

PRECONFIGURED CABLING:

THE SHAPE OF THE FUTURE

BY RICHARD MARTIN

In designing today's electrical and electronic products, small is good; miniature is even better. Regardless of the end market — military, industrial or consumer —

customers expect more features from increasingly compact products, from modems to heavy trucks.

Many examples of miniaturization are available in the modern electronic marketplace.

Modems have shrunk from shoe box to credit card size. Satellite navigation equipment has compressed from bookcase to calculator size, making it practical enough for use in commercial transportation industries. Electronic medical equip-

Cabling ITT's Mobile Radios

Consider the problems experienced by ITT Aerospace Communications Div., Fort Wayne, Ind., which manufactures mobile radios for military jeeps, tanks and personnel carriers. For some time, the company's engineers and technicians had been dissatisfied with products and methods used when installing wire harnesses. ITT Staff Mechanical Engineer Ed Poorman explains, ITT was "encountering numerous wire pinchings on metal points because the wires were in an extremely dense package, especially when we were doing blind mating from a power supply to a chassis." Eventually, this wire pinching would short out the unit in the field, causing power to the radio to shut down.

Initially ITT tried solving this problem by using tightly bundled wire/cable harnesses. "We would make them as flat as we could, but it wasn't consistent," Poorman says. "We couldn't produce the same shape in the same area all the time."

To overcome this obstacle, ITT Aerospace began using one company's* unique center-molded, preconfigured

Center-molded flexible cable harnesses overcome design and space limitations.

flexible cabling. ITT requested a 22" version capable of right-angle turns past metal castings and configured to fit in an extremely tight package. According to Poorman, using the center-molded cable "completely eliminated our wire pinching problem because you don't have a stray wire that's compressed or bent after it's been blind mated. The wires end up in the same position all the time."

In addition to eliminating pinch points, Poorman says the new cable saves time during installation. "It's an extreme improvement for assembly alone because we can tailor make it for the application and our personnel drop it right into the place where it's supposed to go. Our assembly times are 20 percent faster."

ITT discovered still other advantages. "Because the exact location of each wire in every harness is identical," Poorman says, "it's much easier to meet our electromagnetic interference (EMI) and radio frequency interference (RFI) requirements in our quality control tests." He adds the cabling is totally field repairable; repairing a single faulty wire in the harness maintains the harness integrity.

Lower Profile, More Flexibility in Demand

These center-molded flexible cables not only have solved difficulties experienced by ITT Aerospace, but

SPEC SHEET

✓ **End Applications:** Robotics, communications equipment, portable computers, transportation, machine tools, medical equipment and aerospace equipment

✓ **Related Products:** Connectors, hand tools, test equipment

✓ **Main Points:** Newly developed center-molded flexible cabling offers designers:

- a lower profile,
- increased flexibility,
- less weight,
- vibration and abrasion resistance,
- convection cooling,
- field repairability,
- faster installation,
- a consistent shape, and
- custom configuration.

ment, formerly confined to the hospital, now is portable enough for field emergency teams. Printers, laptop computers, tape recorders, stereo speakers, fax machines and portable telephones all are considerably smaller than their ancestors.

To build smaller, lighter end products, design engineers need smaller, lighter materials and components. Even end products that maintain their size, such as automobiles, industrial robots, large trucks, machine tools and other heavy equipment, are incorporating more electronic controls and sensors. Customers want full-featured performance, so manufacturers are packing an increasing amount of electronics into the finished unit.

One factor impeding miniaturization has been the use of old-fashioned, bulky and unwieldy wire and cable harnesses. One explanation for their continued use may be that electrical/electronic design engineers usually cite cabling as the last consideration in the design process.



many other problems generated by old-fashioned wire/cable harnesses as well.

Chuck Wheeler, Midcon president, says "At the most fundamental level, companies spend billions of dollars annually to build smaller semiconductors and microprocessors and sensors. In turn, their customers spend tens of billions of dollars to buy smaller chips, embedded controls and sensors." But traditional wire harnesses simply have not kept pace with miniaturization-related developments.

Center-molded flexible cabling is a hybrid product that overcomes limitations inherent to conventional wire harnesses and ribbon cables. It differs from conventional wire harnesses in that its individual wires consistently are held in place, making the cabling flatter, smaller and easier to handle. It differs from traditional ribbon cables because individual wires move freely within its open-weave compound; they are not bound inside the polyurethane media like a regular ribbon cable. This feature allows center-molded flexible cables to withstand up to 500,000 flexes without wire breakage. Figure 1 outlines the differences between conventional wire harnesses, ribbon cables and center-molded flexible cables.

Solved: Nine Common Wire/Cable Problems

Old-fashioned wire/cable harnesses and ribbons have other limitations. Design engineers commonly site the following nine problems associated with conventional wire and cable products. These problems usually can be alleviated with center-molded flexible cabling.

Problem 1: Wire harnesses are bulky and consume too much space.

Solution: Center-molded flexible cables may use less than half of the space of an old-style harness. Depending on the configuration, a 0.625" high version of this cable type contains as many wires as a conventional 1.5" wire harness. "This provides for clutter-free design and easy access in a housing," says Floyd Ysbrand, Midcon manager of research and development.

Problem 2: Old-style harness assembly and installation is labor intensive and time consuming.

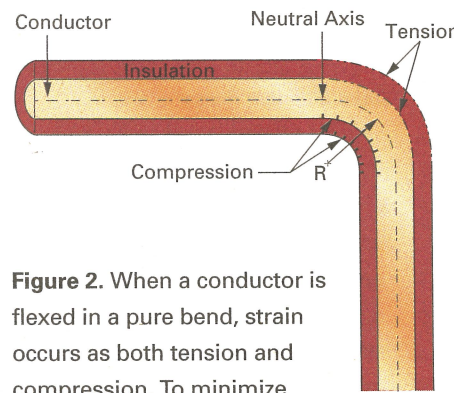


Figure 2. When a conductor is flexed in a pure bend, strain occurs as both tension and compression. To minimize strain, center-molded flexible cabling has an increased bend radius, "R," which distributes stress over a broader area.

WIRE HARNESS/CABLE CLOSE-UP			
Feature	Conventional Harness	Molded Ribbon Cables	Center-Molded Flexible Cables
Profile	Thick, bulky	Flat, thin	Flat, thinner than molded ribbon
Individual Wire Repairability	No	No	Yes
Weight	Lightweight	Heavyweight	Lightweight, up to 30% lighter than laced harnesses
Convection Cooling	Limited	No	Yes
EMI/RFI Shielding	Difficult	Simple	Simple
Assembly and Installation	Difficult	Simple	Simple
Vibration and Abrasion Resistance	No	Yes	Yes
Pinch and Clampdown Avoidance	No	Yes	Yes
Right-Angle Corner Routing	No	Yes	Yes
Crosstalk Avoidance	No	Yes	Yes
Appearance	Looks untidy	Looks neat	Looks neat
Cost	Low	40% more than laced harnesses	7-10% more than molded ribbon

Figure 1.

Solution: ITT Aerospace's assembly times now are 20 percent faster since it began using center-molded flexible cabling. Two factors contribute to faster installation times — the cable's flat, low profile and predictable, compliant behavior.

Problem 3: Loose wires in harnesses and assemblies are pinched when an electrical housing is shut or clamped down.

Solution: Center-molded flexible cabling's consistent shape reduces cable pinch points when electrical housings are closed. The wires stay put; they do not crimp or splay. "That gives designers extra freedom when they're working with wiring setups in tight spaces," Ysbrand says. "Plus, we can add eyelets or straps on the sides of the cable to mount it on a connector or fasten it in place."

Problem 4: Conventional harness repair is time consuming and costly. Locating and removing a broken wire is difficult.

Solution: "Center-molded flexible cabling originally was designed for field repairs," Ysbrand says. "Once you've identified the bad wire, you attach a new wire to it and pull it into the position as you remove the damaged one. The whole procedure takes less than 30 seconds for cables up to 2' long."

Problem 5: Standard wire harnesses are difficult to route around 90° corners or sharp edges.

Solution: These center-molded flexible cables can be custom shaped into most configurations that go around corners, make right-angle turns or skirt sharp objects.

Problem 6: Ordinary wire assemblies, even ribbon cables, fracture and break

under stress, whether from vibration, motion, abrasion or dithering.

Solution: Center-molded flexible cables dissipate stress to the wires, enduring up to 500,000 flexes without breaking. "It flexes well because the wires move freely within the molded compound; they aren't stuck within the assembly like regular ribbon cables," Ysbrand says. During movement of wires in the woven harness, center-molded flexible cabling distributes stress evenly throughout the length of the wires, rather than concentrating it at one point (Figure 2).

Problem 7: Regular ribbon cables and wire harnesses are difficult to keep cool. Round-jacketed, laced or cable-tied harnesses tend to retard cooling because heat generated by individual wires must travel through neighboring wires to the perimeter before convection cooling occurs.

Solution: Center-molded flexible cables employ a flat profile with an open-weave design, allowing each wire to achieve direct convection cooling.

Problem 8: At high data rates, crosstalk always is a concern with conventional harnesses.

Solution: Individual wires in the center-molded flexible cable design are held in constant relationship to each other and never touch. As a result, crosstalk at high data rates is minimized because wires cannot become intertwined.

Problem 9: Wire harnesses are heavy.

Solution: Center-molded flexible cables originally were designed for an aerospace manufacturer wishing to reduce the weight of a conventional molded ribbon design. Depending on the application, they weigh as much as 30 percent less than conventional harnesses.

Conclusion

Old-fashioned wire bundles and harnesses tend to impede efficient design, slowing down the drive to miniaturization. New products like this center-molded flexible cabling help accelerate the trend.

For example, truck and heavy equipment vehicle manufacturers have started using such cables because of space limitations in vehicles and chassis areas requiring point-to-point wiring. Others benefitting from the use of center-molded flexible cables include the aerospace, industrial robotic and medical industries, each of which is producing increasingly smaller products.

While many commercial and military customers continue using conventional ribbon cables and wire harnesses, an increasing number are willing to pay the extra 7 to 10 percent for the features provided by center-molded versions, especially those with tight design considerations. ✓

*Midcon Cables Co., Joplin, Mo., a division of Esterline Technologies' Aerospace and Defense Group, Bellevue, Wash.

RICHARD MARTIN is a technical writer with The Hays Co., a technical communications consulting firm located in Seattle, Wash. For more information, contact Charles Wheeler, Midcon Cables Co., 2500 Davis Blvd., P.O. Box 1786, Joplin, Mo. 64802; (417) 781-4331; fax (417) 781-7237.

