eABF®—The New Approach to Enterprise Fiber Optic Cabling

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Abstract

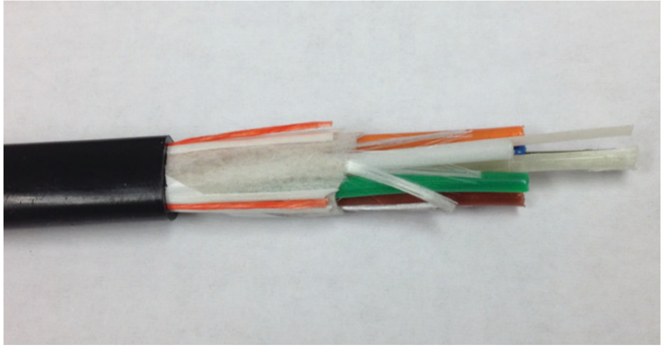
This article introduces an innovative cabling solution for the fiber optic structured cabling market. The new technology, eABF Enterprise Blown Fiber, is revolutionary in its design approach and offers the network cabling system engineer a highly scalable, flexible and smart solution. Before we get into the details of eABF, a brief overview of current fiber optic cable designs for enterprise-based structured cabling is in order.

Introduction

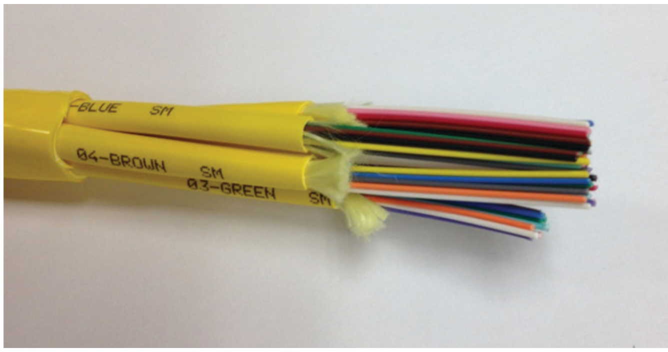
The term "structured cabling" is most often associated with single building and multi-building campus cabling infrastructures that are comprised of horizontal cabling and vertical or backbone cabling. The horizontal cabling is, for the vast majority of applications, comprised of TIA/EIA-568 defined balanced unshielded twisted pair (UTP) copper cabling, e.g., Category 5e, Category 6 and Category 6a. For the backbone and cross-connect segments, fiber optic cables are used and this will be the application environment on which this paper is focused. For the backbone environment, there are two main cable designs considered by network cabling designers: conventional fiber optic cabling and traditional blown systems. Each of these design concepts has features and benefits that drive the decision on which technology to use.

Conventional Fiber Optic Cabling

Conventional fiber optic cabling continues to be the dominant selection for providing optical fiber connectivity for the backbone and interconnect segments of the structure cabling system. Two main conventional cable types are used: tight buffer premise distribution cables (PDC) and loose tube cables (LT). Each cable construction has its own benefits over the other. Regardless of their specific construction, the fiber optic cables are design to meet the optical, physical, mechanical and environmental requirements defined in the industry cabling standards. These standards include; ICEA-83-596-2011 "Standard for Optical Fiber Premise Distribution Cable, S-104-696 "Standard for Indoor-Outdoor Fiber Optic Cable," and Telcordia® GR-409-CORE "Generic Requirements for Indoor Fiber Optic Cable" specifications.



Loose Tube Cable



Premise Distribution Cable (PDC)

Fig. 1—Conventional Fiber Optic Cables

For PDC designs, the primary advantage over LT is that they are specifically constructed for direct and immediate connectorization without the need for optical fiber preparation such as the fitting of breakout or furcation tubing over the fiber. The main disadvantage over LT is that they are usually more expensive and bulkier for a given fiber count.

The LT construction, typically requires additional handling during the termination phase of the installation, but offers the designer higher fiber counts in the same cross-section compared to a PDC design. The LT constructions are comprised of water-blocked buffer tubes and UV-resistant jackets and are usually installed in outside plant or indoor/outdoor segments of the cabling infrastructure.

The PDC and LT constructions are intended to be installed via high-tension pulling methods and/or laid within cable tray systems. The main attraction and continued appeal for these conventional designs is that they are standards compliant, stand-alone cables that do not require special handling or installation considerations that are needed for the other cable type—traditional blown fiber.

Traditional Blown Fiber

Traditional blown fiber design approach utilizes the combination of two main components: the "multi-tube-cable" (MTC) and the micro-fiber unit (MFU). The MTC is made of multiple micro-tubes bundled into a cable-like configuration with an overall sheath. The MTC is designed so that it can provide all the mechanical, physical and environmental protection to the optical fibers (MFUs) that are to be blown into the micro-tubes after the MTC is installed.

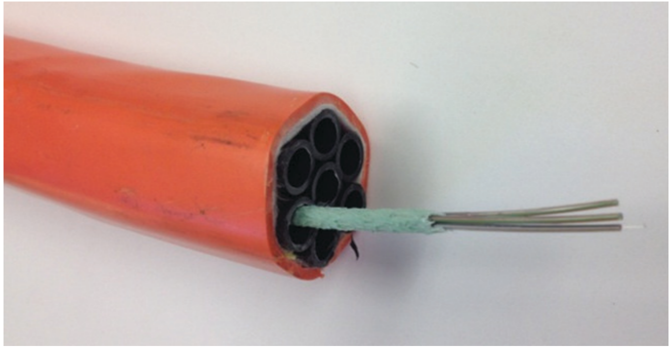


Fig. 2—Traditional blown fiber showing the orange-sheathed, multiple micro-tube cable (MTC) and aqua-colored, micro-fiber unit (MFU).

The MFUs are not cables in the traditional sense since they are not qualified to meet any cable standards as stand-alone cabling components. The MFU is a relatively fragile fiber bundle package and is designed specifically to be light weight so that it can be blown over distances within the MFC. It is not intended to be handled with the same rigors as one usually sees with conventional cabling. It is the specific and necessary combination of the MFU and the MTC that allow the system to function as a blown fiber cabling system. This is an important differentiator of traditional blown fiber compared to conventional fiber optic cables. Because the MFU is not a stand-alone cable, it must be secured within the MTC duct system in order for the fibers to be protected all the way to termination.

Comparison of general features of traditional blown fiber and conventional fiber optic cabling.

FEATURE	TRADITIONAL BLOWN FIBER	CONVENTIONAL LT OR PDC FO CABLING
TIA/EIA 568 Compliant cable	No*	Yes
Telcordia® GR-409 Compliant cable	No*	Yes
Flame Rated Cable	No*	Yes
Water-blocked fiber optic cable	No*	Yes**
Fibers protected outside of pathway	No*	Yes
Add new fibers within original pathway	Yes	No

* Must be used in combination with specially constructed micro-tube pathway/tube cable.
** Provided that qualified, standards-compliant indoor/outdoor cable is used.

The main purpose a traditional blown fiber system is considered over conventional fiber optic cabling is its ability to allow for low-cost, future optical fiber additions to the pathway without having to pull in new cable or add extra pathway space. The low cost fiber upgrade capability is supported by adding fibers to unused micro-tubes within the MTC. This is the key advantage over conventional cable and the foundation of the value proposition associated with traditional blown fiber systems.

Why is Blown Fiber Selected over Conventional Fiber Optic Cabling?

Value proposition for traditional blown fiber—The primary reason for selecting traditional blown fiber over conventional fiber optic cable is centered on cost savings for future optical fiber additions and upgrades to the previously-installed MTC. Conventional fiber optic cabling upgrades to an existing pathway require nearly the same amount of time and labor costs as were invested in the initial installation. With a traditional blown architecture, the MTC selected so as to provide spare micro-tubes that allow for the addition of new optical fibers by simply blowing in new MFUs. This approach of installing new fibers to the existing MTC is significantly less expensive and disruptive to the workspace when compared to upgrades using conventional fiber optic cabling.

Blown fiber provides cost saving for future installation in several ways:

- Reduced installation labor time and costs to blow in additional fibers to installed MTC
- Reduced work space disruption during the installation—no need to access pathway routes during blowing of additional MFUs
- Reduced planning and logistics for scheduling the installation of new optical fiber

The following table illustrates a typical cost savings comparison between conventional fiber optic cabling and traditional blown fiber. Using traditional blown fiber, it is the savings associated future moves, adds and changes (MACs) that is the appeal of this technology. The total labor cost savings can exceed 50%, compared to conventional fiber optic cabling.

INSTALLATION OF A 48-F I/O RISER BACKBONE CABLE/PATHWAY	INITIAL INSTALL	PER MAC COST #1	PER MAC COST #2	TOTAL COST*
Conventional 48-F I/O PDC Fiber Optic Cable	1	1	1	3
Traditional blown fiber (7-Way Tube Cable, 2 x 24-bundles) with 168-F max. capacity	1.5x	0.25x	0.25x	2

* Traditional Blown Fiber compared to conventional fiber optic cabling offers a > 30% savings after two MACs.

So why is traditional blown fiber not the preferred technology over conventional fiber optic cabling? There are several reasons for this. First, the initial cost to install a traditional blown fiber system is more expensive than conventional cabling. Even with the future benefits of blown fiber and the opportunity to recover the initial costs premium by saving money on future pathway upgrades, many customers are reluctant to spend the extra money on the front end of the network cable/pathway installation. Another reason for not selecting blown fiber technology is the need for special equipment, system design, handling and installation training that differs from mainstream conventional fiber optic cabling methodologies. There is little doubt that, if the system designer could incorporate the low-cost upgrade capabilities of traditional blown fiber with the ease-of-handling of conventional fiber optic cabling, blown fiber technology would become the dominant technology today for enterprise-based fiber optic structured cabling and cross-connect applications. This is the goal of eABF.

The New Approach—eABF

A new and greatly improved approach to enterprise fiber optic structured cabling has been developed by AFL and Dura-Line. This new technology is called eABF Enterprise Blown Fiber. This technology was developed to combine the value of future, low cost installation inherent with blown fiber and incorporate many of the familiar beneficial attributes of conventional fiber optic cabling. The remainder of this discussion will focus on the main components of eABF and highlight how the eABF solution compares to the two legacy cable types.

eABF Cable Component

Several important cabling standards, as mentioned previously, are used to develop fiber optic cables for enterprise fiber optic cable applications. The eABF cable was developed by AFL to meet many stand-alone cable performance specifications within these guidelines yet function as a lightweight high-performance blown cable.

The cable is made of stranded optical fibers, aramid yarn strength yarns and a specially designed high-drag, low friction jacketing system. The materials are combined to produce a standards compliant cable with mechanical and physical robustness while still being small and lightweight. These cable properties allow the cable to be installed and handled more aggressively than the relatively fragile MFUs associated with traditional blown fiber.

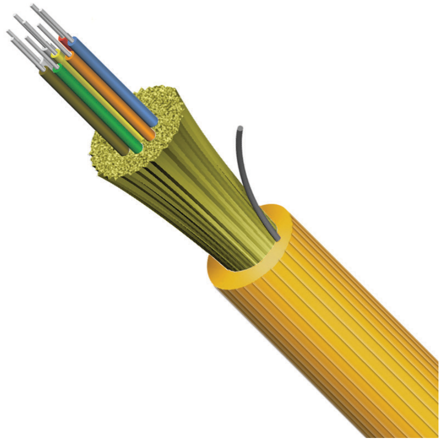


Fig. 3—eABF Fiber Optic Cable

Fig. 4—Mid-span figure 8 using onward blow method. With this installation technique, eABF cable can be installed over great distances.

In addition to mechanical and physical ratings of eABF, the product also functions either a riser (OFNR) or plenum (OFNP) rated, stand-alone cable. This means that after the eABF cable exits the MicroDuct system it can be routed between floors, under raised-floors or across ceiling spaces while still complying with flame safety building codes.

Another benefit of the standards compliant eABF cable is that, once it exits the MicroDuct, it does not need to be protected in additional furcation tubing as is usually done with traditional blown fiber. This means that time to install and secure eABF is the same as conventional fiber optic cables.

eABF cables can be:

- Pushed without air for hundreds of feet,
- Blown for many thousands of feet, with air assist, from a single blow-point,
- Blown over distances only limited by bulk cable reel lengths using air assist and mid-span accumulation methods. (The mechanical toughness of eABF cables allow the product to be handled with less concern for fiber damage.)
- Routed in equipment room and rack cable management spaces without protective tubing,
- Secured and tied in equipment rack cable elements without using furcation tubes
- Routed in vertical riser shafts for several hundred feet without support loops
- Routed in riser or plenum spaces outside the MicroDuct

Fig. 5—No furcation tube required to route eABF in cable management space

eABF MicroDuct Component

The eABF MicroDuct system has been developed by Dura-Line and based on their proven FuturePath® MicroDuct technology. For the eABF duct system, the Enterprise FuturePath MicroDuct products have been established as the standard pathway component.

The eABF MicroDuct product is made from high-performance polymers that allows the MicroDuct to meet OSP, riser or plenum flame ratings yet maintain excellent dimensional stability not seen in other micro-tube manufacturers' products. This dimensional stability yields a MicroDuct pathway that can be installed in many types of applications yet not experience deformation or collapse of micro-tubes as is prone to happen in other duct systems.

Fig. 6—In this installation example, the eABF riser-rated FuturePath (ivory cable) shows almost no sag whereas the other riser-rated MTC shows significant sag. (Both ducts were installed at the same time and have been in place for over two years.)

Another key feature of the eABF MicroDuct product is the permanent, ultra-low friction Silicore® lining. This non-wear, permanent silicone-based material is co-extruded during the production of the MicroDuct and eliminates the need to apply blowing lubricants as recommended by other blown fiber companies.

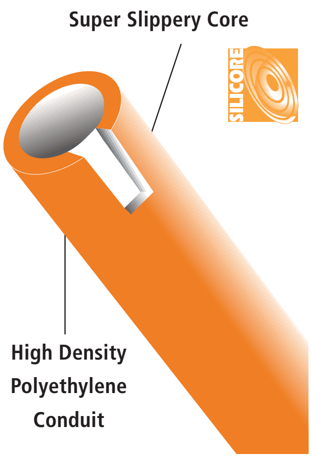


Fig. 7—Figure 5 FuturePath with Silicore lining

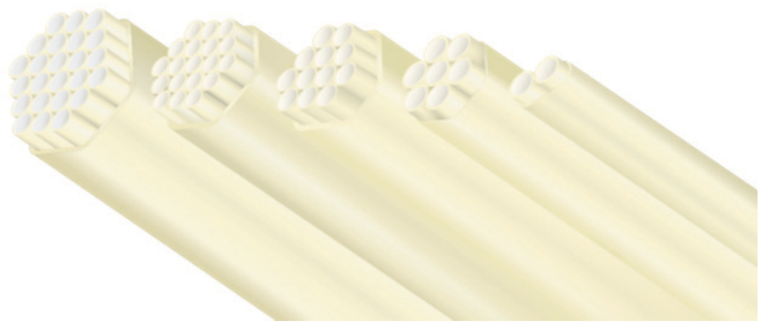


Fig. 8—FuturePath with Silicore lining

The eABF FuturePath MicroDuct product line uses primarily the 8.5 mm/6 mm MicroDuct size and is the foundation of the eABF cabling solution. This size MicroDuct comes in many duct-counts as illustrated in this table.

The combination of the 48-fiber eABF cable and the eABF MicroDuct offer the network cable designer double the fiber density that is available in traditional blown fiber products. For example, the 48-fiber eABF cable installed in a fully populated 7-way 8.5/6 MicroDuct doubles the amount of fiber that was available previously with tradition blown fiber.

OD/ID (MM)	DURA-LINE FUTUREPATH (NO. OF MICRODUCTS)	FUTUREPATH DIAMETER (MM)	FIBER COUNT (eABF 48-F)
8.5/6	1-way	8.5	48
	2-way	11x19	96
(OSP,	3-way	20	144
Riser,	4-way	24	192
Plenum)	7-way	28	336
	12-way	37	576
	19-way	45	912
	24-way	54	1,152

The following table provides a comparative summary of eABF, traditional blown fiber and conventional fiber optic cabling and shows how each compares to the other in meeting important design considerations associated with fiber optic structured cabling.

FEATURE	TRADITIONAL BLOWN FIBER	CONVENTIONAL PDC FO CABLING	eABF
TIA/EIA-568-C Compliant cable	No*	Yes	Yes
Telcordia® GR-409 Compliant cable	No*	Yes	Yes
Flame Rated, Stand-alone cable	No*	Yes	Yes
Water-blocked fiber optic cable	No*	Yes***	Yes
Fibers protected outside of pathway	No*	Yes	Yes
Add new fibers within original pathway	Yes	No	Yes
Cable "pushable" within duct/pathway	No	Yes	Yes (>250-ft)
Highest Fiber Density	No** (3.4-fibers/mm^2)	No (1.5-fibers/mm^2)	Yes** (4.2-fibers/mm^2)
Smallest spaced used in cable management rack channels	No (0.3 mm^2/fiber)	No (0.5 mm^2/fiber)	Yes (0.24 mm^2/fiber)

* Must be used in combination with specially constructed micro-tube pathway/tube cable

** Maximum blown fiber fiber-count is 24-F/8 mm micro-tube
Maximum eABF fiber-count is 48-F/8.5 mm MicroDuct

*** Provided that qualified, standards-compliant indoor/outdoor cable is used.

The next table is an expansion of the previous cost comparison chart with eABF now included. It can be seen that, because of the higher fiber density and improved handling and installation properties, eABF offers even more costs savings for future pathway fiber upgrades compared to traditional blown fiber. There is also a lower premium associated with eABF for the initial installation compared to traditional blown fiber making it more cost competitive with conventional fiber optic cabling. (It is necessary to note that, while this installation example as well as other application environments can yield the same or even lower cost differences between conventional fiber optic cable, each installation design and associated costs can vary greatly.)

INSTALLATION OF A 48-F I/O RISER BACKBONE CABLE/PATHWAY	INITIAL INSTALL COST*	1ST PER MAC COST*	2ND PER MAC COST*	TOTAL COST*
Conventional 48-F I/O PDC Fiber Optic Cable	1	1	1	3
Traditional blown fiber (7-Way Tube Cable, 2 x 24-bundles) with 168-f max. capacity	1.5x	0.25x	0.25x	2
eABF (4-Way FuturePath, 1 x 48-F eABF Cable) with 192-f max. capacity	1.3x	0.15x	0.15x	1.6
RESULTS:				
eABF Compared to Conventional PDC FO Cabling	eABF is only 25% Premium	eABF offers up to 85% savings	eABF offers up to 85% savings	45% savings using eABF
eABF Compared to traditional blown fiber	eABF is 25% less	eABF >10% savings	eABF >10% savings	20% savings using eABF

* Cost values are normalized based on conventional cabling material and labor.

Conclusion

The eABF cabling system offers the network design engineer a new approach to creating a cost effective, "living" fiber optic cable and pathway system for their enterprise fiber optic structured cabling system. The standards-compliant eABF cable and MicroDuct elements allow for easier, more familiar planning and installation practices similar to conventional fiber optic cable technology as well as provide for the upgrade flexibility associated with blown fiber cabling. This means that the network cable designer now has the ability to design a cost-effective cabling platform that is more scalable, flexible and affordable than what was previously available. With eABF, the customer gets the best of both approaches.

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