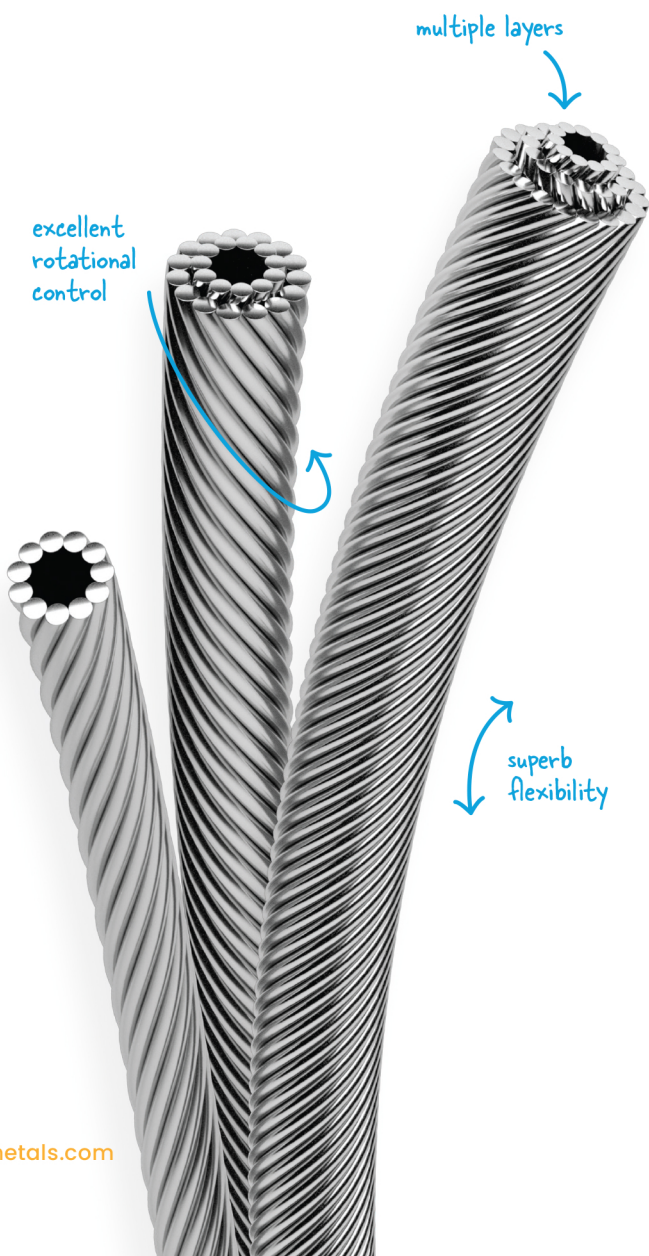




HHS[®] tube

Improved torque transmission
and kink resistance



Stranded material solutions

Precise control and customized flexibility, coupled with an open working channel, makes HHS® tube a top performer in applications requiring torque transmission and navigation along tortuous paths without whip or kinks. Manufactured in single, double, or triple layers, HHS® tube can be tailored to help advance the performance of your applications. Discover what makes this product so unique in helping drive material solutions for our customers.

Understanding the benefits

Certain applications require higher performance than what can be achieved in an unifilar coil. And that's where HHS® tube is different. By selecting single, double, or triple layer and by adjusting the design parameters, such as the number of filars per layer, filar diameters, and lay direction, HHS® tube can be customized for flexibility, torque, tension, compression, and rotational control.

Typical end uses

While HHS® tube possesses exceptional characteristics that allow it to serve any number of applications, we've seen our customers use it in:

- › Endovascular devices
- › Minimally invasive tools
- › Catheter devices
- › Delivery devices
- › Urological tools
- › Atherectomy devices
- › Bioconductors
- › Structural heart devices
- › Intravascular, ultrasound, and optical tomography

Materials

We leverage our knowledge of materials and wire drawing processes to create custom HHS® tube. The most commonly used materials include:

304V STAINLESS STEEL for high strength

316LVM STAINLESS STEEL for improved ductility and corrosion resistance

35N LT™ ALLOY for fatigue life

NITINOL for shape-set parts

Types of HHS® tube

HHS® tube is available in three construction configurations: single, double, and triple layer. In general, the number of filars per layer for all three constructions is between 3 and 18. Lay direction depends on your needs but typically alternates per layer.

SINGLE LAYER provides the greatest potential torque, is highly customizable for elongation, and is the least expensive design path.

- › **Inside diameter:** 0.127 mm to 2.2098 mm [0.0050 in to 0.087 in]
- › **Outside diameter:** 0.1778 mm to 3.556 mm [0.0070 in to 0.1400 in]
- › **Wall thickness (filar diameter):** 0.254 mm to 0.508 mm [0.0010 in to 0.0200 in]

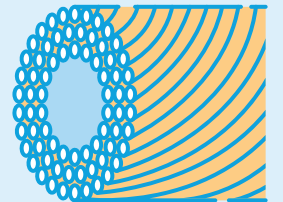
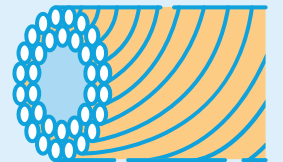
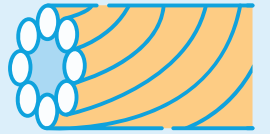
DOUBLE LAYER offers improved bidirectional torque transmission and multi-characteristic development.

- › **Inside diameter:** 0.254 mm to 2.2098 mm [0.0100 in to 0.087 in]
- › **Outside diameter:** 0.3556 mm to 4.318 mm [0.0140 in to 0.1700 in]
- › **Wall thickness:** 0.508 mm to 1.016 mm [0.0020 in to 0.0400 in]

TRIPLE LAYER delivers the most evenly distributed bidirectional torque transmission, provides smooth rotation and stable lumen under load. Popular for customers with large design envelopes.

- › **Inside diameter:** 0.254 mm to 2.2098 mm [0.0100 in to 0.087 in]
- › **Outside diameter:** 0.4064 mm to 4.572 mm [0.0160 in to 0.1800 in]
- › **Wall thickness:** 0.762 mm to 1.524 mm [0.0030 in to 0.0600 in]

All values are representative of constructions within our manufacturing capabilities. Inquiries outside of these ranges will be evaluated on a case-by-case basis.



End terminations

Shear cut: A highly efficient end termination, it is widely used if ends will be removed or are unimportant to additional processing. Individual filars may shift during shipping and handling.



EDM cut: This square cut enables additional processing. Individual filars may shift during shipping and handling. Accompanied by laser welding for optimal end termination.



Band weld + EDM cut: A square cut with filars secured in place.



Band weld + EDM cut + face weld: Square cut with filars secured in place and all layers mechanically engaged, with slight edge break possible on inner diameter and/or outer diameter.



Additional capabilities

Your custom-made HHS® tube can undergo a number of additional processing steps to further tailor it to your needs:

TAPER GRINDING / OUTSIDE DIAMETER STEP GRINDING remove material from outer surface for easier assembly and customized flexibility

COATING electrical insulation or chemical separation with custom coatings

MECHANICAL ASSEMBLY of specialized HHS® tube to hypotubes, end fittings, or other constructions to streamline your manufacturing process

SHAPE SETTING custom Nitinol wire constructions that can deform and return to a set shape

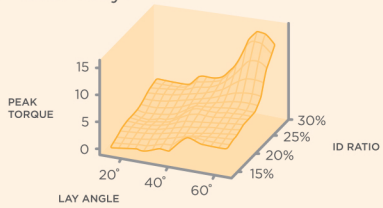
SWAGING to increase pushability, tensile strength, and torque

CUSTOM TESTING upon request to evaluate certain mechanical properties

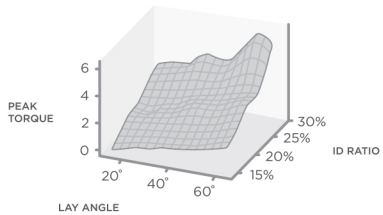
Exploring deeper connections

To help you better understand the relationship between HHS® tube configuration changes and certain mechanical properties, we've created 3D graphs below. These graphs apply to single layer HHS® tube only.

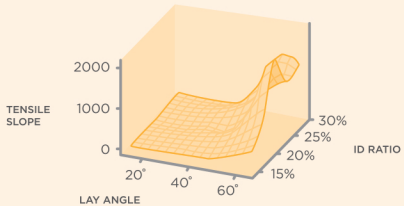
Peak torque relationship: primary direction



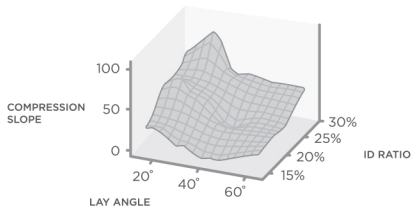
Peak torque relationship: secondary direction



Tensile loading relationship



Compression loading relationship



Understanding naming conventions

To learn more about the relationship between the naming aspects of HHS® tube, we've broken it down for you to see.

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪

1 x 12 x 0.127; 0.889 + 12 (0.127); 1.143 / 1.1176 x 1.27 m

- ① 1 Indicates singular filars surround the open center (core) as opposed to filar groups
- ② 12 Number of filars
- ③ 0.127 mm [0.005 in] Diameter of each individual filar
- ④ 0.889 mm [0.035 in] Intermediate outer diameter
- ⑤ + Each subsequent layer is indicated by a "+"
- ⑥ 12 Number of filars
- ⑦ 0.127 mm [0.005 in] Diameter of each individual filar
- ⑧ 1.143 mm [0.045 in] Final outer diameter
- ⑨ / Indicates a process that will alter the outer diameter of the HHS® tube
- ⑩ 1.1176 mm [0.044 in] Indicates a diameter reduction (swaging)
**Note: If the number is larger, it's indicating a coating which will also be noted in the suffix of the description.*
- ⑪ 1.27 m [50 in] Length of HHS® tube



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