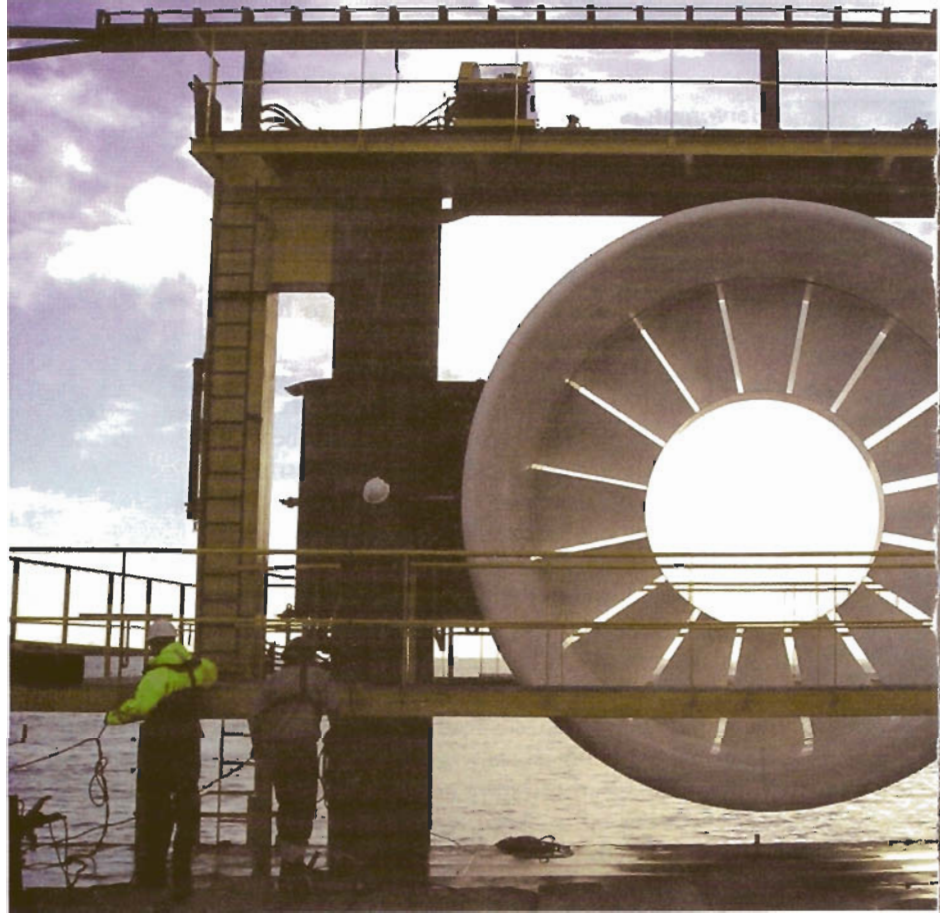


3 Triple threat: Cables, Carriers, Connectors

Don't let your cabling concerns become an afterthought. Today's motion systems deserve more than that out of their lifelines. Find out the latest trends in cable, carrier, and connector technology in this forum on maximizing productivity.



Need to know

How do cables, carriers, and connectors boost productivity?

Dave • Alpha: The enemy of productivity is, obviously, the failure of any component within the system. With respect to cable, the two most important factors are selecting the proper type of cable for the motion-centric application, and then correctly installing it. Flexing cables typically carry different flex life cycle performance ratings; therefore, it's necessary to select one with flex life capabilities commensurate with the other system components.

Rick • Lapp: Nobody wants downtime. Specifying the right cable for a continuous flex application is key for longevity and productivity. Just because a cable feels flexible does not mean it's a continuous flex cable. When specifying, make sure the cable is rated for continuous flexing and has test data to support the performance. The jacket compound is another factor, depending on the environment. For example, in a machine tool application, a poly-

urethane jacket is best to withstand cutting from metal shavings. Using multi-contact electrical connectors can also help minimize downtime by providing a quick disconnect for the cable or cable-track assembly, allowing easy replacement and correct wiring.

Paul • Gore: If someone selects the wrong cables or decides not to follow the track manufacturer's design criteria, it will hurt their end user's profitability and long-term market reputation. Cables that fail in the field will cause expensive downtime when they need to be replaced. Even worse, failing cables can cause sporadic manufacturing problems from intermittent signals. We once had a customer who had to fly cameras and field engineers all over the world to replace FireWire cables that had not been designed for flexing.

Mark • A&A: Increasing demands for productivity typically require machine builders to increase speed, duty cycle, and work area. As a result, carriers must be designed to handle the demands of higher cycles

Cable carriers are used in a wide range of applications, such as this tidal turbine that generates electric power through the inflow and outflow of water at high and low tide.

today's automation environment is the umbilical between the moving mechanism and the fixed power and/or control source, which requires a system to protect the machinery lifelines. Of critical importance is selecting the right mix of continuous-flex cables, maintenance free connectors, and a cable-carrier system suited for each other and for the equipment's life expectancy.

Cable commandments

What's your best advice on specifying, sizing, and applying connectivity solutions?

Dave • Alpha: In order to maximize cable life:

- Select the proper cable for the required motion (rolling, bending, torsional, or variable motion flex) and throughput.
- Consider special environmental ratings, such as temperature range or chemical resistance.
- Before securing the cables, cycle the unit several times to ensure the cables can move freely. Evaluate if further dressing (protective sleeving, tubing) is required.
- When installing cable into a track, do not twist, bend, or kink the cable.
- Inspect the system regularly for signs of damage or excess wear.

Rick • Lapp: Do not clamp the cable along the cable track or to one another inside the track. Only clamp at the ends and make sure the cable has free movement.

Let the cable relax prior to installing. Every cable wants to lay a certain way. Installing a cable in any

other state causes it to twist or corkscrew.

The bend radius (BR) of the cable track is the largest BR for the cable installed. For example, if four cables have BRs of 0.25, 0.35, 0.5, and 0.6 in., the cable track must have a BR of 0.6 in. or greater for optimal performance.

Cable weight should be evenly distributed, placing heavier cables on the outside and lighter ones inside. Separators help keep space between cables.

Validate and verify test parameters. Look at speed, length, BR, acceleration speed, and time tested as performance indicators.

Paul • Gore: Flat cable eliminates the need for dividers often used to protect and support round cable in cable chains. This translates to smaller, lighter, and less expensive carriers. Flat cables can be stacked on top of each other, allowing better cable management.

Consider using self-supported flat cables in place of track for short stroke lengths of 0.5 m or less. Eliminating track reduces cost, weight, particulation, and vibration.

Require cable suppliers to provide flex test data and prove flex test capability for custom applications.

Cables with extruded silicone, PVC, or polyurethane jackets can cause problems in cable chains because they generate high levels of particulation. Their sticky jacket also causes cable to creep and kink when flexed in the contained space within a cable chain.

Mark • A&A: Make sure to leave enough room for cables (nominal OD + 10%), hoses (nominal OD + 20%, as high pressure hoses expand,

in longer travels under higher speed and acceleration. When application variables are considered up front, carriers are reliable cable management solutions that offer consistent, low maintenance performance. However, poorly designed carrier systems can cause catastrophic failure, weak machine performance, and downtime.

Joe • igus: The design of a cable carrier can contribute to productivity by assisting rapid installation or replacement of cables and hoses. For example, designs offering split, zipper-style, or hinged crossbars mean cables or hoses do not have to be pulled out of or threaded into one end of a cable carrier, but can just be pushed straight in along its length. Production throughput can also be increased with pre-assembled cable carrier systems, ready to be installed on a machine. These plug-and-play solutions come equipped with all cables, hoses, connectors, mounting brackets, and other accessories.

Stephan • KabelSchlepp: One of the most vital considerations in

contract, and shrink), and required separation inside the carrier.

Consider the required BR of the cables and hoses (consult specs) when selecting the minimum BR of the carrier to prevent wear and premature failure.

When using high pressure hoses, consult the carrier manufacturer for specific advice on optimum crossbar styles and types, and locations of strain relief clamps.

Joe • igus: Specify a cable carrier in terms of the distance it needs to travel, the number of cycles per hour it must complete, and the maximum permissible speed and acceleration it should achieve. When sizing, establish what the maximum BR, height, and width of the cable carrier can be. As a rule, keep the BR at least 10 times the OD of the largest cable or hose. Many applications have limited space, so factor in camber — the curvature of the upper portion of the cable carrier along its unsupported length — when assessing available height.

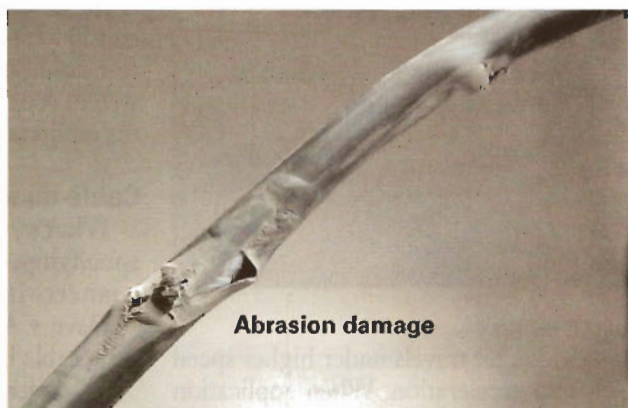
Survival guide

What's the worst that can happen if a cable, carrier, or connector is not specified or installed correctly?

Dave • Alpha: Don't move flexing cables from one installation to another after they have been used. We heard about one situation where a cable track failed, but rather than discard the cable and track together, the end-user decided to reuse the existing cable in a new replacement



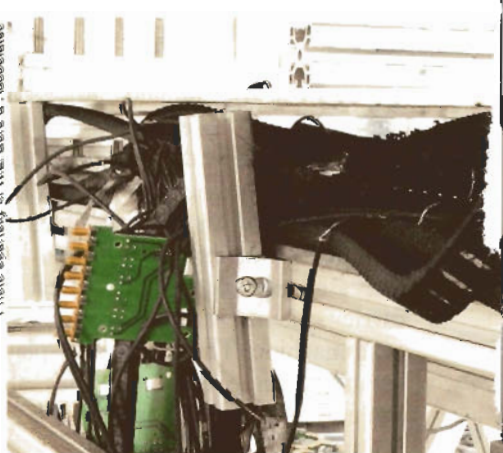
Photos courtesy of Alpha Wire



track. After a short number of cycles, the cable failed.

Abrasion that results from choosing the wrong flexing cable is another common reason for failure. Choosing the right flexing cable based on the application and required flex life cycles, as well as dressing the cable

Photo courtesy of W.L. Gore & Associates



Catastrophic cable chain failure — yikes!

in high stress areas with abrasion-resistant tubing products, will ensure maximum productivity.

Rick • Lapp:

- A cable installed against its grain/memory will corkscrew and fail quickly.
- Never clamp cables together inside a track. It restricts movement.
- Don't over pack a cable track with cables. The use of separators is suggested when more than four cables are installed.
- Make sure the connector's voltage and current rating match the application. Undersizing the connector can result in shortened service life or the possibility of extreme failure and an unsafe condition.

We once had a cable failure within a month of installation. The end-user didn't follow our installation guidelines and just pulled the cable off the reel and into the track. We explained how he should let the cables relax and get into the position they are most comfortable. The next

day, we went to help him with the installation. When we arrived, our cables were on the floor with signs all around saying, "SSSHHHH — Cables Relaxing." We had a good a laugh, installed the cables properly, and to this day have not received a call about any failures.

Paul • Gore: Cable chain failure is rare, but catastrophic. When it happens, it can cause a system to completely shut down.

Digital signals such as Ethernet, FireWire, and Camera Link fail easily in flex applications. Loss of signal will happen long before cable shows signs of wear because the electrical properties of the cable change, attenuating high-frequency digital signals typical in today's industrial environments. Only use cables that are proven to maintain signal integrity for flex.

Mark • A&A: We once had a long travel nylon carrier installed at a casino in Las Vegas where the carrier was submerged underwater. Our carrier was a bolted together system that performed without failure for

several years. When it came time to replace it, the casino maintenance team was approached by another manufacturer that offered a snap together system. The team thought the new system would be easier to install and access than ours, so they purchased it. They soon discovered that snap together also means snap apart. Both systems were manufactured from glass-reinforced nylon, which swells when it absorbs water. While the swelling didn't cause problems in the bolted system, the new system began to have disconnecting links. After several failures in less than a year, the system was replaced with one of ours.

Joe • igus: In short, unsupported applications, cable carriers will support their own weight for half the distance traveled. Eventually, the combination of unsupported length and fill weight means the carrier will sag. This, together with high acceleration and cycle duty, means the sag will reach a critical level and the carrier will fail. Other common failure modes include:

Loss of continuity: Copper conductors sever and break after repeated bending due to work-hardening and fracturing or an incorrect pitch length not suitable for the BR.

Corkscrewing: The cable is poorly configured; inner cores are compressed while the outer cores are stretched during movement. The cable deforms into a corkscrew shape.

Jacket cracking: A cable's cores untwist under its outer jacket, creating bulges that eventually burst under the strain.

Cable's crystal ball

If you could create the ideal cable, carrier, or connector, what would it look like?

Dave • Alpha: The ideal cable would have an infinite lifetime in any range of motion, through wide



A Nylatrac cable carrier manages underwater cables that supply power to the pirate ship at Treasure Island Hotel and Casino in Las Vegas, as it moves back and forth during nightly shows.

Productivity Forum

temperature ranges, and when exposed to a host of chemicals — all at a reasonable cost.

Rick • Lapp:

- Flexing fiber optic to carry more signals with fewer conductors
- Smaller configurations to reduce weight
- New compounds that can perform better and be extruded thinner
- Reduced BR potential to two or three times cable OD
- More efficient ways to remove backtwist from cable

Joe • igus: The perfect cable carrier would operate quieter and faster. It would also carry heavier loads and have a longer life than any currently offered. **MSD**