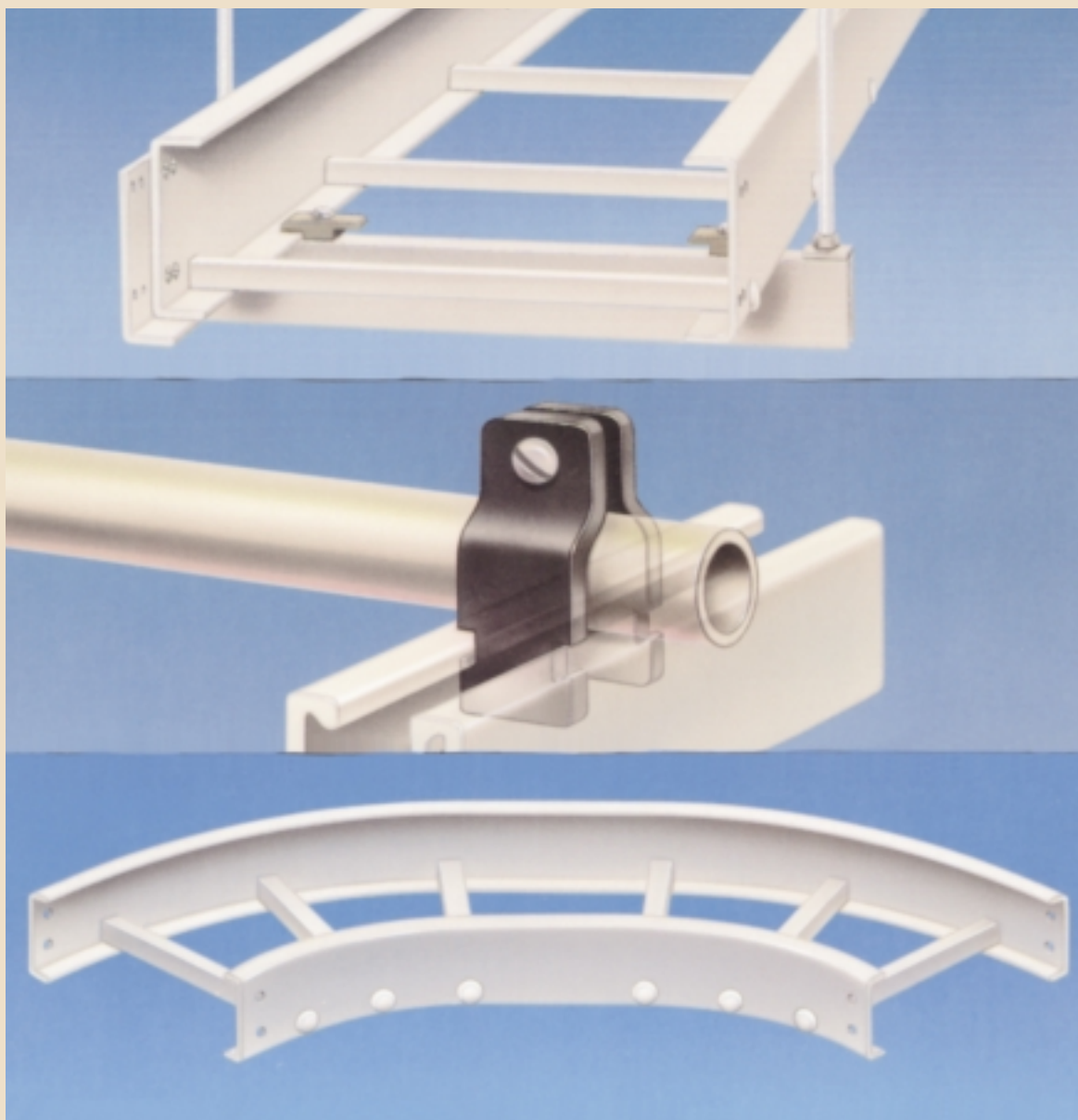


FIBERGLASS CABLE TRAY SYSTEMS



B-Line[®]



SYSTEMS THAT MAKE SENSE

Introduction

Cooper B-Line®

Manufacturer of Cable Tray, Strut Systems, Spring Steel Fasteners, Pipe Hangers, Telecom Support Systems, Electrical Enclosures and Meter Mounting Equipment.

Introduction to Cable Tray:

Cooper B-Line is a world-wide respected manufacturer of quality Cable Tray Systems with over 30 years of experience. The B-Line® Brand offers the most complete line of Cable Tray Systems. The Fiberglass Systems are featured in this catalog. These systems provide a unique assembly process, which utilizes both a mechanical and adhesive connection. Fiberglass Cable Tray systems are manufactured from glass fiber reinforced plastic shapes that meet ASTM E-84, Class 1 Flame Rating and self-extinguishing requirements of ASTM D-635. The NEMA loadings listed in this brochure are tested under the guidelines of the current NEMA and CSA Standard. CSA testing is a third party witnessed testing process. Standard colors are gray for polyester resin and beige for vinyl ester resin. Applications for glass fiber reinforced polyester and vinyl ester resin cable tray systems include some corrosive atmospheres and where non-conductive material is required.

Cable Tray Memberships

NEMA 5FG Fiberglass Section
NEMA 5VE Metallic Section
Cable Tray Institute

Cable Tray Fabrication Locations

- Troy, Illinois
- Norcross, Georgia
- Reno, Nevada
- Roswell, New Mexico

Cooper B-Line®

B-Line®



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The information contained herein has been carefully checked for accuracy and is believed to be correct and current. No warranty, either expressed or implied, is made as to either its applicability to, or its compatibility with, specific requirements, of this information, nor for damages consequent to its use. All design characteristics, specifications, tolerances and similar information are subject to change without notice.

Technical Data

Corrosion Guide

The information shown in this corrosion guide is based on full immersion laboratory tests and data generated from resin manufacturer's data. It should be noted that in some of the environments listed, splashes and spill situations may result in a more corrosive situation than indicated due to the evaporation of water. Regular wash down is recommended in these situations.

All data represents the best available information and is believed to be correct. The data should not be construed as a warranty of performance for that product as presented in these tables. User tests should be performed to determine suitability of service if there is any doubt or concern. Such variables as concentration, temperature, time and combined chemical effects of mixtures of chemicals make it impossible to specify the exact suitability of fiber reinforced plastics in all environments. B-Line will be happy to supply material samples for testing. These recommendations should only be used as a guide and B-Line does not take responsibility for design or suitability of materials for service intended. In no event will B-Line be liable for any consequential or special damages for any defective material or workmanship including without limitation, labor charge, other expense or damage to properties resulting from loss of materials or profits or increased expenses of operations.

CHEMICAL ENVIRONMENT	POLYESTER		VINYL ESTER	
	Max Wt. %	Max Oper. Temp °F	Max Wt. %	Max Oper. Temp °F
Acetic Acid	10	190	10	210
Acetic Acid	50	125	50	180
Acetone	N/R	N/R	100	75
Aluminum Chloride	SAT	170	SAT	200
Aluminum Hydroxide	SAT	160	SAT	170
Aluminum Nitrate	SAT	150	SAT	170
Aluminum Sulfate	SAT	180	SAT	200
Ammonium Chloride	SAT	170	SAT	190
Ammonium Hydroxide	1	100	10	150
Ammonium Hydroxide	28	N/R	28	100
Ammonium Carbonate	N/R	N/R	SAT	150
Ammonium Bicarbonate	15	125	SAT	130
Ammonium Nitrate	SAT	160	SAT	190
Ammonium Persulfate	SAT	N/R	SAT	150
Ammonium Sulfate	SAT	170	SAT	200
Amyl Alcohol	ALL	N/R	ALL	90
Amyl Alcohol Vapor	-	140	-	120
Benzene	N/R	N/R	100	140
Benzene Sulfonic Acid	25	110	SAT	200
Benzoic Acid	SAT	150	SAT	200
Benzoyl Alcohol	100	N/R	100	N/R
Borax	SAT	170	SAT	200
Calcium Carbonate	SAT	170	SAT	200
Calcium Chloride	SAT	170	SAT	200
Calcium Hydroxide	25	70	25	165
Calcium Nitrate	SAT	180	SAT	200
Calcium Sulfate	SAT	180	SAT	200
Carbon Disulfide	N/R	N/R	N/R	N/R
Carbonic Acid	SAT	130	SAT	180
Carbon Dioxide Gas	-	200	-	200
Carbon Monoxide Gas	-	200	-	200
Carbon Tetrachloride	N/R	N/R	100	75
Chlorine, Dry Gas	-	140	-	170
Chlorine, Wet Gas	-	N/R	-	180
Chlorine Water	SAT	80	SAT	180

CHEMICAL ENVIRONMENT	POLYESTER		VINYL ESTER	
	Max Wt. %	Max Oper. Temp °F	Max Wt. %	Max Oper. Temp °F
Chromic Acid	5	70	10	120
Citric Acid	SAT	170	SAT	200
Copper Chloride	SAT	170	SAT	200
Copper Cyanide	SAT	170	SAT	200
Copper Nitrate	SAT	170	SAT	200
Crude Oil, Sour	100	170	100	200
Cyclohexane	N/R	N/R	N/R	N/R
Cyclohexane, Vapor	ALL	100	ALL	130
Diesel Fuel	100	160	100	180
Diethyl Ether	N/R	N/R	N/R	N/R
Dimethyl Phthalate	N/R	N/R	N/R	N/R
Ethanol	50	75	50	90
Ethyl Acetate	N/R	N/R	N/R	N/R
Ethylene Chloride	N/R	N/R	N/R	N/R
Ethylene Glycol	100	90	100	200
Fatty Acids	SAT	180	SAT	200
Ferric Chloride	SAT	170	SAT	200
Ferric Nitrate	SAT	170	SAT	200
Ferric Sulfate	SAT	170	SAT	200
Ferrous Chloride	SAT	170	SAT	200
Fluoboric Acid	N/R	N/R	SAT	165
Fluosilicic Acid	N/R	N/R	SAT	70
Formaldehyde	50	75	50	100
Formic Acid	N/R	N/R	50	100
Gasoline	100	80	100	150
Glucose	100	170	100	200
Glycerine	100	150	100	200
Heptane	100	110	100	120
Hexane	100	90	100	130
Hydrobromic Acid	50	120	50	120
Hydrochloric Acid	10	150	10	200
Hydrochloric Acid	20	140	20	190
Hydrochloric Acid	37	75	37	95
Hydrofluoric Acid	N/R	N/R	15	80
Hydrogen Bromide, Dry	100	190	100	200

-: No Information Available

N/R: Not Recommended

SAT: Saturated Solution

FUM: Fumes

Corrosion Guide

CHEMICAL ENVIRONMENT	POLYESTER		VINYL ESTER	
	Max Wt. %	Max Oper. Temp °F	Max Wt. %	Max Oper. Temp °F
Hydrogen Bromide, Wet	100	75	100	130
Hydrogen Chloride	-	120	-	200
Hydrogen Peroxide	5	100	30	100
Hydrogen Sulfide, Dry	100	170	100	210
Hydrogen Sulfide, Wet	100	170	100	210
Hypochlorous Acid	20	80	20	150
Isopropyl Alcohol	N/R	N/R	15	80
Kerosene	100	140	100	180
Lactic Acid	SAT	170	SAT	200
Lead Acetate	SAT	170	SAT	200
Lead Chloride	SAT	140	SAT	200
Lead Nitrate	SAT	-	SAT	200
Linseed Oil	100	150	100	190
Lithium Chloride	SAT	150	SAT	190
Magnesium Carbonate	SAT	140	SAT	170
Magnesium Chloride	SAT	170	SAT	200
Magnesium Hydroxide	SAT	150	SAT	190
Magnesium Nitrate	SAT	140	SAT	180
Magnesium Sulfate	SAT	170	SAT	190
Mercuric Chloride	SAT	150	SAT	190
Mercurous Chloride	SAT	140	SAT	180
Methyl Ethyl Ketone	N/R	N/R	N/R	N/R
Mineral Oils	100	170	100	200
Monochlorobenzene	N/R	N/R	N/R	N/R
Naphtha	100	140	100	170
Nickel Chloride	SAT	170	SAT	200
Nickel Nitrate	SAT	170	SAT	200
Nickel Sulfate	SAT	170	SAT	200
Nitric Acid	5	140	5	150
Nitric Acid	20	70	20	100
Oleic Acid	100	170	100	190
Oxalic Acid	ALL	75	ALL	120
Paper Mill Liquors	-	100	-	120
Perchloroethylene	100	N/R	100	N/R
Perchloric Acid	N/R	N/R	10	150
Perchloric Acid	N/R	N/R	30	80
Phosphoric Acid	10	160	10	200
Phosphoric Acid	100	120	100	200
Potassium Aluminum Sulfate	SAT	170	SAT	200
Potassium Bicarbonate	50	80	50	140
Potassium Carbonate	10	N/R	10	120
Potassium Chloride	SAT	170	SAT	200
Potassium Dichromate	SAT	170	SAT	200

CHEMICAL ENVIRONMENT	POLYESTER		VINYL ESTER	
	Max Wt.	Max Oper. Temp °F	Max Wt. %	Max Oper. Temp °F
Potassium Hydroxide	N/R	N/R	25	150
Potassium Nitrate	SAT	170	SAT	200
Potassium Permanganate	100	80	100	210
Potassium Sulfate	SAT	170	SAT	200
Propylene Glycol	ALL	170	ALL	200
Phthalic Acid	-	-	SAT	200
Sodium Acetate	SAT	160	SAT	200
Sodium Benzoate	SAT	170	SAT	200
Sodium Bicarbonate	SAT	160	SAT	175
Sodium Bisulfate	ALL	170	ALL	200
Sodium Bromide	ALL	170	ALL	200
Sodium Carbonate	10	80	35	160
Sodium Chloride	SAT	170	SAT	200
Sodium Cyanide	SAT	170	SAT	200
Sodium Hydroxide	N/R	N/R	50	150
Sodium Hydroxide	N/R	N/R	25	80
Sodium Hypochloride	N/R	N/R	10	150
Sodium Monophosphate	SAT	170	SAT	200
Sodium Nitrate	SAT	170	SAT	200
Sodium Sulfate	SAT	170	SAT	200
Sodium Thiosulfate	ALL	100	ALL	120
Stannic Chloride	SAT	160	SAT	190
Styrene	N/R	N/R	N/R	N/R
Sulfated Detergent	0/50	170	0/50	200
Sulfur Dioxide	100	80	100	200
Sulfur Trioxide	100	80	100	200
Sulfuric Acid	93	N/R	93	N/R
Sulfuric Acid	50	N/R	50	180
Sulfuric Acid	25	75	25	190
Sulfurous Acid	SAT	80	N/R	N/R
Tartaric Acid	SAT	170	SAT	200
Tetrachloroethylene	N/R	N/R	FUM	75
Toluene	N/R	N/R	N/R	N/R
Trisodium Phosphate	N/R	N/R	SAT	175
Urea	SAT	130	SAT	140
Vinegar	100	170	100	200
Water, Distilled	100	170	100	190
Water, Tap	100	170	100	190
Water, Sea	SAT	170	SAT	190
Xylene	N/R	N/R	N/R	N/R
Zinc Chloride	SAT	170	SAT	200
Zinc Nitrate	SAT	170	SAT	200
Zinc Sulfate	SAT	170	SAT	200

Technical Data

- : No Information Available

N/R: Not Recommended

SAT: Saturated Solution

FUM: Fumes

Technical Data

Load Data

Effect of Temperature

Strength properties of reinforced plastics are reduced when continuously exposed to elevated temperatures. Working loads shall be reduced based on the following:

Temperature in Degrees F	Approximate Percent of Strength
75	100
100	90
125	78
150	68
175	60
200	52

NEMA Standard 8-10-1986
If unusual temperature conditions exist, the manufacturer should be consulted.
Authorized Engineering information 8-20-1986

Cable Tray Performance Standards & Class Designations

After all anticipated loads are calculated they should be added together to obtain a working load. (Example: Working Load = Cable + Concentrated + Wind) see page 6. This working load should be used, along with the maximum support spacing, to select a span/load designation from Table 1. The selected load/span designation can be used to specify your requirement. Should a 20C with a safety factor of 1.5 not be adequate, change to a safety factor of 2 or decrease support span.

Table 1

Load kg/m (lb/ft)	Span, m (ft)				
	2.4 (8)	3.0 (10)	3.7 (12)	4.9 (16)	6.0 (20)
37 (25)	—	A	—	—	—
67 (45)	—	—	—	—	D
74 (50)	8A	—	12A	16A	20A
97 (65)	—	C	—	—	—
112 (75)	8B	—	12B	16B	E or 20B
149 (100)	8C	—	12C	16C	20C
179 (120)	—	D	—	—	—
299 (200)	—	E	—	—	—

Typical Properties of Pultruded Components

B-Line Fiberglass Cable Tray systems are manufactured from glass fiber-reinforced plastic shapes that meet ASTM E-84, Smoke Density rating for polyester of 680, for vinyl ester 1025, Class 1 Flame Rating and self-extinguishing requirements of ASTM D-635. A surface veil is applied during pultrusion to insure a resin-rich surface and ultraviolet resistance.

Flame Resistance (FTMS 406-2023) ign/burn, seconds	75/75
Intermittent Flame Test (HLT-15), rating	100
Flammability Test (ASTM D635) Ignition Burning Time	none 0 sec.

Properties	Test Method	Unit/ Value	3" & 4" Cable Tray, Cable Channel		6" Cable Tray	
			Longitudinal	Transverse	Longitudinal	Transverse
Tensile Strength	ASTM D638	psi	30,000	7,000	40,000	4,500
Tensile Modulus	ASTM D638	psi x 10 ⁶	2.5	.8	3.2	.6
Flexural Strength	ASTM D790	psi	30,000	10,000	40,000	10,000
Flexural Modulus	ASTM D790	psi x 10 ⁶	1.6	.8	2.1	.8
Izod Impact	ASTM D256	ft - lbs/in	28	4	28	4
Compressive Strength	ASTM D695	psi	30,000	15,000	40,000	10,000
Compressive Modulus	ASTM D695	psi x 10 ⁶	2.5	1.0	3.2	.7
Barcol Hardness	ASTM D2583	-	45	45	45	45
Sheer Strength	ASTM D732	psi	5,500	5,500	5,500	5,500
Density	ASTM D1505	lbs/in ³	.058-.062	-	.072 - .076	-
Coefficient of Thermal Expansion	ASTM D696	in/in/°F	5.0 x 10 ⁻⁶	-	5.0 x 10 ⁻⁶	-
Water Absorption	ASTM D570	Max %	0.5	-	0.5	-
Dielectric Strength	ASTM D149	V/mil (vpm)	200	-	200	-
Flammability Classification	UL94	VO	-	-	-	-
Flame Spread	ASTM E-84	20 Max	-	-	-	-

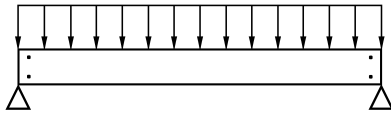
Structural Characteristics of Cable Tray and Supports

When viewed in its installed condition, any cable tray system performs functionally as a beam under a uniformly distributed load. There are four basic beam configurations typically found in a cable tray installation. All four types of beams support cable tray but each differ in the way that the beam is attached to the support.

The first two beam configurations, simple and continuous, apply to the cable tray itself. The second two beam configurations, cantilever and fixed, apply more to the cable tray supports than to the cable tray itself.

Simple Beam

A good example of simple beam is a single straight section of cable tray supported but not fastened at either end. When the tray is loaded the cable tray is allowed to deflect.



Simply beam analysis is used almost universally for beam comparisons even though it is seldom practical in field installations. The three most prominent reasons for using a simple beam analysis are: calculations are simplified; it represents the worst case loading; and testing is simple and reliable. The published load data in the B-Line cable tray catalog is based on the simple beam analysis per NEMA Standard FG-1.

Standard B-Line Label

WARNING!

Do Not Use As A Walkway, Ladder,
Or Support For Personnel.

Use Only As A Mechanical Support For Cables, Tubing and Raceways

Catalog Number:
(and description)

Shipping Ticket: 8062-5555

Minimum Area: 000 SQ. IN.

Purchase order: 11198

Mark Number: 11198

Max Load/Span (Class):

VENTILATED
Reference File #LR36026

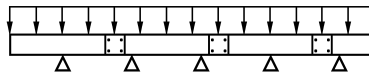
B-Line®

30781011477135

Continuous Beam

Continuous beam is the beam configuration most commonly used in cable tray installations. An example of this configuration is where cable trays are installed across several supports to form a number of spans. The continuous beam possesses traits of both the simple and fixed beams.

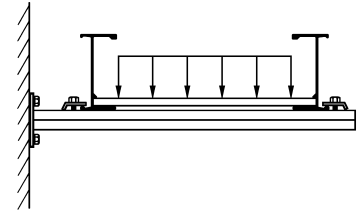
When equal loads are applied to all spans simultaneously, the counterbalancing effect of the loads on both sides of a support restricts the movement of the cable tray at the support. The effect is similar to that of a fixed beam. The end spans behave substantially like simple beams. When cable trays of identical design are compared, continuous beam installations will typically have approximately half the deflection of a simple beam of the same span. Therefore, simple beam data should be used for a general comparison only.



Cantilever Beam

A cantilever beam configuration occurs when one end of the beam is rigidly attached to the support and the other end is unsupported. This type of configuration is typically used when wall mounting a bracket to support cable tray. Since one end is unsupported,

the cantilever beam will hold considerably less load than a comparable simple beam.

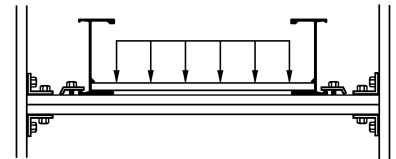


Technical Data

Fixed Beam

A fixed beam configuration has both ends of the beam rigidly attached to the supports. A good example of a fixed beam is the rung of a cable tray. By attaching the ends of the rung to the side rails, the ends are not free to move, bend or twist. This restriction in end movement effectively increases the load carrying capacity of the member.

Fixed beam configurations are also typically found in strut rack type support systems. These types of racks are found extensively in tunnel applications for support of pipe and cable tray.



Warning! Walkways

It should be noted that cable tray is designed as a support for power or control cables, or both and is not intended or designed to be a walkway for personnel, the user is urged to display appropriate warnings cautioning against the use of this support as a walkway. The following language is suggested:

WARNING! Not to be used as a walkway, ladder or support for personnel. To be used only as a mechanical support for cables and tubing.

Technical Data

Structural Characteristics of Cable Tray and Supports

Cable Loads

The cable load is simply the total weight of all the cables to be placed in the tray. This load should be expressed in lbs./ft.

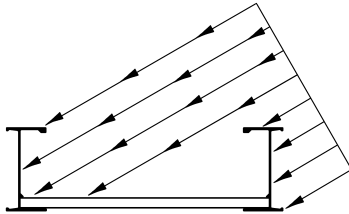
Concentrated Loads

A concentrated static load represents a static weight applied between the side rails. Tap boxes, conduit attachments and long cable drops are just some of the many types of concentrated loads. When so specified, these concentrated static loads may be converted to an equivalent, uniform load (W_e) in pounds per linear foot by using the following formula:

$$W_e = \frac{2x \text{ (concentrated static load)}}{\text{span length (ft.)}}$$

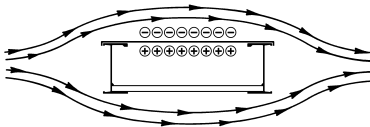
Wind Loads

Wind loads need to be determined for all outdoor cable tray installations. Most outdoor cable trays are ladder type trays, therefore the



Detail 1

most severe loading to be considered is pressure on the tray side rails (see Detail 1). When covers are installed on outdoor cable trays, another factor to be considered is the aerodynamic effect which can produce a lift strong enough to separate a cover from a tray. Wind moving across a covered tray (see Detail 2) creates a positive pressure inside the tray and a negative pressure above the cover. This pressure difference can lift the cover off the tray.



Detail 2

B-Line recommends the use of heavy duty wrap-around cover clamps when covered trays are installed in an area where strong winds occur.

Ice Loads

Glaze ice is the most commonly seen form of ice build-up. It is the result of rain or drizzle freezing on impact with an exposed object. Generally, only the top surface (or the cover) and the windward side of a cable tray system is significantly coated with ice. The maximum design load to be added due to ice should be determined from local and federal weather bureau information.

Snow Loads

Snow is measured by density and thickness. The density of snow varies almost as much as its thickness. The additional design load from snowfall should be determined using local snowfall records which can be obtained from local and federal weather bureaus.

Seismic Loads

In recent years a great deal of testing and evaluation of cable tray systems, and their supports, has been performed. The conclusions reached from these evaluations have shown the cable tray/strut support system exhibited more seismic capacity than originally expected. One of the factors contributing to this is the energy dissipating motion of the cables within the tray. Another factor is the high degree of ductility of the cable tray and the support material. These factors, working in conjunction with a properly designed cable tray system, should afford reasonable assurance to withstand even strong motion earthquakes. Please consult the factory with your specific seismic specifications and request a seismic brochure.

Splices

A lot of attention has been given to the strength of the side rails. These load bearing side rails must be spliced to form a continuous system, therefore the design of the splice plate is very important. The splice plate needs to be both strong and simple to install. These characteristics have been designed into B-Line's splice plates.

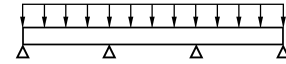
B-Line's new high strength "L" shaped LAY-IN splice plate offers several advantages:

- 1) stronger than flat plate splices.
- 2) time saving - holds tray in position before fasteners are inserted.
- 3) provides base for an expansion splice to function - no vertical binding.
- 4) discourages splice on support-positioning, over the support is the worst place to splice - Fig 3.

The location of splices in a continuous span cable tray system is also very important. The splices should be located at points of minimum stress whenever practical. NEMA standards FG-1 limits the use of splice plates as follows:

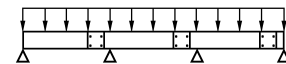
Unspliced straight sections should be used on a simple span and on end spans of continuous runs. Straight section lengths should be equal to or greater than the span length to ensure not more than one splice between supports. See Figures 1 through 3 for examples on splicing configurations.

Typical Continuous Span Configuration
Figure 1



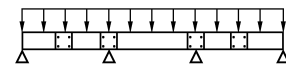
- + Maximum positive moment
- Maximum negative moment

Preferred Splice Plate Locations
Figure 2



- Preferred splice location:
- 1/4 span

Undesirable Splice Plate Locations
Figure 3



- Undesired location:
- over supports
 - mid spans

Cable Tray Thermal Contraction and Expansion

It is important that thermal contraction and expansion be considered when installing cable tray systems. The length of the straight cable tray runs and the temperature differential govern the number of expansion splice plates required (see Table 1 below).

The cable tray should be anchored at the support nearest to its midpoint between the expansion splice plates and secured by expansion guides at all other support locations (see Figure 1). The cable tray should be permitted longitudinal movement in both directions from that fixed point.

Accurate gap settings at the time of installation is necessary for the proper operation of the expansion splice plates. The following procedure should assist the installer in determining the correct gap: (see Figure 2)

- 1 Plot the highest expected tray temperature on the maximum temperature line.
- 2 Plot the lowest expected tray temperature on the minimum temperature line.
- 3 Draw a line between the maximum and minimum points.
- 4 Plot the tray temperature at the time of installation to determine the gap setting.

X : Denotes hold-down clamp (anchor) at support.
 - : Denotes expansion guide clamp at support.

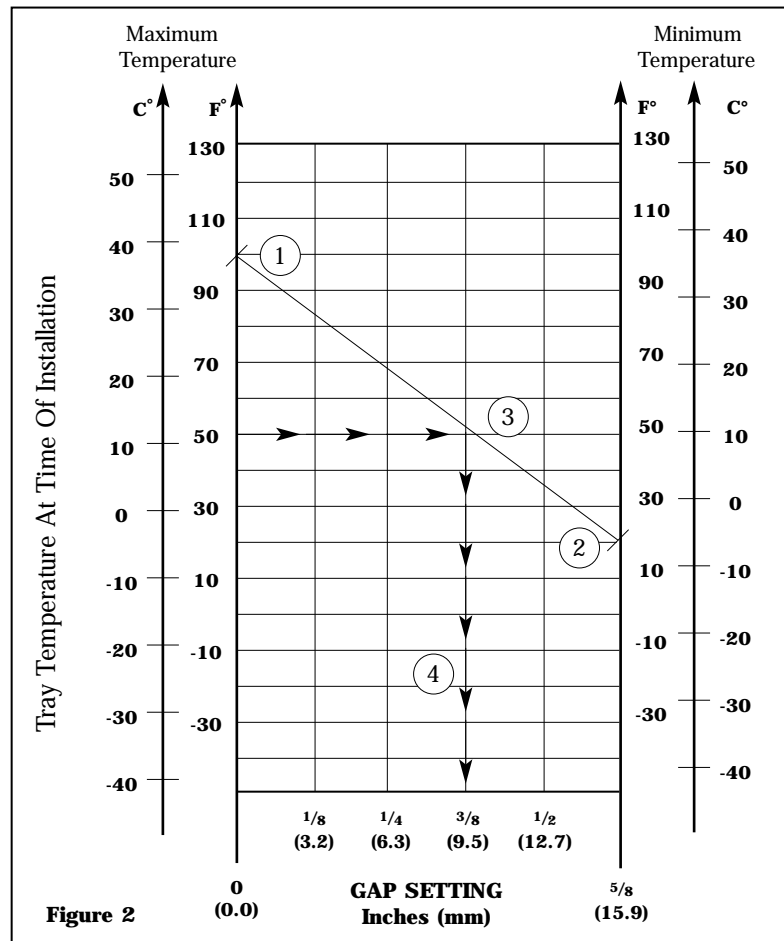
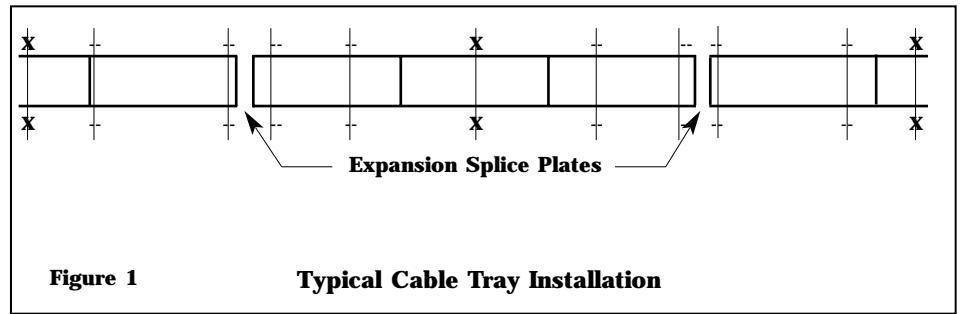


Table 1

Expansion or Contraction for Various Temperature Differences		
Temperature Differential °F (°C)	Cable Tray Length for 1" Expansion	Tray Length for Each Expansion Connector*
25 (-4)	667 Feet (203.3m)	417 Feet (127.1m)
50 (10)	333 Feet (101.5m)	208 Feet (63.4m)
75 (24)	222 Feet (67.6m)	139 Feet (42.3m)
100 (38)	167 Feet (50.9m)	104 Feet (31.7m)
125 (51)	133 Feet (40.5m)	83 Feet (25.3m)
150 (65)	111 Feet (33.8m)	69 Feet (21.0m)
175 (79)	95 Feet (28.9m)	59 Feet (18.0m)

Note for gap set and hold down/guide location, see installation instruction above.

*1" (25.4mm) slotted holes in each expansion connector allow 5/8" (15.9mm) total expansion or contraction.

Authorized Engineering Information 8-20-1986

Technical Data

Cable Tray Installation Guide

Installation of B-Line fiberglass cable tray should be made in accordance with the standards set by NEMA Publication VE-2, Cable Tray Installation Guide, and National Electrical Code, Article 318.

- Always observe common safety practices when assembling tray and fittings. Installations generally require some field cutting. Dust created during fabrication presents no serious health hazard, but skin irritation may be experienced by some workers.
- Operators of saws and drills should wear masks, long sleeve shirts or coveralls.
- Fabrication with fiberglass is relatively easy and comparable to working with wood. Ordinary hand tools may be used in most cases.
- Avoid excessive pressure when sawing or drilling. Too much force can rapidly dull tools and also produce excessive heat which softens the bonding resin in the fiberglass resulting in a ragged edge rather than a clean-cut edge.
- Field cutting is simple and can be accomplished with a circular power saw with an abrasive cut-off wheel (masonry type) or hack saw (24 to 32 teeth per inch).
- Drill fiberglass as you would drill hard wood. Standard twist drills are more than adequate.
- Any surface that has been drilled, cut, sanded or otherwise broken, **must be sealed** with a compatible resin. (see page 43)
- Carbide tipped saw blades and drill bits are recommended when cutting large quantities.
- Support the fiberglass material firmly during cutting operations to keep material from shifting which may cause chipping at the cut edge.
- Each tray section length should be equal to or greater than the support span.
- When possible, the splice should be located at quarter span.
- Fittings should be supported as per NEMA FG-1.

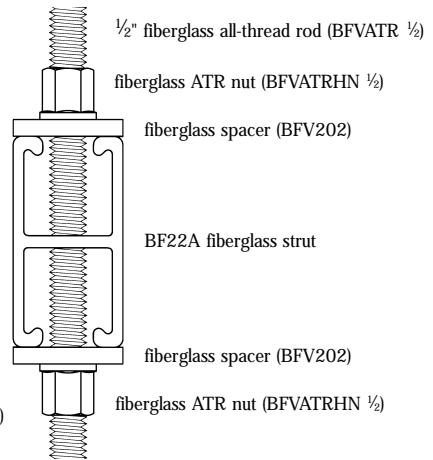
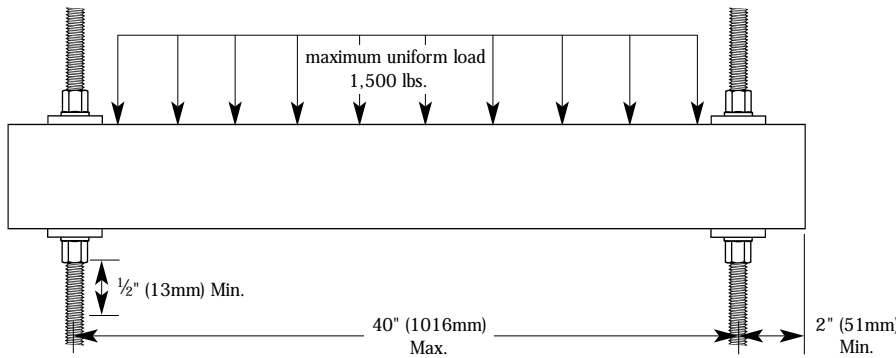
Recommended Fiberglass Trapeze Hanging Systems

Notes:

- 1) A snug three to four ft.-lbs. torque is sufficient for all thread rod nuts.
- 2) When supporting cable tray, the spacing between each trapeze should not exceed the distance between splice plates.
- 3) When hanging from beam, B-Line BFPU751 series clamps provide extra thread engagement necessary for load ratings. All thread rod must be fully engaged in the clamp.
- 4) Design load safety factor is 3:1

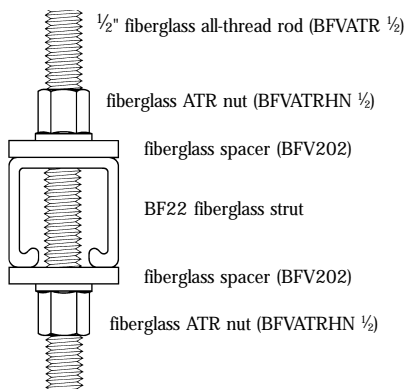
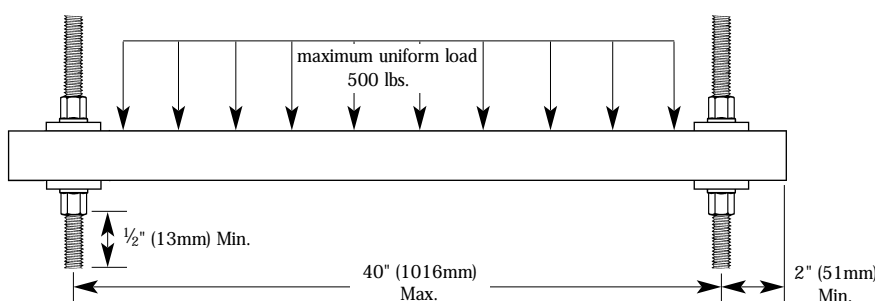
BF22A Strut:

2" max between material being supported and rod



BF22 Strut:

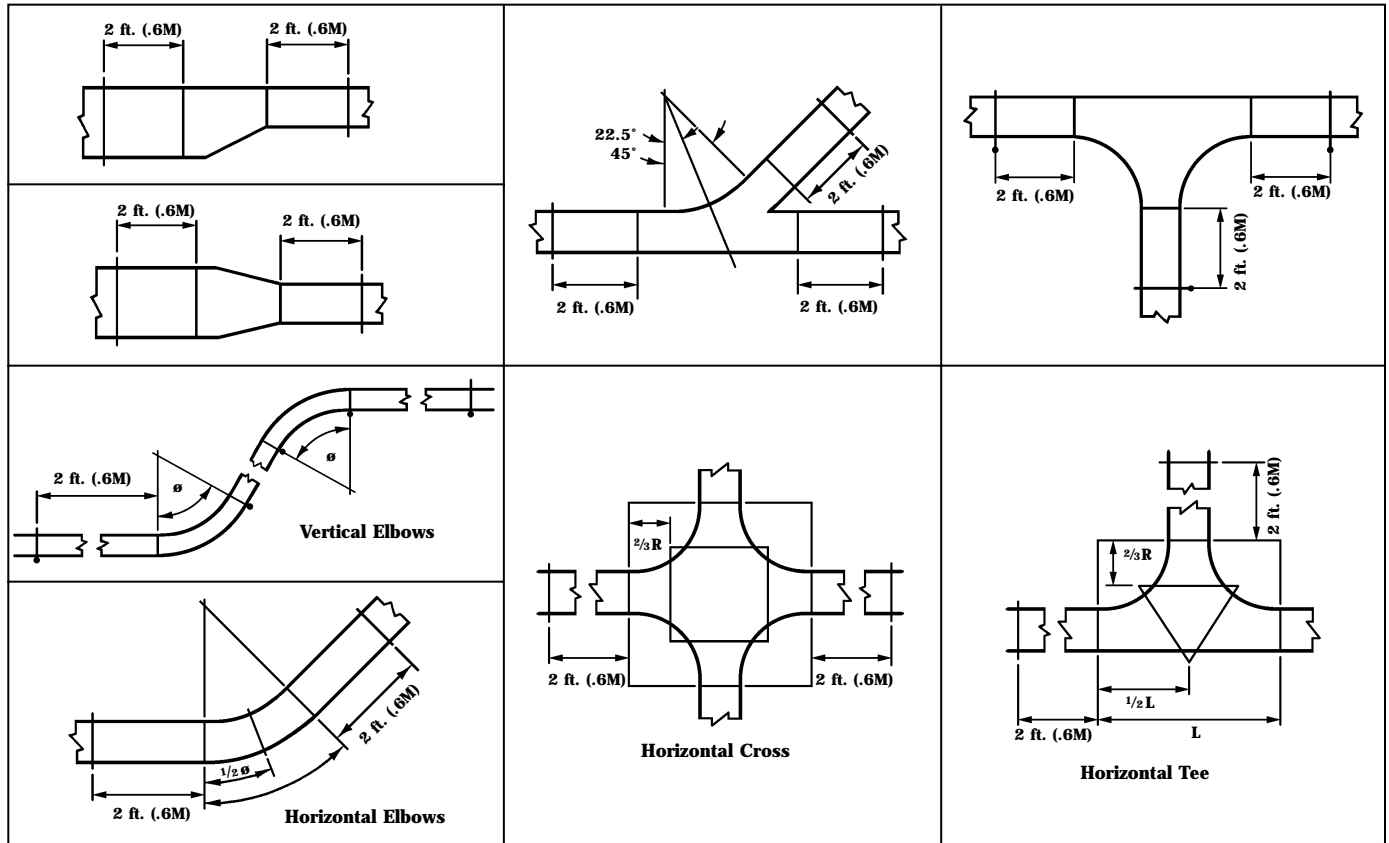
2" max between material being supported and rod



Note: For vinyl ester resin, 'V' must be added appropriately to part number. Example: BFV22A.

Cable Tray Support Locations for Fittings

per NEMA VE-2 Installation Guide



Technical Data

$\theta = 30^\circ, 45^\circ, 60^\circ, 90^\circ$

How To Size Cable Tray

Based on the National Electrical Code - 1993, Section 318

The National Electrical Code Article 318 was written primarily for verifying the cable fill in cable trays but little has been done to convert this information into a design procedure.

In the development of a complete cable tray support system, B-Line established a simple method of determining the right size tray to support any given amount of cables. The following tables cover our method for determining cable tray widths based on tray design and system voltage.

Table I

Table I is subdivided into two categories covering electrical service of 2000 volts or less. The first, Category A, is for any mixture of power or lighting cables with any mixture of control or signal cables. Category B is used when control and/or signal cables only are being used.

Control Circuit - the circuit of a control apparatus or system that carries the electric signals directing the performance of the controller, but does not carry the main power (NEC Article 100).

Signaling Circuit - any electric circuit that energizes signaling equipment (NEC Article 100).

Table II

Table II has only one category of electrical service and that is 2001 volts and over for types MV and MC cables both single and multiconductor. Type MV is a single or multiconductor solid dielectric insulated cable rated 2001 volts or higher (NEC Article 326).

Type MC cable is a factory assembly of one or more conductors, each individually insulated and enclosed in a metallic sheath or interlocking tape, or a smooth or corrugated tube (NEC Article 334).

Cables other than Types MV and MC can be installed provided they are "specifically approved for installation in cable trays."

Table III

Table III covers 3, 4 and 6 inch ventilated cable channels.

Tray Sizing Procedure		
Step 1. Select proper cable tray table below based on cable voltage and tray type.		
Cable Voltage	Cable Tray Type	Use:
2000 Volts or less	Ladder, Cable Tray	Table I
2001 Volts or more	Ladder, Cable Tray	Table II
2001 Volts or less	Cable Channel, ventilated	Table III

Technical Data

How To Size Cable Tray

Tables I - Ladder Cable Tray - for cables rated 2000 volts or less

For power or lighting or any mixture of power, lighting, control or signal cables:

1. Multiconductor Cable

Conductor sizes 4/0 and larger*	tray width \geq Sd	NEC 318-9(a) (1)
Conductor sizes 3/0 and smaller	tray width \geq 0.857 Sa	NEC 318-9(a) (2)

Example: Calculate width of cable tray required for the following Type TC Cables.

6	4/c	500 kcmil	Power:	Diameter = 3.14	6 x 3.14 = 18.84
21	4/c	#8 AWG	Lighting:	Area = 0.407	.857 (21 x 0.407) = 7.32
20	5/c	#12 AWG	Control:	Area = 0.170	.857 (20 x 0.170) = 2.91
					29.07

Solution: Use 30 inch wide tray

2. Single Conductor Cable

Conductor sizes 250 MCM thru 900 MCM† only	tray width \geq 0.023 Sa*	NEC 318-10(a) (2)
Conductor sizes 3/0 and smaller	tray width \geq 0.857 Sa	NEC 318-10(a) (4)

Example: Calculate width of cable tray required for the following Type THW Wires.

6	1/c	4/0 AWG	Power:	Diameter = 0.710	(6 x 0.71) = 4.26
9	1/c	500 kcmil	Power:	Area = 0.83	.923 (9 x 0.83) = 6.89
6	1/c	250 kcmil	Power:	Area = 0.49	.923 (6 x 0.49) = 2.71
					13.86

Solution: Use 18 inch wide tray

3. Mixture of Single and Multiconductor Cable

Example: Calculate width of cable tray required for the following mix of cables. Use guidelines from (1) & (2) above.

2	3/c	250 kcmil	Type MC	Power:	Diameter = 1.84	2 x 1.84 = 3.68
12	4/c	#8 AWG	Type TC	Lighting:	Area = 0.41	.857 (12 x 0.41) = 4.22
60	4/c	#12 AWG	Type TC	Control:	Area = 0.12	.857 (60 x 0.12) = 6.17
4	1/c	1/0AWG	Type THW	Power:	Diameter = 0.55	(4 x 0.55) = 2.20
6	1/c	500kc mil	Type THW	Power:	Area = 0.83	.923 (6 x 0.83) = 4.60
					20.87	

Solution: Use 24 inch wide tray

For control and/or signal duty cable only:

1. Multiconductor Cable

$$\text{tray width} \geq \frac{2Sa}{D} \quad \text{NEC 318-9(b)}$$

All conductor sizes**

Example: Calculate width of cable tray required for the following Type TC Cables in 4 inch deep tray.

24	16/c	16 AWG	Control:	Area = 0.29	2(24 x 0.29) ÷ 4 = 3.48
42	4/c	12 AWG	Control:	Area = 0.13	2(42 x 0.13) ÷ 4 = 2.73
18	4/c	10 AWG	Control:	Area = 0.20	2(18 x 0.20) ÷ 4 = 1.80
					8.01

Solution: Use 24 inch wide tray

* The 4/0 and larger cable shall be installed in a single layer and no other cables shall be placed on them.

** For computation only depth D can not exceed 6 inches.

† For 1000 MCM and larger single conductor cable, refer to NEC 318-10(a)1 for sizing information.

Sd = the sum of the diameters, in inches, of all cables in the same ladder cable tray.

Sa = the sum of the cross-sectional areas, in square inches, of all cables in the same ladder cable tray.

How To Size Cable Tray

Table II - Ladder - for cables rated 2000 volts or less

For MV or MC cables:

1. Mixture of Single and Multiconductor Cable

NEC 318-12

All conductor sizes†		tray width \geq Sd			
Example: Calculate width of cable tray required for the following cables.					
4	1/c	500 kcmil	Type MV	Diameter = 1.05	4 x 1.05 = 4.20
10	3/c	2/0 AWG	Type MC	Diameter = 1.55	10 x 1.55 = 15.50
4	3/c	4/0 AWG	Type MV	Diameter = 1.78	4 x 1.78 = 7.12
					26.82

Solution: Use 30 inch wide tray

Table III - Cable Channel, Ventilated - for cables rated 2000 volts or less

For power, lighting, control and/or signal duty cables:

1. Multiconductor Cable (all size cables)

NEC 318-9(E)

	3 inch wide	4 inch wide	6 inch wide
One cable only	Sa \leq 2.3 in ²	Sa \leq 4.5 in ²	Sa \leq 7.0 in ²
Two or more cables	Sa \leq 1.3 in ²	Sa \leq 2.5 in ²	Sa \leq 3.8 in ²

Example: Calculate width of cable channel required for the following Type TC Cables.

1	3/c	1/0 AWG	Area = 1.17 which is less than 1.3. Use 3 inch wide.
1	4/c	300 kcmil	Area = 3.77 which is less than 4.5. Use 3 inch wide.
6	4/c	#10 AWG	Area = 6 x 0.20 = 1.20 which is less than 1.3. Use 3 inch wide.
2	3/c	1/0 AWG	Area = 2 x 1.17 = 2.34 which is less than 2.5. Use 4 inch wide.

2. Single Conductor (1/0 AWG or larger)

NEC 318-10(b)

	3 inch wide	4 inch wide	6 inch wide
Any number of cables	Sd \leq 3.0	Sd \leq 4.0	Sd \leq 6.0

Example: Type THW Cables.

3	1/c	500 kcmil	Type THW	Diameter = 3 x 1.029 = 3.09 which is less than 4.0. Use 4 inch wide.
8	1/c	4/0 kcmil	Type THW	Diameter = 8 x 0.71 = 5.68 which is less than 6.0. Use 6 inch wide.

† Cables shall be installed in a single layer. Where single conductor cables are triplexed, quadruplexed or bound together in circuit groups, the sum of the diameters of the single conductors shall not exceed the cable tray width and these groups shall be installed in single layer arrangement.

Sd = the sum of the diameters, in inches, of all cables in the same ladder cable tray.

Sa = the sum of the cross-sectional areas, in square inches, of all cables in the same ladder cable tray.

Covers (Derating)

When cable trays are continuously covered for more than six feet with solid unventilated covers, the ampacity of the installed cables must be reduced per NEC-1993.

2000 volts or less

- MULTICONDUCTOR CABLES
 - use 95% of tables 310-16 and 310-18
- SINGLE CONDUCTOR CABLES
 - 600 MCM and larger use 70% of tables 310-17 and 310-19
 - 1/0 AWG thru 500 kc mil use 60% of tables 310-17 and 310-19

2001 volts and over

- MULTICONDUCTOR CABLES
 - use 95% of tables 310-75 and 310-76
- SINGLE CONDUCTOR CABLES
 - use 70% of tables 310-69 and 310-70

Cross-Sectional Area

Rarely is the cross-sectional area of a multiconductor cable given in manufacturers literature or the National Electrical Code. To calculate the cross-sectional area simply square the diameter and multiply by 0.7854. The diameter used in the calculations is the overall outside diameter (O.D.) of the cable including insulation and/or armor.

$$\text{Cross Sectional Area (Square Inches)} = 0.7854 (\text{O.D.})^2$$

Multipliers Used in Tables

The multipliers used in all tables are mathematical equivalents of Tables 318-9 and 318-10 of the National Electrical Code-1993.

An example can be found in column 1 of Table 318-9. The proportion of cable tray width (size inches) to allowable fill (seven square inches) is 0.857 for 3/0 and smaller multiconductor cables in ladder type trays. Therefore the product of 0.857 and the cross-sectional area of cables is the tray width.

Technical Data

Recommended Cable Tray Specifications

1.0 Cable Tray Design

- 1.1 Cable Tray Systems shall be made of straight sections, fittings and accessories as defined in the latest NEMA standards publication FG-1.

2.0 Cable Tray Design

- 2.1 Straight section structural elements; side rails, rungs and splice plates shall be pultruded from glass fiber reinforced polyester or vinyl ester resin.
- 2.2 Pultruded shapes shall be constructed with a surface veil to insure a resin-rich surface and ultraviolet resistance.
- 2.3 Pultruded shapes shall meet ASTM E-84, Class 1 flame rating and self-extinguishing requirements of ASTM D-635.

3.0 Construction

- 3.1 Straight section lengths will be 120 inches (10ft.) or 240 inches (20 ft.) standard.
- 3.2 Side rails will be inward "C" configuration and be predrilled to accept splice plates.
- 3.3 Loading depths for cable tray systems shall be 5", 3" or 2" as per NEMA FG-1 tolerances. Overall heights shall be 6", 4" or 3" respectively.
- 3.4 Loading classifications and test specimens shall be per NEMA FG-1.

3.5 Fittings

- 3.5.1 Molded fittings shall be formed with a minimum 3" tangent following the radius.
- 3.5.2 3" loading depth systems shall have 90° and 45° molded fittings in 12" or 24" radius.
- 3.5.3 5" loading depth systems shall have 90° and 45° molded fittings in 24" or 36" radius.
- 3.5.4 All fittings not included in 3.5.2 or 3.5.3 should be of mitered construction.
- 3.6 Width - usable inside tray width shall be 6", 9", 12", 18", 24", 30" or 36". Outside width shall not exceed inside by more than a total of 2".
- 3.7 Straight and expansion splice plates will be of "L" shaped lay-in design with an eight-bolt pattern in 5" fill systems and four-bolt pattern in 3" and 2" fill systems.
- 3.8 Dimension tolerances will be per NEMA FG-1.
- 3.9 Cable tray must have integral connection between side rails and rungs consisting of non-metallic mechanical fasteners and adhesive bonding.

4.0 Manufacture

- 4.1 All manufacturing practices will be in accordance with NEMA FG-1.
- 4.2 Cable trays shall be by B-Line Systems, Inc., or approved NEMA FG-1 member.