

MACHINE DESIGN

JANUARY 23, 2003
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A PENTON PUBLICATION
Periodicals
USPS 881 Approved Poly

The Right side of the track

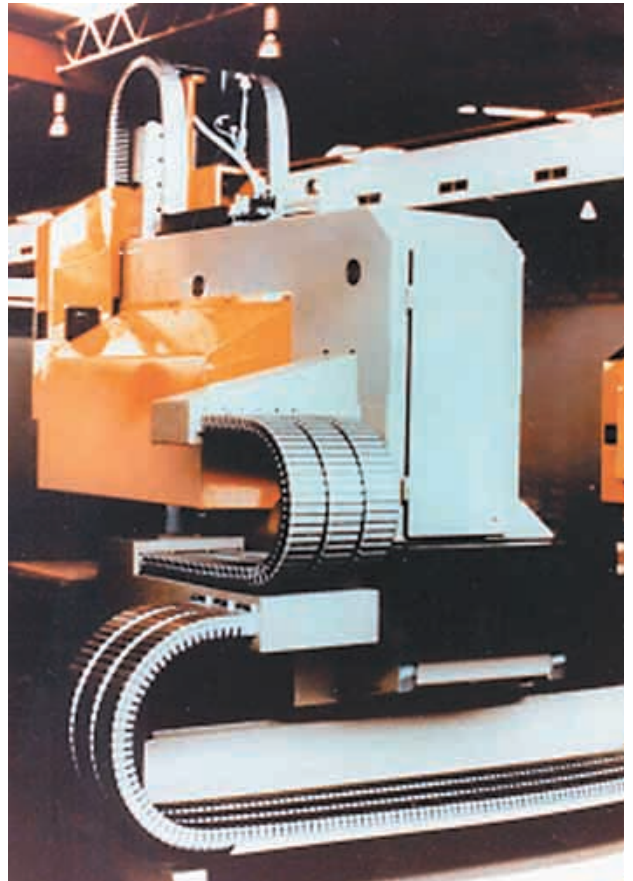
Some basic knowledge of motion applications helps in properly selecting cable and track for the perfect fit.

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Amidst all the whiz-bang technology that goes into motion-control and robotic systems — motors, controllers, drives, and feedback devices — one very important piece of the puzzle is often overlooked; the lowly cable hardware, and its support structure. But the truth is that even when all system components are in perfect working order, cable failure means no signal transmission and therefore no movement. To avoid costly mistakes, take some time and learn about the design and selection of cable and track.

Cable catechism

The first thing to know is the relationship between cable, cable tracks, and accessories. Cables actually carry the power and signals for the system; the cable



Cable tracks protect cables and hoses in machinery and robotics equipment.

Track calculations

To determine the amount of track needed, determine total travel length and the type of mounting (center or off center.) Then, locate the fixed end and determine the type of movement.

Two different equations help determine track length. For center mounting:

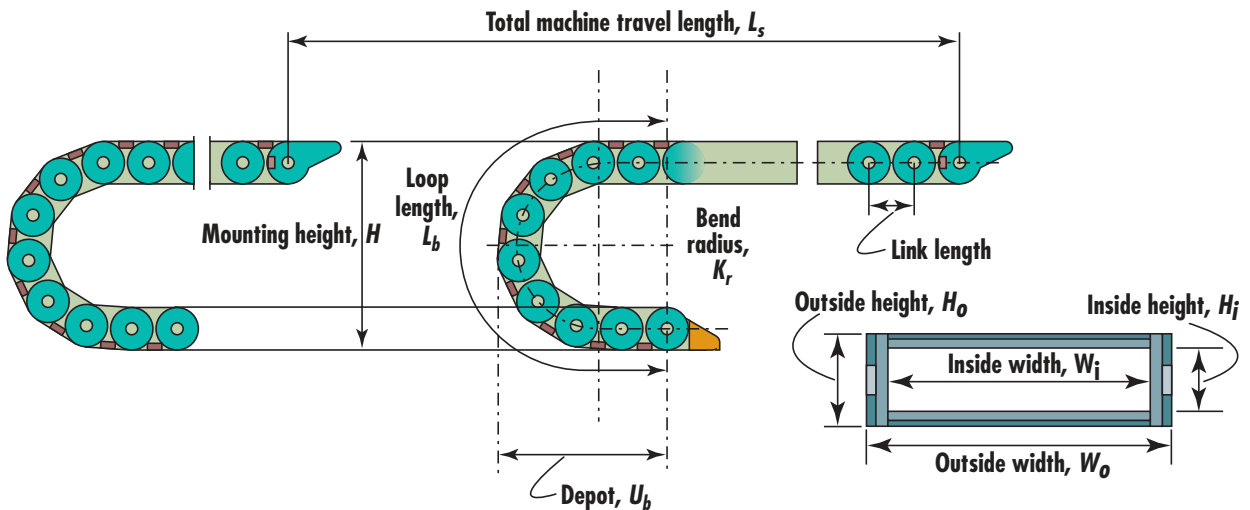
$$M_c = (L_s/2) + L_b$$

where the number of links equal the total length, M_c , divided by the link length.

The off-center mounting equation is:

$$M_{oc} = (L_s/2) + \text{Off-center} + L_b$$

where again, the number of links equals the total length, M_{oc} , divided by the link length.



track protects the cable. Common accessories on tracks include dividers, brackets, and frame stays.

There are many types of cables designed for different applications, environments, and industries. When dealing with motion control, three basic types of motion determine the cable design: static or stationary, continuous rolling or bending flex, and torsional or multiaxis. Static, as the name implies, involves no movement. Solid wire and low-grade compounds are usually sufficient in such designs. If the cable is used in a harsh environment and is exposed to oils or chemicals, make sure the jacketing material can withstand those compounds.

Continuous flex cables are typically used in continuous motion applications. The cable is designed with stranded wire and specially formulated thermoplastics for insulation and jacketing material. Important considerations include the number of bend cycles, bend radius, and again, the operating environment.

Finally, torsional or multiaxis cable is typically used in robot arms or other applications having two directions of motion. This special cable configuration uses stranded wire. Depending upon the application

Nomenclature

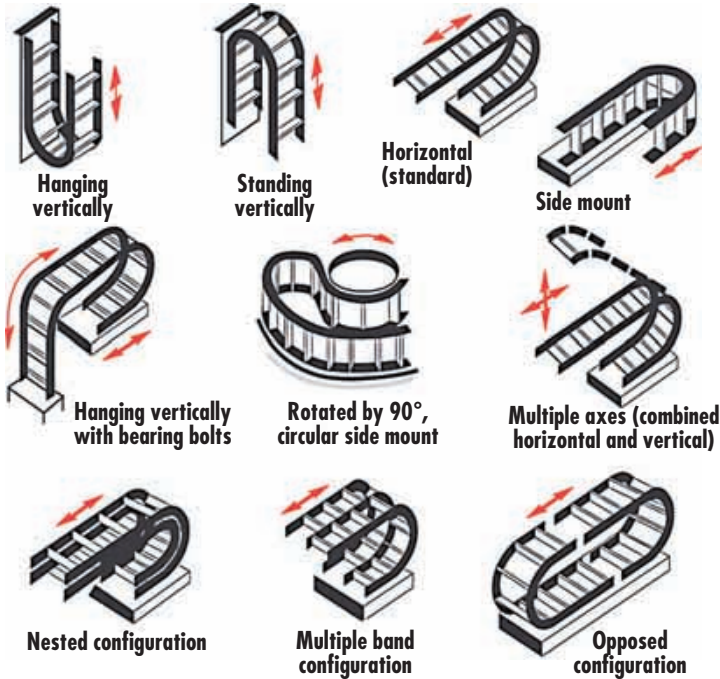
- H = Mounting height
- H_i = Inside height
- H_o = Outside height
- K_r = Bend radius
- L_s = Total machine travel length
- L_b = Loop length
- U_b = Depot
- W_i = Inside width
- W_o = Outside width

requirements, special thermoplastics are used as insulation materials to withstand mechanical abuse.

On the right track

The most important factor when designing a cabling system is to understand the application. Know the requirements and the limitations of the equipment

Cable track movement variations



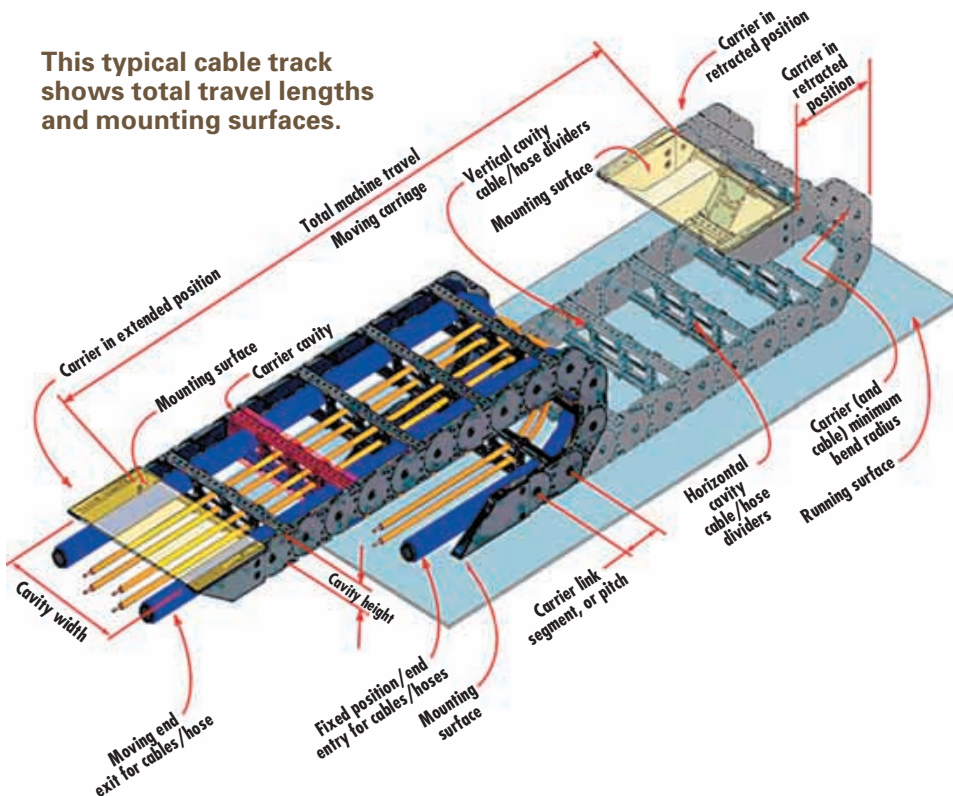
Knowing the type of movement aids in selecting the proper track material. The majority of movements pictured use plastic track. Metal is mostly used in horizontal configurations.

to which the cable will attach. Also, analyze the cable motion before selecting the cable track.

The two most common types of cable tracks are plastic and metal. Plastic varieties, made of nylon, generally resist chemical attack. They are also lighter, more flexible, and less expensive than metal. Metal cable tracks are made of zinc-plated steel. They need less support than plastic tracks, handle higher operating temperatures, and are more durable in harsh environments.

Machines with a short stroke generally use plastic track. Metal tracks are better in demanding applications, for instance where hot weld splashes would melt plastic on contact. Plastic can ride atop other plastic track, but metal can't ride on top of metal because of rigidity and the higher coefficient of friction. Also, plastic can hang or sag without any support but heavier metal track can't. The operating temperature range for plastic track is -25 to 100°C . For aluminum track, the range is -25 to 250°C , and for nonaluminum metal (i.e., stainless steel) the range is -25 to 400°C .

This typical cable track shows total travel lengths and mounting surfaces.



Usually on a machine, one end of the cable track moves and the other is fixed. Two basic mounting configurations are center and off-center mount. Center mount means that the track moves half to the left and half to the right of the fixed point. Or in other words, the fixed point is in the middle.

An off-center mount configuration means that the movement is not equidistant from the fixed point. Sometimes the track can't be mounted in the center because of machine restrictions. In this case more track is needed to compensate for the fact that the fixed end isn't centered.

Next, determine the proper carrier type and

size. Determine the minimum bend radius of the components inside the track. Cable and hose manufacturers usually supply minimum bend radius information. A rule of thumb for hoses is that the minimum radius should be five times or greater than the diameter of the hose, and for hydraulic lines 7.5 times or greater than the diameter. A tighter bend radius puts more stress on the hose. Also, the bend radius will depend on the pressure in certain applications. Choose a track that is slightly larger than minimum bend radius. Width clearance for cable inside the cable track is 10%, for hoses 20%. Height clearance for both cable and hoses is approximately 20%.

Distribute the weight inside the track as evenly as possible and put the heavy components on the outside. Check the travel distance for unsupported length.

Cables and hoses can be arranged in straight lines by using horizontal and vertical dividers. It's a good idea to place heavy cables and hoses closer to the outside and the lighter ones in the center. Putting all the heavy cables on one side will make the track tend to move in that direction. Sometimes, cables must be stacked a few



layers high, calling for both horizontal and vertical dividers.

Next, watch out for the height of the track and the clearance needed. An enclosed machine might put limits on space. Another important factor to consider is the depot, which is the length of track needed when the track completely retracts. A lot of times, thought is given to the total travel length only. But when the track completely retracts, there must be room for the loop of track. Otherwise it will hit against an obstacle such as a wall. ■

Plastic cable track is typically made from chemical-resistant nylon, weighs less, and is less expensive than metal track.