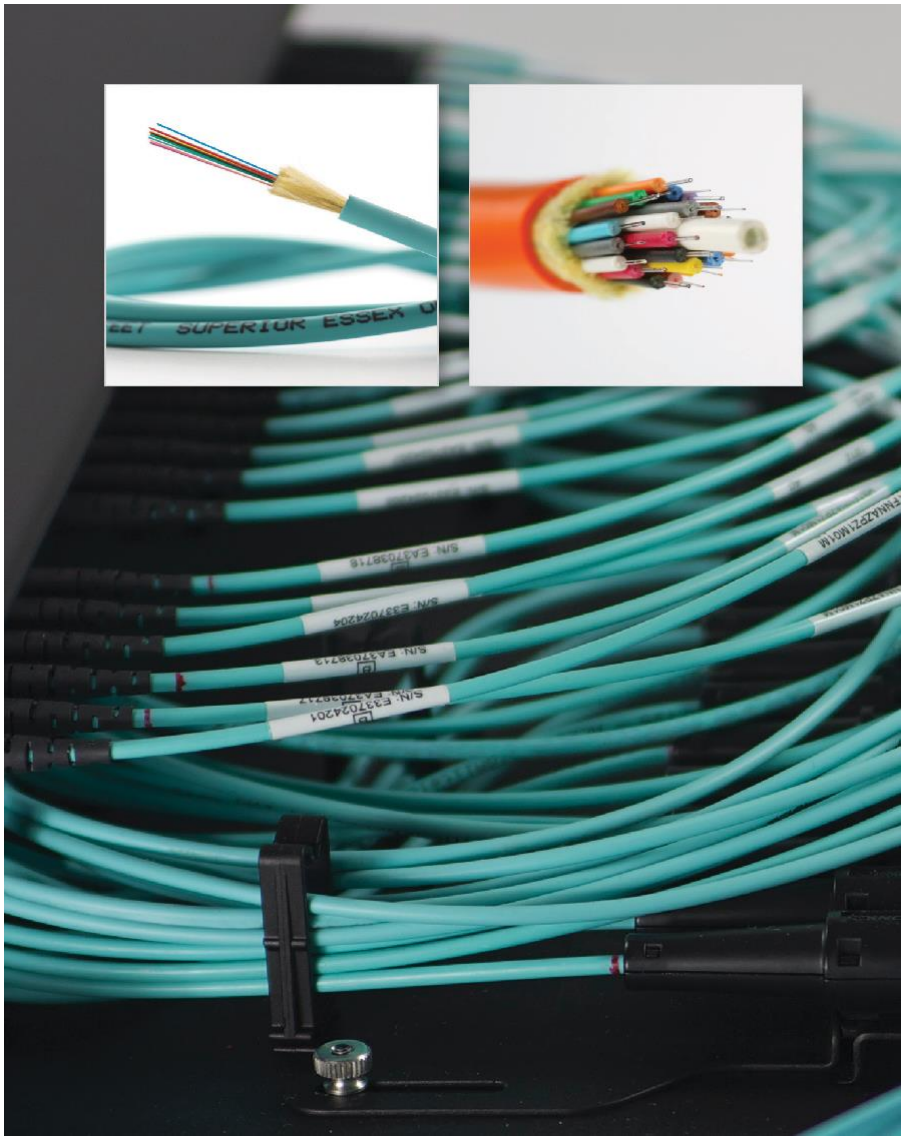
Environmental Product Declaration

Superior Essex Optical Fiber Data Cable

PLENUM RATED



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

SUPERIOR ESSEX®

At Superior Essex we believe that the technology that interconnects the world should also respect it. Cabling that is manufactured sustainably in a third-party certified zero waste to landfill facility as well as a facility that has reduced their Scope 1 and Scope 2 carbon emissions by 21% since 2011 is just the start. We take pride in the transparency of our total life cycle impacts through our environmental product declaration efforts and are working diligently to not only be transparent about our impacts but also reducing these impacts for the betterment of today and to the future, tomorrow.

UL CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

SUPERIOR ESSEX

Fiber Plenum Cable: 34 Series, P4 Interconnect, P4 Series, 44 Single Unit, 44 Series, W4 Series, V4 Series, L4 Series, and PowerWise® Fiber (CL3P-OF, CMP-OF, FPLP-OF)

CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION ULCOM/EPD

According to ISO 14025

EPD Program and Program Operator Name, Address, Logo, and Website	UL Environment 333 Pfingsten Road Northbrook, IL 60611	https://www.ul.com/ https://spot.ul.com
General Program Instructions and Version Number	General Program Instructions v.2.4 July 2018	
Manufacturer Name and Address	Superior Essex Inc. 5770 Powers Ferry Rd NW Atlanta, GA 30327	
Declaration Number	4789047039.103.1	
Declared Product & Functional Unit or Declared Unit	Superior Essex Optical Fiber Data Cable-Plenum Rated; 1m	
Reference PCR and Version Number	P.E.P Association. PCR for Electrical, Electronic and HVAC-R Products (2015) P.E.P Association. PSR Specific Rules for Wires, Cables and Accessories (2015)	
Description of Product Application/Use	Fourteen premises fiber optic 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.	
Product RSL Description (if Appl.)	5 years with a 100% use rate	
Markets of Applicability	North America	
Date of Issue	October 1, 2020	
Period of Validity	5 Years	
EPD Type	Product-Specific	
Range of Dataset Variability	N/A	
EPD Scope	Cradle to grave	
Year(s) of Reported Primary Data	2018	
LCA Software & Version Number	GaBi 9	
LCI Database(s) & Version Number	GaBi 2019 LCI database (Service Pack 39)	
LCIA Methodology & Version Number	CML-IA, version 2016	

This PCR review was conducted by:	PEP ecopassport Program PCR Review Commitee
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Grant R. Martin Grant R. Martin, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria Thomas P. Gloria, Industrial Ecology Consultants

LIMITATIONS

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; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible". Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

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According to ISO 14025

1. Product Definition and Information

Description of Company/Organization

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

Fourteen premises fiber optic 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, ONR, OFCP, or OFCR. Most of these products are cut to custom lengths and shipped on reels.

2 mm Microarray Breakout Part Number: V4 Series / F447
The 2 mm Microarray Breakout cable from Superior Essex is designed for high performance in a small package. The premises loose tube design consists of 8 or 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 plenum fire protection. The cable is available with TeraFlex® single mode, and TeraFlex laser-optimized 50/125 micron 10G/150 (OM2+), 10G/300 (OM3) and 10G/550 (OM4) multimode fiber types.

3 mm Microarray Breakout Part Number: P4 Series / F449
The 3 mm Microarray Breakout cable from Superior Essex is designed for high performance in a small package. The premises loose tube design consists of 3 mm microarray interconnect cable subunits, each of which contain either eight or 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.

Dry Block, Sunlight Resistant, Indoor/Outdoor Part Number: W4 Series / F409
The Superior Essex Dry Block, Sunlight Resistant Indoor/Outdoor Plenum cable is designed to survive the toughest installation and environmental conditions. Not only does the cable exceed the rigorous Indoor/Outdoor plenum cable performance requirements of ICEA 696, but its proprietary thermoplastic jacket makes it resistant to mechanical abrasion, chemicals, oil and sunlight. The cable core consists of 2 through 24 fibers for the single unit and, for the multi-unit, 3 to 6 subunits of 6 or 12 fibers each. GRP and aramid yarn dielectric strength elements give the cable both strength and flexibility and the core is fully water-blocking using dry SAP technology. The cable is available in TeraFlex® Bend Resistant optical fiber types, including both single mode, 62.5, and OM3/4 multimode fiber

Microarray Data Center Interconnect Part Number: P4 Interconnect
The Microarray Data Center Interconnect Cables from Superior Essex are designed for high performance in a small package. The 2-fiber through 12-fiber premises loose tube interconnect has an outside diameter of only 2 mm or 3 mm. The 24-fiber duplex contains two, 12-fiber 3 mm 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.

Multi-Unit Distribution Part Number: 44 Series
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 TeraFlex® 10G/150 – laser optimized 50 µm multimode fiber. All fibers exceed industry requirements. 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. Subunits are constructed using dielectric aramid yarns for strength while maintaining flexibility and are jacketed using the color appropriate to the type of fiber in the cable. The subunits are then stranded around a flexible high-strength glass reinforced rod which provides exceptional resistance to dimensional changes due to temperature. A durable, flame resistant outer jacket is applied over the cable core using appropriate OFNR or OFNP rated materials.

Simplex, Duplex and Quad Interconnect Part Number: 34 Series / F406 / F407 / F402 / F405 / C4 / B4 / A4
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. The design consists of flexible tight buffer material extruded over the fiber to a diameter of 900 µm for use with standard connectors. Dielectric yarns are applied for additional strength and a flame retardant PVC jacket covers the strength members. Appropriate materials are used to achieve an OFNR (riser) or OFNP (plenum) rating. Standard 2.9 mm and small form factor 2 mm diameters are available for simplex and duplex designs.

Single Unit Distribution Part Number: 44 Single Unit / F403 / F404
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.

Interlock Armored, Tight Buffer Part Number: L4 Series / F203 / F204
The Interlock Armored Microarray Breakout cable from Superior Essex is designed for high performance with robust mechanical protection. The premises loose tube 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. A RoHS-compliant flexible jacket protects the core while providing fire protection. Finally, the cable is interlock armored with aluminum and jacketed.

PowerWise® Fiber Part Number: CL3P-OF, CMP-OF and FPLP-OF
The PowerWise® cable is designed for premises applications where either the distance or the power requirements of the end device exceed what Power over Ethernet is capable of reaching or supplying. The cable consists of two (2) – 2 mm bend resistant fiber simplex interconnect cables and two (2) – stranded 16 AWG copper conductors. The two simplex interconnect cables allow direct and secure connection to LC or SC type mechanical connectors. The core is surrounded by strength yarns that provide the cable with the tensile strength to meet the distribution cable requirements of ANSI/ ICEA S-83-596. The cable is UL Listed CL3R-OF/CL3P-OF, CMR-OF/ CMP-OF and FPLR-OF/FPLP-OF

Application

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

Material Composition

The raw material and packaging inputs for the plenum fiber optic cables are listed in Table 1.

Table 1: Material Inputs (including packaging) for Plenum Fiber Optic Cables [kg / meter]

	34 Series	P4 Interconnect	P4 Series	44 Single Unit	44 Series	W4 Series	V4 Series	L4 Series	CL3P-OF, CMP-OF, FPLP-OF
Fiber	2.90E-04	1.74E-03	5.40E-02	1.74E-03	5.13E-02	2.84E-02	2.55E-02	1.32E-02	3.25E-03
Aramid yarn	1.72E-03	1.89E-03	1.12E-02	3.80E-03	2.83E-02	1.94E-02	6.72E-03	2.88E-02	1.03E-03
Ink	2.54E-05	1.52E-04	9.22E-04	1.52E-04	9.14E-04	6.14E-04	9.16E-04	9.22E-04	1.27E-05
Aluminum	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.17E-01	2.44E-04
PET	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.13E-03	0.00E+00	0.00E+00	0.00E+00
PVDF	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.69E-01	0.00E+00	6.92E-01	4.24E-02
PVC	1.87E-02	3.33E-02	2.62E-01	5.79E-02	5.39E-01	3.27E-01	1.27E-01	1.79E-06	1.79E-06
Pkg - Cardboard	2.23E-07	1.64E-06	1.64E-06	0.00E+00	2.68E-06	6.10E-07	2.23E-06	8.77E-06	2.68E-02
Pkg - HDPE	2.68E-02	2.68E-02	0.00E+00	0.00E+00	0.00E+00	2.68E-02	2.68E-02	1.23E+00	1.64E-06
Pkg - Polystyrene	1.93E-07	1.49E-06	1.49E-06	2.98E-03	2.38E-06	5.36E-07	1.93E-06	7.67E-06	9.23E-07
Pkg - Polypropylene	1.10E-07	8.48E-07	8.48E-07	1.49E-03	1.34E-06	3.13E-07	1.12E-06	4.38E-06	1.12E-02
Pkg - Wood	1.34E-03	1.03E-02	1.03E-02	4.46E-03	1.64E-02	3.72E-03	1.35E-02	5.30E-02	3.25E-03
Total	**4.86E-02**	**7.42E-02**	**3.38E-01**	**7.25E-02**	**6.36E-01**	**5.82E-01**	**2.00E-01**	**2.23E+00**	**8.49E-02**

Manufacturing

The first step in the process 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 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. This is followed immediately by a printer that prints length and other information onto the jacketed cable, then by another cooling trough, and finally by winding the cable onto a spool for packaging. Final product is cut to custom lengths per customer order and is generally shipped via plywood reels.

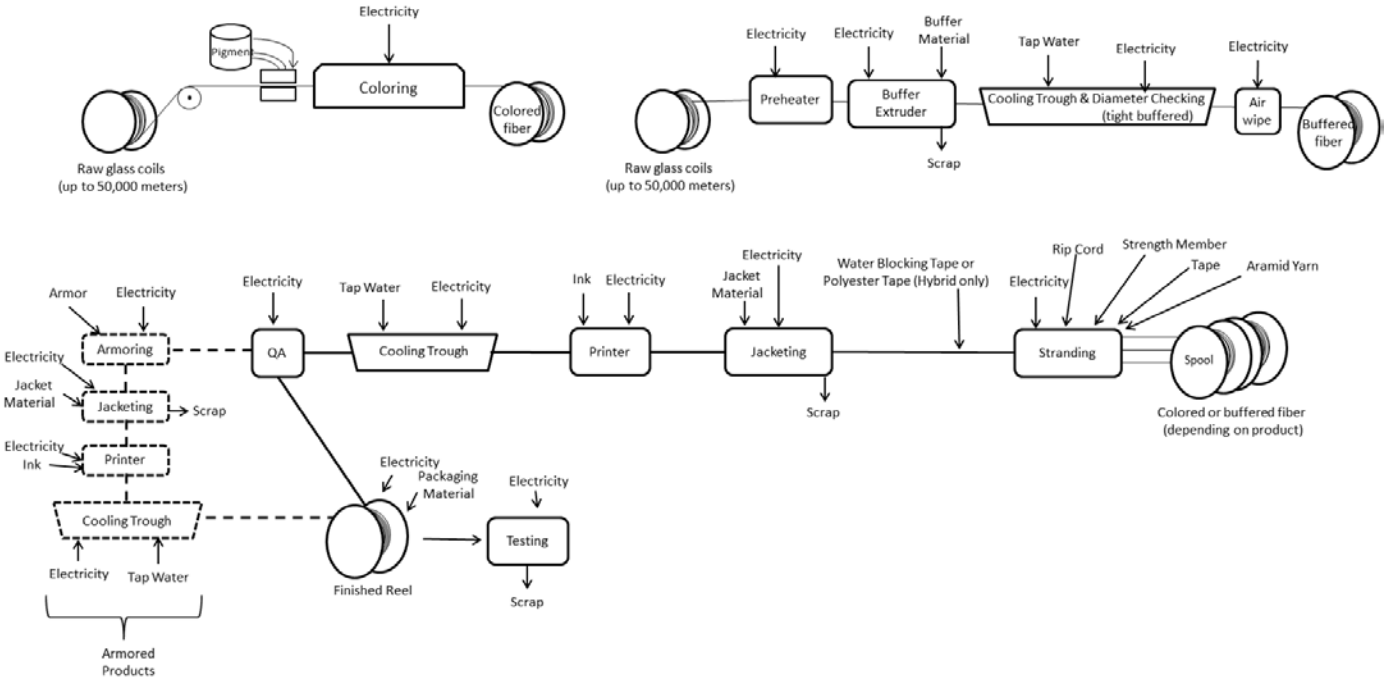

Figure 1: Manufacturing Process Flow of Plenum Fiber Data Cable

Figure 2: Photographs of Manufacturing Process

2. Life Cycle Assessment Background Information

Functional Unit

The functional unit for the study is defined as required by the PEP PSR for Wire, Cable, and Accessories, Product Specific Rules and PEP-PCR-ed3-EN-2015 04 02 as:

*To transmit a communication signal on **1 meter,** according to the protocol and category relevant to each cable (outlined below), for a period of **5 years** with a **100% use rate**.*

The fiber products assessed in this study are designed as single-mode or multimode cables; the main difference between the two is that the latter has much larger core diameter. Single-mode and multimode cables each follow their own set of protocols, as seen below in Table 2.

Table 2: Single-mode and Multimode Protocols

Cable type	Protocol
Multimode	10GBASE-SR
	1000BASE-SX
	10BASE-FL
Single mode	100BASE-LX
	1000BASE-LX
	10GBASE-LR

Cable mode type for each cable product is listed in Table 3.

Table 3: Mode Type for each Cable

Product name	Single or Multimode
34 Series	Multimode
P4 Interconnect	Multimode
P4 Series	Single mode
44 Single Unit	Multimode
44 Series	Single mode
W4 Series	Multimode
V4 Series	Multimode
L4 Series	Multimode
CL3P-OF, CMP-OF, FPLP-OF	Multimode

System Boundary

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

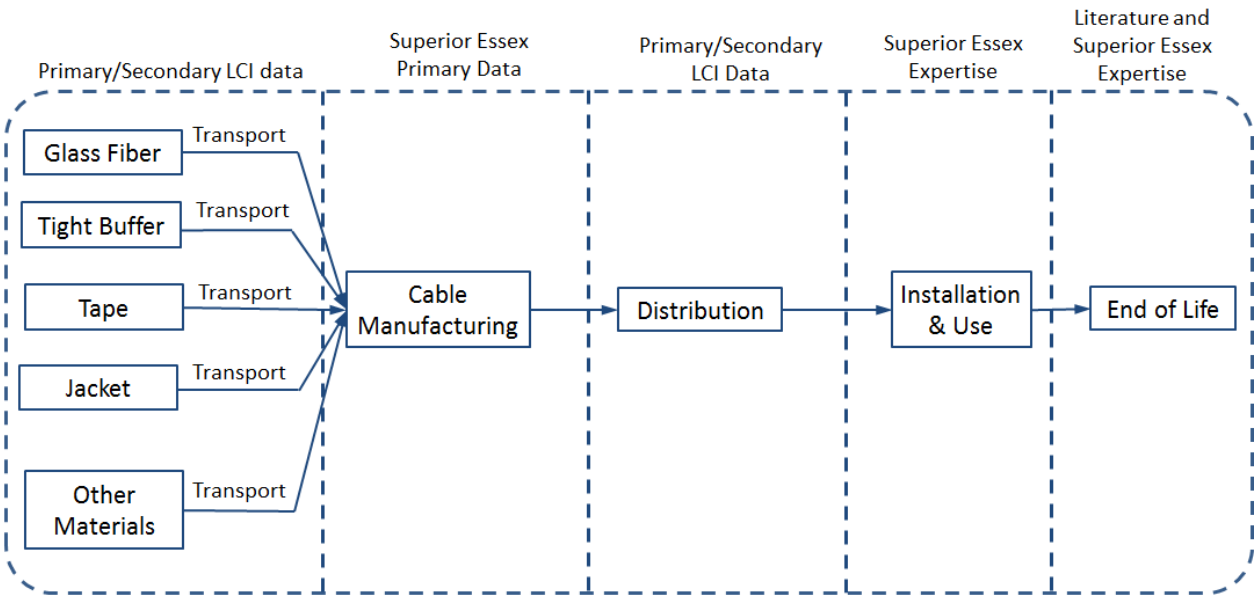

Figure 3: System Boundary

Cut-off Criteria

All known data, including packaging of the finished product, were included in the analysis. The one exception was energy consumed by installation test equipment, which is estimated to be negligible. Capital goods and infrastructure required to produce and install the cables were excluded.

Period under Review

The data represent the production of fiber cable at Superior Essex facilities from calendar year 2018.

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 product.

Software and Background Data

The LCA model was created using the GaBi 9 Software system for life cycle engineering, developed by Sphera. The GaBi 2019 LCI database (Service Pack 39) provides the life cycle inventory data for several of the raw and process materials obtained from the background system.

Transportation

Superior Essex provided resource transportation mode and distance data to support the modeling of raw material inbound transportation. Finished products were modelled as being shipped 953 miles by truck. This calculated average was based on Superior Essex sales data as part of the company's 2014 EPDs; the same assumption is still representative for current data as Superior Essex has not seen dramatic changes in the makeup or locations of their customers.

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 cables have 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 PCR's cut-off criteria.

The lifetime of the product is widely variable. Products are most often replaced not due to performance degradation, but due to improvements in technology over time, for which corresponding increases in bandwidth and data speeds are demanded by building tenants. 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 very little energy and requires no maintenance over its 5 year service life; power loss assumptions for multimode and single mode cables are show below in Table 4.

Table 4: Fiber cable power loss

Cable type	Protocol	Power loss (µW/m)
Multimode	10GBASE-SR	**0.76**
	1000BASE-SX	
	10BASE-FL	
Single mode	100BASE-LX	**0.09**
	1000BASE-LX	
	10GBASE-LR	

End-of-Life

In conformance with the PEP PCR, this study assumes that metal components of fiber cables are separated and recycled at the end of life with all remaining materials being disposed as the average US municipal solid waste disposition. The average US disposition includes 82% landfill and 18% incineration.

3. Life Cycle Assessment Results

Life Cycle Impact Assessment Results

The potential environmental impacts listed below were assessed throughout the life cycle of the plenum data cable products as defined above, per one meter of cable. The environmental impacts were analyzed using CML methodology. In Table 5 below, the following abbreviations have been used for the impact categories:

- GWP – Global Warming Potential
- AP – Acidification Potential
- EP – Eutrophication Potential
- ODP – Ozone Depletion Potential
- POCP – Photochemical Ozone Creation Potential
- ADPe – Abiotic Depletion Potential – Elements
- PED – Primary Energy Demand

Table 5: Cradle-to-Grave Life Cycle Impact Assessment Results per 1 meter of Cable

Impact Category	Unit	34 Series				
		Mfg	Distribution	Installation	Use	EoL
GWP	kg CO_2-eq.	4.24E-01	7.51E-03	2.89E-02	1.95E-05	3.55E-03
AP	kg SO_2-eq.	7.35E-04	1.81E-05	5.51E-05	5.82E-08	1.01E-05
EP	kg PO_4^{3-}-eq.	1.62E-04	5.16E-06	1.21E-05	3.17E-09	1.90E-06
ODP	kg R11-eq.	3.60E-12	7.55E-19	1.89E-13	6.40E-20	5.34E-18
POCP	kg C_2H_4-eq.	7.35E-05	-5.34E-06	2.77E-06	3.52E-09	-1.07E-06
ADPe	kg Sb-eq.	7.36E+00	1.12E-01	4.58E-01	2.43E-04	5.05E-02
PED	MJ	7.99E+00	1.13E-01	4.92E-01	3.11E-04	5.30E-02
Net Water Use	m^3	4.10E-03	1.36E-05	2.25E-04	1.09E-07	8.36E-06
Air Pollution	m^3	2.18E+01	3.36E-01	1.98E+00	9.66E-04	1.89E-01
Water Pollution	m^3	2.42E-01	4.19E-03	1.50E-02	4.72E-06	1.51E-03

Impact Category	Unit	P4 Interconnect				
		Mfg	Distribution	Installation	Use	EoL
GWP	kg CO_2-eq.	6.50E-01	1.14E-02	5.39E-02	1.95E-05	6.34E-03
AP	kg SO_2-eq.	1.14E-03	2.74E-05	1.01E-04	5.82E-08	1.79E-05
EP	kg PO_4^{3-}-eq.	2.05E-04	7.83E-06	1.99E-05	3.17E-09	3.38E-06
ODP	kg R11-eq.	6.53E-12	1.15E-18	3.43E-13	6.40E-20	9.53E-18
POCP	kg C_2H_4-eq.	1.10E-04	-8.11E-06	9.95E-06	3.52E-09	-1.91E-06
ADPe	kg Sb-eq.	1.09E+01	1.71E-01	6.70E-01	2.43E-04	9.01E-02
PED	MJ	1.19E+01	1.72E-01	7.25E-01	3.11E-04	9.45E-02
Net Water Use	m^3	4.76E-03	2.06E-05	2.64E-04	1.09E-07	1.49E-05
Air Pollution	m^3	3.26E+01	5.09E-01	6.47E+00	9.66E-04	3.36E-01
Water Pollution	m^3	3.96E-01	6.36E-03	2.40E-02	4.72E-06	2.70E-03

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Impact Category	Unit	P4 Series				
		Mfg	Distribution	Installation	Use	EoL
GWP	kg CO_2-eq.	4.69E+00	5.21E-02	2.68E-01	2.31E-06	5.60E-02
AP	kg SO_2-eq.	8.01E-03	1.25E-04	4.66E-04	6.89E-09	1.58E-04
EP	kg PO_4^{3-}-eq.	9.07E-04	3.58E-05	5.77E-05	3.76E-10	2.99E-05
ODP	kg R11-eq.	5.08E-11	5.23E-18	2.67E-12	7.57E-21	8.42E-17
POCP	kg C_2H_4-eq.	6.91E-04	-3.70E-05	4.03E-05	4.17E-10	-1.69E-05
ADPe	kg Sb-eq.	7.02E+01	7.79E-01	3.80E+00	2.88E-05	7.96E-01
PED	MJ	7.81E+01	7.84E-01	4.22E+00	3.69E-05	8.35E-01
Net Water Use	m^3	1.59E-02	9.40E-05	8.51E-04	1.29E-08	1.32E-04
Air Pollution	m^3	2.06E+02	2.33E+00	1.59E+01	1.14E-04	2.97E+00
Water Pollution	m^3	3.01E+00	2.91E-02	1.62E-01	5.59E-07	2.39E-02

Impact Category	Unit	44 Single Unit				
		Mfg	Distribution	Installation	Use	EoL
GWP	kg CO_2-eq.	9.71E-01	1.12E-02	5.94E-02	1.95E-05	1.09E-02
AP	kg SO_2-eq.	1.62E-03	2.68E-05	1.02E-04	5.82E-08	3.07E-05
EP	kg PO_4^{3-}-eq.	2.56E-04	7.66E-06	1.72E-05	3.17E-09	5.80E-06
ODP	kg R11-eq.	1.12E-11	1.12E-18	5.90E-13	6.40E-20	1.63E-17
POCP	kg C_2H_4-eq.	1.48E-04	-7.93E-06	9.67E-06	3.52E-09	-3.27E-06
ADPe	kg Sb-eq.	1.48E+01	1.67E-01	8.17E-01	2.43E-04	1.54E-01
PED	MJ	1.64E+01	1.68E-01	9.02E-01	3.11E-04	1.62E-01
Net Water Use	m^3	5.53E-03	2.01E-05	2.97E-04	1.09E-07	2.56E-05
Air Pollution	m^3	4.36E+01	4.98E-01	4.35E+00	9.66E-04	5.77E-01
Water Pollution	m^3	6.21E-01	6.23E-03	3.39E-02	4.72E-06	4.63E-03

Impact Category	Unit	44 Series				
		Mfg	Distribution	Installation	Use	EoL
GWP	kg CO_2-eq.	8.90E+00	9.77E-02	5.02E-01	2.31E-06	1.06E-01
AP	kg SO_2-eq.	1.47E-02	2.35E-04	8.46E-04	6.89E-09	3.00E-04
EP	kg PO_4^{3-}-eq.	1.65E-03	6.71E-05	1.03E-04	3.76E-10	5.65E-05
ODP	kg R11-eq.	1.04E-10	9.82E-18	5.46E-12	7.57E-21	1.59E-16
POCP	kg C_2H_4-eq.	1.31E-03	-6.95E-05	7.36E-05	4.17E-10	-3.19E-05
ADPe	kg Sb-eq.	1.34E+02	1.46E+00	7.27E+00	2.88E-05	1.50E+00
PED	MJ	1.50E+02	1.47E+00	8.07E+00	3.69E-05	1.58E+00
Net Water Use	m^3	2.78E-02	1.76E-04	1.49E-03	1.29E-08	2.49E-04
Air Pollution	m^3	3.85E+02	4.36E+00	2.77E+01	1.14E-04	5.62E+00
Water Pollution	m^3	5.71E+00	5.45E-02	3.07E-01	5.59E-07	4.51E-02

Impact Category	Unit	W4 Series				
		Mfg	Distribution	Installation	Use	EoL
GWP	kg CO_2-eq.	8.75E+00	8.94E-02	4.80E-01	1.95E-05	9.43E-02
AP	kg SO_2-eq.	1.50E-02	2.15E-04	8.38E-04	5.82E-08	2.67E-04
EP	kg PO_4^{3-}-eq.	1.65E-03	6.14E-05	9.73E-05	3.17E-09	5.03E-05
ODP	kg R11-eq.	2.23E-06	8.99E-18	1.17E-07	6.40E-20	1.42E-16
POCP	kg C_2H_4-eq.	1.29E-03	-6.36E-05	6.37E-05	3.52E-09	-2.84E-05
ADPe	kg Sb-eq.	1.33E+02	1.34E+00	7.21E+00	2.43E-04	1.34E+00
PED	MJ	1.48E+02	1.35E+00	7.98E+00	3.11E-04	1.41E+00
Net Water Use	m^3	3.32E-02	1.61E-04	1.78E-03	1.09E-07	2.22E-04
Air Pollution	m^3	3.76E+02	3.99E+00	2.21E+01	9.66E-04	5.00E+00
Water Pollution	m^3	5.14E+00	4.99E-02	2.77E-01	4.72E-06	4.02E-02

Impact Category	Unit	V4 Series				
		Mfg	Distribution	Installation	Use	EoL
GWP	kg CO_2-eq.	2.38E+00	3.07E-02	1.51E-01	1.95E-05	2.73E-02
AP	kg SO_2-eq.	4.11E-03	7.39E-05	2.71E-04	5.82E-08	7.73E-05
EP	kg PO_4^{3-}-eq.	5.10E-04	2.11E-05	3.91E-05	3.17E-09	1.46E-05
ODP	kg R11-eq.	2.48E-11	3.09E-18	1.31E-12	6.40E-20	4.11E-17
POCP	kg C_2H_4-eq.	3.63E-04	-2.19E-05	2.41E-05	3.52E-09	-8.22E-06
ADPe	kg Sb-eq.	3.68E+01	4.60E-01	2.07E+00	2.43E-04	3.88E-01
PED	MJ	4.08E+01	4.62E-01	2.28E+00	3.11E-04	4.07E-01
Net Water Use	m^3	9.58E-03	5.55E-05	5.23E-04	1.09E-07	6.43E-05
Air Pollution	m^3	1.08E+02	1.37E+00	1.19E+01	9.66E-04	1.45E+00
Water Pollution	m^3	1.50E+00	1.72E-02	8.36E-02	4.72E-06	1.17E-02

Impact Category	Unit	L4 Series				
		Mfg	Distribution	Installation	Use	EoL
GWP	kg CO_2-eq.	1.82E+01	3.43E-01	1.25E+00	1.95E-05	1.63E-01
AP	kg SO_2-eq.	3.59E-02	8.24E-04	2.62E-03	5.82E-08	4.60E-04
EP	kg PO_4^{3-}-eq.	3.66E-03	2.35E-04	3.53E-04	3.17E-09	8.68E-05
ODP	kg R11-eq.	2.23E-10	3.44E-17	1.17E-11	6.40E-20	2.44E-16
POCP	kg C_2H_4-eq.	3.18E-03	-2.44E-04	1.12E-04	3.52E-09	-4.89E-05
ADPe	kg Sb-eq.	3.16E+02	5.13E+00	1.98E+01	2.43E-04	2.31E+00
PED	MJ	3.43E+02	5.16E+00	2.13E+01	3.11E-04	2.42E+00
Net Water Use	m^3	8.74E+01	6.18E-01	5.00E+00	1.09E-04	3.83E-01
Air Pollution	m^3	9.94E+02	1.53E+01	8.66E+01	9.66E-04	8.63E+00
Water Pollution	m^3	1.17E+01	1.91E-01	7.21E-01	4.72E-06	6.93E-02

Impact Category	Unit	CL3P-OF, CMP-OF, FPLP-OF				
		Mfg	Distribution	Installation	Use	EoL
GWP	kg CO_2-eq.	1.82E+01	3.43E-01	1.25E+00	1.95E-05	1.63E-01
AP	kg SO_2-eq.	3.59E-02	8.24E-04	2.62E-03	5.82E-08	4.60E-04
EP	kg PO_4^{3-}-eq.	3.66E-03	2.35E-04	3.53E-04	3.17E-09	8.68E-05
ODP	kg R11-eq.	2.23E-10	3.44E-17	1.17E-11	6.40E-20	2.44E-16
POCP	kg C_2H_4-eq.	3.18E-03	-2.44E-04	1.12E-04	3.52E-09	-4.89E-05
ADPe	kg Sb-eq.	3.16E+02	5.13E+00	1.98E+01	2.43E-04	2.31E+00
PED	MJ	3.43E+02	5.16E+00	2.13E+01	3.11E-04	2.42E+00
Net Water Use	m^3	8.74E+01	6.18E-01	5.00E+00	1.09E-04	3.83E-01
Air Pollution	m^3	9.94E+02	1.53E+01	8.66E+01	9.66E-04	8.63E+00
Water Pollution	m^3	1.17E+01	1.91E-01	7.21E-01	4.72E-06	6.93E-02

Life Cycle Impact Inventory Results

In Table 6 below, the following abbreviations (per EN 15804) have been used for the Inventory metrics:

- PERT – Primary Energy Renewable Total
- PENRT – Primary Energy Non-Renewable Total
- FW – Fresh Water
- HWD – Hazardous Waste Disposed
- NHWD – Non Hazardous Waste Disposed
- RWD – Recycled Waste Disposed

Table 6: Inventory Metrics per 1 meter of Cable

Impact Category	Unit	34 Series				
		Mfg	Distribution	Installation	Use	EoL
PERT	MJ	6.88E-01	3.50E-03	3.94E-02	4.26E-05	3.23E-03
PENRT	MJ	7.99E+00	1.13E-01	4.92E-01	3.11E-04	5.30E-02
FW	m^3	4.10E-03	1.36E-05	2.25E-04	1.09E-07	8.36E-06
HWD	kg	2.82E-08	9.16E-10	1.96E-09	1.37E-13	2.95E-10
NHWD	kg	4.13E-01	4.26E-06	5.20E-02	9.79E-08	2.09E-02
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Impact Category	Unit	P4 Interconnect				
		Mfg	Distribution	Installation	Use	EoL
PERT	MJ	1.24E+00	5.31E-03	6.95E-02	4.26E-05	5.77E-03
PENRT	MJ	1.19E+01	1.72E-01	7.25E-01	3.11E-04	9.45E-02
FW	m^3	4.76E-03	2.06E-05	2.64E-04	1.09E-07	1.49E-05
HWD	kg	5.98E-08	1.39E-09	3.79E-09	1.37E-13	5.25E-10
NHWD	kg	4.14E-01	6.47E-06	5.92E-02	9.79E-08	3.72E-02
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Impact Category	Unit	P4 Series				
		Mfg	Distribution	Installation	Use	EoL
PERT	MJ	9.13E+00	2.43E-02	4.86E-01	5.05E-06	5.10E-02
PENRT	MJ	7.81E+01	7.84E-01	4.22E+00	3.69E-05	8.35E-01
FW	m^3	1.59E-02	9.40E-05	8.51E-04	1.29E-08	1.32E-04
HWD	kg	4.30E-07	6.35E-09	2.34E-08	1.62E-14	4.64E-09
NHWD	kg	4.43E-01	2.95E-05	4.83E-02	1.16E-08	3.29E-01
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Impact Category	Unit	44 Single Unit				
		Mfg	Distribution	Installation	Use	EoL
PERT	MJ	1.86E+00	5.19E-03	9.95E-02	4.26E-05	9.89E-03
PENRT	MJ	1.64E+01	1.68E-01	9.02E-01	3.11E-04	1.62E-01
FW	m^3	5.53E-03	2.01E-05	2.97E-04	1.09E-07	2.56E-05
HWD	kg	8.99E-08	1.36E-09	4.98E-09	1.37E-13	9.01E-10
NHWD	kg	4.16E-01	6.33E-06	3.31E-02	9.79E-08	6.38E-02
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Impact Category	Unit	44 Series				
		Mfg	Distribution	Installation	Use	EoL
PERT	MJ	1.72E+01	4.55E-02	9.17E-01	5.05E-06	9.64E-02
PENRT	MJ	1.50E+02	1.47E+00	8.07E+00	3.69E-05	1.58E+00
FW	m^3	2.78E-02	1.76E-04	1.49E-03	1.29E-08	2.49E-04
HWD	kg	7.73E-07	1.19E-08	4.20E-08	1.62E-14	8.78E-09
NHWD	kg	4.61E-01	5.54E-05	6.81E-02	1.16E-08	6.22E-01
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Impact Category	Unit	W4 Series				
		Mfg	Distribution	Installation	Use	EoL
PERT	MJ	1.85E+01	4.16E-02	9.83E-01	4.26E-05	8.58E-02
PENRT	MJ	1.48E+02	1.35E+00	7.98E+00	3.11E-04	1.41E+00
FW	m^3	3.32E-02	1.61E-04	1.78E-03	1.09E-07	2.22E-04
HWD	kg	5.13E-07	1.09E-08	2.84E-08	1.37E-13	7.82E-09
NHWD	kg	4.65E-01	5.07E-05	8.40E-02	9.79E-08	5.54E-01
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Impact Category	Unit	V4 Series				
		Mfg	Distribution	Installation	Use	EoL
PERT	MJ	4.62E+00	1.43E-02	2.49E-01	4.26E-05	2.49E-02
PENRT	MJ	4.08E+01	4.62E-01	2.28E+00	3.11E-04	4.07E-01
FW	m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Impact Category	Unit	L4 Series				
		Mfg	Distribution	Installation	Use	EoL
PERT	MJ	3.55E+01	1.60E-01	2.02E+00	4.26E-05	1.48E-01
PENRT	MJ	3.43E+02	5.16E+00	2.13E+01	3.11E-04	2.42E+00
FW	m^3	8.74E-02	6.18E-04	5.00E-03	1.09E-07	3.83E-04
HWD	kg	2.59E-03	4.18E-08	1.36E-04	1.37E-13	1.35E-08
NHWD	kg	9.00E-01	1.94E-04	1.43E+00	9.79E-08	9.55E-01
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Impact Category	Unit	CL3P-OF, CMP-OF, FPLP-OF				
		Mfg	Distribution	Installation	Use	EoL
PERT	MJ	1.24E+00	4.38E-03	6.14E-02	4.26E-05	1.09E-02
PENRT	MJ	1.07E+01	1.41E-01	5.34E-01	3.11E-04	1.78E-01
FW	m^3	4.15E-03	1.70E-05	1.70E-04	1.09E-07	2.82E-05
HWD	kg	2.08E-08	1.15E-09	1.72E-09	1.37E-13	9.93E-10
NHWD	kg	2.38E-01	5.33E-06	7.65E-03	9.79E-08	7.03E-02
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

4. Optional Environmental Information

Organizational Third-Party Certification

A third-party audit was conducted by GreenCircle Certified, LLC for the hazardous and non-hazardous waste streams. The audit verified that the Brownwood, TX facility is a Zero Waste to Landfill facility during this study's reference period.

5. References

- ANSI/TIA-568-C. 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
- 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*
- Krieger, T. et al. *New Fire Hazard and Environmental Burden Evaluations of Electrical Cable Installations Utilizing ISO 14040 Environmental Methodologies*. DuPont. November 10, 2007.
- 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
- P.E.P. Association. PSR *Product Specific Rules for Wires, Cables and Accessories. PSR-0001-ed3-EN 2015 10 16. 2015.*
- P.E.P. Association. PCR. *Product Category Rules for Electrical, Electronic and HVAC-R Products. PEP-PCR-ed3-EN-2015 04 02. 2015.*
- 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
- US EPA Waste Reduction Model (WARM)

6. Contact Information

LCA Development

This EPD and corresponding LCA were prepared by Sphera with GaBi Software and data.

Contact Superior Essex

For more information, please visit http://www.ce.superioressex.com, or contact Technical Support at

Comm.TechSupport@spsx.com or +1 (877) 263-2818.

Superior Essex is located at: 6120 Powers Ferry Road, Suite 150 Atlanta, GA 30339