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. We will be happy to supply material samples for testing. These recommendations should only be used as a guide and we do not take responsibility for design or suitability of materials for service intended. In no event will we 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
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
Perchlorethylene	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

-: No Information Available N/R: Not Recommended SAT: Saturated Solution FUM: Fumes

Load Data

Fiberglass Cable Tray and Cable Channel are offered in three (3) versions for applications as follows:

Standard Series	Resin Type	Color	Meets
13F, 24F, 36F, 46F, 48F FCC-03, FCC-04, FCC-06, FCC-08	Fire Retardant Polyester	Gray	ASTM E-84 Class 1 - UL94 VO Good Corrosion Resistance in most environments
High Performance			
13FV, 24FV, 36FV, 46FV, 48FV FCCV-03, FCCV-04, FCCV-06, FCCV-08	Fire Retardant Vinyl Ester	Beige	ASTM E-84 Class 1 - UL94 VO Improved Corrosion Resistance For more severe environments Higher Heat Distortion Temperature

Effect of Temperature

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

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

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

Typical Properties of Pultruded Components

Eaton B-Line Division 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
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	-
Dielectic Strength	ASTM D149	V/mil (vpm)	200	-	200	-
Flammability Classification	UL94	VO	-	-	-	-
Flame Spread	ASTM E-84	20 Max	-	-	-	-

Expansion or Contraction for Various Temperature Differences

Temperature Differential	Cable Tray Length for 1" Expansion	Tray Length for Each Expansion Connector*
25°F (13.9°C)	667 Feet (203.3m)	417 Feet (127.1m)
50°F (27.8°C)	333 Feet (101.5m)	208 Feet (63.4m)
75°F (41.7°C)	222 Feet (67.6m)	139 Feet (42.3m)
100°F (55.6°C)	167 Feet (50.9m)	104 Feet (31.7m)
125°F (69.4°C)	133 Feet (40.5m)	83 Feet (25.3m)
150°F (83.3°C)	111 Feet (33.8m)	69 Feet (21.0m)
175°F (97.2°C)	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

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.

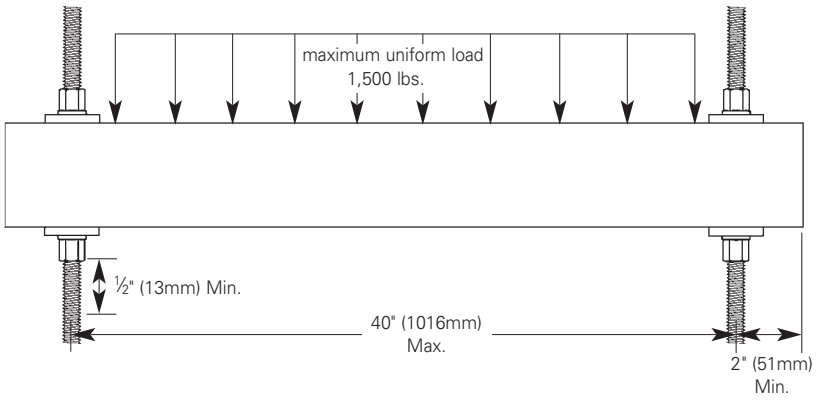
- Always observe common safety practices when assembling tray and fittings. Installations generally require some field cutting. Dust created during fabrication presents no serious health hazard, but skin irritation may be experienced by some workers.
- Operators of saws and drills should wear masks, 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 M-28)
- 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.

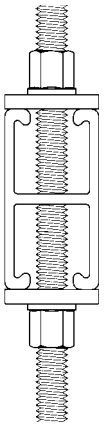
Recommended Fiberglass Trapeze Hanging Systems

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 series BFV751 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

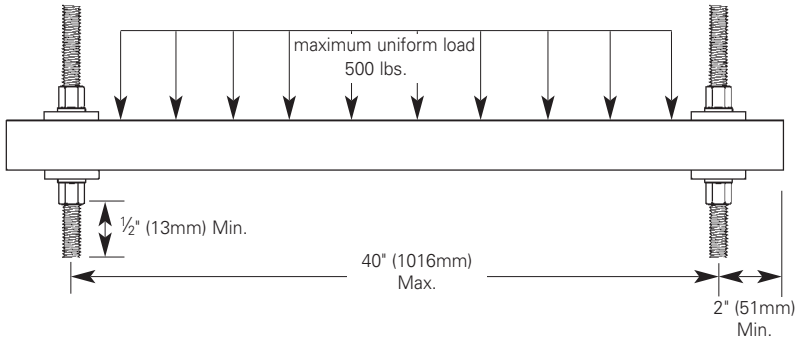
BF22A Strut: 2" max between material being supported and rod

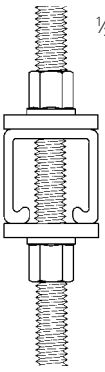




½" fiberglass all-thread rod (BFVATR ½)
fiberglass ATR nut (BFVATRHN ½)
fiberglass spacer (BFV202)
BF22A fiberglass strut
fiberglass spacer (BFV202)
fiberglass ATR nut (BFVATRHN ½)

BF22 Strut: 2" max between material being supported and rod





½" fiberglass all-thread rod (BFVATR ½)
fiberglass ATR nut (BFVATRHN ½)
fiberglass spacer (BFV202)
BF22 fiberglass strut
fiberglass spacer (BFV202)
fiberglass ATR nut (BFVATRHN ½)

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

SECTION 161xx
NON-METALLIC CABLE TRAY
POLYESTER, VINYL ESTER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete cable tray systems as shown on the drawings.

B. Cable tray systems are defined to include, but are not limited to straight sections of [ladder type] [vented bottom type] [solid bottom type] cable trays, bends, tees, elbows, drop-outs, supports and accessories.

1.02 REFERENCES

A. ANSI/NFPA 70 – National Electrical Code

B. NEMA FG 1-2002 – Non-Metallic Cable Tray Systems

C. NEMA VE 2-2002 – Cable Tray Installation Guidelines

1.03 DRAWINGS

A. The drawings, which constitute a part of these specifications, indicate the general route of the cable tray systems. Data presented on these drawings are as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification, of all dimensions, routing, etc., is directed.

B. Specifications and drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Contractor is directed to make field surveys as part of his work prior to submitting system layout drawings.

1.04 SUBMITTALS

A. Submittal Drawings: Submit drawings of cable tray and accessories including clamps, brackets, hanger rods, splice plate connectors, expansion joint assemblies, and fittings, showing accurately scaled components.

B. Product Data: Submit manufacturer's data on cable tray including, but not limited to, types, materials, finishes, rung spacings, inside depths and fitting radii. For side rails and rungs, submit cross sectional properties including Section Modulus (Sx) and Moment of Inertia (Ix).

1.05 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of cable trays and fittings of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. NEMA Compliance: Comply with NEMA Standards Publication Number FG-1, "Non-Metallic Cable Tray Systems".

C. NEC Compliance: Comply with NEC, as applicable to construction and installation of cable tray and cable channel systems (Article 318, NEC).

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver cable tray systems and components carefully to avoid breakage, denting and scoring finishes. Do not install damaged equipment.

B. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials should be unpacked and dried before storage.

continued on page M-8

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with these specifications, Eaton's B-Line series cable tray systems shall be as manufactured by Eaton.

2.02 CABLE TRAY SECTIONS AND COMPONENTS

A. General: Except as otherwise indicated, provide non-metallic cable trays, of types, classes, and sizes indicated; with splice plates, bolts, nuts and washers for connecting units. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features. Cable tray shall be installed according to the latest revision of NEMA VE 2.

B. Material and Finish: Straight section structural elements; side rails, rungs and splice plates shall be pultruded from glass fiber reinforced polyester resin, vinyl ester resin or dis-stat.

C. Pultruded shapes shall be constructed with a surface veil to insure a resin-rich surface and ultraviolet resistance.

D. Pultruded shapes shall meet ASTM E-84, Class 1 flame rating and self-extinguishing requirements of ASTM D-635.

2.03 TYPE OF TRAY SYSTEM

A. Ladder Cable Trays shall consist of two longitudinal members (side rails) with transverse members (rungs) mechanically fastened and adhesively bonded to the side rails. Rungs shall be spaced [6] [9] [12] inches apart. Rung spacing in radiused fittings shall be industry standard 9" and measured at the center of the tray's width. Each rung must be capable of supporting a 200 lb. concentrated load at the center of the cable tray with a safety factor of 1.5 (See following rung loading table).

B. Ventilated Bottom Cable Trays shall consist of two longitudinal members (side rails) with rungs spaced 4" apart.

C. Solid Bottom Cable Trays shall consist of two longitudinal members (side rails) with a solid sheet over rungs spaced on 12" centers.

D. Cable tray loading depth shall be [2] [3] [5] inches per NEMA FG 1.

E. Straight sections shall be supplied in standard [10 foot (3m)] [20 foot (6m)] lengths.

F. Cable tray inside widths shall be [6] [9] [12] [18] [24] [30] [36] inches or as shown on drawings. Outside width shall not exceed inside by more than a total of 2".

G. 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. Splice plates shall be furnished with straight sections and fittings.

H. All fittings must have a minimum radius of [12] [24] [36].

I. Fittings shall be of mitered construction.

J. Dimension tolerances will be per NEMA FG 1.

2.04 LOADING CAPACITIES

A. Cable trays shall meet NEMA class designation: [8C] [12C] [20B] [20C].

Or

A. Cable tray shall be capable of carrying a uniformly distributed load of _____ lbs./ft on a _____ foot support span with a safety factor of 1.5 when supported as a simple span and tested per NEMA VE 1 Section 5.2.

continued on page M-9

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install cable trays as indicated: Installation shall be in accordance with equipment manufacturer's instructions, and with recognized industry practices to ensure that cable tray equipment comply with requirements of NEC and applicable portions of NFPA 70B. Reference NEMA VE 2 for general cable tray installation guidelines.

B. Coordinate cable tray with other electrical work as necessary to properly integrate installation of cable tray work with other work.

C. Provide sufficient space encompassing cable trays to permit access for installing and maintaining cables.

D. Cable tray fitting supports shall be located such that they meet the strength requirements of straight sections. Install fitting supports per NEMA VE 2 guidelines, or in accordance with manufacturer's instructions.

3.02 TESTING

A. Upon request manufacturer shall provide test reports witnessed by an independent testing laboratory of the "worst case" loading conditions outlined in this specification and performed in accordance with the latest revision of NEMA FG 1.