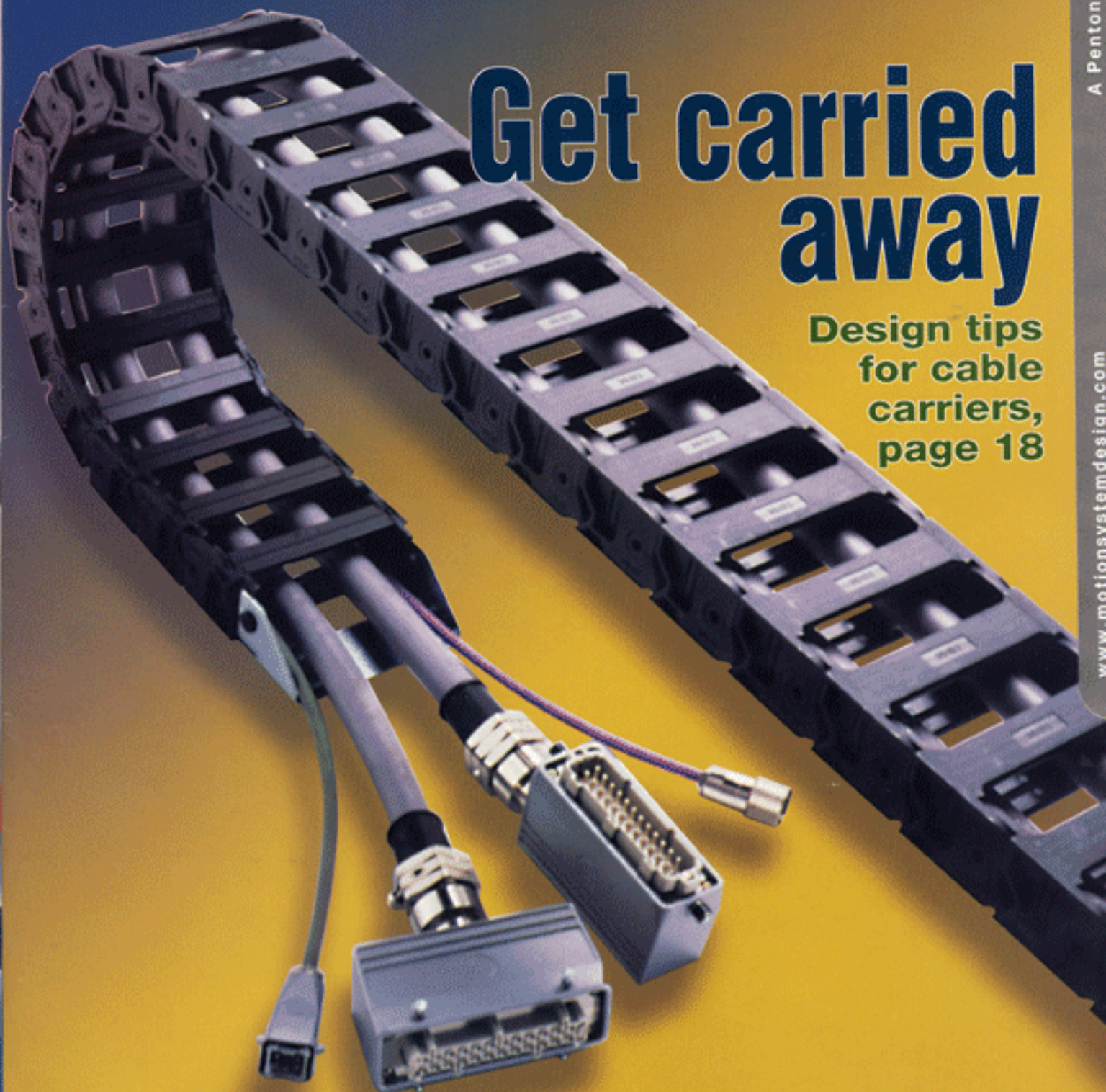


# Motion System Design

## Get carried away

Design tips  
for cable  
carriers,  
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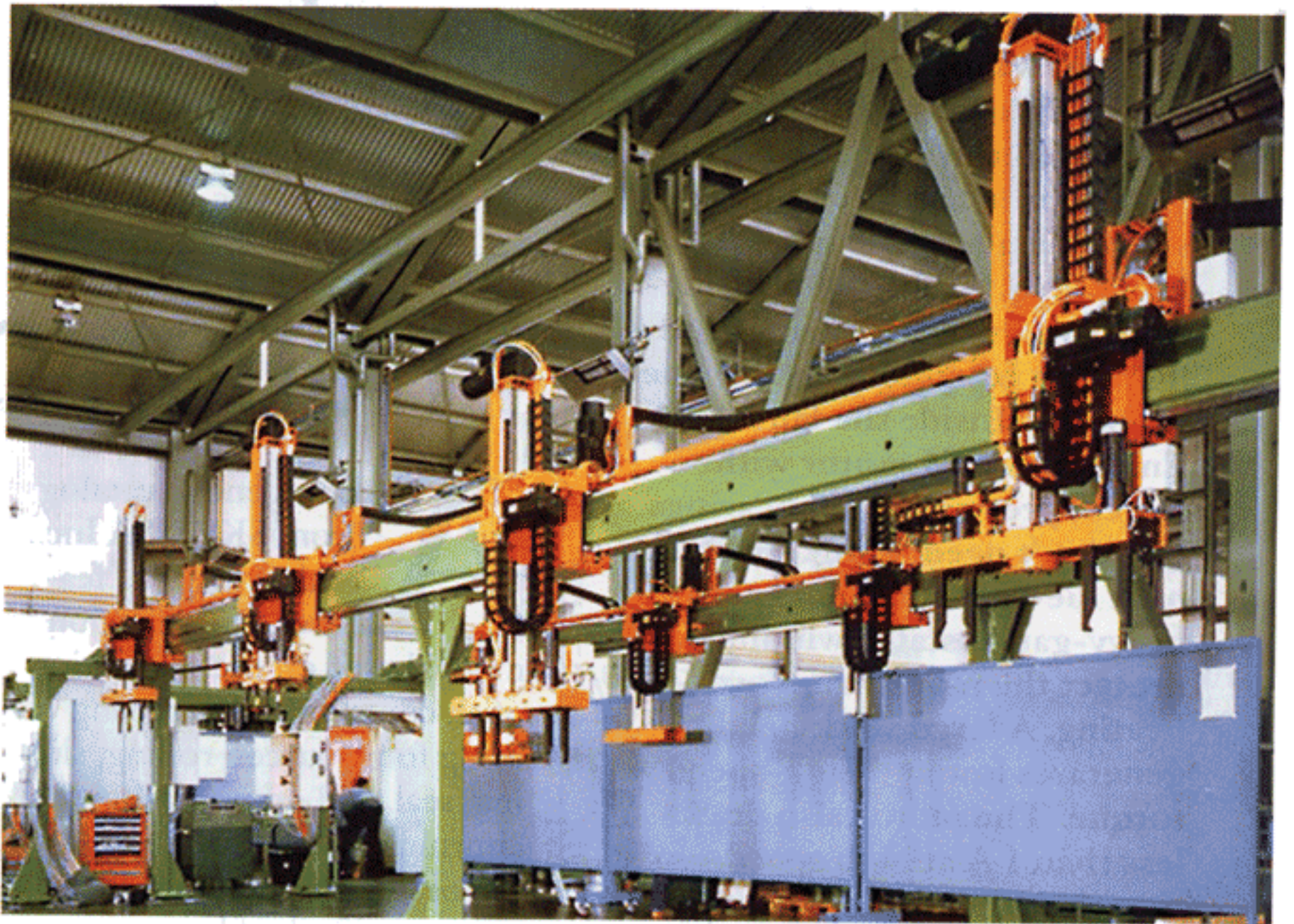
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# Track starts

Compared to other components, cable carriers might seem relatively easy to specify. Still, where the lifelines of a system are involved — power cables, communication lines, and hose — a pragmatic approach helps prevent catastrophes.

**C**orrectly specifying cables is important because they can fail if flexing-cycle and bend-radii limits are exceeded. However, cable carrier design is just as important. Carriers shield and protect cables from fatigue and crimping brought on by exceeding precisely defined geometry limits, so they must be dimensioned like any other motion component. You might say that improperly populated cable carriers “derail” entire production lines. That’s why (once interconnection needs are established and movement requirements solidified) cable and track selection is the first important step toward continuous motion efficiency.

Along with picking the right carrier material, proper cable and hose management is achieved by aligning track components



with proper segregation techniques. There are plastic (nylon) and metal (zinc-plated steel) tracks offered; dividers also come in plastic and metal. Plastic is the most commonly used material because it’s less expensive and quieter. Metal is used in harsher environments (particularly in metal-cutting applications) where weld splash, solvents, coolants, and abrasives exist. It comes down to checking specific setup geometries: Interconnection trains can be kept on track with assembly techniques and documentation to control departure, transit, and destination paths.

## Appropriate construction

Plastic tracks are most common because they're less expensive and quieter. Only the harshest environments contaminated with weld splash, solvents, and abrasives require steel.



Formulas indicate designs with the most functional integrity and determine the appropriate cable carrier size; clearance safety factors are the first considerations.

**Cables:** Add 10% to the outside diameter. This value is  $c\phi + SF$ .

**Pneumatic lines:** Add 15% to the outside diameter. This value is  $pn\phi + SF$ .

**Hydraulic hoses:** Add 20% to the outside diameter. This value is  $hyd\phi + SF$ .

The next step is to determine inner cavity height. The largest of all  $c\phi + SF$ ,  $pn\phi + SF$ , and  $hyd\phi + SF$  values should be determined and then used to determine minimum cavity height.

Finally, **inner cavity width** is calculated by summing all cable and line diameters and safety factors.

$$\sum all\phi = \sum c\phi + SF + \sum pn\phi + SF + \sum hyd\phi + SF$$

Maximum cavity fill should be approximately 60% of the maximum space available for proper cable/track management — in other words, less than 60% of the cavity area. Similarly, the largest cable or hose diameter and a properly applied safety factor determine proper carrier bend radius. Generally a leeway of about 10% or so should be allowed for inherent “crown” or pretension.

### Carrier length

Where should a cable carrier end and begin, and where should it be mounted?

Determining these locations help prevent pulling, stretching, and even disconnection of lines. The fixed point at center of travel should be

$$L_K = \frac{L_S}{2} + L_B$$

Where *total travel* =  $L_S$

*Carrier length* =  $L_K$

And *Loop length* =  $L_B$

Calculated

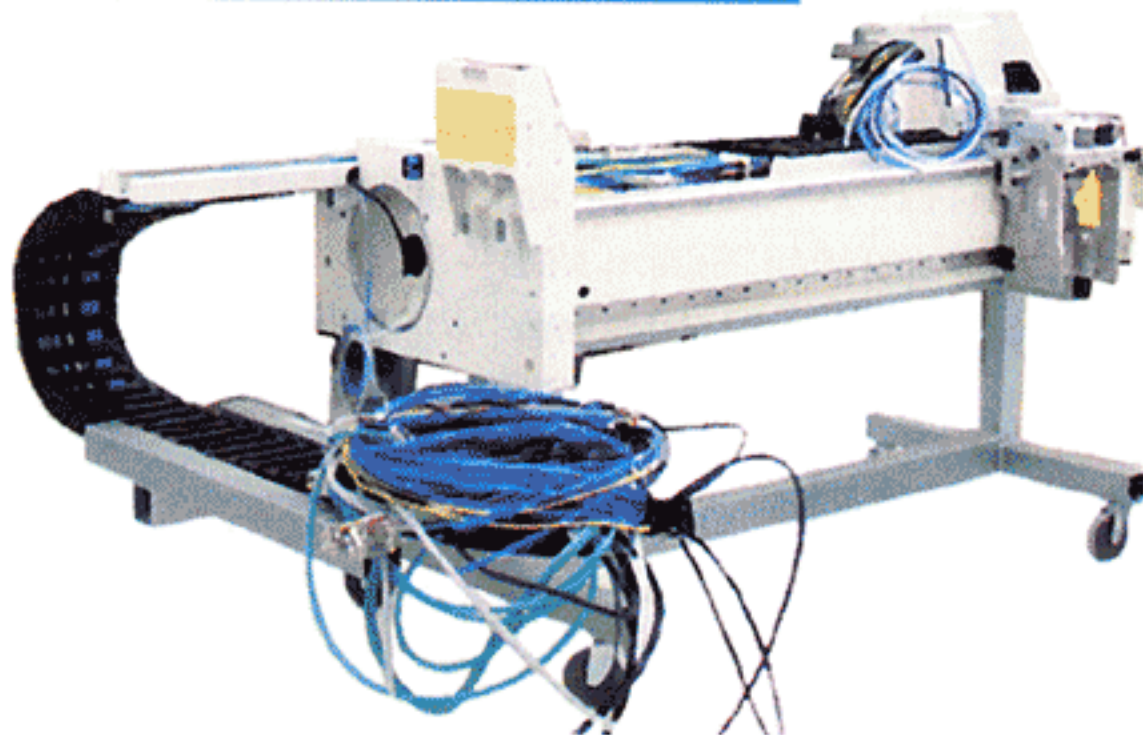
$$L_B = (3.14 \cdot BR) + 2 \cdot t$$

And where  $t$  = link pitch

The fixed point is calculated

$$L_S + L_B + L_K$$

## The whole picture



A pragmatic approach is substantiated by selection criteria for all materials, design interfaces for the entire system, and simulation of the targeted solution.

Proper carrier bend radius is determined by the largest cable or hose diameter. A 10% leeway should be allowed to prevent problems from inherent pretension.

This fixed point at end of travel is also important to verify, because it allows for the most efficient determination of carrier length. Fixed point off center of travel is

$$L_K = \frac{L_S}{2} + L_B + Off_{CMT}$$

Where the total number of links is

$$\sum t = \frac{L_K}{t}$$

After using these formulas for reference, all necessary geometric parameters should be determined to fully define the application. This stage is often when cable track manufacturers want to get involved.

### Customized directions

For easier design evaluations, most manufacturers like to get involved as soon as dimensions are determined. Their concept drawings reveal the best options and push the design along. To properly match materials after meeting system design criteria, internal programs simulate all parameters entailed in a specific populated track application. A software representation of the simulation is generated, along with the quotation and concept drawings.

Perhaps the most important facet of solution-searching is a customized procedural manual. While basic control documents (such as basic population and subassembly drawings) are helpful, procedural manuals take this a step further. General system setup notes, detailed subassembly drawings in AutoCAD or other CAD formats, general population drawings, and specific assembly steps can include illustrated digital pictures of key assembly techniques. Procedural manual are revision-controlled and provided as a proprietary control document for review and control of the entire system solution. This total approach allows for an accurate and repeatable process for assembling populated tracks. **MSD**

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