NEMA STANDARDS
VE 1 – 1991
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CONTENTS

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Section 1

REFERENCED STANDARDS AND DEFINITIONS

1. REFERENCED STANDARDS

In this publication, reference is made to the standards listed below. Copies are available from the indicated source.

American National Standards Institute

11 West 42nd Street

New York, NY 10036

National Fire Protection Association

Batterymarch Park

Quinchy, MA 02269

ANSI/NFPA 70 – 93 National Electrical Code

American Society for Testing Materials

1916 Race Street

Philadelphia, PA 19103

A 123 – 89	Zinc (Hot – Dip Galvanized) Coatings on Iron and Steel Products, Specifications for
A 525 – 87	General requirements, Steel Sheet, Zinc – coated (Galvanized) by the Hot – Dip Process, Specificaitons for
B 633 – 8	Electrodeposited Coatings of Zinc on Iron and Steel, Specifications for
B 766 – 86	Electrodeposited Coatings of Cadmium, Specificatins for

2 . DEFINITIONS

Metallic Cable Tray System

An assembly of Cable tray straight sections, fittings and accessories that forms a rigid structural system to support cables

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Ladder Cable Tray

A prefabricated metal structure consisting of two longitud - inal side Rails connected by individual transverse members.

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Trough Cable Tray

A prefabricated metal structure greater than 4 inches (102) in width consisting of a ventilated bottom within integral or separate longitudinal side rails.

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Solid Bottom Cable Tray (Trunking)

A prefabricated metal structure consisting of a bottom with No openings within integral or separate longitudinal side rails.

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Straight Section

A length of cable tray which has no change in direction or size

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Cable Tray Fitting

A device which is used to change the direction or size of a cable tray system.

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Cable Tray Connector (Splice Plate)

A device which joins cable tray straight sections and fittings or both.

The basic types of connectins (splice plates) are :

1. Rigid
2. Expansion
3. Adjustable
4. Reducer

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Horizontal Elbow (Horizontal Bend)

A Cable tray fitting which changes the direction in the same plane.

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Horizontal Tee

A cable tray fitting which is suitable for joining cable trays in three directions at 90 – degree intervals in the same plane.

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Horizontal Cross

A cable tray fitting which is suitable for joining cable trays in four directions at 90 – degree intervals in the same plane.

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Vertical Elbow (Vertical Bend)

A cable tray fitting which changes directions to a different plane.

An inside vertical elbow changes direction upward from the horizontal plane.

An outside vertical elbow changes direction downward from the horizontal plane.

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Channel Cable Tray

A prefabricated metal structure conisting of a one piece ventilated bottom or solid-bottom channel section, or both, not exceeding 6 inches(152) in width.

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Accessories

Devices which are used to supplement the function of straight sections and fittings and including such items as drop – out, covers conduit adapters, hold-down devices and dividers.

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Cable Tray Support

A device which provides adequate means for supporting cable tray sections and fittings.

The basic types of cable tray supports are:

1. Cantilever bracket
2. indivisual rod suspension

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Cable Tray Support Span

The distance between the center line of supports.

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Section 2

MANUFACTURING STANDARDS

1 . MATERIALS

Cable tray systems shall be made of either corrosion-resistant metal or metal with a corrosion resistant finish.

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Aluminum and staninless steel alloys are inherently corrosion-resistant and no finish coating is required in most environments.

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2. FINISHES

i) Carbon Steel used for cable trays shall be protected against corrosion by one of the following processes.

A. Hot dip mill galvanized in accordance with ASTM Publication No. A 525 G 90 Coating

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Coating designation G 90 of ASTM 525 has an average Zinc coating weight of 1.25 oz. per square foot(0.381 kg/ m^2)of steel, total coating on both surfaces (1.06 mils(0.027) average thickness per side).

Hot -dip mill galvanized coatings are produced by continuous rolling steel sheets or strips in coils through a bath of molten Zinc. The process involves pretreating the steel to make the surface react readily with molten zinc as the strip moves through bath at high speeds. During fabrication where slitting, forming, cutting or welding is performed, the cut edges and heat- affected zone of welding are subject to superficial oxidation. These areas are then protected through electrolytic action of the adjacent zinc surfaces. The coating is smooth ductile and adherent.

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B. Hot – dip galvanized after fabrication in accordance with ASTM Publication No. A123. Class B2.

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Class B2 of ASTM A 123 has an average zinc coating weight of 1.50 oz. per square foot (0.46 /m^2)(2 .55mils) (0.064) average thickness per side

Fabricated products which are hot- dip galvanized are thoroughly cleaned, fluxed and immersed into a bath of molten zinc where they react to form a metallurgically bonded zinc coating. Normal oxidation of the galvanized surfaces will, in short period of time appear as a dull grey or white coating. Some degrees of roughness and variation of thickness can be expected due to the hot dipping process. Because the galvanizing process takes place at the low end of the stress-relieving temperature range, some stress relief occurs and some distortion or warping may result.

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C. Other equivalent commercially available coatings.

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ii). Steel nuts and bolts shall be protected against corrosion by one of the following processes :

A. ASTM Publication No. B 633
B. ASTM Publication No. B 766
C. Other equivalent commercially available coatings.

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3. Ladder Trays

1. ***Length of straight sections*** – 12 feet (3660) plus or minus 3/16 inch(4.76) and 24 feet(7320) plus or minus 5/16 inch(7.94), not including connection if attached.
2. ***Widths*** – 6, 12, 18, 24, 30 and 36 inches (152,305,457,610,762 and 914), plus or minus 1/4 inch (6.35) inside dimensions.

Overall widths shall not exceed inside widths by more than 4 inches(102)

3. ***Depths*** – Inside depths shall be 3, 4, 5 and 6 inches (76.2, 102, 127.0 and 152), plus or minus 3/8 inch (9.53)

Outside depths shall not exceed insides by more than 1 – 1/4 inches (31.7).

4. ***Rung Spacing on Straight Sections*** – 6, 9, 12 or 18 inches (152, 229, 305 or 457) on centers.
5. ***Radii*** – 12, 24 and 36 inches (305, 610, 914).
6. ***Degree of Arc for Elbows*** – 30, 45, 60 and 90 degrees

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4. Trough Trays

1. ***Lengths of Straight Sections*** – 12 feet (3660) plus or minus 3/16 inch(4.76) and 24 feet (7320) plus or minus 5/16 inch (7.94), not including connector if attached.

2. ***Widths*** – 6, 12, 18, 24, 30 and 36 inches (152, 305, 457 610,762 and 914), plus or minus 1/4 inch (6.35) inside dimensions.

Overall widths shall not exceed inside widths by more than 4 inches(102)

3. ***Depths*** – Inside depths shall be 3, 4, 5 and 6 inches (76.2, 102, 127.0 and 152), plus or minus 3/8 inch (9.53)

Outside depths shall not exceed insides depths by more than 1- 1/4 inches (31.7)

4. ***Radii*** – 12, 24 and 36 inches (305, 610, 914).
5. ***Degree of Arc for Elbows*** – 30, 45, 60 and 90 degrees
6. ***Transverse Elements*** – The maximum open spacing between transverse elements shall be 4 inches (102) measured in a direction parallel to the tray side rails.

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5. Solid - Bottom Trays

1. ***Lengths of Straight Sections*** – 12 feet (3660) plus or minus 3/16 inch(4.76) and 24 feet (7320) plus or minus 5/16 inch (7.94), not including connector if attached.
2. ***Widths*** – 6, 12, 18, 24, 30 and 36 inches (152, 305, 457 610,762 and 914), plus or minus 1/4 inch (6.35) inside dimensions.

Overall widths shall not exceed inside widths by more than 4 inches(102)

3. ***Depths*** – Inside depths shall be 3, 4, 5 and 6 inches (76.2, 102, 127.0 and 152), plus or minus 3/8 inch (9.53)

Outside depths shall not exceed insides depths by more than 1- 1/4 inches (31.7)

4. ***Radii*** – 12, 24 and 36 inches (305, 610, 914).
5. ***Degree of Arc for Elbows*** – 30, 45, 60 and 90 degrees
6. **Bottom** – Bottom is solid

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6. Channel Trays

1. ***Lengths of Straight Sections*** – 12 feet (3660) plus or minus 3/16 inch(4.76) and 24 feet (7320) plus or minus 5/16 inch (7.94), not including connector if attached.

2. ***Widths*** –3, 4 and 6 inches (76.2, 102 and 152), plus or minus 1/4 inch (6.35) inside dimensions.
3. *Depths*- 1- 1/4 to 1-3/4 inches (31.7 to 44.4) outside dimensions.
4. ***Radii*** – 12, 24 and 36 inches (305, 610, 914).
5. ***Degree of Arc for Elbows*** – 30, 45, 60 and 90 degrees

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PROTECTION OF CABLE INSULATION

The inside of cable tray systems shall present no sharp edges, burrs or projectoins which can damage cable insulation

NEMA Stadard 7- 14- 1976

FITTINGS

The design and constructin of fittings shall be based on the assumption that they will be supported in accordance with the recommendations given in 6.6 for support locations.

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MARKING OF TRAYS WHEN USED AS EQUIPMENT GROUNDING CONDUCTORS

When steel or aluminum cable tray systems are used as equipment grounding conductors, cable tray sections and fittings shall be marked to show the minimum cross sectional area in accordance with the Article 318 of the *National Electrical Code.*

NEMA Stadard 7- 14- 1976

Section 3

PERFOMANCE STANDARDS AND LOAD/SPAN CLASS DESIGNATIONS

1.WORKING (ALLOWABLE) LOAD CAPACITY

The working (allowable) load capacity represents the ability of a cable tray to support the static weight of cables. It is equivalent to the destruction load capacity, as determined by testing in accordance with 4.1 divided by a safely factor of 1.5

NEMA Stadard 3- 14- 1979

2. LOAD/ SPAN CLASS DESIGNATIONS

There shall be three working load categories of cable tray :

1. 50 lbs /linear ft.(74.4kg/m) (Symbol A)
2. 75 lbs /linear ft.(111.6kg/m) (Symbol B)
3. 100lbs /linear ft.(148.8kg/m) (Symbol C)

and four support span categories of :

1. 8 feet (2.44 m)
2. 12 feet (3.66 m)
3. 16 feet (4.87 m)
4. 20 feet (6.09 m)

NEMA Stadard 3- 14- 1979

Section 4

TEST STANDARDS

DESTRUCTION LOAD TEST

1. Test Specimen

For each design of cable tray, two separate tests shall be made. An unspliced straight section of the widest width shall be used in each test.

For ladder type cable trays rung spacing shall be 12 inches (305) on center

Differences in gauge, height of side rails, rung or bottom to side rail connection, or the configuratin of any part constitute a different design.

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2. Types and length of Span

Test span shall be simple beam spans with free unrestrained ends. Trays shall not have side restraints. Span lengths shall be as specified plus or minus 1- 1/2 inches(38.1)

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3. Orientation of Specimens

Specimens shall be tested in a horizontal position. The total length of the test specimen shall be not more than the specified span length plus 20 percent. Any overhang shall be equal.

4. Supports

Each end of the specimen shall be supported by an 1- 1/8 inch (28.6) wide by 3/4 inch(19.0) high steel bar(s) with a 120 degree "Vee" notch shall rest on a 1 inch (25.4) solid round steel bar which is welded at a maximum of 12 inches (305) on center to a firm steel base, or the specimen shall be supported directly on a 2- 1/2 inch (63.5) maximum diameter round steel bar or heavy wall steel tube welded to a firm steel base.

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5. Loading Material

Loading material shall be steel strips, lead ingots, or other loading meterial.

Steel strips shall have rounded or deburred edges, a maximum thickness of 1/8 inch (3.18) a width of 1- 1/8 (28.6) to 2 inches (50.8), a maximum length of 4 feet (122).

Five lead ingots, each weighing approximately 5 pounds (2.26 kg), shall be interconnected across corners into a string of 5 ingots approximately 22 inches (559) long. Indivisual ingots are normally hexagonal, approximately 3 inches (76.2) in diameter and 1- 1/2 inches (38.1) deep.

Other loading material shall have a maximum weight of 10 pounds (4.53 kgs), a maximum width of 5 inches (127) and a maximum length of 12 inches (305)

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6. Loading

All specimens shall be loaded to destruction. The load shall be applied in at least 10 increments which are approximately equal.

Loading shall be uniformly distributed for the length and breadth of the specimen except that the loading material shall be not closer than 1/2 inch (12.7) nor further than 1 inch (25.4) from the innermost elements of the side rails. It shall be arranged across the tray with a minimum of 3/8 inch (9.53) between stacks so that the loading material does not bridge transversely. All loading material shall be placed between the supports without overhanging.

For loading weight in a ladder type tray, it shall be permissible to cover the bottom of the tray between supports with a flat sheet of No.9 gauge (3.8) flattened expanded material not more than 3 feet (910) long. The expanded metal or steel sheet shall not be fastened to the tray and shall be not closer than 1/2 inch (12.7) to the side rails. The 3-foot (910) lengths shall not overlap. The weight of the expanded metal or sheet steel shall be added to the total weight of the loading material.

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7. Destruction Load Capacity

The toal weight of the loading material on the cable tray at the time it is destroyed shall be considered to be the destruction load capacity of the cable tray.

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8. Interpolation and Extrapolation of Test Data

When allowable load and deflection data are determined by load tests, values for span lengths not tested shall be determined by interpolation from a curve based on values for a minimum of three tested span lengths. Extrapolation towards shorter span lengths is permissible but shall not be used for span lengths longer than the longest span length tested.

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DEFLECTION TEST

The vertical deflection of the tray shall be measured at two points along the line midway between the supports and right angles to the longitudinal axis of the tray. The two points of measurements shall be at the midpoint of the span of each side rail.

The average of these two readings shall be considered to be the vertical deflection of the tray.

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Section 5

SPECIFICATIONS AND DRAWINGS

1. DATA TO APPEAR IN SPECIFICATION

The following statement and minimum data, when applicable, should appear in all cable tray specifications:

1. Cable tray shall be manufactured and installed in accordance with NEMA Standard VE 1- 1991
2. Load / Span Class designations
3. Type
4. Material
5. Finish
6. Rung Spacing
7. Inside Depth
8. Width
9. Fitting Radius
10. Accessories

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2. DATA TO APPEAR ON DRAWINGS

The following minimum data should appear on all cable tray drawings:

1. Type (Ladder, trough ect)
2. Width
3. Straight Section, fitting or accessories
4. Fitting radii
5. Elevation (Bottom of tray)
6. Vertical and Horizontal changes on direction
7. Clearances – vertical and horizontal
8. Number of trays
9. Supports
10. Show graphic Scale

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Section 6

APPLICATION INFORMATION

1. DEFLECTION

Under normal applications deflection limitations should not be included in design criteria for cable tray. However, if unusual or special conditions exist, the manufacturer should be consulted. Limitations of deflection for aesthetic purpose only can result in an over – designed tray system.

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2. CONCETRATED STATIC LOAD

(If required by User)

Some user applications may require that a given concentrated static load be imposed over and above the working load.

Such a concentrated static load represents a static weight applied between the side rails at midspan. When so specified , the concentrated static load may be converted to an equivalent, uniform load(We) in pounds per linear foot (Kilograms per meter) using the formula:

$$We = \frac{2 \times (\text{Concentrated Static Load})}{\text{Span length. (ft.) (m)}}$$

and added to the static weight of cables in the tray. This combined load may be used to select a sutable load/ span designation. If the combined load exceeds the working load, the manufactureer should be consulted.

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3. WARNING! WALKAWAYS

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

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

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4. FITTINGS

Changes in direction should be mechanically continuous and accomplished by use of fittings having dimensions in accordance with 2.3.

Authorized Engineering Information 3- 14 – 1979

5. SUPPORTS

Supports for cable trays should provide a strength and working load capacity sufficient to meet the load requirement of the cable tray systems.

1. Horizontal and vertical trays supports should provide an adequate bearing surface for the tray and should have provisions for hold down clamps or fasteners.
2. In addition vertical tray supports should provide secured means for fastening cable trays to supports.

Authorized Engineering Information 3- 14 – 1979

6. SUPPORT LOCATION

Horizontal Cable Tray Straight Sections

Horizontal cable tray straight sections should be supported at intervals not to exceed the support span for the appropriate NEMA Class Designation. Unspliced straight sections should be used on all simple spans and on end spans of continuous span runs. A support should be located within 2 feet (610) of each side of an expansion connector. Straight section lengths should be equal to or greater than the span length to ensure not more than one splice between supports.

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7. Horizontal Cable Tray Fittings

1. *Horizontal Elbow Supports*
   Supports for horizontal tray fittings should be placed within 2 feet (610) of each fitting extremely, and as follows:
   a). 90-degree supports at the 45-degree point of arc
   b). 60-degree supports at the 30 -degree point of arc
   c). 45-degree supports at the 22- 1/2 -degree point of arc
   (except for the 12 – inch (305) radii)
   d). 30-degree supports at the 15-degree point of arc
   (except for the 12 – inch (305) radii)

2. *Horizontal Tee Supports*
   Within 2 feet (610) of each of the three openings connected to other cable tray items for the 12 inch (305) radius. On all other radii, at least one support should be placed under each side rail of the horizontal tee.

3. *Horizontal Cross Supports*
   Within 2 feet (610) of each of the four openings connected to other cable tray items for the 12 inch (305) radius. On all other radii, at least one support should be placed under each side rail of the horizontal cross.

4. *Horizontal Wye Supports*
   Within 2 feet (610) of each of the four openings connected to other cable tray items, and 22-1/2 degree point of the arc adjacent to the branch.

5. *Reducer Supports*
   Within 2 feet (610) of each fittings extremity.

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8. Vertical Cable Tray Elbows

Vertical cable tray elbows at the top of runs should be supported at each end. Vertical cable tray elbows at the bottom of runs should be supported at the top of the elbow, and within 2 feet (610) of the lower extermity of the elbow.

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9. Vertical Cable Tray Tees

Vertical cable tray trees should be supported within 2 feet (610) of each fitting extremity.

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10. Vertical Straight Section

Vertical straight sections should be supported indoors at appropriate intervals permitted by the building structure; outdoor support intervals should be determined by wind loading . The maximum distance between vertical supports should not exceed 24 feet (7320) on centers.

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11. Sloping Trays

Sloping trays should be supported at intervals not exceeding those for horizontal trays of the same design for the same installation.

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12. Fittings as End of Run

A fitting which is used as an end of the run dropout should have a support attached to it, firmly reinforcing the fitting.

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PROTECTOIN OF CABLE INSULATION

The inside of cable tray systems should present no sharp edges, burrs or projections which could damage cable insulation.

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CABLE INSTALLATION

When installing cable in cable tray, it is important that care and planning be exercised so that the cable or the cable tray is not damaged or destroyed. The cable manufacturer should be contacted for maximum pulling tensions and minimum bending radii and advice on prevention of "egging" or deformation of cable jacketing or shielding.

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