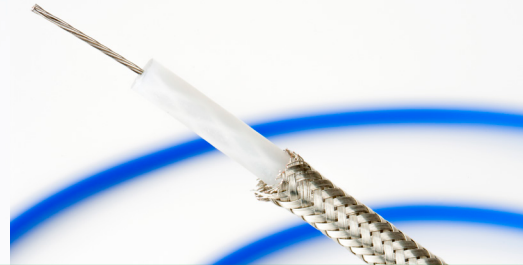




NEW ENGLAND WIRE
TECHNOLOGIES

www.newenglandwire.com



MEDICAL CABLES

WHO WE ARE

New England Wire Technologies is a privately held, employee owned company with a rich history dating back to 1898. Our Lisbon, NH facilities consist of over 385,000 square feet of manufacturing, quality/testing, tooling/machine fabrication and office space. We are an ISO9001:2015 registered company with more than 400 employees. NEWT is committed to being the premier manufacturer of choice for customers requiring specialty wire, cable, cable assemblies and extruded tubing to meet existing and emerging worldwide markets. We pride ourselves on sustaining an organization dedicated to serving its employees and their families in a responsible manner.

WHAT WE DO

NEWT designs and manufactures high-performance, custom medical cable. We specialize in product development, concurrent engineering, design for manufacturability and quick-turn prototyping. We currently supply OEMs for pulse oximetry, fetal monitoring, nerve stimulation devices, defibrillators, cardiac rhythm applications, surgical and dental imaging, hearing devices, footswitch cables and robotic prosthetic applications.

Our team of expert design engineers work with customer supplied requirements or specifications to design cables that perform in the most demanding applications.





- **Custom Manufacturing** – all products are designed and manufactured to your project's unique performance characteristics
- **Research and Development** – expedites the transition of R&D activities from the laboratory to the production floor
- **Custom Design Assistance** – customers provide us with important characteristics and we quickly and accurately develop a design to best fit their need
- **Extensive Modern Testing Facility** – wide range of standard and specialized testing capabilities
- **In-house Tool Making** – provides complete control while offering quick modifications and accelerated prototyping of custom designs
- **Custom Assembly Services** – assembly services provided by our partner companies BAYCABLE and NEI Systems
- **New England Tubing Technologies** – custom manufacturing of medical tubing, catheter shafts, and more

CUSTOM MULTI-CONDUCTOR CABLE

Multi-Conductor Cable

No industry demands more technologically advanced cables built to exacting specifications than medical electronics. And no company has more experience or expertise researching, developing, and manufacturing precision cables for medical applications than New England Wire Technologies.

A multi-conductor cable incorporates multiple conductors into one cable for the ultimate in customization and flexibility. Our highly customized multi-conductor cables utilize a wide range of conductor, shielding, and insulation materials, chosen to suit your specific medical device application requirements. Typical characteristics of our custom multi-conductor medical cables include finely stranded conductors for ultimate flexibility, extended flex life and resistance to fatigue, miniaturization, high or low temperature performance, low triboelectric noise and signal integrity.

We draw on our broad range of manufacturing capabilities and in-depth knowledge of conductor and insulation materials to design and manufacture custom cables that deliver precisely what you're looking for.

Custom Design Options:

- **Miniature cables:** cable conductors as small as 46 AWG integrated to create high performance miniature cables for ultrasound probes and other applications requiring minimum overall diameter.
- **Ultra flexible cables:** the combination of finely stranded conductors and thin wall extrusions result in medical cables with extreme flexibility. Ultra flexible cables are ideally suited to your hand-held surgical instrument requiring unrestricted motion.

- **Extended flex life cables:** high-strength alloys combined with abrasion resistant plastic extrusions result in cable products with superior flex life characteristics. Extended flex life cables are typically specified for applications where high reliability in repeated motion operations is required.
- **Low noise cables:** Our low noise cables utilize constructions and materials that help reduce or eliminate internal noise generation, and are designed to meet exacting specifications for a wide range of applications including EEG, EKG, pacemakers and oximetry.



Hybrid Cable Configurations

A hybrid cable is simply a cable in which multiple sizes or types of conductors or other components are incorporated into a single neat package. A custom hybrid cable can offer the wide range of functionality and the performance required for complex devices and applications without the clutter.

Some finished device manufacturers attempt to meet their variety of connection needs by bundling together many individual wires and components by hand. This approach allows for some design flexibility but unfortunately, the result is often disorganized, difficult to route and not very aesthetically pleasing. A single hybrid cable offers a much cleaner look than a bundle of individual wires, and with overall shielding and jacketing in common, a hybrid cable will typically provide reduced diameter as well. Also, cleaning and sterilization can be much more effective with a single round and smooth jacket rather than a rough bundle.

Some of the design options we offer:

- **Lumens/Vent Tubes** can be utilized to transfer liquids, gases or other cable components such as fiber optic filaments.
- **Strength members** can be anything from stainless steel cables, to monofilaments, to aramid fibers with a no fray extrusion designed to yield high tensile strength and low elongation in your cable.
- **Communication components** including specialty USB, HDMI, fiber optics or other configurations of coax or twisted pairs can be easily incorporated into the design.
- **Thermocouple extension** wires using ANSI standard materials can be bundled into a cable or added with a jacket for breakout.
- **High frequency power** can be supplied using our custom Litz wire preventing heating and saving space and energy.
- **Magnet wire** twisted pairs for low voltage signal can be bundled into many pairs or insulated for breakout with other components such as strength members or power leads.
- **Resistance wires** standard or finely stranded, highly flexible constructions, can be placed in a cable for heating components or placed around tubes to heat the contents.

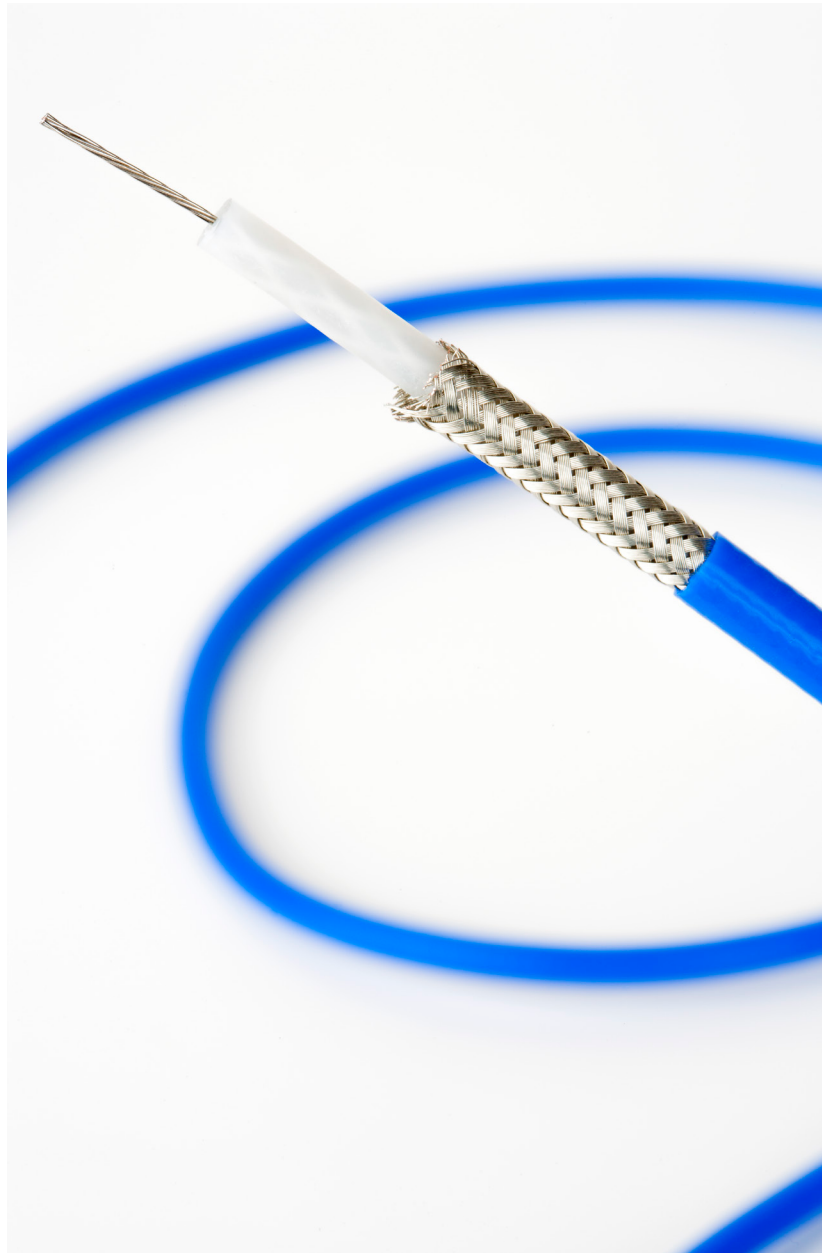


MINIATURE & MICRO-MINIATURE COAX

Miniature and Micro-Miniature Coax

Why accept a standard product for your custom application? New England Wire Technologies has the capability to design, manufacture, and test a wide range of coaxial cables to meet the custom needs of medical device and electronic manufacturers. Our coaxes are manufactured to meet the particular impedance, capacitance, or other exacting electrical requirements requested by our customers. We tailor to the needs of the specific application.

Miniature and micro-miniature coaxial cable from New England Wire Technologies meets the demanding requirements of the medical industry with custom options for the center conductor, dielectric, shield, and jacket. Examples include high strength alloy conductors for superior flex life and foamed dielectrics for reduced size and attenuation. By utilizing high quality low dielectric constant materials, New England Wire is able to reduce size without sacrificing signal integrity. In addition, we have the capability to combine multiple coaxes with other components into larger instrumentation cables.



Custom Endoscopy Cable

New England Wire Technologies is an industry leader in the development, manufacturing and testing of custom endoscopy cable. Our custom endoscopy cables are designed to meet the specific requirements of technologically advanced digital imaging devices.

NEWT offers custom options for all components of our cables, from high strength alloy conductors for superior flex life, to NEWtuf® reinforced jackets for optimum pull strength. In addition, our cable design engineers will work with you from concept through testing to ensure that your cable meets your exact requirements.

Conductors

- Our full range of conductor materials are available including plated copper and high strength alloys
- Typically stranded for improved flexibility
- Miniature (24-32 AWG) & micro-miniature (34-52 AWG) sizes
- Various size components cabled together

Dielectric

- Selected based on electrical, temperature, and size requirements
- Materials include: Polyethylene, Polypropylene, FEP, PFA, ETFE, NEWcel® High Velocity Foamed Dielectrics

Shield

- Typically designed for high shield coverage to maximize shield effectiveness
- Shielding options include braid, spiral, aluminum foil or a combination thereof

Jacket

- NEWtuf® Reinforced Silicone Rubber Cables for optimum pull strength
- TPE

Testing

- Full range of physical and electrical tests performed in-house, including:
- Attenuation, VoP, Inter Pair Skew, Time Delay, Capacitance, Flex, Bend & Endurance, Paddle Flex, Strand Flex, Torsion

Custom Design Options

- Ultra flexible/ High flex life
- High temperature
- Fluid and chemical resistant
- Sterilization/Autoclave compatible
- Low noise (NEWtral®)
- UL AWM rating
- Biocompatible
- Phthalate, Latex, BPA, ADM free
- RoHS compliant
- REACH
- FDA
- ISO 10993
- And more.....

NEWtuf® Reinforced Silicone Rubber Cables

Silicone rubber is the material of choice for ultra flexible, autoclave sterilizable medical electronics cables. Silicone on its own, however, has a physical weakness that can lead to stretching, distortion or breakage after repeated wiping or physical cleansing. NEWtuf® reinforced silicone jackets overcome this concern without impacting biocompatibility, flexibility, heat resistance, sterilization, dimensional requirements, or strippability.

NEWtuf® reinforced jackets provide three times the tensile strength of silicone rubber, and limit elongation distortion to a fraction of a percent. Unlike conventional silicone jacketed cables, NEWtuf® reinforced cable can be repeatedly handled and wiped while maintaining its original appearance and performance.

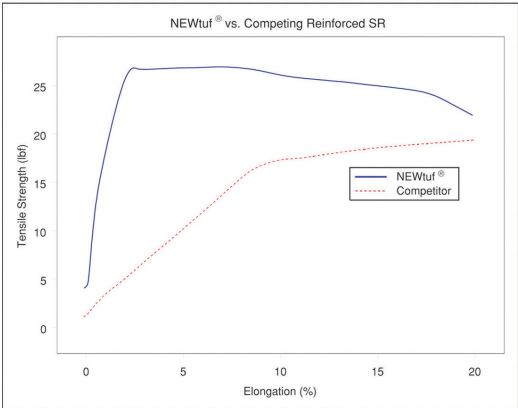


Figure 1: A comparison of the performance of NEWtuf® vs. competing reinforced jackets proves NEWtuf® to be superior.

NEWtuf® Material Properties

Material Properties			
Property	Conventional	NEWtuf®	Competitor
Elongation 5lbf	86%	0.03%	2%
Elongation 20lbf	490%	1%	20%

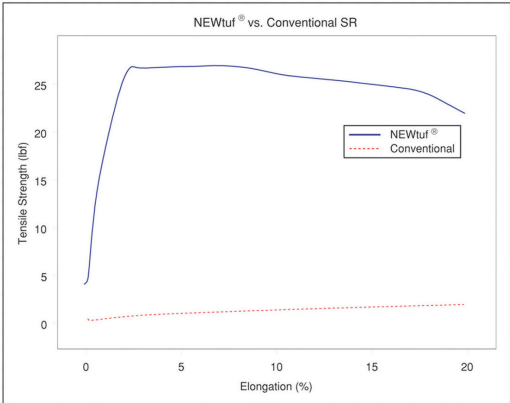
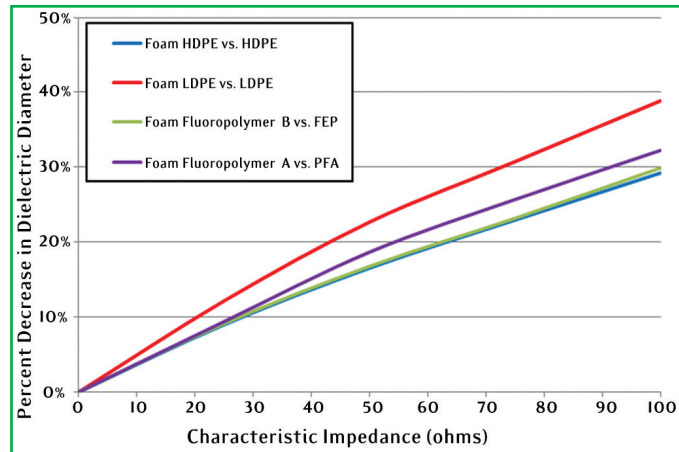
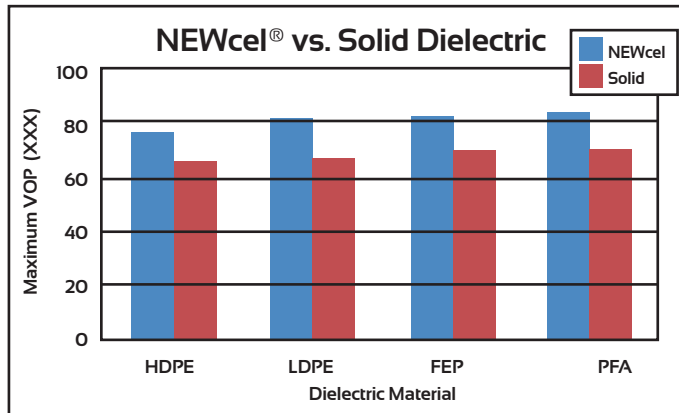


Figure 2: When force is applied, NEWtuf® exhibits very little elongation unlike conventional silicone rubber jackets.



Product Advantages

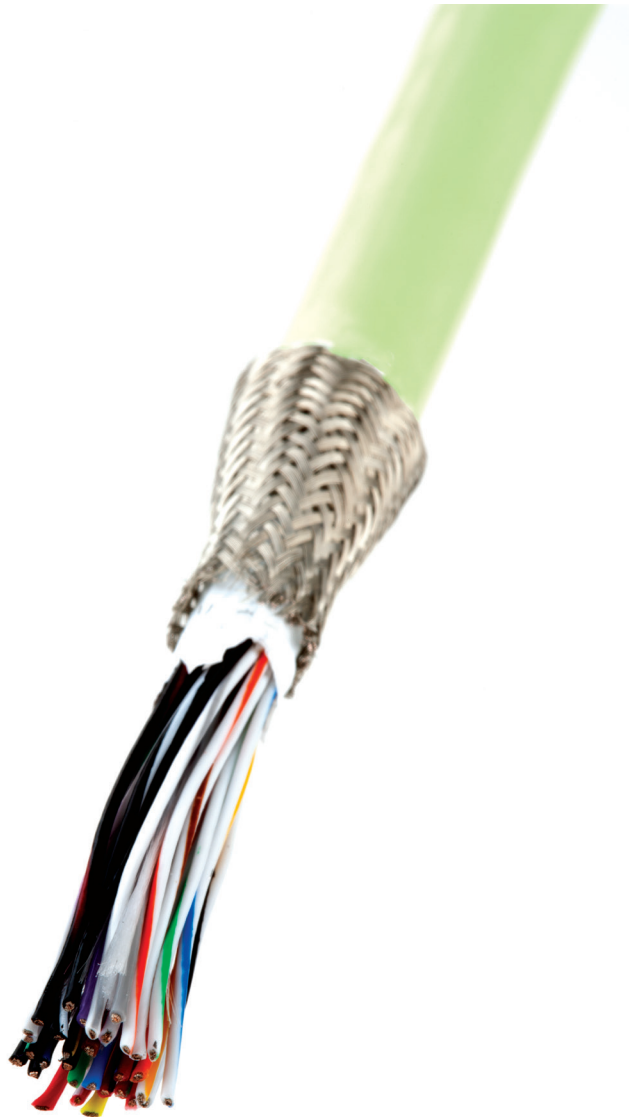
- Reduces Attenuation
- Reduces Cable Size
- Reduces Capacitance
- Wide Temperature Range

NEWcel® Foamed Dielectrics

NEWcel® is a closed-cell foamed dielectric material specifically designed to reduce dielectric constant and dissipation factor yielding low-capacitance, low-loss, high V.O.P. ultraminiature coaxial, triaxial, and twinaxial offerings.

Air is a near perfect dielectric medium allowing a signal to propagate through it at approximately the speed of light. However, an air dielectric is impractical for use as cable insulation. Thus, manufacturers have to resort to using materials with higher dielectric constants (lower propagation velocity) to meet structural requirements.

NEWcel® is the perfect solution. Typical coaxial, triaxial, and twinaxial cables are manufactured using low dielectric constant (2.0-2.6) materials that possess inherently better electrical properties than standard insulation material such as PVC. Using highly controlled extrusion processes, these materials are foamed yielding a dielectric medium with a high air concentration. The result of this process is a significantly reduced dielectric constant (1.43-1.75) that approaches the nearly ideal properties of air without sacrificing structural integrity. This results in a significant capacitance reduction while providing the choice of reduced diameter/same attenuation or same diameter/reduced attenuation.

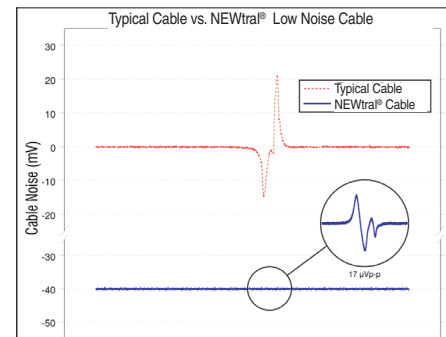


NEWtral® Low Noise Cables

With sensitive signal applications it is essential to utilize transmission lines which limit noise. This is particularly difficult in applications where a cable experiences mechanical shock, vibration, or repeated flexing during use. To combat these concerns New England Wire Technologies offers several low noise options designed to maintain signal integrity.

The Triboelectric Effect is a process by which dissimilar materials can acquire an electric charge through contact. In wire and cable this effect can alter baseline voltage levels or the insulation can act as a capacitor temporarily storing the charge until it is released as a voltage spike. The addition of conductive layers, careful material selection, and special manufacturing techniques can reduce noise by dissipating this charge.

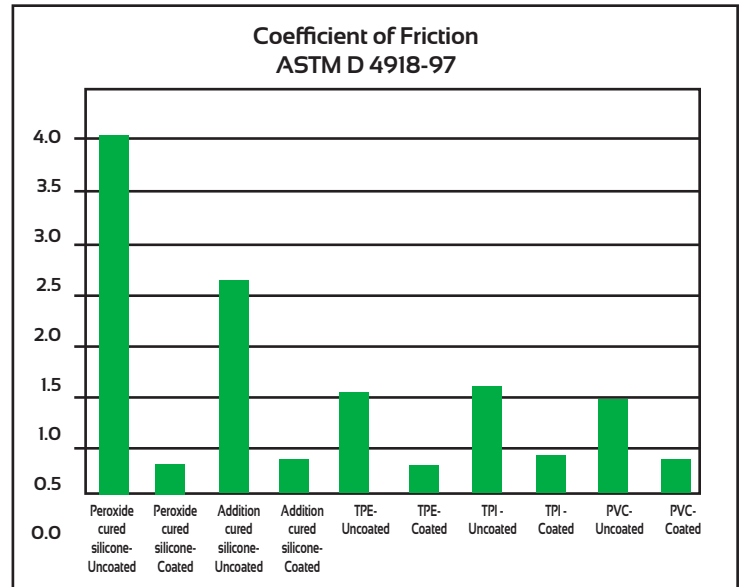
With traditional cable, simply flexing or twisting can generate voltage spikes with magnitudes in the tens of millivolts. Cables utilizing our NEWtral® low noise extrusions and coatings typically see voltage spikes decreased to the microvolt range. New England Wire can work with you to select the low noise option best suited to your application.



Specialty Coatings

New England Wire Technologies offers ultra flexible, autoclave sterilizable cables for medical electronics that incorporate a slip coating without the use of irritating liquids or dusting agents. The coating prevents otherwise tacky materials, such as silicone rubber, from collecting debris or tugging on skin, hair and fabric. The coating grade used at New England Wire Technologies offers optimum lubricity compared to other options, and is an inert, biocompatible dry lubricant that resists heat, radiation, solvents, fungus and bacteria growth. The coating is bonded to the jacket material, and at 1m, it adds virtually nothing to final dimensions.

- Low friction (comfortable, ergonomic surface)
- Biocompatible / inert transparent polymer
- Sterilization / autoclave stable
- Barrier to oxygen, moisture, chemicals, solvents and carbon dioxide
- Hydrophobic
- Chemical and fungal resistance
- Impervious to bodily fluids, solvents, moisture, acids and chemicals
- Extremely thin coating, no build to jacket OD
- Crisp masked edges allow for durably bonded connections - parylene
- Custom masking and thickness specifications readily incorporated into our process - parylene
- 100% overmoldable, no masking required - Sleek™
- Available on bulk length reels - Sleek™



Applications

- Electrosurgical cable products
- Medical electronics
- Patient cables
- Endoscopic cables
- Any cable requiring tack-free surface finish

INSULATION OPTIONS

Insulation	Maximum Temperature	Common Use	Advantages
ETFE	155° C	• Primary in multi-conductor • Coax / Twinax	• Excellent flex modulus • Better at tight bend than other fluoropolymers • Excellent heat resistance • Excellent water/chemical resistance • Very good dielectric properties
FEP	200° C	• Primary in multi-conductor • Coax / Twinax	• Excellent heat resistance • Outstanding water/chemical resistance • Outstanding flame retardancy • Low outgas • Very good dielectric properties
PFA	250° C	• Primary in multi-conductor • Coax / Twinax	• Excellent heat resistance • Outstanding water/chemical resistance • Outstanding flame retardancy • Low outgas • Very good dielectric properties
PE/PP	75° C	• Coax / Twinax	• Very good dielectric properties • Outstanding water resistance
PVC	105° C	• Primary in multi-conductor • Jacket for multi-conductor	• Cost effective • Excellent flexibility • Medical grades
Polyurethane	90° C - 105° C	• Jacket for multi-conductor	• Excellent abrasion resistance • Very good flexibility • Can be coiled • Halogen free • Medical grades
Polyester	90° C - 125° C	• Primary in multi-conductor	• Excellent abrasion resistance • Can be coiled • Excellent flex life characteristics
TPE	90° C - 125° C	• Jacket for multi-conductor	• Highly flexible grades • Medical grades • Light weight grades
Silicone	200° C	• Jacket for multi-conductor	• Outstanding flexibility • Outstanding heat resistance • Medical grades • Can be coiled • NEWtuf® jacket reinforced option
Tape	240° C (up to 400° C in certain conditions)	• Binder wraps • Barrier wraps	• EMF Protection • Improve abrasion resistance range • Flexible • 100% coverage

Generally Acceptable Sterilization Methods

Material	Gamma	ETO	Autoclave	Cidex®	Sterrad®	Bleach (10%)	Isopropyl Alcohol wipe	Ethyl Alcohol wipe	Denatured Alcohol wipe	Virex® wipe	Virex® (Soak >= 10 min)	Sodium Hydroxide	Green soap tincture
PVC	A*	A	U	A+	B	A	A+	A+	A+	A	A	A	A
Polyethylene	A	A	U	A	A	A	A	A	A	-	-	A	-
Nylon	A*	A	U	-	U	U	-	A	-	-	-	A	-
Pellethane®	B	A	U	A	A	A	B+	B+	B+	-	-	B	-
Tecoflex®	B	A	U	-	A	B+	B+	B+	B+	-	U	-	-
ETFE	A	A	A	A	A	A	A	A	A	A	A	A	A
FEP & PFA	U	A	A	A	A	A	A	A	A	A	A	A	A
TPE's	A	A	A**	-	A	A	A	A	A	A	A	A	A
Elexar® & Kraton™	A	A	A**	A	-	A	-	-	-	-	-	-	-
Pebax®	A	A	-	-	-	-	-	-	-	-	-	-	-

Note: Specific sterilization methods and best practices may vary, it is the responsibility of the finished device manufacturer to select and verify the appropriate sterilization method for their device.

Chart Key

A = Generally Acceptable
 B = Minor to Moderate effect (swelling, discoloration, surface clouding, cracking)
 U = Unacceptable
 * = Specific Grade required
 + = Short Term use only
 - = Insufficient Data
 ** = Limited Cycle Use

Flex Life of Alloys and Strands

New England Wire Technologies has considerable experience in design and materials to extend flex life in standard and rigorous use situations. While we test for many existing cable standards including a myriad of UL, CSA, ISO and other standards, the most important standard to meet is high performance in application. Specialized test fixtures have been developed in conjunction with the customer to more precisely match use. This allows tests to more accurately predict life or give better information to extend life.

Smaller gauge sizes develop less stress when subjected to bending. As a result, conductors with finer stranding will survive a larger number of bending cycles without suffering fatigue in comparison to a conductor manufactured with a coarser single end wire.

High tensile strength copper alloys can be used to increase longevity with little impact to conductivity and other electrical parameters while tinsel can be used for ultimate flex life when resistance is not an important parameter.

Selection of plastics for longevity and flex life is critical in designing for long life as well. Harder abrasion resistant plastics work well but choices are also available that maintain flexibility and flex life.

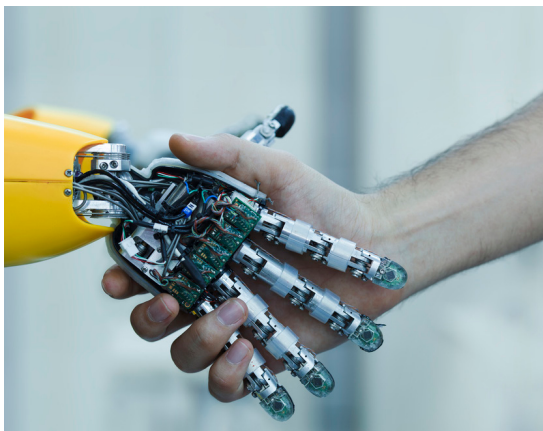


Applications

Advancements in medical technology over the past century have changed the way we practice medicine and saved countless lives. We are committed to helping the world's leading medical device manufacturers create the next generation of life saving technology.

For over 120 years New England Wire Technologies has worked to earn our legendary reputation of superior quality and service to our customers so it makes sense that today we are positioned as the primary source for high-performance, custom medical cable.

Our cable is already at work in pulse oximetry, fetal monitoring and nerve stimulation devices, defibrillators and cardiac rhythm applications, surgical and dental imaging, hearing devices, footswitch cables and robotic prosthetics.



Monitoring

- Endoscopic
- Pulse oximetry
- Fetal & maternal monitoring
- Neuro-monitoring

Imaging

- Brain mapping
- Cardiovascular imaging
- Dental imaging
- Electrosurgical
- Surgical imaging
- Ultrasound
- Surgical navigation
- Test and measurement

Surgical

- Electrosurgical
- Instrumentation leads
- Surgical robots
- Cardiovascular
- Surgical navigation
- Sensors
- Arthroscopic surgery
- Ophthalmic
- Footswitch
- Handheld surgical devices
- RF applications

Cardiac Rhythm & Pain Management

- Nerve stimulation
- Neuro-stimulation
- Defibrillator
- Cardiac rhythm management

Robotics

- Surgical robotics
- Robotic prosthetic application

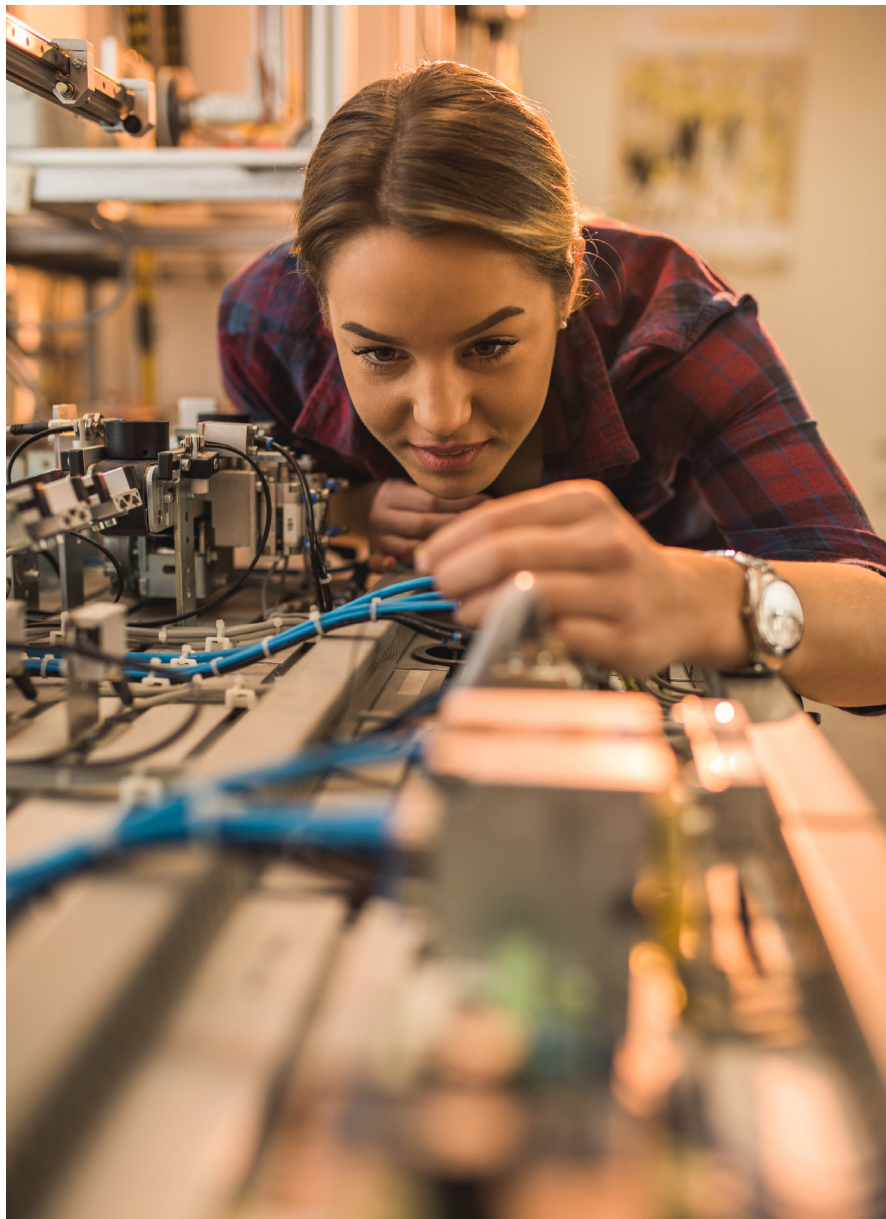
Medical Devices

- Cardiovascular
- Electrosurgical
- Endoscopic applications
- Hearing devices
- Instrumentation leads
- Test & measurement
- Footswitch cables
- Handheld surgical devices
- Fetal & maternal monitoring
- Neuro stimulation
- Hemostatic sealing

Applications Laboratory

New England Wire's Applications Laboratory is equipped with a full-scale production extruder that has capabilities to run a broad range of materials. In addition, we have invested in advanced analytical tools; dynamic mechanical analysis, rheometer, chemical identification instrumentation, and other equipment that is used to help expand the operating space of extruded materials. Furthermore, we are able to help our customers meet performance criteria through use of advanced machines and instrumentation.

These instruments and tools are enabling us to strengthen technical partnerships with our customers by helping them advance their product solutions. Supporting our customers is an Applications Laboratory staff with decades of experience in engineering disciplines ranging from Polymer Science to Operations. NEWT is excited to offer these expanded capabilities and work closely with our customers in developing custom products that serve the medical industry.



CUSTOM DESIGN ASSISTANCE

Working across many different industries over the past 120 years has given us a unique perspective into developing innovative solutions for our customers. The ability to draw from the wide ranging expertise of our engineers and the accumulated institutional knowledge of our company allows us to tackle problems that other companies may not be equipped to solve.

The key to providing the proper solution, regardless of application, is to start with an experienced team of engineers, armed with the latest design tools and technology. This knowledge and expertise, combined with state of the art manufacturing and testing facilities allows our engineers to provide innovative wire and cable solutions and meet the ever changing needs of our customers and rapidly transforming industries and markets.

Customers can provide us with important characteristics (voltage, flexibility, flex life, temperature, current capacity, tensile strength, resistance, impedance, diameter, insertion loss, eye height, etc.) and we can quickly and accurately develop a design to best fit their need.



Our Family of Custom Cable, Tubing and Assembly Solutions

New England Wire Technologies (Lisbon, NH)

In addition to serving the medical electronics market, NEWT also provides custom wire and cable for a wide range of industries including robotics and automation, military and defense, industrial manufacturing, communications and control, audio/video, science and research, and alternative energy. Beyond what has been listed here, we manufacture all types of custom Litz wire, flexible interconnects, power leads, ribbon cables and specialty profiles, braid configurations, and numerous proprietary design options.

New England Tubing Technologies (Lisbon, NH)

NETT provides an array of custom products including medical braid, spiral and braid reinforced tubing, lubricious lined catheter shafts, multi-lumen and multi-durometer tubing, and hybrid tubing. A wide range of value-added and post-processing services such as tipping, hubbing/flaring, shaping/forming, and radiopaque striping are available to further enhance your design.

Bay Associates Wire Technologies (Fremont, CA)

Commonly known as BAYCABLE, Bay designs and manufactures custom cable, coil cords, cable assemblies and electro-mechanical assemblies. Bay's specialty is working with clients to design application specific solutions to complex interconnection problems. Customers include OEM's in the medical, audio, defense and industrial markets.

New England Interconnect Systems (Santa Ana, Mexico)

Innovative interconnect solutions can be manufactured in a state-of-the-art facility designed for high volume applications. NEI Systems' fully certified plant can deliver custom full turnkey over-molded cable assemblies and custom coil cords built to your exacting standards.

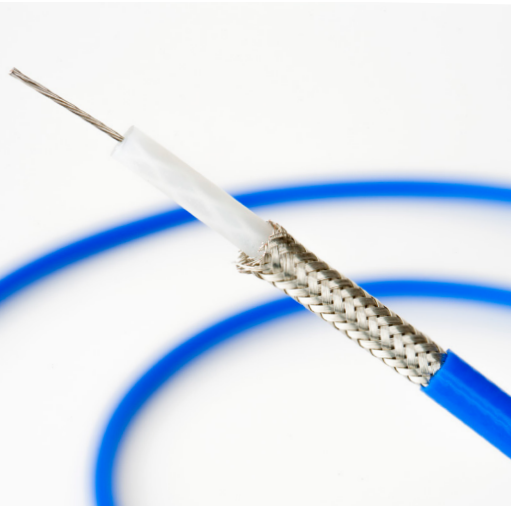
Contact us today to get started on your project!

New England Wire Technologies

603.838.6624

www.newenglandwire.com







ADVANCING INNOVATION FOR OVER 100 YEARS

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We partner with the world's leading medical device manufacturers to create the next generation of life-saving technologies.



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