

Cable Management



An Introduction By


Middle Atlantic Products, Inc.

CABLEMANAGEMENT

When care is given to the management and maintenance of cable entering the rack or enclosure system, the goals of providing customers with a neat, organized and effective system are easily attained.

Today's electronic systems wiring includes voice, data, video, audio, security and control. The facilities and wiring systems must be planned in an integrated manner; all these different wires make their way into racks of equipment.

Managing these cables creates some interesting challenges, as wire bend radius and fastening must meet industry standards. With video going over twisted pair and digital audio transmitted through CAT-5e / CAT-6, it is apparent that audio/video systems integrators should be familiar with the associated standards. Additionally, more devices are being controlled and monitored via Ethernet nodes.

The TIA/EIA (Telecommunications Industries Association & Electronic Industries Association) building telecommunication wiring standards are used to ensure performance. These standards provide guidelines that reduce long-term building operation costs, lead to better infrastructure and are adaptable to changes. TIA/EIA-568A is for commercial buildings cabling, and specifies a generic cabling system that will support a multi-product, multi-vendor environment. Anybody working with these wiring systems in commercial installations should obtain and adhere to the procedures set forth. TIA/EIA-569 relates to commercial building standards for telecommunication pathways and spaces. TIA/EIA-570 covers residential and light commercial wiring standards. These important documents can be ordered at <http://global.ihs.com>.



HOT TIP! Installation of cabling systems during building construction or renovation is significantly less expensive and less disruptive than after the building is occupied. Convincing a client that the small cost associated with running extra wires for future expansion will save them money down the road is important. As a matter of code, according to the NEC (National Electrical Code), abandoned cables must be removed or tagged "For Future Use".

Five Distinct Areas of Cable Management

- ✓ Horizontal cabling
- ✓ Backbone cabling
- ✓ Telecommunications rooms
- ✓ Equipment rooms
- ✓ Equipment racks

Note: These cables can be unshielded twisted-pair (UTP), shielded twisted pair (STP or "screened" cable) or coax, to name a few.

Beware of the Bends and Other Things to Avoid

- ✓ Cable twists
- ✓ Staples
- ✓ Tight cable ties
- ✓ Small bend radii
- ✓ More than 25 lbs. of pull force

Note: All twisted pair cable is manufactured as "loose-fill", meaning there has to be a slight air space inside the sheathing. This reduces mutual capacitance, which reduces data packet error rates. Things like tight cable ties will increase data errors. If cable ties are placed at even increments in a high-density installation using coax, it can cause standing waves.



NEXT loss (near-end crosstalk) is also a problem, and is eliminated with proper terminating procedures. The twist in a pair must remain right up to the connector; too often people un-twist the cable for an inch to aid in termination, and that violates the standards. NEXT is tested and measured with a swept-frequency through a "disturbing pair." Optical fiber cabling standards are increasingly becoming a factor as more and more data are passed through fiber in buildings and racks.



Methods of Bringing Cable Into an Enclosure or Rack System

CABLE ENTRY: FROM ABOVE THROUGH TOP OF RACK

Select enclosures that come standard with wide-open tops for large cable bundles. When adding a top option, select one that includes a removable panel for service convenience

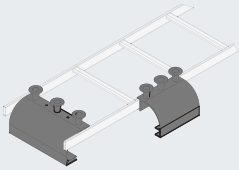
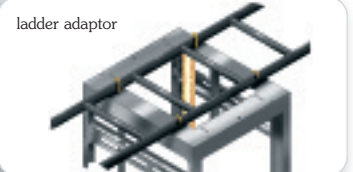
Standard enclosure with wide-open top – cable is dropped in from above.



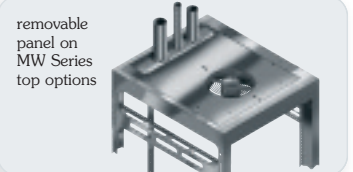
Standard enclosure with fan top option shown – service panel is removed to drop cable bundle into enclosure.



Top options are available that can accept a 6", 9" or 12" wide cable tray or cable ladder. The opening in the top also allows for the use of a cable drop on the cable ladder to maintain proper bend radius of the cable.



The easy-to-machine aluminum panel in many rack tops can also be field punched to accept multiple sizes of conduit.



CABLE ENTRY: FROM BELOW THROUGH BOTTOM OF RACK

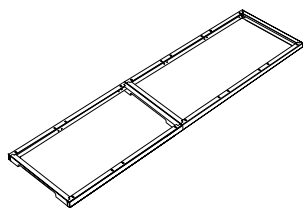
Enclosure bases often feature an open design to accept large cable bundles from below. There is about 3" of space in the bottom of the enclosure before reaching the rackspace area to allow for cable entry up into the enclosure. Enclosures with a unique "upformed base" provide interior room for cable management and coiling unused wire. There are multiple sizes of EKO in the rear of many enclosure bases for piping in conduit.



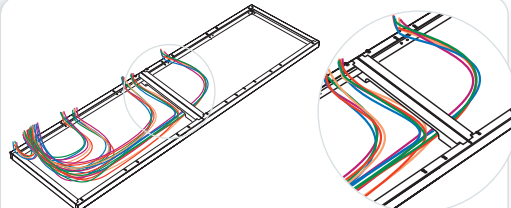
Riser bases provide enclosures with an additional 2½" clearance off the floor and can be used for cabling below each enclosure or cabling from one to another when ganged. Laser knockouts on the ends of many riser bases simplify cable pass-through when they are ganged together.



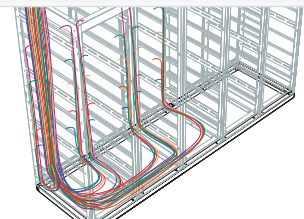
Floor Installations (Non-Raised Floor)



1. Install rises bases



2. Knock out cable pass throughs to route cable between riser bases and into racks



3. Install racks on riser bases

When the riser bases are used with feet and angles it allows the installer to firmly attach enclosures to the sub-floor in Raised Floor/ Access Floor applications.



Dressing Cable Internally

Segregation of cables inside the rack is important – AC power cables or speaker cables should not be run parallel within close proximity to signal wires (within 2”), unless the wires are twisted. Speaker wires can act as AC cables in high-power situations, so the same care should be taken in keeping signal wires away from close parallel runs. Speaker and AC wires can be run in closer proximity, however. Bend radius for twisted-pair cables is standardized at 1½” (3” diameter). This needs to be taken into consideration during the internal wiring layout of a rack. Coax cables should not be kinked, although they are more tolerant than high-speed data to tighter bends.



Bundling of conductors is addressed in the 2005 National Electrical Code (NEC) in Article 310.15(B)(2):

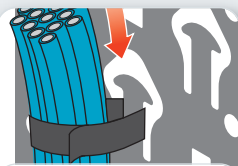
“Where the number of current carrying conductors in a raceway or cable exceeds three, or where single conductor or multiconductor cables are stacked or bundled longer than 24” without maintaining spacing and are not installed in raceways, the allowable ampacity of each conductor shall be reduced as shown in Table 310.15(B)(2)(a):

Number of Current-Carrying Conductors	Adjust Ampacity To
4 to 6	80%
7 to 9	70%
10 to 20	50%
21 to 30	45%
31 to 40	40%
41 & above	35%

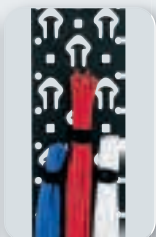
The reason for the required derating is to compensate for the accumulated heating effects that may deteriorate the insulation over time. This information has been extracted from the National Electrical Code (NEC), please refer to this document for these requirements in their entirety.

Vertical Lacer Strips

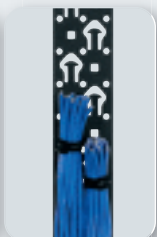
Add as many lacer strips as necessary to route the maximum amount of cable into the enclosure while keeping power and signal cables separate. Vertical lacer strips mount to enclosure rail brackets and allow the installer to lace cable from the top to the bottom of a rack, or vice-versa. They are available in different widths, from 1” to 4¾”. Vertical lacer strips provide a number of ways to dress cable. Some strips are punched with holes for mounting cable tie saddles. Tie saddles have been designed to hold bundles wrapped with cable ties or hook-and-loop straps (such as Velcro®) up to ¾” wide. Some lacer strips include raised lances that accept wire ties or hook-and-loop straps without the need for tie saddle accessories. The most advanced lacer strip will feature holes for mounting vertical power strips, cage nut-mounted accessories and tie saddles. These full-featured lacer strips also include pre-cut tie posts. Assembled cable bundles mount easily to these tie posts; installers slide the cable tie or hook-and-loop strap onto the tie post without the hassle of fishing it through the lacer strip before wrapping the bundle.



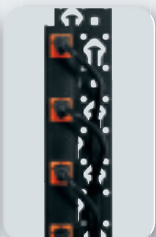
Lacer strips with tie posts allow assembled cable bundles to be mounted easily



LACE-44-OWP



LACE-44-OP



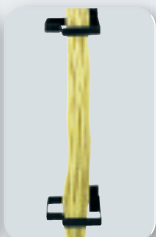
LACE-P



LACE-44LP

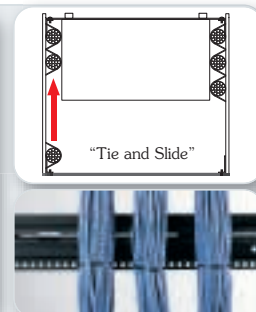


D-RING

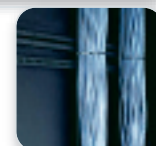


LACE-44-1SP

Effective vertical cable management can be accomplished in many ways, but different regions have adopted unique styles. Integrators along the East Coast of the United States who work in a high-density environment prefer the “tie and slide” technique. This allows smaller cable bundles to be dressed vertically, mounted loosely to the pre-welded horizontal tubes found in some enclosures, and slid in place alongside mounted equipment. By utilizing this space (“no-man’s land”), installers greatly increase the amount of useable area within an enclosure. West Coast integrators mostly prefer using individual, thin vertical lacers with tie saddles. Both examples provide an effective cable management solution and individual enclosures and layouts will dictate which method is best for each installation.



When large (4” diameter) cable bundles are used, a rack with large flanged rackrail should be chosen. The large flanges provide the needed space to dress large bundles without fishing wires behind rail brackets and do not interfere with the rackmount area.



Horizontal Lacer Strips

Most enclosures are furnished with a set of rear rackrail that can be used to mount horizontal lacer bars at any height position. These lacer bars will address two common problems that occur: cable strain relief and running cables from one side of the rack to the other.

Use rail-mount lacer bars when running cables horizontally



Use rail-mount lacer bars as strain relief for connectors

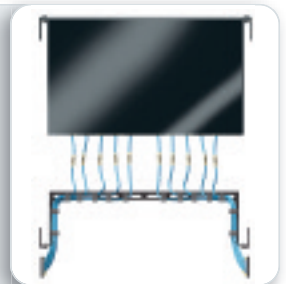
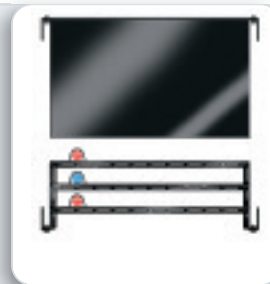
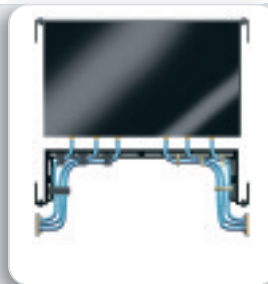


Different style lacer bars are available for different applications. There are round lacer bars, flat and “L” shaped with cable tie slots. They also come with different size offsets such as 1½”, 2”, 4” & 6”. Determine which lacer bar is appropriate for the application.

Offset Lacer Bars

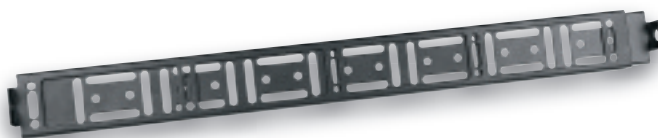
Use offset lacer bars when:

- ✓ Positioning lacer bar close to the rear of the unit for cable strain relief
- ✓ Managing multiple horizontal cable bundles at different depth positions
- ✓ Cable labels need to be seen (offset away from patch field or unit)



Telescoping Lacer Bars

A telescoping lacer bar system is the most advanced horizontal cable management solution. The limitless number of mounting options and configurations allows for complete customization by the installer. Telescoping lacer bars can be mounted to eliminate cable strain and in combination with vertical lacer strips to meet the cabling needs of even the most high-density installation. Cables can be dressed throughout an enclosure using cable ties or hook-and-loop straps. Additionally, telescoping lacer bars feature mounting holes to accommodate vertical lacer strips and the mounting brackets for vertical power strips.



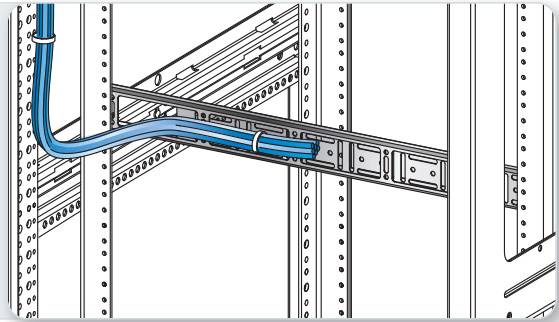
Horizontal Telescoping Lacer Bar (closed)

Front To Rear Telescoping Lacer Bar (extended)



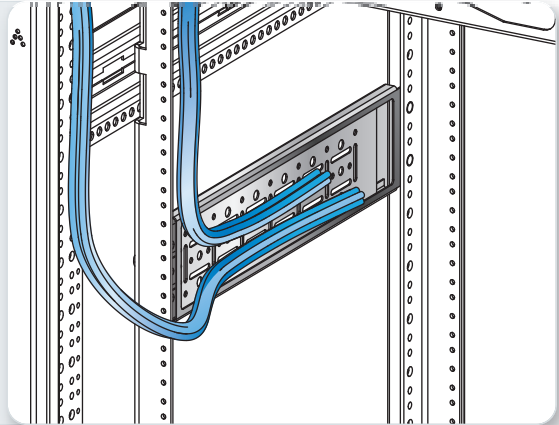
Horizontal telescoping lacer bars adjust to fit enclosure widths from 19" to 30". The lacer bar can be mounted vertically or, to be used for reducing cable strain, it can be mounted horizontally as a cable tray. The horizontal telescoping lacer bar can be mounted to rackrail brackets or to the inside flange of the rackrail itself. The hole pattern is such that an installer may also mount the lacer bar directly to opposing vertical lacer strips.

Provides side cable management off of rear rail or rail brackets



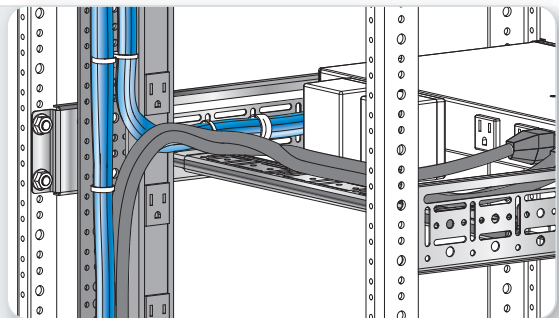
Front to rear telescoping lacer bars feature slots for cable ties or hook-and-loop straps. The slot patterns have been created to help manage cable bundles that run vertically or parallel to the floor. These lacer bars are available in several fixed and several adjustable lengths. Depending on the model, the front to rear telescoping lacer bar can mount to the front and rear rackrail of enclosures from 14½" to 50" deep. The hole patterns of front to rear telescoping lacer bars accept mounting of vertical lacer strips and the mounting brackets for vertical power strips. The hole patterns have also been sized to accept the mounting of horizontal telescoping lacer bars for the creation of a complete, versatile cable management solution.

Provides front to back cable management, off of front to mid rail or front to rear rail



The complete telescoping lacer bar system incorporates vertical lacer strips, vertical power strips, horizontal cable management and vertical cable management. Cables are protected from cable strain and dressed according to the proper bend radius. The telescoping lacer bars adjust to fit the depth and width of the host enclosure. The complete, configured system is the most effective and the most comprehensive solution for dressing cables within an enclosure.

The system can also be used to mount power and vertical lacer



Horizontal Cabling Tips 'N Tricks

- ✓ Feed from both sides when cable radius is large
- ✓ Use offset bars to get close to the rear of equipment without adding rackrail
- ✓ Leave room for cable labels

Note: Neat and tidy is always best



Industry Requirements

Different cables and signals have different requirements. The data market has high densities and is bend-radius sensitive. Video broadcast has a large quantity of coax cables and/or high definition cables that are bend radius sensitive. Security installations now have DVRs (Digital Video Recorders) where camera cables do not run to a switcher. The DVR provides that function which means many cables need to be dressed directly to the equipment. Audio with its sensitive gain structure needs special care for hum and buzz. By following standards and common-sense rules, today's complicated rack integration can look good and work well thanks to proper cable management.

Cable Management Accessories

Tie saddles are the easiest way to manage cable ties. Completed cable bundles can be hooked directly onto the tie saddles. By eliminating the need to fish cable ties through small holes or around lacer bars, tie saddles reduce installation time. Additionally, a robust tie saddle will accommodate hook and loop straps up to $\frac{3}{4}$ " wide. Tie saddles can be mounted to rail brackets, rackrail, telescoping lacer bars and some vertical lacer strips.



Hook-and-loop cable fasteners should be used when installing cable that is sensitive to strain or when the wrap is so tight that a cable tie would affect the performance of the cable. This problem is common when installing CAT-5e or CAT-6 cables.

Hook-and-loop straps can be opened and reused, making it easy to modify an installation in the future. If cable will be added or removed from a bundle, hook-and-loop straps should be used instead of cable ties. Cable ties must be cut, thrown away and replaced whenever cable bundles are modified.



To properly install a hook-and-loop cable strap:



1. Pull cable strap through tie point on lacer bar.



2. Loop through opening in cable strap.



3. Pull snug. Do not pull too tight.



4. Place cable bundle parallel to lacer bar.



5. Wrap strap around cable bundle and lacer bar to secure.

Cable friendly rack screws are $\frac{3}{8}$ " long with a radiused end point. Because these 10-32 threaded screws do not extend far beyond the rackrail, they minimize the chance of cables chafing or being damaged by sharper, longer hardware. When dressing cables up against the inside of rackrail, these cable friendly screws are the best way to prevent accidental cable damage.



Dressing Cable Internally

In racks where a high density of cables is anticipated, it is often helpful to cut cable and bundle for testing what bend radius is possible. Many times integrators find out too late that the cables simply cannot be effectively run. Prior testing on a bench allows better planning.



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