Laser Wire Stripping

Laser Wire Stripping: Explaining Our Technology

Wire stripping is simply the removal of the insulation, which covers the electrically conducting wires, in order to make the wire ready for termination.

Conventional wire stripping techniques have developed to include mechanical, abrasive, chemical or thermal methods. But each method has its associated problems such as conductor damage, slow processing speed, a lack of precision and poor quality.

In contrast, laser wire stripping has a fast process time, excellent precision and outstanding process control. Most importantly, laser wire stripping eliminates contact with the wire and by using the correct laser type it is possible to completely eliminate the risk of damage to the conductor or shield.

Background to Laser Wire Stripping

Modern electronic devices, as well as the communications systems that link them, are full of wire. From the enormous conductors that route local-area-network data around microwave communications systems to the miles and miles of wiring that connect all the critical control and communications systems on aircraft and other transportation systems, to the minute strands that provide interconnections in microelectronic systems or carry the signals in medical implants, wires are indispensable for moving signal and power about.

The traditional method of mechanical wire stripping employs metal blades to cut through the insulation, enabling it to be pulled away over the end of the conductor. However, even though modern mechanical stripping equipment incorporates shaped blades, automatic wire handling and precise blade control, it still shares one thing with the handyman's wire stripper: both need careful attention to avoid wire damage.

Historically, designers and manufacturers had to accept a degree of damage to the wire conductor from the use of mechanical blades for stripping. To accommodate this, the electrical resistance of the wire is often specified with a higher tolerance than would otherwise be necessary; which essentially means specifying a larger conductor; this makes the whole wire larger and more costly.

In critical manufacturing applications such an approach is unacceptable and, where quality is all-important, damage free laser wire stripping comes into its own. For state-of-the-art applications it is critical to be able to strip insulation precisely from wire without damage to the
conductor. Laser-based wire strippers accomplish this simply, by relying on the ability of light to selectively remove non-metallic insulating materials while leaving the metallic conductor completely untouched.

(Notice a picture showing mechanical and laser stripping methods)

Above left: Mechanically stripped, twin core shielded cable.
Above right: The same cable laser stripped.

Manual or semi-automatic mechanical, chemical or thermal wire stripping methods have well known quality assurance problems. The mechanical blade is the most widely used tool to strip wires. It is best suited to cutting through the insulation on a regular shaped circular cross-section wire; i.e. the humble single core wire. Even so, damage to the conductor may result from the use of blades that are worn or that do not fit the shape of the wire correctly or from inadequate control of the stripping process. Furthermore, mechanical methods are not well suited to stripping twisted or shielded cables that do not have a regular, circular cross-section.

Very long process times and environmental issues impair chemical wire stripping techniques. These chemical processes often use hot sulphuric acid or hydrogen peroxide, which are difficult to use and control. In addition the chemicals are quite reactive and require careful handling and disposal must be carried out with due regard to the environment and current legislation.

Thermal methods require very fine process control and frequent calibration in order to maintain quality. Thermal processes also often require a secondary operation to remove any remaining strands of insulation from around the conductor.

Laser wire stripping, in contrast has a fast process time, excellent precision and outstanding process control. Most importantly, laser wire stripping eliminates contact with the wire and by using the correct laser type it is possible to completely eliminate the risk of damage to the conductor or shield.

The Development of Laser Wire Stripping

Research into laser wire stripping originated in 1976 when NASA initiated a programme
Laser stripped aerospace wire (O.D. 12.5mm/0.5 inch, Teflon over Polyimide/Kapton)

NASA compared the effect of various types of lasers on the insulating and conducting materials of the wire and found that the CO2 laser was the best choice for the task at hand. During the laser wire stripping process the energy or radiation emitted by the laser is absorbed strongly by the insulating material. As the laser penetrates the insulation it vaporises the material through to the conductor.

However, the conductor strongly reflects the radiation at the CO2 laser wavelength and is therefore unaffected by the laser beam. Because the metallic conductor is essentially a mirror at the wavelength of the laser, the process is
effectively “self terminating”, that is the laser vaporises all of the insulating material down to the conductor and then stops, so no process control is required to prevent damage to the conductor.

Since 1987, when RtMc, Inc, now Spectrum Technologies USA, Inc (http://www.spectrumtech.com/contact/spectrum-technologies-usa-inc/), introduced the first commercial CO2 Laser Wire Stripping machine, there has been an increasing need for the further development of laser technology to enable an increasing range of insulating materials and wire types to be stripped. This is due to the development of new insulation types, new ways of extruding the insulating material onto wire, varying bonding properties and the trend for smaller, lighter-weight wire applications, combined with the development of new products using these wires.

**Laser Wire Stripping Today**

During this period Spectrum Technologies has become the leading manufacturer and supplier of Laser Wire stripping products to international industry, having delivered many hundreds of units to customers around the World. Spectrum's SIENNA™ range of laser wire strippers (http://www.spectrumtech.com/product/laser-wire-strippers/) has been developed incorporating various lasers and delivery systems and can successfully remove almost any insulation from any wire form.

There is an increasing need for products to become light-weight, more reliable, more efficient and more cost effective as conventional methods for stripping wire will become increasingly outdated. Laser wire stripping provides many advantages over conventional methods. Some of the advantages and benefits are:

- **No conductor damage** - the laser cannot damage the metal conductor even if it is plated with another metal such as tin or silver – reduces quality assurance requirements and enables designers to specify tighter tolerances and user lighter weight wires
- **Able to process 99% of all insulation types** – one piece of equipment can cope with a wide variety of wire and insulation types and can process a range of wire types without the need for time-consuming changes in set up
- **Highest achievable strip quality** – guarantees reproducible results and maximises yields, thereby reducing costs
- **Able to process multiple wires simultaneously** – increases productivity
- **Able to strip a variety of wire sizes** from less than 25 μm up to 25m (0.001 – 1.000 in.) diameter – one process supports damage free stripping across the widest range of wire sizes
- **Able to strip a variety of wire forms** the same machine can process flat, round, twisted, or shielded cable with little or no tooling changes – improves equipment utilisation and productivity
- **Able to hold tight tolerances** of +/- 25 μm (0.001 inch) – for precision applications
- **Variable strip patterns** can be programmed to remove the insulation at any location on the wire – see below
Because laser wire stripping is a **non-contact process** and the beam can be controlled very precisely, it is possible to direct the laser beam to achieve a variety of stripping patterns, many of which are virtually impossible by other means, as shown below:

- End strip – Crosscut or Crosscut & slit
- Windows
- Mini Window
- Angled cuts
- Programmable patterns at any point on wire or ribbon cable.

Laser wire stripping can process the following wire and cable insulation types and forms:

**Variable Cable Type**

- Single core wire
- Twin leads
- Twisted pairs
- Multi-conductor cables
- Shielded/screened wire and cable
- Ribbon cable
- Coaxial cable
- Complex 2D and 3D shaped conductors, e.g. coils

**Variable Cable Size**

- 1 AWG to 50 AWG and smaller
- Ribbon and flat cable up to 285 mm (11.4”) width

**Insulation Capability**

- PTFE /Teflon®
- Silicone
- PVC
- Kapton®
- Mylar®
- Kynar®
- Fiberglass
- ML
- Nylon
- Polyurethane
- Formvar®
- Polyester
- Polyesterimide
- Epoxy
- Enameled coatings
- DVDF
- ETFE/Tefzel®
- Milene
- Polyethylene
- Polyimide
- PVDF and other hard, soft or high temperature material

**Laser Wire Stripping in Practice**

In our mainstream SIENNA wire strippers (http://www.spectrumtech.com/product/laser-wire-strippers/) the laser beam is focused down to a very small spot size and is passed over the wire at a pre-set speed. The laser then vaporises the selected areas of insulation, removing it in a narrow line.

As noted previously, the laser does not damage the wire conductor because the metallic materials are highly reflective to the CO2 laser beam, whereas the insulating materials are generally highly absorbing. As the beam passes over the wire it cuts precisely through the insulation, rather like an invisible hot knife through butter, creating a neat cut down to the conductor and leaving the insulation to be easily removed. Through a combination of moving the work piece and the beam, a variety of strip geometries are possible from our different products, depending upon the requirements of the application, such as cross-cuts and slits windows, etc.

SIENNA laser wire strippers may be used either as stand-alone equipment or as part of an automated system. Where the equipment is to be used as a stand-alone facility the wire may be processed as a batch, hand loaded by the operator, either singly or set up in groups on a tooling plate. Setting up on a tooling plate speeds up the stripping process and increases productivity in situations where batches of the same wire type require processing; once set up, the plate is loaded into the wire stripper which makes one or more passes across the wires, stripping them in parallel.

Alternatively, our wire strippers can be automated by the provision of a SIENNA AWH automated wire handling system (http://www.spectrumtech.com/product/laser-wire-strippers/sienna-awh/) as part of an integrated set up in which wire is fed automatically through the stripper from a reel. In this way jobs can be automatically processed as batches via the SIENNA system controller. For higher levels of automation, our products are also available to systems integrators who may need to integrate them into more complex automation systems.

To facilitate the use of the SIENNA wire strippers, Spectrum Technologies provides a range of ancillary equipment, including control systems, chillers and air purification units to provide a complete turn key solution to each customers requirements.
When the laser beam interacts with organic materials, it typically produces process fumes and particles, which must be removed from the vicinity of the equipment. To do this we can provide the ACS-5 (http://www.spectrumtech.com/product/laser-wire-strippers/acs-5/) for air extraction and purification for use with all SIENNA equipment. Alternatively, if the customer has suitable venting and filtration systems available, the exhaust outlet on SIENNA wire strippers can be hooked up directly to this.

For some applications we need to use other laser types, either to deal with more difficult insulation types or to work at smaller dimensions.

If you have a need that cannot be met with one of our mainstream SIENNA products, we will be happy to discuss your application with you. We can undertake process evaluation and development in our application laboratories and if appropriate we can tailor a system accordingly (see below).

Future Developments and Applications

New technological developments and increased innovation are continuing in all market sectors. Advances in new product development are changing the way devices or components function, look and communicate. With these new advances, the wiring of these devices continues to change: circuitry is getting smaller and faster while wire manufacturers are developing new insulating materials, smaller diameter wires with new cable and wire configurations that are able to surpass previous performance. As materials and component designs advance and get smaller, they require improved manufacturing processes to ensure higher product quality levels are maintained while production costs are lowered.

As products become lighter weight, more reliable, more efficient and more cost effective, conventional methods for stripping wire are becoming increasingly outdated and unacceptable. Whether it is damage to the wire, the need for constant monitoring of blades to ensure quality standards or the high cost for replacement parts, designers and manufacturers are discovering that they need to find alternatives to these methods.

Spectrum Technologies is focused on providing laser based technology solutions for the removal of insulating materials, whether for metallic wires or for fibre optics as well as for other applications in advanced manufacturing. As we continue our research into the development and application of new laser process technology, please feel free to contact us (http://www.spectrumtech.com/contact/contact-form/) if you have a problem that you would like to discuss with us that cannot be met with one of our standard products.
PRODUCTS
› Laser Wire Markers (/product/laser-wire-markers/)
› Laser Wire Strippers (/product/laser-wire-strippers/)
› Magnet Wire Strippers (/product/magnet-wire-stripping/)
› Measure & Cut Systems (/product/measure-cut-system/)
› Inkjet Wire Markers (/product/inkjet-wire-markers/)
› Nova Wire Handling (/product/nova-wire-handling/)
› Quality Assurance (/product/quality-assurance/)
› Printers & Readers (/product/printers-readers/)
› Spectrum Services (/product/other-services/)

APPLICATIONS (/APPLICATIONS/)
› Wire Sample Gallery (/applications/wire-sample-gallery/)

NEWS (/LATEST/)
› News & Events (/latest/newsblog/)
› Projects (/latest/projects/)
› Spectrum In The Press (/latest/spectrum-in-press/)

RESOURCES (/RESOURCES/)
› Annual Reports (/resources/reports-accounts/)
› Technical Papers (/applications/technical-reports/)
› Policies (/resources/policies-documents/)

CONTACT US (/CONTACT/)
› Contact Us (/contact/contact-form/)
› Agents & Distributors (/contact/agents-distributors/)
› Technical Support (/contact/technical-support/)

Site by Horizon (http://www.horizondml.co.uk)

© Spectrum Technologies. All Rights Reserved. Registered in England and Wales, No.2385991, Western Avenue, Bridgend, CF31 3RT, UK