

White Paper Series – Part III:

OIL AND GAS CONNECTION SOLUTIONS

EXTREME ENVIRONMENTS | COMPLEX REQUIREMENTS

CUSTOM INNOVATIONS
CONNECTOR + CABLE

EXECUTIVE SUMMARY

Continuing LEMO and Northwire's collaborative white paper series is an in-depth analysis of the extreme environmental factors and electrical, mechanical, regulatory, and end-user demands of the oil and gas industry. These fuel sources continue to be dominant players in energy production around the world, and the extraction and refinement of oil and natural gas is constantly being examined and improved to increase efficiency and lower costs. Whether you are operating in the Alaskan cold or Middle Eastern heat, far offshore or underground, exposed to the elements or in a demanding plant environment, reliability is critical. LEMO and Northwire offer proven cable and connector solutions that deliver high performance and durability through extreme environments and complex requirements.

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VALUABLE INVESTMENTS FOR ISOLATED ENVIRONMENTS

Whether standing in a remote North Dakota field, far offshore on the ocean, or deep underground, the machinery used to reach oil and gas reserves faces many challenges. These systems may be isolated, needing to be operated remotely. In most cases, the equipment is subject to severe conditions and extreme elements. What all of these sites have in common is the need for high performance, rugged durability, and total reliability.

Many purchasing managers and key decision makers are focused on the immediate bottom-line impact of the critical components and equipment needed for wells, pipes, and rigs. Avoid this narrow-minded view by considering the total cost of ownership. A price-centric perspective often overlooks:

- **Product quality**
- **Service quality**
- **Labor and training costs**
- **Installation difficulty**
- **Risk management and safety**
- **Repair and replacement costs**

A long-term approach to profitability and overall success can save managers a headache down the road. Choosing a supplier based on subject matter expertise, compliance and certifications, and relevant industry experience delivers lasting cost savings. Minimize expensive repairs, labor, and liability in the future by committing to a quality investment with a trusted design and manufacturing partner.



CASE IN POINT: WEST TEXAS WELL'S WIND WOES

A distant oil well became a looming problem for one project manager. Isolated in a field in West Texas, the remotely monitored well was suffering from increased downtime. An eight-hour drive was required to check on the well in person, so any interruption to productivity resulted in significant time and profit losses.

The problem came down to an issue with the cable that powered and controlled the equipment. Strong winds blew the cable into the machinery's moving parts, where it became caught and damaged. Northwire redesigned the cable to fit the specific needs of the oil well and its location, creating a high performance retractable cable that stayed in place. Additionally, EMI shielding and oil resistance offered extra protection against the environment. The project manager's investment in cable assemblies tailored to a specific application decreased reoccurring repairs, high downtime, and the need for long drives while restoring productivity and profitability to the well.



CUSTOM SOLUTIONS SOLVE “ONE SIZE FITS ALL” FAILURES

Off-the-shelf products are a tempting option when immediate cost savings and ease are the goals. For a while, these components may function as advertised. Eventually, however, the hidden downsides of “standard” parts will arise. Whether they are quickly obvious after a difficult installation or are not discovered until an inferior material or manufacturing non-conformance requires hours of extra work, these short-term fits rarely turn into long-term solutions.

Ensure that your unique project requirements translate into exact product specifications by relying on custom components precisely designed and manufactured by Subject Matter Experts (SMEs). The SMEs at LEMO and Northwire examine specific usage needs, environmental challenges, relevant certifications, and other critical-to-quality factors when creating custom cables, connectors, and cable assemblies.

Once a comprehensive needs analysis has taken place, LEMO and Northwire leverage rapid prototyping capabilities to compare design variations, validate specific materials, and test cable systems to conditions beyond their real world use. The result is a field-proven product that provides streamlined integration with existing equipment, adherence to necessary standards, and a reliable long lifetime to support vital systems.



CASE IN POINT: CANADIAN RIG RECEIVES ADDED LIFE

One Canadian drilling rig manager finally had enough with cabling that constantly seemed to be on its last legs. Standard coil cords used in the rig's machinery were failing after minimal use.

When Northwire was brought into the project, its SMEs identified high temperatures caused by friction in the inner mechanisms as the primary reason for the quick failure of the coiled cables. Equipped with years of experience working on both retractable coiled cords and components utilized in the oil and gas industry, Northwire's SMEs designed and tested a new retractile cable that was resistant to extreme temperatures.

Integrating high temperature resistant materials into the cable system greatly improved the product's useful lifetime, allowing the drilling rig to maintain the desired level of productivity. Creating a custom cable that addressed application-specific challenges saved the drilling rig manager from a constant stream of replacements and repairs.

RUGGED RELIABILITY FOR EXTREME ENVIRONMENTS

Leveraging decades of expertise and a global resource base, LEMO and Northwire understand the unique difficulties that must be overcome when designing and manufacturing components for the oil and gas industry. Every minute of downtime costs money, and equipment is often vulnerable in isolated, harsh conditions as well as complex and demanding industrial facilities.

To optimize these critical systems, LEMO and Northwire offer customizable products ideal for applications including a variety of:

- Oil rigs and drilling wells
- Offshore oil platforms
- Remote subsea wells
- Natural gas drilling rigs
- Pipeline transport stations
- Oil and gas refineries
- Processing plants
- Measuring and testing equipment

Due to the diversity within these systems, and the significant role that cables, connectors, and cable assemblies play within the systems, rugged reliability is of utmost importance. These essential components are required to stand up against extreme environmental elements such as:

- Crude oil and natural gas
- Strong winds and inclement weather
- Extreme high and low temperatures
- Fresh and salt water spray
- Underwater and shipboard conditions
- High flex and continual motion
- Corrosion and chemicals
- Mechanical lubricants
- High pressures
- Underground conditions
- UV rays
- And more

From sensitive communication setups and complex control systems to powerful drill components and robust industrial automation, choose the cable and connectors trusted to deliver high performance and long life in the most severe environments.



CASE IN POINT: UV ADDITIVE PREVENTS “SUNBURN”

Outdoor oil and gas machinery faces a wide range of environmental enemies. In addition to wind, water, and weather, UV rays present a challenge to these systems. UV rays degrade cable assemblies over time and cause discoloration, cracking, and even disintegration in some cases. Additionally, UV ray damage makes the cable more vulnerable to abrasion and other elemental exposure.

To prevent this damage and extend the lifetime of cable jacketing, an oil rig cable supplier came to Northwire for help. Northwire's SMEs worked with the supplier to develop a custom UV additive that protected the cable assemblies from the effects of direct sunlight and increased the products' lifespan.

REPLACING RUBBER IS NOW AN OPTION

Power and communication cables in harsh environments require more rugged jacket materials. A failure of materials could be catastrophic to life and environment. While rubber has historically been used due to its oil, chemical, abrasion, and cut resistance capabilities, current engineered TPEs can equal or in some instances surpass this performance. See how Northwire's TPE jacketed products compare:

Arctic rated materials offer superior flexibility and a low cost alternative to rubber. Northwire's <i>innovative solutions</i> are available with the industry's fastest lead times of 5, 10, and 15 days compared to typical lead times of 8-16 weeks for rubber products.			
BENEFITS:			
Northwire's extreme cold temperature materials are over-mold and assembly compatible with a long life expectancy. A wide variety of options are available for shield, over-braid, foil, composite and custom designs including retractability and flexibility. Proven performance in cold climates where high reliability is required. Standards, agency and environmental compliance include UL 1309, CSA 245, IEEE 1580 and compliant to ABS, NFPA and ANSI standards. Custom color options available, including exact matches to Pantone or RAL numbers.			
DYNAMIC RANGE OF USE:	Material Options		
Aboard offshore and fixed oil drilling rigs			
Marine environments	Neoprene	CPE	TPE
FEATURES			
Signal	✓	✓	✓
Control	✓	✓	✓
Instrumentation	✓	✓	✓
Low Power Distribution	✓	✓	✓
ATTRIBUTES			
Material Type	Thermoset	Thermoset	Thermoplastic
Low-Temperature Rating	-40°C	-40°C	-55°C
High-Temperature Rating	90°C	90°C	90°C
Cold Bend	-40°C	-40°C	-55°C
Cold Impact	-	-	-40°C
Flame Retardant	FT4/IEEE 1202 Vertical Tray	FT4/IEEE 1202 Vertical Tray	FT4/IEEE 1202 Vertical Tray
Wet Location Use	✓	✓	✓
Oil Resistance	✓	✓	✓
Oil Resistant to Marine Standards	✓	✓	✓
Washdown Resistance	✓	✓	✓
Chemical Resistance	✓	✓	✓
Sunlight/UV Resistance	✓	✓	✓
1,000 Hour Weatherometer Compliance	-	-	✓
Weld Flash Resistant	✓	✓	✓
Weld Slag Resistant	✓	✓	✓
FLEXIBILITY			
Torsional Flex	✓	✓	✓
Rolling Flex	✓	✓	✓
Variable Flex	✓	✓	✓
Bend Flex	✓	✓	✓
Radial Flex	✓	✓	✓
Continuous Flex	✓	✓	✓
STANDARDS, AGENCY AND ENVIRONMENTAL COMPLIANCE			
UL	✓	✓	✓
cUL	✓	✓	-
CSA	-	-	✓
NEC	✓	✓	✓
ABS	-	-	✓
ANSI	✓	✓	✓
NFPA 70	✓	✓	✓
NFPA 79	✓	✓	✓
REACH	✓	✓	✓
ROHS2	✓	✓	✓
IEEE	✓	✓	✓

Key:

✓

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Featured

Not Applicable

Cost Competitive Options Available



DATA INTEGRITY FOR INDUSTRIAL APPLICATIONS

Once crude oil and natural gas have been extracted, they must go through refining and processing. Though these processes generally happen within indoor factory environments shielded from the elements, cable systems and assemblies face new demands. From running equipment and transferring data to ensuring proper communication and maintaining uptime, cables and connectors must provide reliable high performance in tough plant environments.

Optimized for factories and plants using networked process automation and control, Northwire's awarded DataCELL® FOUNDATION™ fieldbus cable meets this market need. This NWI-exclusive innovation was designed to make industrial networking easier, faster, and more reliable through multi-pair fieldbus trunk lines in plant installations. The advantages of multi-pair fieldbus trunk cables over single-pair trunk lines include cost savings through simpler installation and more compact cable housing. Neater assemblage and the ability to merge control and instrument points into common junction boxes and bus segments streamlines installation and supports operators. Additional cost savings are realized as a FOUNDATION™ fieldbus five-pair trunk cable typically costs less than five single-pair cables.

Other features and benefits of Northwire's industrial networking cable line, which has been serving petrochemical and other plants with networked processes for over 15 years, include:

- **Smooth jacketing for easy stripping and effortless, secure installation**
- **16 and 18 AWG, single and multi-pair bus cable options**
- **ITC/PLTC rating for exposed-run applications**
- **Options for CSA, HL ABCD armored versions**
- **Arctic-rated ITC/PLTC-listed version**
- **RoHS compliant, UL 1309 marine shipboard-listed version**
- **Cut and abrasion resistant TPE outer jacket**
- **Crush and impact resistance comparable to metal clad cable – but without metal**
- **Options for low-frequency noise immunity available**
- **Multiple shield, jacket, and inner-conductor color options**
- **Approved for use in Class I & II, Div. 2 hazardous locations**
- **Compliant with FOUNDATION™ fieldbus specifications for type “A” cables**
- **And much more**

Electrically precise and fully compliant to relevant standards, these rugged process automation cables deliver cost savings, reliability, durability, data integrity, and a trusted long lifespan for customers with a diverse set of needs.

CASE IN POINT: U MARSHAL-EZ OFFERS SPEED AND SIMPLICITY

Factories and plants often faced networking issues in their marshaling cabinets due to loose foils, unprotected pairs, and compromised shielding that allowed cross-continuity between pairs. It was difficult to install loose pairs – which meant extra time and money spent – and conductors became exposed.

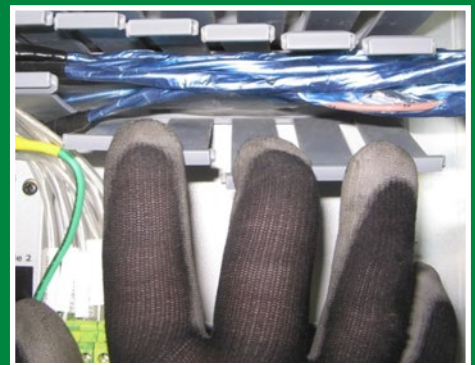
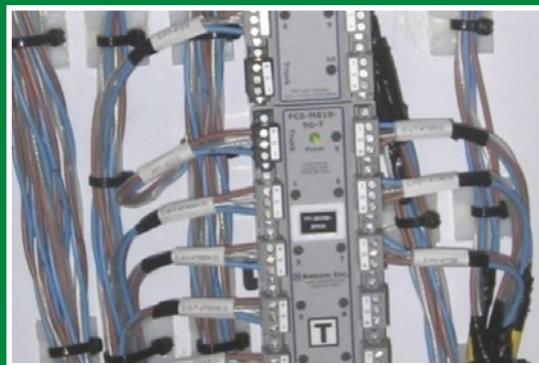
In an effort to add simplicity, speed, and safety to these marshaling cabinets and critical systems, Northwire designed a solution. The DataCELL® FOUNDATION™ fieldbus Marshal-EZ (M-EZ) Cable was born from Northwire's commitment to continual innovation and constant improvement. Installation is neat, shielding is intact and protected with no possibility of cross-continuity between shields, and circuit integrity is ensured.

This "EZ" installation saves time and money, and is interoperable with all junction boxes and terminal blocks. Availability in configurations from 2 to 24 shielded twisted pairs (STPs), Northwire's M-EZ cable requires no shrink tubing, offers superior ground system integrity, and protects pairs from moisture and dust.

Additional benefits include:

- **Tightly controlled electrical properties: 100Ω +/-10Ω**
- **UL listed ITC-ER and PLTC-ER**
- **CSA CMX Outdoor CMG listed and AWM recognized**
- **Temperature resistant from -40°C to 105°C**
- **Flame and UV resistant**
- **As crush and impact resistant as metal clad cable – but without metal**
- **And more**

In 2010, Northwire won the Network Hardware Control Engineers' Choice Award for its M-EZ cable. Trusted by customers across the nation, this NWI innovation is a significant step forward for plant and factory operators looking for a cost-competitive cable solution.





STREAMLINE OPERATIONS WITH TECHNICAL CONNECTORS

In 2014, the LEMO Group acquired Northwire in order to give a unified experience and expanded capabilities to both companies' valued customers. The partnership enables this by offering a comprehensive suite of custom connectors, wire and cable, retractable cords, and cable assemblies for a broad spectrum of extreme applications, including those in the oil and gas industry. Discover fully integrated product offerings, a global range of resources, and rapid responsive service for your project needs.

Seamlessly integrated for total reliability and centrally sourced for cost and time savings, the partnership between LEMO and Northwire simplifies your supply chain and supports your purchasing process. Instead of independently sourcing each cable and connector component for drilling equipment, testing and surveying tools, refinery plants, and beyond, work with one central supplier armed with a worldwide network of partners. From your initial specification questions to fast delivery on a final product, LEMO and Northwire are your strategic partners for standard and custom cable systems and more.

To complement Northwire's high quality wire and cable lines for oil and gas applications, LEMO offers custom concentric connector solutions optimized for rugged drilling and refinery needs. Robust and precise, these durable connectors are equipped to handle harsh environments over an extended life. LEMO serves oil and gas equipment suppliers with ruggedized connectors that overcome common challenges in:

- Oil exploration and surveying
- Hostile outdoor environments
- Systems operating at increased drilling depths
- Underwater and shipboard equipment
- MWD – Measurement while drilling
- LWD – Logging while drilling
- Industrial and process automation

LEMO connectors resist environmental factors found in oil and gas extraction sites such as shock and vibration, salt spray corrosion, extreme temperatures, underground and underwater conditions, and beyond. In the refining and processing stages, LEMO's complete line of industrial connectors handles heavy use in plants and factories.

When vital systems require 100% reliability, LEMO's best-in-class multi-pin connectors provide an ideal solution. These trusted concentric connectors include features such as:

- Custom outer shells meeting particular user needs in latching, mounting and mating
- High temperature epoxies for harsh environments up to 200°C
- Easy integration into tooling string
- Up to 10 contacts available
- RoHS and REACH compliant
- Cable assembly compatible
- And more



Connect with LEMO and Northwire today about your unique project needs or custom cable or connector design and development.

IDENTIFY CRITICAL-TO-QUALITY FACTORS

The first step to selecting the ideal cable for your unique application is to define critical-to-quality factors. These involve electrical, mechanical, ergonomic, aesthetic, harsh duty, and end-user requirements along with specific environmental, government, or third party agency certifications that must be met for a certain use or location. In the oil and gas industry, major critical-to-quality factors include:

1. Application.

Cable assemblies used in oil drilling mechanisms differ greatly from those used on an offshore platform or in a refinery.

2. Compliance.

Identify required ratings, agency listings, government certifications and environmental standards such as UL, ANSI, CSA, CE, IEEE, ABS, RoHS2, REACH, and 1,000 hour weatherometer requirement.

3. Features.

Cable assemblies may offer a combination of signal, control, instrumentation and power.

4. Flex.

A wide range of flex options exists for components that require regular motion. Common flex options include retractable, cold bend, torsional, rolling, variable, bend, and continuous flex.

5. Environment.

Build the optimal cable design based on the location of your machinery. Systems that power and control offshore platforms, for example, may need additional waterproofing or salt spray corrosion resistance.

6. Temperatures.

From Alaskan lows to Texan highs, find a cable system that stands up to extreme temperatures outdoors and resists friction-made heat from internal mechanisms.

7. Oil Resistance.

Vital when used near raw or refined oil and gas, AWM approvals for oil resistance – Oil Res I and II – are likely beneficial or even required.



RAPID DEVELOPMENT OF TAILORED SOLUTIONS

Unique project challenges demand unique project solutions. Whether customizing a standard product – such as LEMO's concentric connector or Northwire's Marshal-EZ cable – or creating an inventive new design, rely on LEMO and NWI for rapid development of tailored solutions.

Powered by the experience of innovative SMEs and state-of-the-art technology, LEMO and Northwire offer responsive design, prototyping, testing, development, and deployment services for custom cables and connectors.

"Every customer should have easy, affordable, timely access to custom cable products when that's the best solution for an application. Smart manufacturers have adapted to provide customers with this necessary service. Customers want their cable their way, not the manufacturer's way. It's a change of mindset in our industry."

– Katina Kravik, CEO of Northwire Inc.



Enjoy comprehensive support from *Concept to Completion* with services including:

- **Research and new product development**
- **Design, modeling, and materials validation**
- **Injection molding and assembly**
- **Prototyping and 3D printing**
- **Pilots and clinical trials**
- **Low volume through high volume production**
- **Materials sourcing and supply chain simplification**
- **Logistics and life cycle innovation**
- **Fast delivery and personalized service excellence**

Your partners for original equipment manufacturing and contract engineering, LEMO and Northwire leverage professional certifications in Six Sigma®, Lean, Project Management and the American Society for Quality. Receive guaranteed high quality products with no minimums and the shortest lead times in the industry.

Increase reliability and performance while decreasing long-term expenses by exploring custom cable creation. Contact LEMO and Northwire to learn more about standard and custom products for your next project in the oil and gas industry. Discuss your exacting requirements with an SME and receive individualized attention from customer care representatives.

ABOUT US

LEMO is the acknowledged leader in the design and manufacture of precision custom connection and cable solutions. LEMO's high quality Push-Pull connectors are found in a variety of challenging application environments including medical, industrial control, test and measurement, audio-video, and telecommunications.

LEMO has been designing custom connectors for over six decades. Offering more than 75,000 combinations of products that continue to grow through tailored, specific designs, LEMO and its affiliated sister companies REDEL, NORTHWIRE, and COELVER currently serve more than 100,000 customers in over 80 countries around the world.

In the summer of 2014, LEMO Group acquired Northwire, Inc. with the goal of providing a seamless experience with expanded capabilities to both companies' valued customers by offering a comprehensive suite of custom connector, cable and assembly offerings for a diverse range of extreme applications. This means comprehensive product offerings, a wider range of resources, and rapid responses to your project needs.

Northwire, celebrating over 43 years of innovation, has corporate headquarters and manufacturing in Osceola, Wisconsin and engineering and manufacturing in Santa Teresa, New Mexico. The cable supplier is the premier partner for the design, manufacture and contract services of custom technical products including wire and cable, retractable cable, cable assemblies, connectors, harnesses, injection molding, over-molding and contract engineering and OEM (Original Equipment Manufacturer) for diverse applications in life sciences, energy, MIL-Spec, industrial, machine vision, architectural lighting, underwater, and more.

The custom wire and cable, retractable cables, and cable assemblies from Northwire work seamlessly with the diverse selection of wire connectors produced by LEMO.



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