while capable of providing load strengths of > 50,000 lbs.

Whether your system requires steel, Kevlar, Vectran, or other strength members, SM or MM fibers, low or high voltage electrical conductors—BIRNS can engineer a custom EOM solution for you.



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Technical/Warranty

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