



BIW Connector Systems



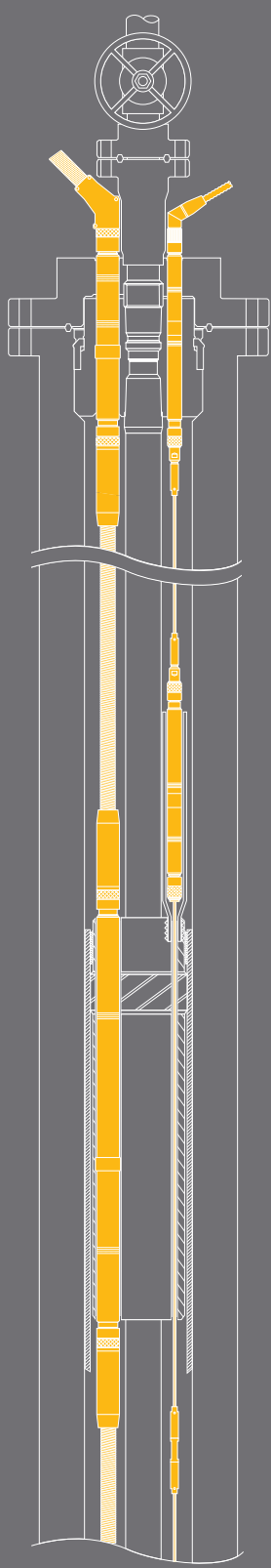
Electrical Feedthru Systems for Oil and Gas Wells

BIW Connector Systems®

BIW Connector Systems, a part of ITT since 2001, is the pioneer supplier of electrical connector systems used by the petroleum industry in applications that include electrical submersible pumps, oil and gas reservoir monitoring instruments and downhole heaters. These pressure and safety barrier products have been supplied since 1973.

State-of-the-art engineering and production capability combined with high performance elastomeric and thermoplastic technology provide customers with robust products that perform reliably in harsh environments. BIW Connector Systems supplies the industry with the widest range of products manufactured under ISO 9001-2008 and ATEX certified quality and manufacturing systems, setting the standard for quality, reliability and ease of installation. A culture of forward-looking innovation and resourcefulness promotes continual process and product improvement and new system development.





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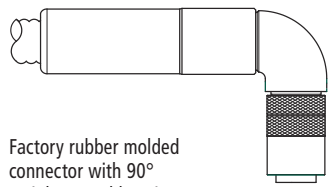
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Testing and Analysis Capability

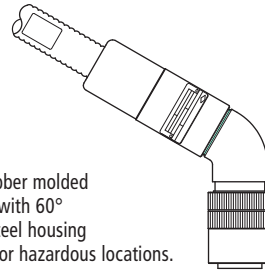
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Surface Connectors

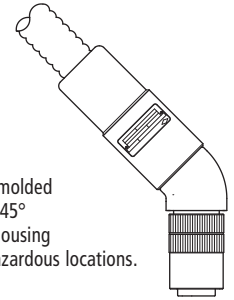
Safe, long-lasting, separable surface power connectors are available in a variety of shapes to fit any wellhead and cable installation space requirement.



Factory rubber molded connector with 90° stainless steel housing, approved for hazardous locations.



Factory rubber molded connector with 60° stainless steel housing approved for hazardous locations.

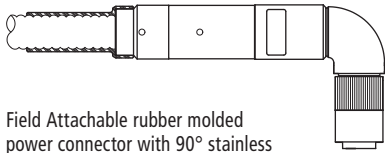


Factory rubber molded connector with 45° stainless steel housing approved for hazardous locations.

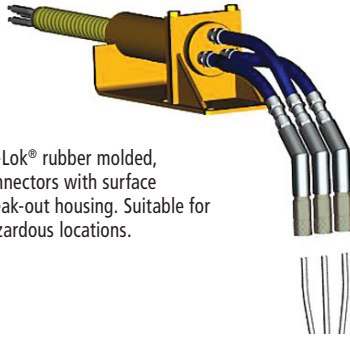
Features and Benefits

- Standard power system ratings for ESP applications up to 5kV, 215A.
- Temperature ratings from -55° to 300° F. Special designs rated up to 450° F.
- Surface equipment for downhole heaters rated to 2.4kV, 215A.
- Nickel aluminum bronze coupling nuts with knurled exteriors allow firm grip.
- Copper socket contacts with louvered spring contact bands provide highly efficient and durable electrical connections.
- Advanced proprietary elastomeric compounds perform insulation and sealing functions reliably in oil and water environments.
- Some systems feature designs composed of PEEK or molded rubber construction that permit fast assembly in the field.
- Heavy-duty metal housings help protect connectors and extend run life.
- Numerous angle options allow fitting to a variety of wellhead and “christmas tree” configurations.
- CAPTOR® design is available for power connectors. This design features a metal-to-metal keying system. This eliminates damage associated with over-tightening when connector is mated to the feedthru or from extreme bends in the cable.
- Third-party-approved 5kV explosion proof connectors are available with National Electric Code (NEC) compliant, UL approved, three conductor MV 105 metal clad hazardous location cable with shielded conductors.
- Surface cable length can be modified to suit location of junction box or power supply.
- The available Lipseal™ is an integrally molded peripheral seal in the connector that seals on a smooth shoulder on the feedthru shell.

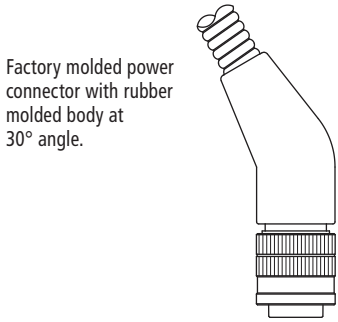
Surface Connectors



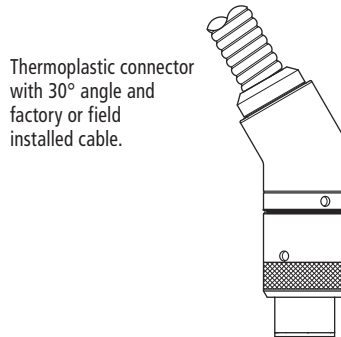
Field Attachable rubber molded power connector with 90° stainless steel housing. Approved for hazardous locations



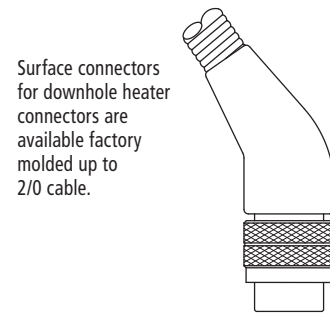
Tri-Lok® rubber molded, connectors with surface break-out housing. Suitable for hazardous locations.



Factory molded power connector with rubber molded body at 30° angle.



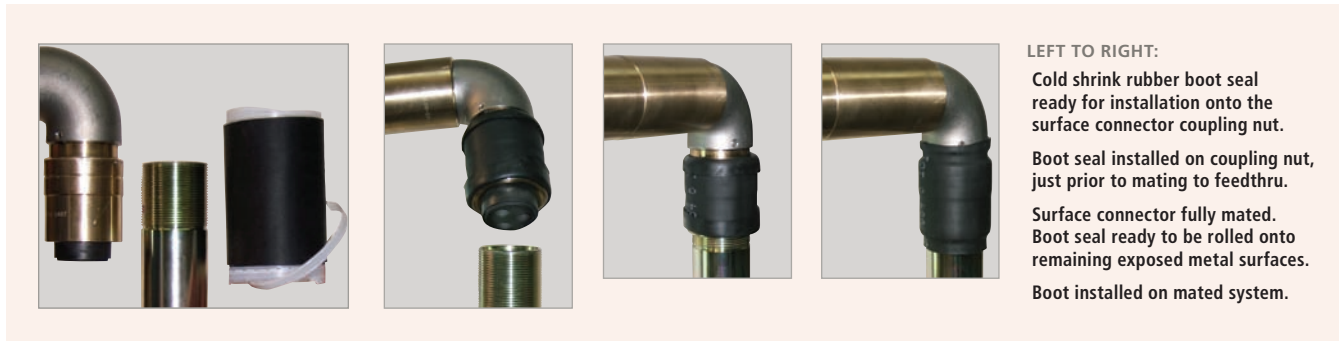
Thermoplastic connector with 30° angle and factory or field installed cable.



Surface connectors for downhole heater connectors are available factory molded up to 2/0 cable.

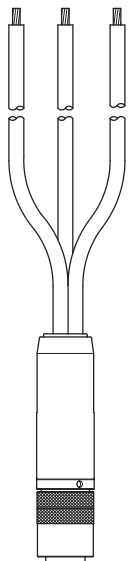
Accessories

Rubber boots are available to protect engagement threads from corrosion, allowing easy un-mating of connector.



LEFT TO RIGHT:
Cold shrink rubber boot seal ready for installation onto the surface connector coupling nut.
Boot seal installed on coupling nut, just prior to mating to feedthru.
Surface connector fully mated. Boot seal ready to be rolled onto remaining exposed metal surfaces.
Boot installed on mated system.

Locking mechanisms are available to prevent unauthorized or accidental un-mating of energized connectors.

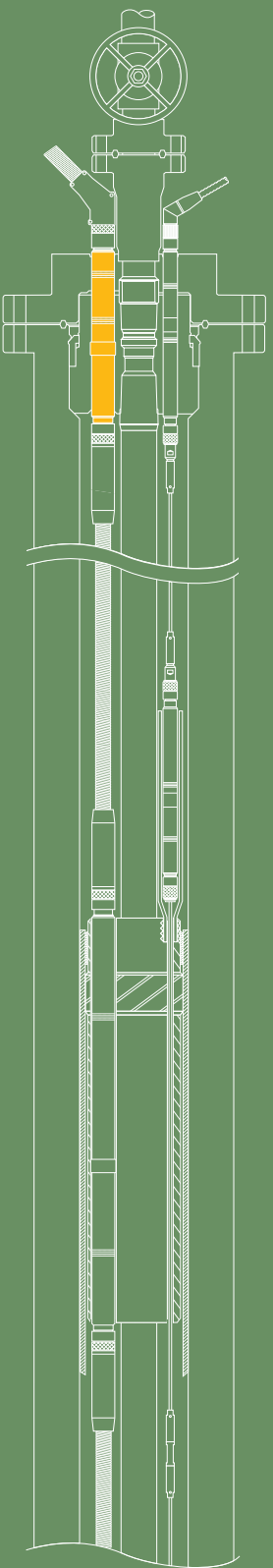


Test connectors are available to safely mate to the feedthru to be tested. Use of this connector prevents flash-over across the feedthru pins. These units include a factory molded, customer specified length of cable prepared for connection to test leads.

Surface Test Connector

Wellhead Feedthrus

The feedthru portion of the system provides a fluid block at the wellhead permitting electrical power to pass safely and reliably through the well's pressure barrier. BIW Connector Systems works with the wellhead manufacturer to assure proper fit and material compatibility. New configurations are continually being developed to meet specific customer requirements.



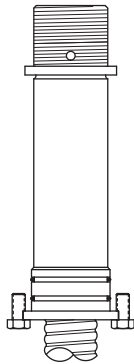
Thread-in Design
Feedthru seals in the tubing hanger and the adapter flange with O-rings and is held in place with threads on the metal shell.



Drop-N-Lok™ Design
Feedthru uses metal-to-metal seals backed up with O-rings and is held in place with a retaining nut pulling against a machined shoulder on the metal shell using the Drop-N-Lok design.



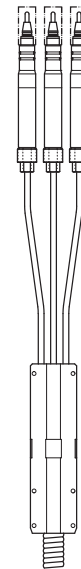
Drop-N-Lok Design
Downhole cable is factory molded to lower end of feedthru. This feedthru is stabbed in from the top and is held in place with a retaining nut using the Drop-N-Lok design.



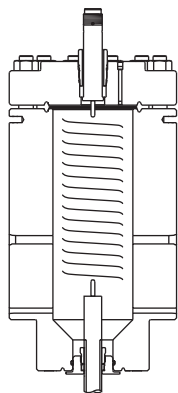
E-Zee Feed®
Feedthru stabs into tubing hanger from lower side and is held with bolts from the bottom and an upper retaining nut. This feedthru can be supplied as a field attachable kit, eliminating a downhole splice.



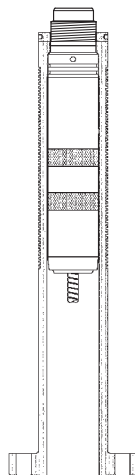
Safe-T-Lok®
Feedthru is molded to cable at both ends.



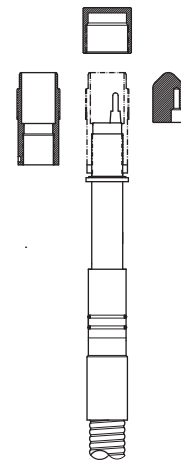
Tri-Lok®
In situations where the tubing in the wellhead must be centralized, the Tri-Lok system can be used. Shown is the version where separate single pin feedthrus are used to provide pressure barriers for each of the three power conductors. Note that with this one-piece factory molded cable breakout assembly, installation is quick and the surface connector system (see page 5) can be prepared for easy installation before the blow-out preventer (BOP) is removed. Also available is a version using three, 3/8" Duplex tubes through the wellhead.



Coiled Tubing Application
Feedthru is installed onto flexible cable in the field for coiled tubing applications.



High Temperature Application
Feedthru is terminated onto downhole cable in the field and is then installed in a stand-off adapter used for cooling the feedthru (F/T) in steam injection applications. The F/T assembly is then locked with a retaining nut.

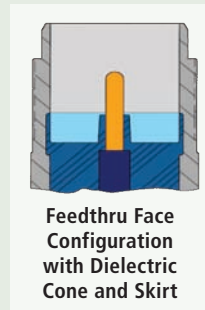


Kwik-Lok®
Removable surface connector interface allows narrow metal shell with lower molded cable to be stabbed through the tubing hanger from the bottom and retained with a threaded nut on the top side. This can be used when 3/2" tubing is used with 7" casing.

Wellhead Feedthrus

Features and Benefits

- Standard power system ratings for Electrical Submersible Pump (ESP) applications up to 5kV, 215A.
- Feedthrus for downhole heaters rated to 2.4kV, 215A.
- Temperature rating from -55° to 300° F. Special designs rated up to 450° F.
- Pressure ratings to 5,000 psi. Designs are type tested to 13,500 psi.
- Heavy-duty metal shells prevent collapse from high pressure well conditions and are a key element in maintaining a fluid barrier at the wellhead. The final assembly assures safe, reliable delivery of electrical power to downhole applications.
- Internal construction features solid copper conductors, state-of-the-art insulation and strong pressure barrier materials that combine to deliver reliable performance. The feedthru face design features extended dielectric protection.
- O-ring materials are available in Viton[®]*, AFLAS^{®**} or other compounds upon request to assure reliable sealing in a variety of conditions.
- Standard shell material is 4130/4140 alloy steel that meets NACE MR 0175 and API specifications for strength and resistance to sulfide stress cracking. All feedthru shells are also available in corrosion-resistant materials as required.
- The available CAPTOR metal keying system results in a very strong feedthru/connector interface.
- Drop-N-Lok feedthru shell designs are available that allow the tubing hanger to be manufactured without threads to hold the feedthru in place. Use of this design reduces costs and eliminates damaged threads.



CAPTOR Interface



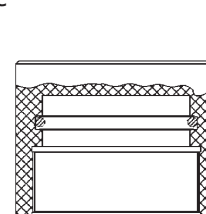
Hundreds of feedthru options are available.

Accessories

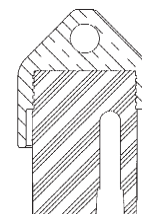
“Dummy” mandrels with identical profiles as the actual feedthrus are available in solid metal for stack-up and pressure tests of wellheads. They are also used to seal the feedthru bore prior to installation of the ESP.

Pressure and thread protector caps are available for use on the upper end of feedthrus during installation and BOP pressure tests.

- The pressure cap seals out fluids during BOP tests, keeping the feedthru face clean.
- The bullnose cap in NI/AL bronze guides the adapter flange safely over the feedthru during its installation.



Pressure Cap



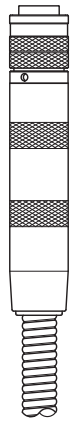
Bullnose Protective Cap

*VITON is a registered trademark of DuPont.

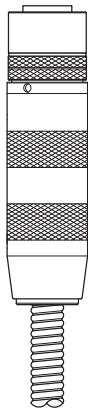
**AFLAS is a registered trademark of Asahi Glass Co.

Downhole Connectors

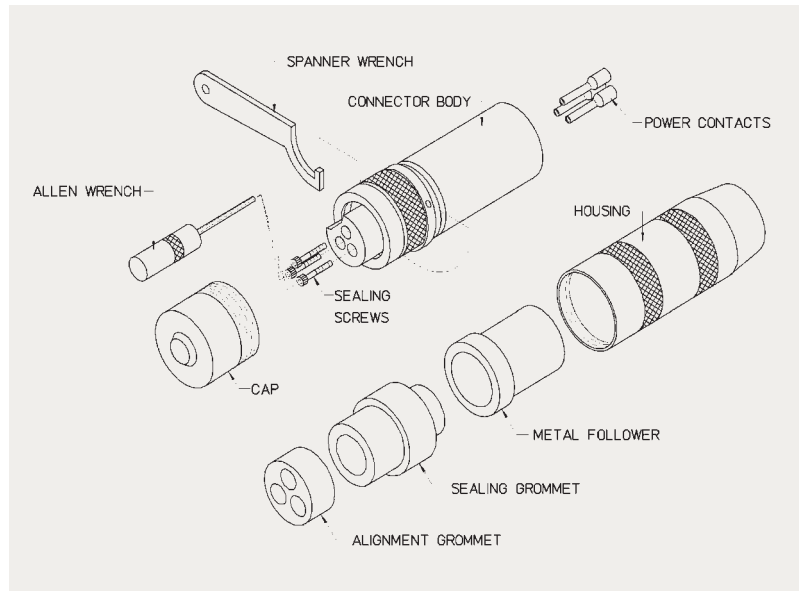
The downhole connectors are protected with robust metal shells and are available with factory molded cable “pigtails” or are Field Attachable onto the power cable. These reliable, long-lasting, easy-to-install connectors protect the electrical circuit from downhole fluids.



Factory Molded connectors can be supplied with customer specified round or flat cables from NO. 6 AWG up to 2/0.



Field Attachable connectors are available for round or flat cables in sizes from NO. 6 AWG up to NO. 1 AWG.

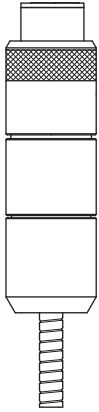


Components of Rubber Molded Field Attachable Connector for Round or Flat Cable

Features and Benefits

- Standard power system ratings for ESP applications up to 5kV, 215A.
- Connector equipment for downhole heaters rated to 2.4kV, 215A.
- Temperature rating from -55° to 300° F. Special designs rated up to 450° F.
- Copper socket contacts with louvered spring contact bands provide highly efficient and durable electrical connections.
- Advanced proprietary elastomeric compounds perform insulation and sealing functions reliably in oil, water and gas environments.
- Field Attachable connectors (both the elastomeric compound and PEEK designs) save rig time because their use eliminates the more time-consuming cable splices.
- Heavy-duty metal housings provide mechanical protection for the electrical components.
- The available Lipseal provides superior sealing in both high- and low-pressure conditions.

Downhole Connectors

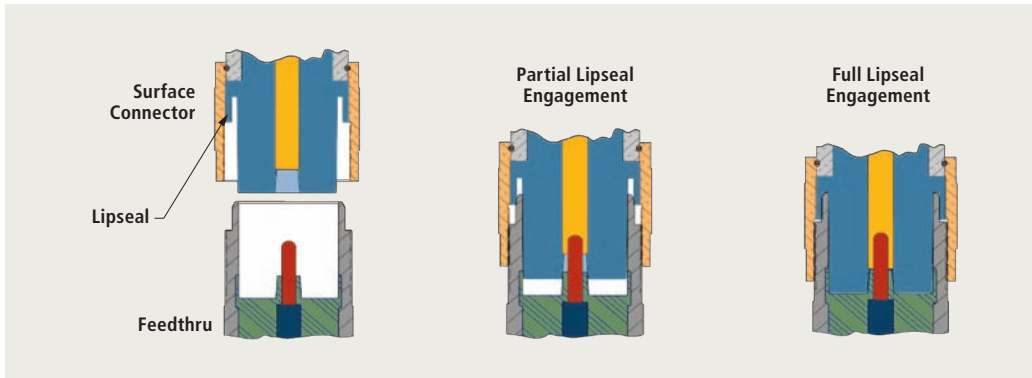


Field Attachable connectors are available with PEEK construction. Kits are available for round or flat cables in sizes from NO. 4 AWG up to NO. 1 AWG. The length of the housing is shorter than other styles of Field Attachable or Factory Molded connectors. This has proven to be useful when space is limited below the wellhead tubing hanger.



Field Attachable Connector with PEEK Construction

Lipseal



Lipseal Engagement Steps

Accessories

A field attachable male/female in-line connector assembly is available for use as a replacement for three conductor cable splices. With a 2.5" OD, these 15" long assemblies can be safely used below the off-set tubing hangers and above and below the off-set packers used in ESP completions.

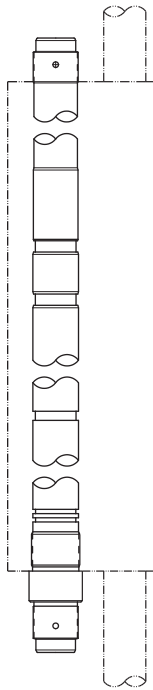
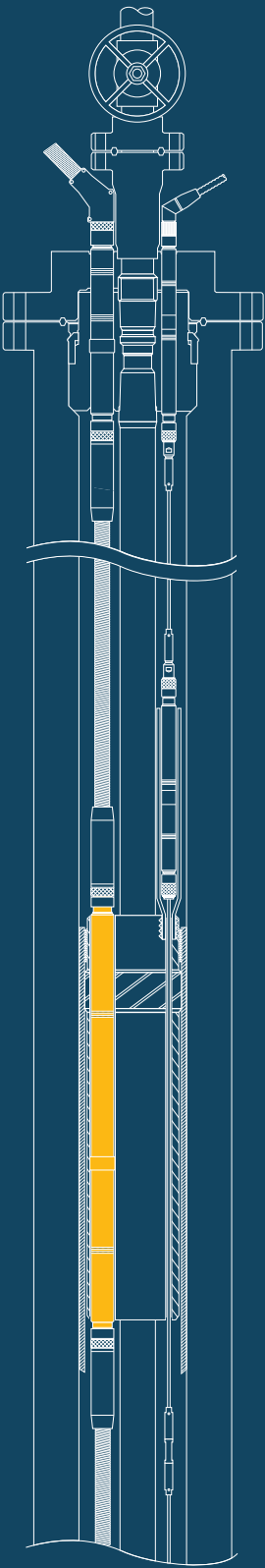
Refurbish kits and parts are available for some Field Attachable connectors.



A Field Attachable Male/Female In-line Power Connector Assembly

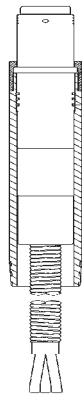
Packer Feedthrus

The packer feedthru portion of the system provides a fluid barrier at the packer permitting electrical power to pass safely and reliably through the packer and down to the ESP motor or downhole heater. BIW Connector Systems works with packer manufacturers to assure proper fit and material compatibility. New configurations are continually being developed to meet specific customer requirements.



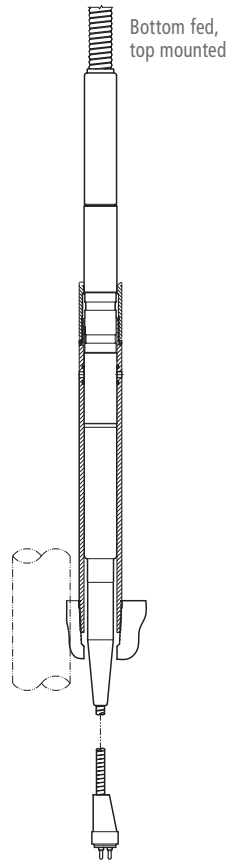
Integrally Mounted Design

Feedthru seals in the packer with O-rings and is held in place with threads or retention rings on the metal shell. This configuration allows use of connectors above and below the packer.

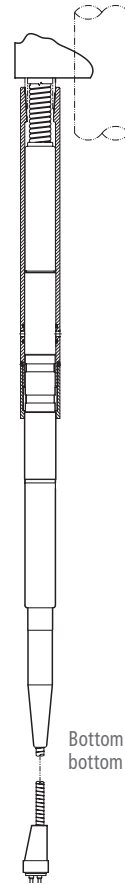


Drop-N-Lok Design

Power cable is factory molded to lower end of feedthru. This configuration requires a crossover adapter and the cable must be spliced to the power cable or MLE below the packer. Adjustment slots are available to take slack out of cable after splicing.



Bottom fed, top mounted



Bottom fed, bottom mounted

Drop-N-Lok Design

Cable is factory molded to feedthru shell at top and bottom. Crossover adapter has adjustment slots to take slack out of cable after splicing. Systems shown are factory molded on the bottom side to customer supplied motor lead extensions with potheads.

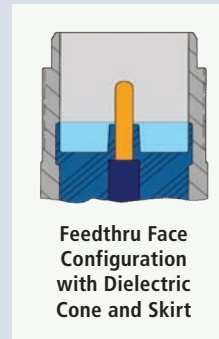
Lower end of integral packer power feedthru. When the red dot on the threads is covered by the downhole connector, the system is fully mated.



Packer Feedthrus

Features and Benefits

- Standard power system ratings for ESP applications up to 5kV, 215A.
- Temperature rating from -55° to 300° F. Special designs rated up to 450° F.
- Pressure ratings to 5,000 psi. Designs are type tested to 13,500 psi.
- Heavy-duty metal shells prevent collapse from high pressure well conditions and are a key element in maintaining a fluid barrier at the packer. The final assembly assures safe, reliable delivery of electrical power to downhole applications.
- Internal construction features solid copper conductors, state-of-the-art insulation and strong pressure barrier materials that combine to deliver reliable performance in harsh downhole conditions. The feedthru face design features extended dielectric protection.
- O-ring materials are available in Viton, AFLAS or other compounds upon request to assure reliable sealing in a variety of downhole conditions.
- Standard shell material is 4130/4140 alloy steel that meets NACE MR 0175 specifications. All shells are available in other corrosion-resistant alloys.
- Packer systems are available for use with round or flat cables from NO. 6 AWG up to NO. 1 AWG and can service a wide range of downhole ESP or heater requirements. In situations where the tubing must be centralized in the packer, a Tri-Lok® system is available that allows three separate power conductors in 3/8" Duplex tubes to pass through the packer. Further details and drawings available upon request.
- Drop-N-Lok packer feedthru shell designs are available that allow feedthrus with molded cable "pigtailed" to be held in place with a retaining nut. Because there is no need to turn the entire assembly during installation, time is saved and there are no threads to be damaged.

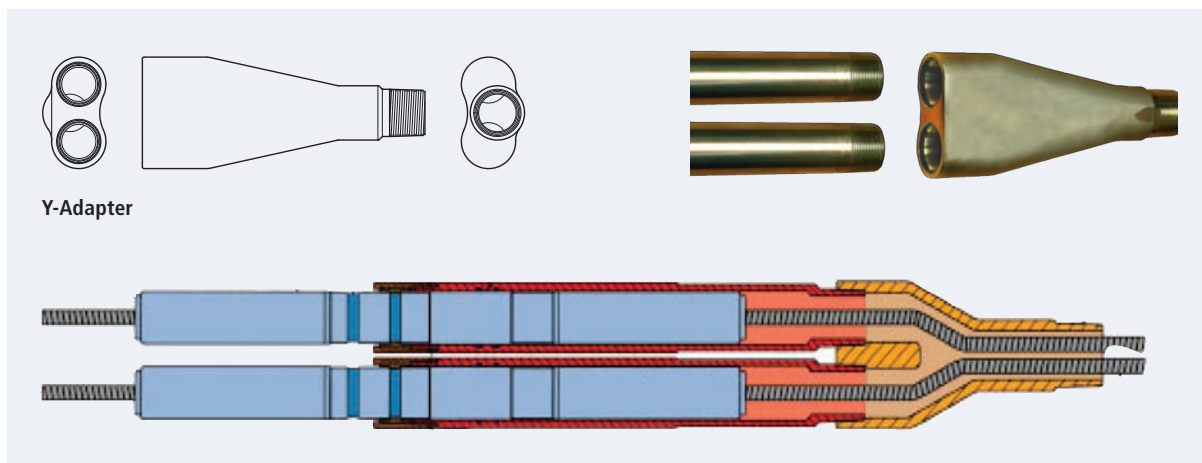


Accessories

"Dummy" mandrels with identical profiles as the actual feedthru are available in solid metal for stack-up and pressure tests of packer assemblies. They are also available to seal the feedthru bore prior to installation of the ESP.

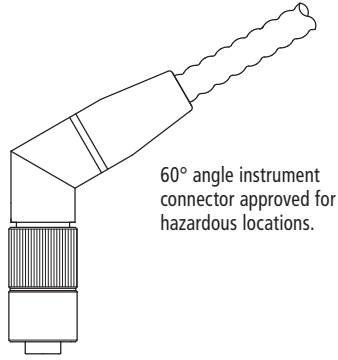
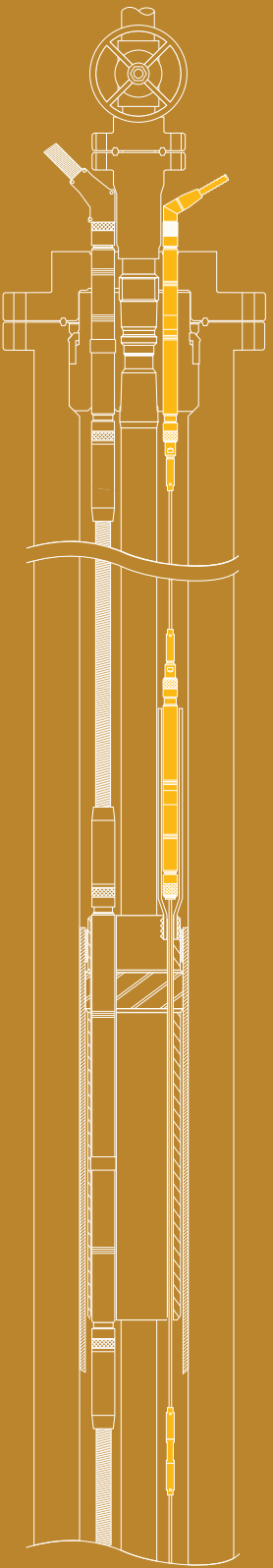
Dual ESP Completions

This Y-adapter allows the use of standard ESP packers when two ESP systems are deployed.



Smart Well Feedthrus and Connectors

Instrumentation feedthrus and connectors satisfy the growing need to safely and reliably obtain well data and to electrically activate subsurface valves.



60° angle instrument connector approved for hazardous locations.



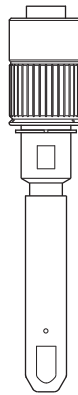
Straight instrument connector with a stainless steel housing. Approved for hazardous locations..



Feedthru seals in the tubing hanger and the adapter flange with O-rings and is held in place with threads on the metal shell.



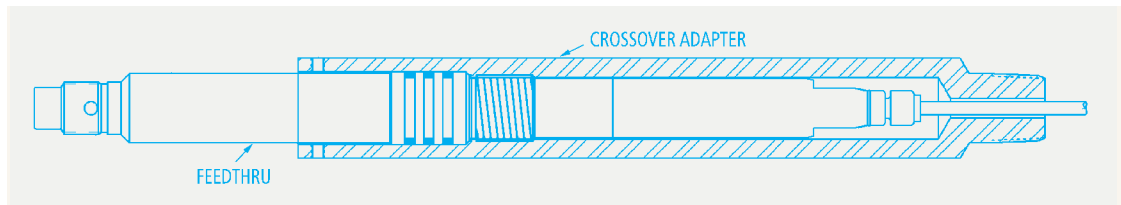
Feedthru uses metal-to-metal seals backed up with O-rings and is held in place with a retaining nut pulling against a machined shoulder on the metal shell.



Field attachable connectors are supplied for use with 1/4" metal clad, one or two conductor I-wire cable. The external seal to the 1/4" tube can be verified before running this connector into the well.



Instrument packer feedthru has factory molded lower cable and a crossover adapter (not shown) to fit the top end of the packer. Splice assemblies are also available to join the cable from the packer feedthru to the I-wire cable below the packer.



Smart Well Packer Feedthru with Crossover Adapter

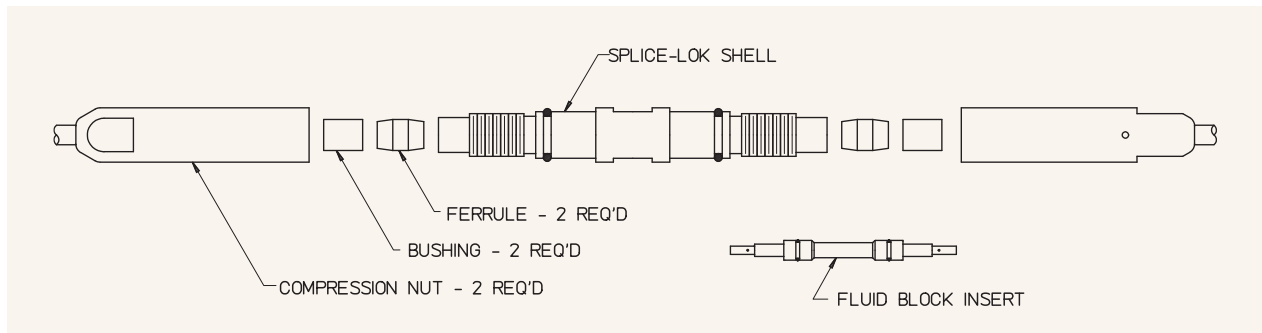
Smart Well Feedthrus and Connectors

Features and Benefits

- Smart well feedthrus and connectors are rated 600 Volts, 15A.
- Pressure ratings to 5,000 psi. Designs are type-tested to 13,500 PSI.
- Temperature ratings from -55° to 300° F.
- For higher ratings, contact BIW.
- Heavy-duty metal feedthru shells prevent collapse from high pressure well conditions and are a key element in maintaining a fluid barrier at the wellhead and packer.
- Standard feedthru shell material is stainless steel that meets NACE MR 0175 and API specifications for strength and resistance to sulfide stress cracking. All feedthru and connector shells are also available in other materials as required.
- O-ring materials are available in Viton, AFLAS or other compounds upon request to assure reliable sealing in a variety of conditions.
- Feedthru internal construction features solid copper conductors, state-of-the-art insulation and strong pressure barrier materials that combine to deliver reliable performance.

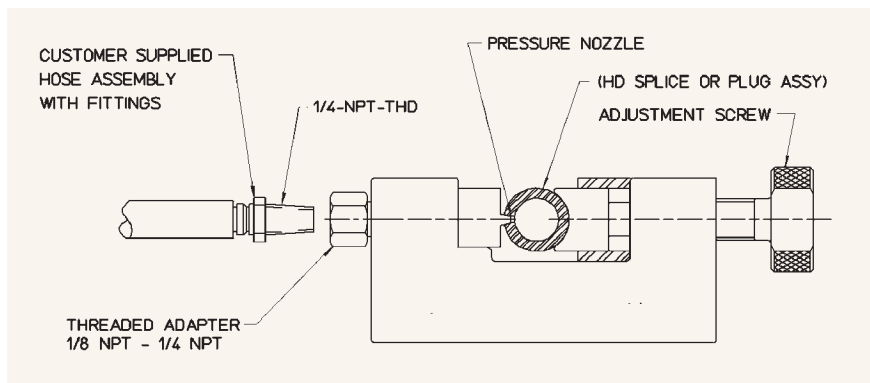
Accessories

Splice assemblies available in stainless steel and Inconel for use with 1/4", metal-clad instrument cables.



Metal Clad Instrument Cable Splice Assembly with Fluid Block Insert

A pressure test fixture is available to permit verification of metal-to-metal seals used on Field Attachable connectors and splice assemblies prior to installing them in the well.



Test Fixture

Field Support

BIW Connector Systems has a team of field training personnel available for providing: ongoing field service technician training; train-the-trainer instructions at OEM headquarters and regional locations; and assistance with installation of new BIW Connector Systems products.



Field Service Technician Training

Instruction is provided in the processes used in assembling Field Attachable connectors, as well as proper installation of wellhead and packer feedthrus and downhole power and instrument connectors. Certificates of completion are provided and records maintained of all such training.

Train-the-Trainers

Because most of the equipment that BIW Connector Systems supplies to the oil recovery industry is installed by field service personnel from the various electrical submersible pump (ESP) companies, BIW Connector Systems is committed to providing in-depth instruction to the training personnel at the OEM training bases and key service centers around the world.

Installation Training

BIW Connector Systems continues to develop new products and has on-going collaboration efforts with customers at their research centers and field locations. BIW Connector Systems field service or engineering personnel are provided to assist with the installation of new products wherever necessary. This support drives the flow of information so that "best practices" are used in the installation process and feedback is obtained from the field to further improve the products.



TOP LEFT: Teaching field service technicians.

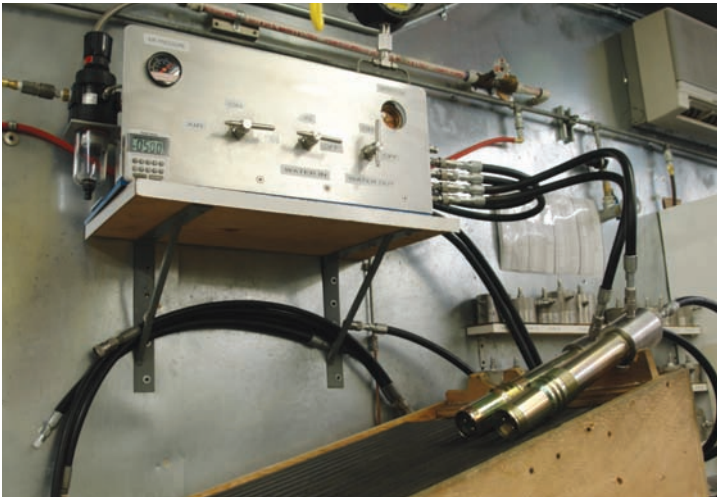
TOP RIGHT: Installation of BIW wellhead feedthru equipment in a Long Beach Oil and Development Company steam flood project in Southern California

CENTER: A trainer instructional session.

BOTTOM: Wellhead fit-up test of BIW feedthru in a Singapore-based facility. Note bullnose cap on feedthru.

Testing and Analysis Capability

BIW Connector Systems commits engineering and lab resources to ongoing R & D efforts, as well as using field operational feedback to develop new products and improve existing equipment.



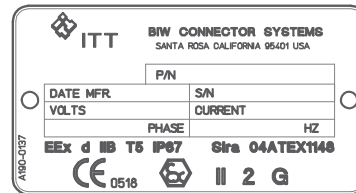
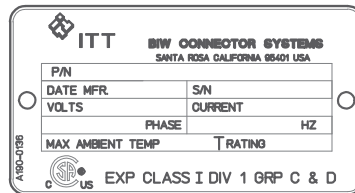
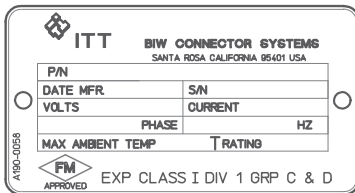
LEFT: Hydrostatic pressure tests are run on 100% of BIW wellhead feedthrus.

ABOVE: Analysis of returned equipment allows for product improvement and better training of field personnel.

Quality Programs and Approvals

All equipment is manufactured under the BIW Connector Systems' ISO 9001-2008 and ATEX certified quality programs.

Explosion proof approvals to USA (NEC), Canadian (CSA), European (ATEX) and other international standards have been issued by third party testing/approval agencies such as: Factory Mutual, CSA, SIRA, ISSeP and CEPEL.

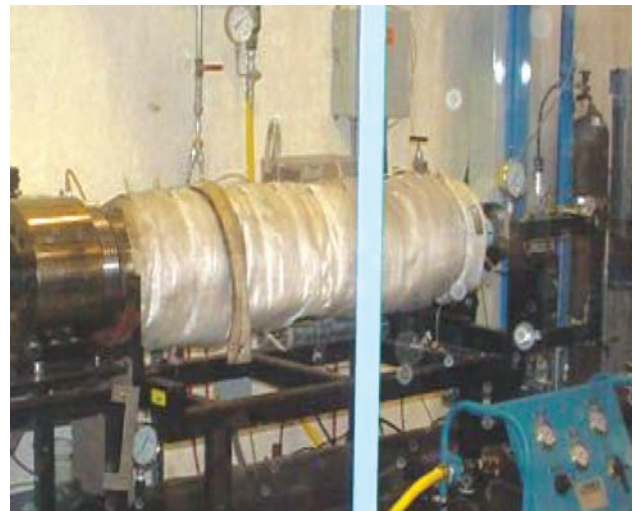


Examples of Labels showing approvals for hazardous locations

Test Equipment

The BIW Connector Systems test equipment at the Santa Rosa, California facility includes the following:

- **Pressure Testing**
 - 7,000 psi at 450° F in diesel/water/nitrogen mix
 - 19,000 psi at room temperature in water
- **Electrical Testing**
 - Dielectric withstanding to 75kV
 - Insulation resistance
 - 600A heat rise
- **Environmental Testing**
 - Salt spray testing
 - Temperature testing from -40° to +21,00° F



Pressure Test Vessel shown behind safety shield.

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The BIW quality system is certified under ISO 9001:2008.

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