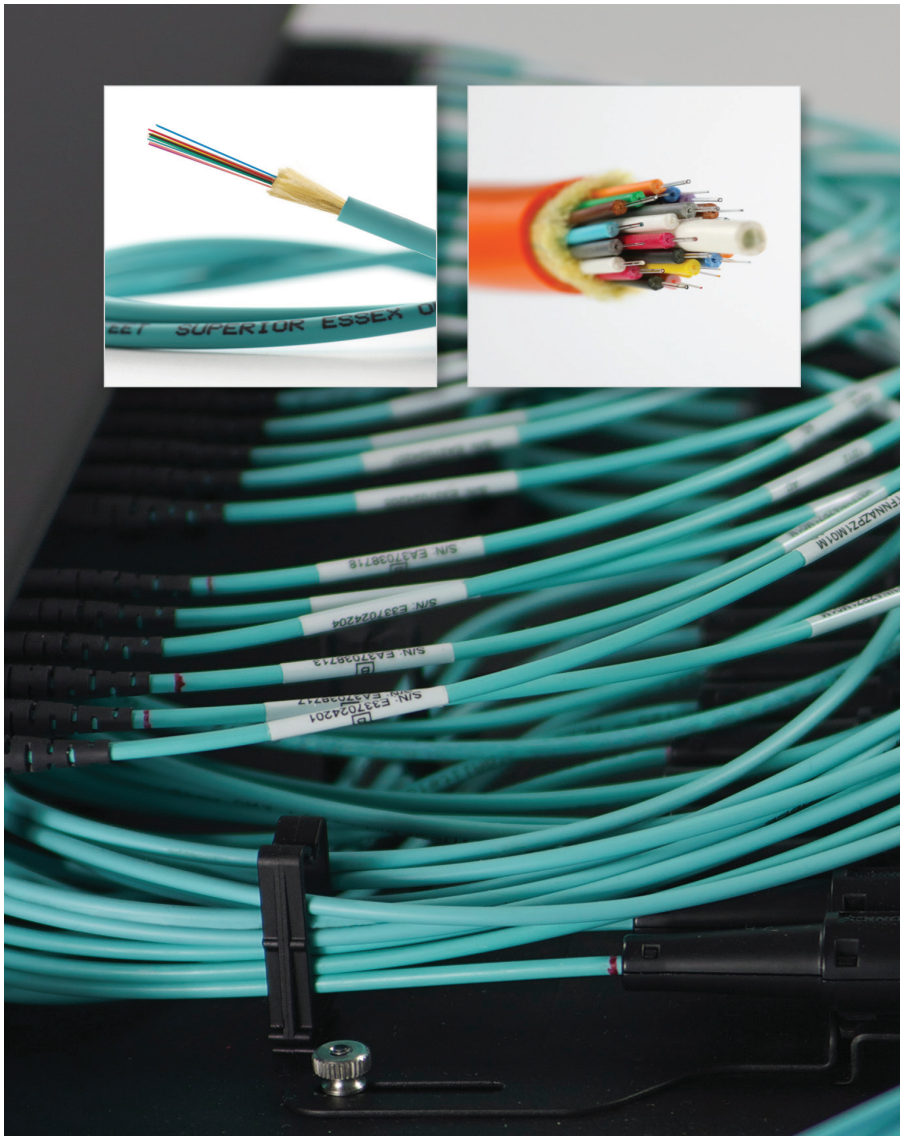
Environmental Product Declaration

Superior Essex Optical Fiber Data Cable

PLENUM RATED



All Superior Essex plenum optical fiber data cables including single mode and multimode fiber

SUPERIOR ESSEX®

"Our environmental initiative is more than just a company objective; it is an ethical responsibility to our communities and to future generations. We have made the commitment to continuously improve the environmental sustainability of our operation and products and to lead by example."

Tim Waldner
President,
Superior Essex International LP

The Plan

Superior Essex focuses on conservation, recycling, and minimizing any negative impact on the worldwide community. We aim to continuously reduce our environmental footprint to preserve and protect the natural environment.

The Promise

We practice a high level of environmental sustainability in our manufacturing processes by conducting operations in a safe and environmentally responsible manner. By evaluating and measuring environmental performance, we continue to strive to meet worldwide environmental programs and initiatives.

UL CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

Simplex, Duplex Quad Interconnect; Microarray Data Center Interconnect; 2mm Microarray Breakout; 3mm Microarray Breakout; 3mm Interlock Armored, Microarray Breakout; Single Unit Distribution; Premises Fiber BrakeBox; Multi-Unit Distribution; Indoor/Outdoor Sunlight Resistant; Dry Block, Sunlight Resistant , Indoor/Outdoor; Hybrid Premises Fiber; Interlock Armor, Tight Buffer

Premises Fiber Optic Plenum Cable

According to ISO 14025

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025 and ISO 21930. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL Environment
DECLARATION HOLDER	Superior Essex
DECLARATION NUMBER	4786513765.101.1
DECLARED PRODUCT	Plenum Rated Optical Fiber Data Cable
REFERENCE PCR	PCR for EPDs: Wire & Cable PCR 2013:1.0
DATE OF ISSUE	December 11, 2014
PERIOD OF VALIDITY	5 Years
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications

The PCR review was conducted by:	Environment and Development Foundation PCR Addendum: UL Environment
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	Wade Stout, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas Gloria, Life Cycle Services, LLC

Product Definition and Information

Company Description

Superior Essex is a global leader in the design, manufacture and supply of wire and cable products. This declaration is presented as we develop our product stewardship program to evaluate and reduce the impacts of products and processes throughout the corporation and business groups.

Product Description

Twelve premises fiber optic plenum cable products are covered in this declaration. Plenum cables are installed in the plenum spaces of buildings and must meet associated fire safety test standards. All products listed below are UL Listed OFNP or OFCP. Most of these products are shipped on custom length reels.

Simplex, Duplex, Quad Interconnect Part Number: 34/A4/B4/C4

Simplex, Duplex and Quad Optical Fiber Interconnect Cables are typically used for patch cords and intrabuilding installations. Superior Essex designed these cables for environments where small size, flexible construction and flame resistance are required. These cables are available in both riser and plenum versions. Higher performance optical fibers are offered, including bend insensitive G.657.A1 single mode and 10G/300 OM3 and 10G/550 OM4 laser optimized 50 µm multimode.

Microarray Data Center Interconnect Part number: P4

The Microarray Data Center Interconnect Cables from Superior Essex are designed for high performance in a small package. The 12-fiber interconnect has an outside diameter of only 3.0 mm. The 24-fiber single unit employs two, 12-fiber microtubes that are ideal for 24-fiber MTP®/MPO array connectors. The 24-fiber duplex contains two, 12-fiber 3.0mm interconnect cables with an overjacket. The fibers can be fusion spliced, connectorized to high density MTP/MPO mechanical array connectors or attached to standard single ferrule mechanical connectors (LC, SC, ST, etc.) via a furcation kit. The loose fibers are surrounded by aramid yarns and a low smoke PVC (LSPVC) plenum or riser-rated jacket. Its small size allows for denser fiber routing than traditional tight buffered cables; its loose-tube construction gives it superior performance and installation ease compared to ribbon interconnect cable.

2mm Microarray Breakout Part number: V4

The Microarray Breakout cable from Superior Essex is designed for high performance in a small package. The design consists of 12-fiber 2 mm microarray interconnect cable subunits, each of which contain twelve 250 micron fibers. The aramid yarns inside the subunit allow the subunit to be crimped directly onto an MTP®/MPO connector. The 2 mm subunits are stranded around a central strength element that is both flexible and robust enough to pass backbone installation requirements. The stranded subunits are held to the strength element core by binder yarns and/or tapes ensuring excellent temperature performance. Finally, a RoHS-compliant flexible jacket protects the core from the rigors of installation while providing riser or plenum fire protection. The cable is available with TeraFlex® single mode, and laser-optimized 50/125 micron 10G/150 (OM2+), 10G/300 (OM3) and 10G/550 (OM4) multimode fiber types.

3mm Microarray Breakout Part number: P4

The Microarray Breakout cable from Superior Essex is designed for high performance in a small package. The design consists of 12-fiber 3 mm microarray interconnect cable subunits, each of which contain twelve 250 micron fibers. The aramid yarns inside the subunit allow the subunit to be crimped directly onto an MTP®/MPO connector. The 3 mm subunits are stranded around a central strength element that is both flexible and robust enough to pass backbone installation requirements. The stranded subunits are held to the strength element core by binder yarns and/or tapes ensuring excellent temperature performance. Finally, a RoHS-compliant flexible jacket protects the core from the rigors of installation while providing riser or plenum fire protection. The cable is available with TeraFlex® single mode, and laser-optimized 50/125 micron 10G/150 (OM2+), 10G/300 (OM3) and 10G/550 (OM4) multimode fiber types.

Environment

3mm Interlock Armored, Microarray Breakout Part number: L4

The Interlock Armored Microarray Breakout cable from Superior Essex is designed for high performance with robust mechanical protection. The design consists of 12-fiber 3 mm microarray interconnect cable subunits, each of which contain twelve 250 micron fibers. The aramid yarns inside the subunit allow the subunit to be crimped directly onto an MTP®/MPO connector. The 3 mm subunits are stranded around a central strength element that is both flexible and robust enough to pass backbone installation requirements. The stranded subunits are held to the strength element core by binder yarns and/or tapes ensuring excellent temperature performance. A RoHS-compliant flexible jacket protects the core while providing fire protection. Finally, the cable is interlock armored with either aluminum (standard) or steel and jacketed. The cable is available with TeraFlex® single mode or laseroptimized 50/125 micron 10G/150 (OM2+), 10G/300 (OM3) or 10G/550 (OM4) multimode fiber types.

Single Unit Distribution Part number: 44

These Superior Essex premises distribution optical fiber cables are constructed using a single unit – single jacket RoHS-compliant design with fiber counts from 6 through 24. The design consists of flexible 900 µm tight buffered industry standard 250 µm fibers (900/250/125 µm) and is suitable for use with standard connectors, like the SC, ST, and FC, and small-form-factor connectors like the LC. Dielectric aramid yarns are applied for strength while maintaining flexibility. The 18 and 24-fiber cable designs have a flexible glass reinforced central strength element for added durability and performance. A durable, flame resistant outer jacket is applied over the cable core using appropriate OFNR or OFNP rated materials.

Premises Fiber BrakeBox Part number: 34/44

Superior Essex offers premises fiber cable products packaged in a BrakeBox® design, which includes the innovative QuickCount® footage marking and a variable resistance system that virtually eliminates reel over-spin and tangling. The BrakeBox packaging is a true advantage for installers who are pulling fiber cable in multiple locations. It not only stacks and travels better, it also protects the fiber cable better than an open reel. The box features two resistance mechanisms on both sides of the reel, each of which has three resistance settings. The variable brakes control back-tension preventing over-spin and tangling.

Multi-Unit Distribution Part number: 44

Premises Multi-unit Distribution Optical Fiber Cables are constructed using 6 or 12-fiber subunits stranded around a central strength member in a RoHS-compliant design for fiber counts from 18 through 144. Standard fibers for these cables include Reduced Water Peak (RWP) single mode, TeraGain® 220/600 62.5 µm multimode and TeraGain 10G/150 – laser optimized 50 µm multimode fiber. All fibers exceed industry requirements.

Indoor/Outdoor Sunlight Resistant Part number: 24

Indoor/Outdoor Sunlight Resistant Tight Buffer Plenum optical fiber cables are ideally suited for installations that require partial or complete routing of pathways outside the building. These cables can be installed in inner ducts and steam tunnels, as well as within building riser and plenum locations. The tight buffer feature of these indoor/outdoor cables eliminates the need for breakout kits and/or other special termination equipment associated with loose tube cables. The outer jacket is comprised of a rugged UL Listed sunlight resistant polymer that allows for the cable to be exposed to direct sunlight without the concern of material degradation. The cable is not designed for prolonged submersion in water, therefore it is not recommended for direct buried service nor within buried conduit which can flood.

Dry Block, Sunlight Resistant, Indoor/Outdoor Part number: W4

The Dry Block, Sunlight Resistant Indoor/Outdoor Tight Buffer Riser Rated Cable line offers the system designer the ultimate in premises optical fiber cable utility. These cables can be installed in open spaces, trays, conduits, inner-ducts, trenches, steam tunnels and building riser locations. These cables incorporate the latest in dry water-blocking technology. This system of water blocking eliminates the need to clean off the traditional gel-based water-blocking compounds found in loosetube cables. In addition, breakout kits and or other special termination equipment associated with loose tube Outside Plant (OSP) cables are not required. The outer jacket is comprised of a rugged UL Listed, sunlight resistant, black polymer that allows for the cable to be exposed to longterm direct sunlight without the concern of material degradation. All fiber types are available, including 50/125 µm, 62.5/125 µm and single mode.

Environment

Hybrid Premises Fiber Part number: 44

Superior Essex offers a broad line of products including multimode and single mode fibers within the same optical fiber cable. The use of hybrid fiber designs have proven useful to network systems designers because they offer the flexibility to run diverse applications upgrades without the need to install new cables. Superior Essex hybrid optical fiber cables are available in stranded tight buffer premises distribution cables, as well as all other loose tube cable product designs. Hybrid cables are used for standard campus networking applications and can be manufactured with a wide variety of fiber type combinations. They will save the designer and the customer significant costs over the lifetime of the physical cable plant.

Interlock Armor, Tight Buffer Part number: L4

Interlock Armored Optical Fiber Cables provide for an extremely well protected cable package ideally suited for harsh environments. The armor is available in aluminum or steel and comes with either an OFCR (riser) or OFCP (plenum) rating. This design offers the system designer a product that can be installed in high traffic areas where added mechanical protection and security are required. The flexible interlock armored cable design is also popular for retrofit applications and eliminates the need to install rigid conduit while still meeting building code guidelines.

Manufacturing Locations

These plenum fiber optic cables are manufactured in Brownwood, Texas. This facility provided the primary data for the life cycle assessment. This declaration represents the average performance of the heaviest available version of each of the plenum fiber optic cables.

Applications and Uses

The products listed are used in the plenum spaces of buildings. Applications for the plenum products include 10BASE-T through 100GBASE-T Ethernet.

Material Inputs

The raw material inputs for the plenum fiber optic cables are listed in Table 1. Table 2 details the average packaging associated with with each product.

Pounds per 100 feet (lb/100ft)	Optical Fiber	Tight buffer	Dielectric Aramid Strength Member	Central Strength Member	Rip Cord	Binder Yarn	Outer Jacket	Interlock Armor	Polyester Tape	Total Weight per Length
Simplex, Duplex, Quad Interconnect	0.018	0.253	0.116	-	-	-	1.003	-	-	1.391
Microarray Data Center Interconnect	0.110	1.102	0.115	-	0.011	-	0.771	-	-	2.109
2mm Microarray Breakout	0.442	1.330	0.439	0.009	0.011	-	8.501	-	-	10.732
3mm Microarray Breakout	0.442	1.330	0.517	0.009	0.011	-	9.304	-	-	11.613
3 mm Interlock Armored, Microarray Breakout	0.442	1.330	0.517	0.009	0.011	-	0.000	11.783	-	14.092
Single Unit Distribution	0.110	1.525	0.463	0.006	0.058	-	4.577	-	-	6.739
Premises Fiber BrakeBox	0.055	4.580	0.942	-	0.065	0.207	18.239	-	1.640	25.732
Multi-Unit Distribution	0.662	4.580	0.942	-	0.065	0.207	18.239	-	1.640	26.339
Indoor/Outdoor Sunlight Resistant	0.331	4.582	0.919	0.006	0.068	-	21.428	-	-	27.334
Dry Block, Sunlight Resistant, Indoor/Outdoor	0.110	0.760	0.267	-	0.000	-	2.754	-	-	3.894
Hybrid Premises Fiber	0.331	3.571	0.235	0.013	0.075	-	12.524	-	0.145	16.894
Interlock Armor, Tight Buffer	0.442	4.580	0.942	-	0.065	0.207	18.239	11.783	0.145	36.406

Table 1: Material Inputs for Plenum Fiber Optic Cables

Material (lb per 100 ft)	Simplex, Duplex, Quad Interconnect	Microarray Data Center Interconnect	2mm Microarray Breakout	3mm Microarray Breakout	3mm Interlock Armored, Microarray Breakout	Single Unit Distribution	Premises Fiber BrakeBox	Multi-Unit Distribution	Indoor/Outdoor Sunlight Resistant	Dry Block, Sunlight Resistant, Indoor/Outdoor	Hybrid Premises Fiber	Interlock Armor, Tight Buffer
Plywood	9.0E-02	1.4E-01	6.9E-01	9.1E-01	7.5E-01	4.4E-01	1.7E+00	1.7E+00	1.8E+00	2.5E-01	1.1E+00	2.4E+00
Cardboard	1.5E-05	2.2E-05	1.1E-04	1.5E-04	1.2E-04	7.2E-05	2.7E-04	2.8E-04	2.9E-04	4.1E-05	1.8E-04	3.9E-04
Polystyrene	1.3E-05	2.0E-05	1.0E-04	1.3E-04	1.1E-04	6.3E-05	2.4E-04	2.4E-04	2.5E-04	3.6E-05	1.6E-04	3.4E-04
Polypropylene	7.4E-06	1.1E-05	5.7E-05	7.5E-05	6.2E-05	3.6E-05	1.4E-04	1.4E-04	1.5E-04	2.1E-05	9.0E-05	1.9E-04
Total	9.0E-02	1.4E-01	6.9E-01	9.1E-01	7.5E-01	4.4E-01	1.7E+00	1.7E+00	1.8E+00	2.5E-01	1.1E+00	2.4E+00
Non-Renewable Materials	9.0E-02	1.4E-01	6.9E-01	9.1E-01	7.5E-01	4.4E-01	1.7E+00	1.7E+00	1.8E+00	2.5E-01	1.1E+00	2.4E+00
Renewable Materials	1.5E-05	2.2E-05	1.1E-04	1.5E-04	1.2E-04	7.2E-05	2.7E-04	2.8E-04	2.9E-04	4.1E-05	1.8E-04	3.9E-04

Table 2: Average Packaging Material Inputs

Manufacturing Process

The first step in fiber optic cable manufacturing is the inspection and testing of optical fibers as Superior Essex does not manufacture its own optical fibers. The clear glass fibers are then either colored via UV inking or, for tight buffered cable products, a colored PVC coating is applied by passing the raw glass fiber through the heated buffer and into a water cooling trough. The buffered cable leaves the cooling trough and passes through an air wipe to remove excess moisture as it is wound onto another coil. All types of fiber then require some form of sheathing process. At this step, fibers are automatically fed through an extruder. The sheathed fiber is then passed through a water cooling trough that slowly cools and hardens the tube and is rolled onto another reel. In tight buffered sheathing processes, cables are fed into an extruder along with special strength yarns. A fire retardant plastic material is extruded to form the protective tube around the fibers and is then cooled in a water trough. Depending on the number of fibers required, multiple tubes of fiber may be combined through fiber stranding. Cable spools, along with strength members, tape, yarns, and armoring materials (if applicable based on the intended use of the cable) are then fed into an electric stranding machine where the internal contents of the cable are assembled together. The cable spools are then fed into a jacketing machine, where jacket material is extruded onto the stranded cable, followed immediately by a printer than prints length and other information onto the jacketed cable, followed by another cooling trough, and onto a spool for packaging. Final product is generally shipped via plywood reels that are cut to custom lengths per customer order.

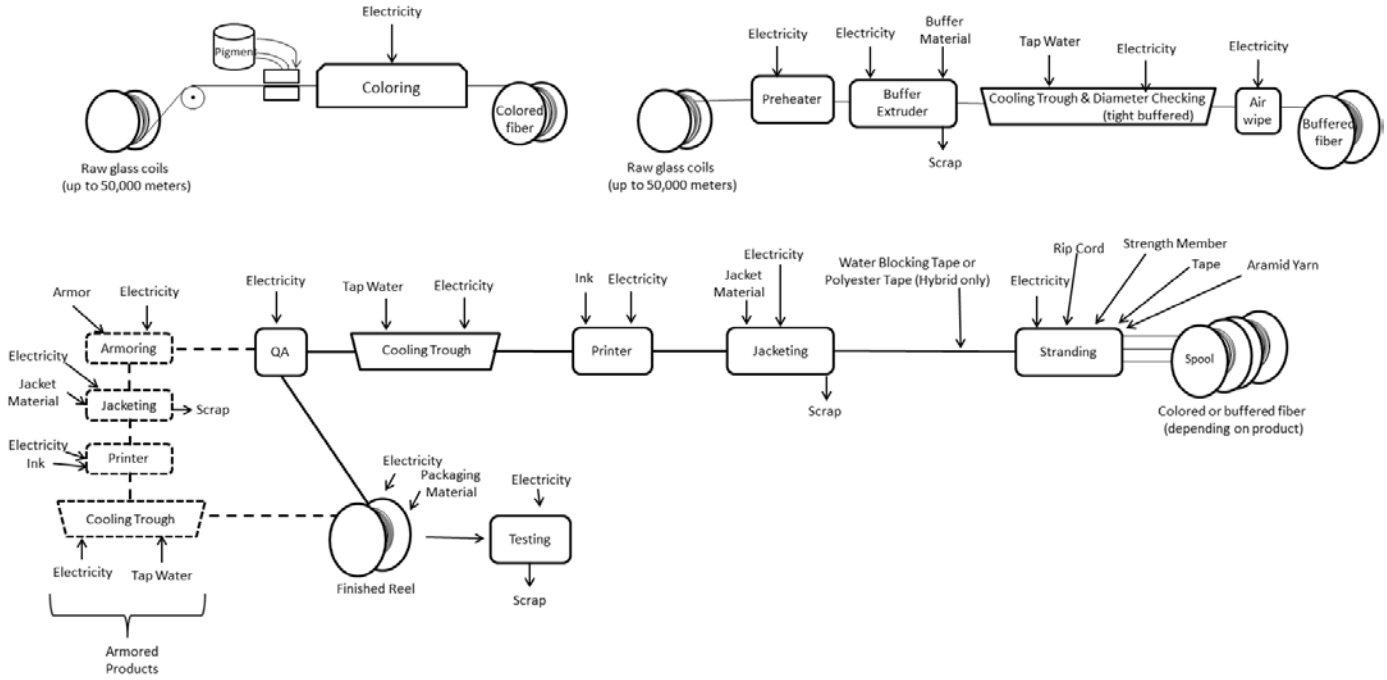


Figure 1: Manufacturing Process Flow of Plenum Fiber Optic Cable

Figure 2: Photographs of Manufacturing Process

Life Cycle Assessment Description

Functional Unit

Environmental impacts are reported per functional unit of a product and the functional unit is the basis for comparison in an LCA. For the fiber optic cable, the functional unit is 100ft of cable.

Life Cycle Stages Assessed

Life Cycle Boundary	EPD Life Cycle Stage
Superior Essex Plenum Cable Business-to-Business	Raw Material Acquisition
	Manufacturing
	Packaging/Storage
Superior Essex Plenum Cable Business-to-Consumer	Marketing and Distribution
	Installation
	Use
	Waste Disposal

Table 3: Life Cycle Stages Assessed

System Boundary

This project considers the life cycle activities from resource extraction through installation and end-of-life effects. The boundary covers raw material acquisition, manufacturing, marketing, use and waste disposal as seen in Figure 3.

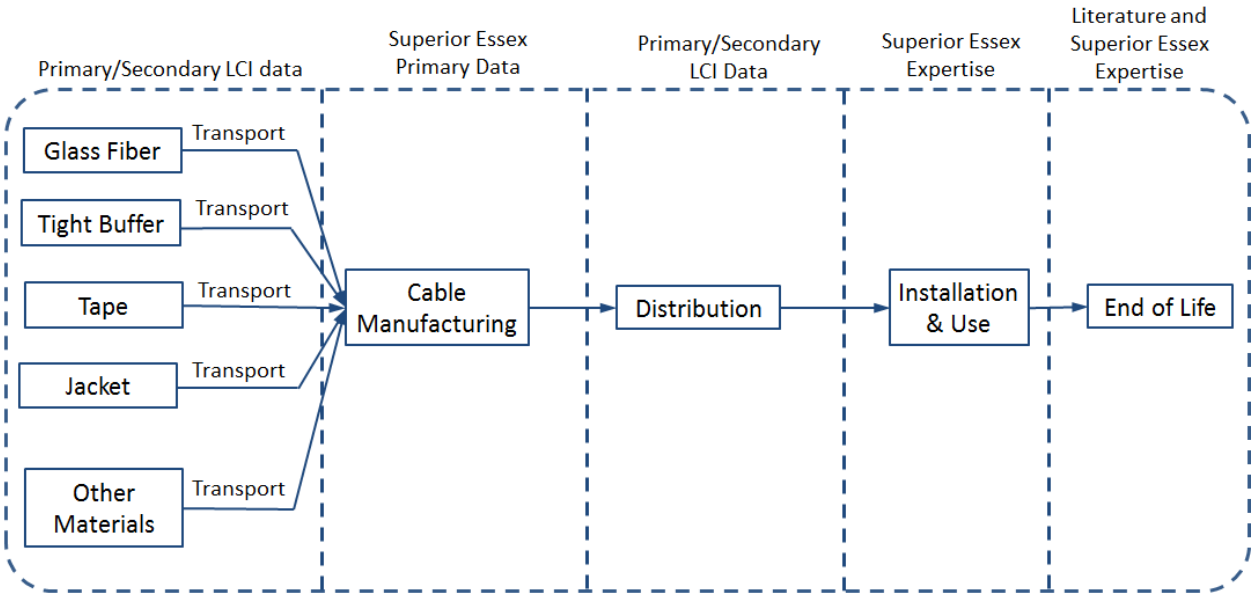


Figure 3: System Boundary

Allocation

Allocation for manufacturing energy was conducted based on production mass and then multiplied by the product weight per hundred feet. Water and waste items were allocated per length of production.

Cut-off Criteria

For any impact category, if the sum of various impacts from a specific process/activity is less than 1% of the impact equivalent in that category, such a process/activity may be neglected during the inventory analysis. Nonetheless, the accumulated impact of neglected process/activity may not exceed 5%. Components and materials omitted from the LCA shall be documented.

This EPD is in compliance with the cut-off criteria. Components and materials omitted from the LCA shall be documented. Capital items for the production processes (machines, buildings, etc.) were not taken into consideration.

Period under Consideration

The data used refer to the production processes of the fiber optic cable production facility from calendar year 2013.

Software and Background Data

For life cycle modeling the SimaPro v8.02 Software System for Life Cycle Engineering, an internationally recognized LCA modeling software program, was used. All background data sets relevant for production and disposal were available in this software. Background and secondary datasets were modeled using the US LCI database, developed by the National Renewable Energy Laboratory, as well as the ecoinvent v3 database, which is developed by the Swiss Centre for Life Cycle Inventories.

Marketing and Distribution

The finished products were modeled as being shipped 1000 miles by truck.

Transportation

The manufacturing plant provided resource transportation mode and distance data to support the calculation of raw material transportation flows. The transportation LCI data from the US LCI database (kg-km basis) were used to develop the resource transportation LCI profile. Final products were modelled as being shipped 1000 miles by truck.

Installation and Use Stage

The premises fiber optic plenum cable products are distributed globally, but primarily throughout the United States and Canada. An average installation scrap rate of 5% was assumed in this study, as determined by interviews with installers and the expertise of Superior Essex. Installers routinely use battery-powered signal testing devices (a popular brand name is Fluke) during installation to ensure cable has been installed properly. The electricity consumed (based on calculations from the specifications of a late model Fluke device) is negligible compared to the rest of the installation or life cycle impacts and therefore was excluded from the study as allowed by the cut-off criteria.

The lifetime of the product is widely variable and is most often replaced not due to performance or degradation, but due to improvements in technology over time, for which corresponding increases in bandwidth and data speeds are demanded. Since the product is usually installed in a well-protected and undisturbed part of a building, the cable can continue to function throughout the life of the building. Fiber optic cable is a passive product after installation and during the use stage. The product consumes no energy and requires no maintenance. Therefore, no use stage impacts were measured, and thus none are presented in these results.

End-of-Life

The study assumes that fiber optic cables are not recycled at the end of life with 100% of materials being disposed as the average US municipal solid waste disposition. The average US disposition includes 82% landfill and 18% incineration.

Life Cycle Inventory

Energy Use

Life Cycle Stage	Simplex, Duplex, Quad Interconnect	Microarray Data Center Interconnect	2mm Microarray Breakout	3mm Microarray Breakout	3mm Interlock Armored, Microarray Breakout	Single Unit Distribution	Premises Fiber BrakeBox	Multi-Unit Distribution	Indoor/Outdoor Sunlight Resistant	Dry Block, Sunlight Resistant, Indoor/Outdoor	Hybrid Premises Fiber	Interlock Armor, Tight Buffer
Raw Material Acquisition	4.0E+01	5.8E+01	3.0E+02	3.3E+02	1.5E+03	1.9E+02	7.8E+02	8.0E+02	7.5E+02	1.1E+02	4.6E+02	2.1E+03
Manufacturing	7.6E+00	1.2E+01	5.9E+01	6.4E+01	7.7E+01	3.7E+01	1.4E+02	1.4E+02	1.5E+02	2.1E+01	9.2E+01	2.0E+02
Marketing	1.3E+00	2.0E+00	1.0E+01	1.1E+01	1.4E+01	6.5E+00	2.5E+01	2.6E+01	2.6E+01	3.8E+00	1.6E+01	3.5E+01
Installation	1.9E-02	2.8E-02	1.4E-01	1.6E-01	1.9E-01	9.0E-02	3.4E-01	3.5E-01	3.6E-01	5.2E-02	2.3E-01	4.9E-01
Waste Disposal	1.2E+00	1.9E+00	9.6E+00	1.0E+01	1.3E+01	6.0E+00	2.3E+01	2.3E+01	2.4E+01	3.5E+00	1.5E+01	3.2E+01
Total Cradle-to-Grave	5.0E+01	7.4E+01	3.8E+02	4.1E+02	1.6E+03	2.4E+02	9.7E+02	9.9E+02	9.5E+02	1.4E+02	5.9E+02	2.3E+03

Table 4: Cradle-to-Grave Cumulative Energy Demand (MJ) per 100 feet of Cable

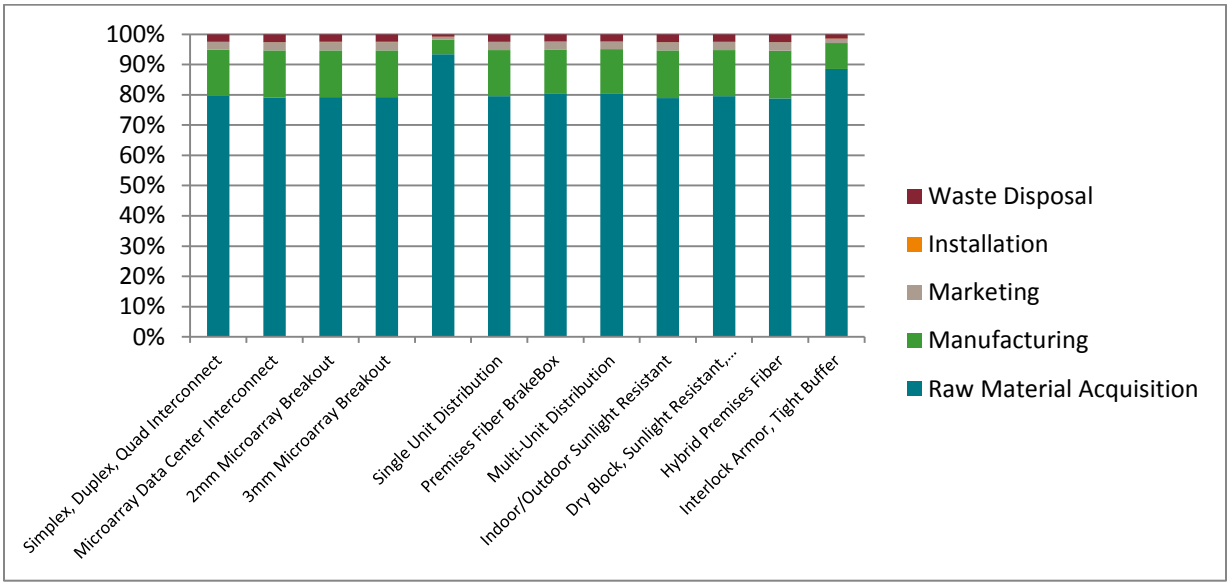


Figure 4: Cradle-to-Grave Cumulative Energy Demand

Use of Resources

Impact Category	Simplex, Duplex, Quad Interconnect						Microarray Data Center Interconnect						2mm Microarray Breakout					
	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave
Non renewable energy (MJ)	3.8E+01	7.6E+00	1.3E+00	1.8E-02	1.2E+00	4.8E+01	5.6E+01	1.1E+01	2.0E+00	2.8E-02	1.8E+00	7.2E+01	2.8E+02	5.8E+01	1.0E+01	1.4E-01	9.3E+00	3.6E+02
Renewable energy (MJ)	2.2E+00	2.8E-02	0.0E+00	1.2E-04	3.9E-02	2.2E+00	1.9E+00	4.2E-02	0.0E+00	1.8E-04	5.9E-02	2.0E+00	1.8E+01	2.2E-01	0.0E+00	9.0E-04	3.0E-01	1.8E+01
Net Water Use (m3)	2.0E+01	1.2E-01	0.0E+00	6.9E-04	2.4E-01	2.0E+01	1.6E+01	1.8E-01	0.0E+00	1.0E-03	3.7E-01	1.6E+01	1.6E+02	9.2E-01	0.0E+00	5.3E-03	1.9E+00	1.7E+02
Impact Category	3mm Microarray Breakout						3mm Interlock Armored, Microarray Breakout						Single Unit Distribution					
	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave
Non renewable energy (MJ)	3.1E+02	6.3E+01	1.1E+01	1.5E-01	1.0E+01	3.9E+02	1.3E+03	7.7E+01	1.4E+01	1.9E-01	1.2E+01	1.4E+03	1.8E+02	3.7E+01	6.5E+00	8.9E-02	5.8E+00	2.3E+02
Renewable energy (MJ)	1.9E+01	2.3E-01	0.0E+00	9.8E-04	3.2E-01	2.0E+01	1.4E+02	2.8E-01	0.0E+00	1.2E-03	3.9E-01	1.4E+02	1.0E+01	1.4E-01	0.0E+00	5.7E-04	1.9E-01	1.0E+01
Net Water Use (m3)	1.8E+02	9.9E-01	0.0E+00	5.7E-03	2.0E+00	1.8E+02	1.3E+03	1.2E+00	0.0E+00	7.0E-03	2.5E+00	1.3E+03	8.9E+01	5.8E-01	0.0E+00	3.3E-03	1.2E+00	9.1E+01
Impact Category	Premises Fiber BrakeBox						Multi-Unit Distribution						Indoor/Outdoor Sunlight Resistant					
	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave
Non renewable energy (MJ)	7.4E+02	1.4E+02	2.5E+01	3.4E-01	2.2E+01	9.3E+02	7.6E+02	1.4E+02	2.6E+01	3.5E-01	2.3E+01	9.5E+02	7.1E+02	1.5E+02	2.6E+01	3.6E-01	2.4E+01	9.1E+02
Renewable energy (MJ)	4.0E+01	5.2E-01	0.0E+00	2.2E-03	7.2E-01	4.1E+01	4.0E+01	5.3E-01	0.0E+00	2.2E-03	7.3E-01	4.2E+01	4.5E+01	5.5E-01	0.0E+00	2.3E-03	7.6E-01	4.6E+01
Net Water Use (m3)	3.6E+02	2.2E+00	0.0E+00	1.3E-02	4.5E+00	3.6E+02	3.6E+02	2.3E+00	0.0E+00	1.3E-02	4.6E+00	3.7E+02	4.1E+02	2.3E+00	0.0E+00	1.4E-02	4.8E+00	4.2E+02
Impact Category	Dry Block, Sunlight Resistant, Indoor/Outdoor						Hybrid Premises Fiber						Interlock Armor, Tight Buffer					
	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave
Non renewable energy (MJ)	1.1E+02	2.1E+01	3.8E+00	5.2E-02	3.4E+00	1.3E+02	4.4E+02	9.2E+01	1.6E+01	2.2E-01	1.5E+01	5.6E+02	1.9E+03	2.0E+02	3.5E+01	4.8E-01	3.1E+01	2.2E+03
Renewable energy (MJ)	5.9E+00	7.8E-02	0.0E+00	3.3E-04	1.1E-01	6.1E+00	2.6E+01	3.4E-01	0.0E+00	1.4E-03	4.7E-01	2.7E+01	1.8E+02	7.3E-01	0.0E+00	3.1E-03	1.0E+00	1.8E+02
Net Water Use (m3)	5.4E+01	3.3E-01	0.0E+00	1.9E-03	6.9E-01	5.5E+01	2.4E+02	1.4E+00	0.0E+00	8.4E-03	3.0E+00	2.4E+02	1.6E+03	3.1E+00	0.0E+00	1.8E-02	6.4E+00	1.6E+03

Table 5: Cradle-to-Grave non-renewable energy, renewable energy, and water use per 100ft of Cable

Waste Management

Life Cycle Stage	Simplex, Duplex, Quad Inter-connect	Micro-array Data Center Inter-connect	2mm Micro-array Breakout	3mm Microarray Breakout	3mm Interlock Armored, Micro-array Breakout	Single Unit Distribu-tion	Premises Fiber BrakeBox	Multi-Unit Distribution	Indoor/Outdoor Sunlight Resis-tant	Dry Block, Sunlight Resis-tant, Indoor/ Outdoor	Hybrid Premises Fiber	Interlock Armor, Tight Buffer	Simplex, Duplex, Quad Interconnect	Microarray Data Center Inter-connect
Incineration (with and without energy recovery)	2.7E-01	4.2E-01	2.1E+00	2.2E+00	2.7E+00	1.3E+00	5.0E+00	5.1E+00	5.3E+00	7.5E-01	3.6E+00	7.0E+00	2.7E-01	4.2E-01
Landfill (nonhazard-ous waste)	4.0E+00	4.8E+00	3.1E+01	3.4E+01	1.4E+02	1.9E+01	7.6E+01	7.7E+01	7.8E+01	1.1E+01	3.0E+01	2.1E+02	4.0E+00	4.8E+00
Hazardous Waste	9.8E-03	7.7E-03	8.3E-02	9.1E-02	5.2E-02	4.5E-02	1.8E-01	1.8E-01	2.1E-01	2.7E-02	2.0E-02	2.3E-01	9.8E-03	7.7E-03
Landfill Avoidance (recycling)	2.1E-01	2.8E-01	1.5E+00	1.6E+00	6.2E+00	9.5E-01	3.5E+00	3.7E+00	3.5E+00	5.6E-01	1.8E+00	8.9E+00	2.1E-01	2.8E-01

Table 6: Cradle-to-Grave Waste (kg) per 100ft of Cable

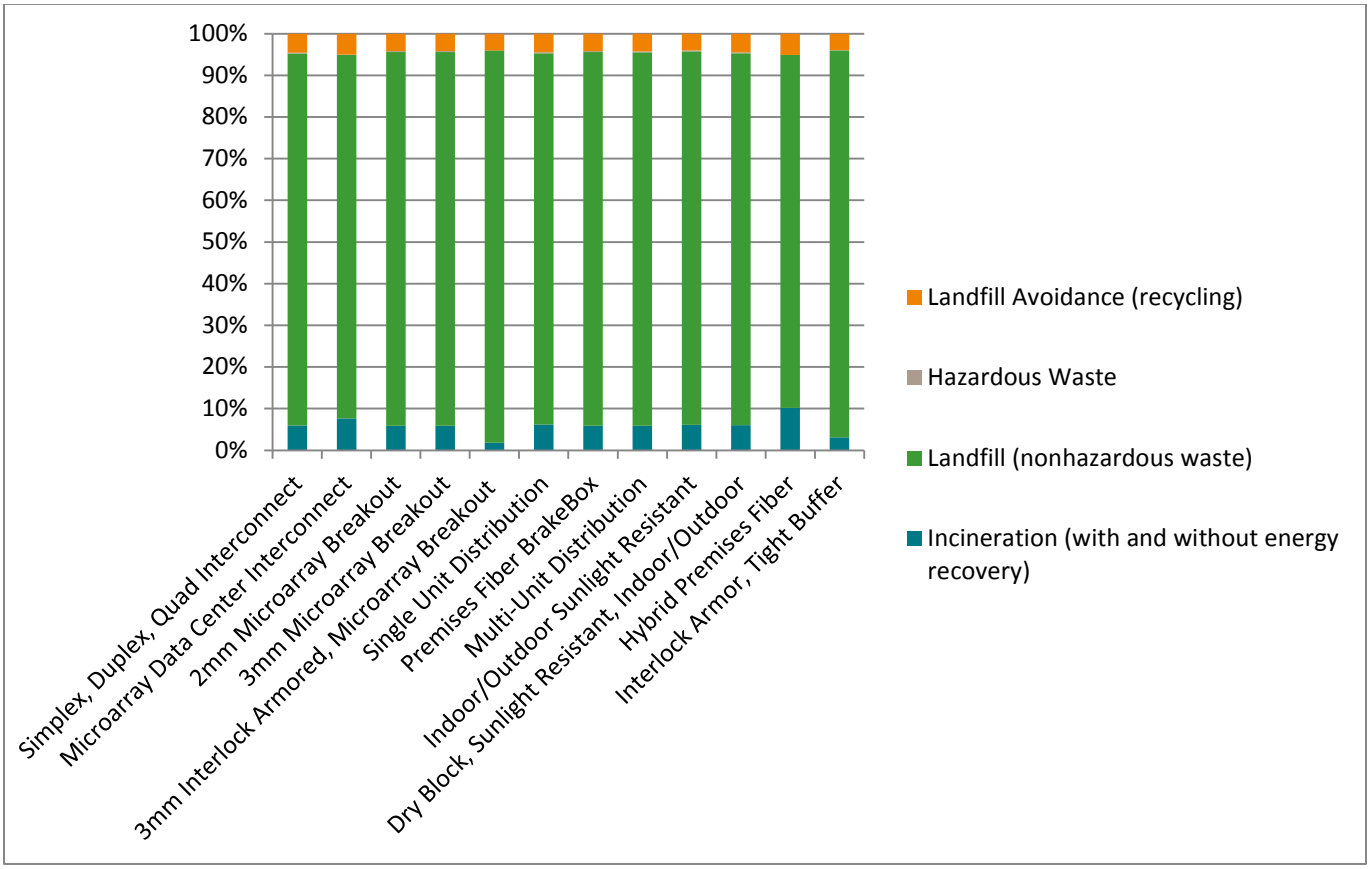


Figure 5: Cradle-to-Grave Waste

Life Cycle Impact Assessment

The environmental impacts listed below were assessed throughout the life cycle of the plenum fiber optic cable products as defined above, per 100 feet of cable. The environmental impacts were analyzed using TRACI 2.1 methodology.

Impact Category	Simplex, Duplex, Quad Interconnect						Microarray Data Center Interconnect						2mm Microarray Breakout					
	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave
Global Warming (kg CO_2 eq)	2.1E+00	4.6E-01	9.9E-02	2.6E-03	3.0E-01	3.0E+00	3.0E+00	7.0E-01	1.5E-01	4.0E-03	4.5E-01	4.3E+00	1.6E+01	3.6E+00	7.6E-01	2.0E-02	2.3E+00	2.2E+01
Acidification (kg SO_2 eq)	2.3E-02	4.0E-03	5.9E-04	5.6E-06	5.2E-04	2.8E-02	3.3E-02	6.1E-03	8.9E-04	8.5E-06	7.9E-04	4.1E-02	1.7E-01	3.1E-02	4.6E-03	4.3E-05	4.0E-03	2.1E-01
Eutrophication (kg N eq)	8.7E-02	1.9E-04	3.3E-05	2.6E-04	3.5E-04	8.8E-02	8.3E-02	2.9E-04	5.0E-05	4.0E-04	5.4E-04	8.4E-02	7.2E-01	1.5E-03	2.5E-04	2.0E-03	2.7E-03	7.3E-01
Smog (kg O_3 eq)	2.0E-01	2.2E-02	1.6E-02	1.4E-04	6.5E-03	2.4E-01	2.4E-01	3.4E-02	2.5E-02	2.2E-04	9.9E-03	3.1E-01	1.5E+00	1.7E-01	1.2E-01	1.1E-03	5.0E-02	1.9E+00
Ozone Depletion (kg CFC-11 eq)	2.3E-07	1.7E-09	3.8E-12	2.4E-10	6.5E-09	2.4E-07	2.9E-07	2.6E-09	5.7E-12	3.7E-10	9.8E-09	3.0E-07	1.7E-06	1.3E-08	2.9E-11	1.9E-09	5.0E-08	1.7E-06

Impact Category	3mm Microarray Breakout						3mm Interlock Armored, Microarray Breakout						Single Unit Distribution					
	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave
Global Warming (kg CO_2 eq)	1.7E+01	3.9E+00	8.3E-01	2.2E-02	2.5E+00	2.4E+01	9.2E+01	4.7E+00	1.0E+00	2.7E-02	3.0E+00	1.0E+02	1.0E+01	2.2E+00	4.8E-01	1.3E-02	1.4E+00	1.4E+01
Acidification (kg SO_2 eq)	1.9E-01	3.4E-02	4.9E-03	4.7E-05	4.3E-03	2.3E-01	4.6E-01	4.1E-02	6.0E-03	5.7E-05	5.2E-03	5.1E-01	1.1E-01	2.0E-02	2.9E-03	2.7E-05	2.5E-03	1.3E-01
Eutrophication (kg N eq)	7.9E-01	1.6E-03	2.7E-04	2.2E-03	3.0E-03	8.0E-01	2.7E-01	1.9E-03	3.3E-04	2.7E-03	3.6E-03	2.8E-01	4.0E-01	9.1E-04	1.6E-04	1.3E-03	1.7E-03	4.1E-01
Smog (kg O_3 eq)	1.6E+00	1.9E-01	1.3E-01	1.2E-03	5.4E-02	2.0E+00	6.1E+00	2.3E-01	1.6E-01	1.5E-03	6.6E-02	6.6E+00	9.2E-01	1.1E-01	7.8E-02	6.9E-04	3.2E-02	1.1E+00
Ozone Depletion (kg CFC-11 eq)	1.8E-06	1.4E-08	3.1E-11	2.0E-09	5.4E-08	1.9E-06	1.1E-05	1.7E-08	3.8E-11	2.4E-09	6.6E-08	1.1E-05	1.1E-06	8.3E-09	1.8E-11	1.2E-09	3.1E-08	1.1E-06

Impact Category	Premises Fiber BrakeBox						Multi-Unit Distribution						Indoor/Outdoor Sunlight Resistant					
	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave
Global Warming (kg CO_2 eq)	4.0E+01	8.5E+00	1.8E+00	4.9E-02	5.5E+00	5.6E+01	4.1E+01	8.7E+00	1.9E+00	5.0E-02	5.6E+00	5.8E+01	3.9E+01	9.1E+00	1.9E+00	5.2E-02	5.8E+00	5.6E+01
Acidification (kg SO_2 eq)	4.1E-01	7.5E-02	1.1E-02	1.0E-04	9.6E-03	5.1E-01	4.2E-01	7.7E-02	1.1E-02	1.1E-04	9.8E-03	5.2E-01	4.4E-01	8.0E-02	1.2E-02	1.1E-04	1.0E-02	5.4E-01
Eutrophication (kg N eq)	1.6E+00	3.5E-03	6.1E-04	4.9E-03	6.6E-03	1.6E+00	1.6E+00	3.6E-03	6.2E-04	5.0E-03	6.7E-03	1.6E+00	1.8E+00	3.7E-03	6.5E-04	5.2E-03	7.0E-03	1.9E+00
Smog (kg O_3 eq)	3.7E+00	4.1E-01	3.0E-01	2.7E-03	1.2E-01	4.5E+00	3.8E+00	4.2E-01	3.1E-01	2.7E-03	1.2E-01	4.6E+00	3.7E+00	4.4E-01	3.2E-01	2.8E-03	1.3E-01	4.6E+00
Ozone Depletion (kg CFC-11 eq)	4.4E-06	3.2E-08	7.0E-11	4.5E-09	1.2E-07	4.5E-06	4.4E-06	3.2E-08	7.1E-11	4.6E-09	1.2E-07	4.6E-06	4.2E-06	3.4E-08	7.4E-11	4.7E-09	1.3E-07	4.3E-06

Impact Category	Dry Block, Sunlight Resistant, Indoor/Outdoor						Hybrid Premises Fiber						Interlock Armor, Tight Buffer					
	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave	Raw Material	Manufacturing	Marketing	Installation	Waste Disposal	Cradle to Grave
Global warming (kg CO_2 eq)	5.9E+00	1.3E+00	2.8E-01	7.4E-03	8.3E-01	8.3E+00	2.4E+01	5.6E+00	1.2E+00	3.2E-02	3.6E+00	3.4E+01	1.2E+02	1.2E+01	2.6E+00	6.9E-02	7.7E+00	1.5E+02
Acidification (kg SO_2 eq)	6.3E-02	1.1E-02	1.7E-03	1.6E-05	1.4E-03	7.8E-02	2.7E-01	4.9E-02	7.2E-03	6.8E-05	6.3E-03	3.3E-01	8.2E-01	1.1E-01	1.5E-02	1.5E-04	1.4E-02	9.5E-01
Eutrophication (kg N eq)	2.4E-01	5.3E-04	9.2E-05	7.4E-04	9.9E-04	2.4E-01	1.1E+00	2.3E-03	4.0E-04	3.2E-03	4.3E-03	1.1E+00	1.8E+00	4.9E-03	8.6E-04	6.9E-03	9.3E-03	1.8E+00
Smog (kg O_3 eq)	5.4E-01	6.3E-02	4.5E-02	4.0E-04	1.8E-02	6.7E-01	2.2E+00	2.7E-01	2.0E-01	1.7E-03	7.9E-02	2.8E+00	9.2E+00	5.9E-01	4.2E-01	3.8E-03	1.7E-01	1.0E+01
Ozone Depletion (kg CFC-11 eq)	6.2E-07	4.8E-09	1.1E-11	6.7E-10	1.8E-08	6.5E-07	2.5E-06	2.1E-08	4.6E-11	2.9E-09	7.9E-08	2.6E-06	1.4E-05	4.5E-08	9.9E-11	6.3E-09	1.7E-07	1.4E-05

Table 7: Cradle-to-Grave Life Cycle Impact Assessment Results per 100 ft of Cable

References

- ANSI/TIA-568-C.3 Optical Fiber Cabling Components Standard
- C22.2 NO. 214-08 (R2013) - Communications cables (Bi-national standard, with UL 444)
- EN 15804:2012 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products
- EPA, Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI)
- EPA, Wire and Cable Insulation and Jacketing: Life-Cycle Assessments for Selected Applications, June 2008, EPA 744-R-08-001
- FTC Part 260, Green guides
- (ILCD, 2010) Joint Research Commission, 2010, ILCD Handbook: General Guide for Life Cycle Assessment
- Intergovernmental Panel on Climate Change (IPCC)
- ISO 14025:2006 *Environmental labels and declarations – Type III environmental declarations – Principles and procedures*
- ISO 14040:2006 *Environmental management - Life cycle assessment – Principles and framework*
- ISO 14044:2006 *Environmental management - Life cycle assessment – Requirements and guidelines*
- ISO 21930:2007 *Sustainability in building construction – Environmental declaration of building products*
- NFPA 262: Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
- NFPA 70®: National Electrical Code
- UL 44 Standard Thermoset-Insulated Wires and Cables
- UL 1666 Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
- USEPA Waste Reduction Model (WARM)

LCA Development

This EPD and corresponding LCA were prepared by Sustainable Solutions Corporation of Royersford, Pennsylvania.

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