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Introduction

Decade after decade, for nearly 60 years, MP Husky continues to be the trusted and proven name in Cable Tray. With more systems installed in more industries and environments than any other manufacturer, you can rest assured MP Husky has the experience and capability to meet your most demanding requirements. As we begin another decade, MP Husky is stronger than ever and positioned to lead the industry with the latest innovations, eco-friendly products, and engineering and manufacturing technologies. Our focus continues to remain on providing unmatched customer support, investing in our people, protecting the environment, and providing the most technologically advanced and engineered systems. *MP Husky - Engineered to Support Powerful Reputations.*



Description and Selection

Cable Tray systems provide rigid structural support for cables in a variety of commercial and industrial applications. The basic styles of cable tray are: Ladder, Trough, Center Rail, Wire Basket and Channel. For a more comprehensive description of the construction and utilization of these types of tray, turn to Sections 2, 3, 4, 5, 6, 7, 8, 9, 14, 15 and 16 in this catalog.

Husky Ladder

Ladder consists of two longitudinal side members connected by individual traverse members. It is intended for use primarily for power cable or control cable support and excels in heavy loading and longer span applications. It is available in I-Beam, Flange-In and Flange-Out designs.



Husky Trough

Trough has a corrugated solid or ventilated bottom, 4" rung spacing or flat bottom pan design which is contained within longitudinal side members. It is especially appropriate for control and instrumentation cables.



Husky Channel

Channel is a one piece support with either ventilated or solid bottom sections. These sections are used with power cables, multiple control, or signal circuit cables.





Technical Information

Description and Selection

Husky Wire Basket

Techtray is a wire mesh cable tray system that utilizes high mechanical strength steel wire that is welded into a 2" x 2" grid system. Typically used to carry data communication and fiber optic cables, with a high degree of flexibility during installation due to capability and ease of fabricating fittings in the field.



Husky Pan Tray

Husky Way straight sections are one piece formed pan that provides a smooth flat bottom and a fill depth that is almost the same as the outside height of the tray. With a cover it provides complete protection of your cables. (Cover sold separately)

Husky EMI Tray is another option available to our customers (See Section 8 of this catalog).



Since Cable Tray is used in a wide variety of applications and under widely varying conditions, it is important that you gain an understanding of material specifications and structural design and apply that knowledge when selecting trays and specifying fittings, parts, and accessories. Some of the considerations are:

1. NEMA Class / CSA Class

Using the charts on the next page, determine the correct class of tray as it relates to your desired loading capacity per foot and support span. You will also need to know the weight of the cable and at what span it will be supported.

2. Material

MP Husky cable tray is available in aluminum, stainless steel and hot dip galvanized after fabrication or pre-galvanized steel, zinc plated, galvanized and fiberglass.

3. Tray Depth

A loading depth from 2" to 10" is available, this varies by tray type.

4. Tray Width

Standard widths are 6", 9", 12", 18", 24", 30" and 36". (Many other widths available on Wire Basket Tray)

5. Tray Type

Nine types of tray are available: Ladder, Trough, Channel, I-Beam, Center Spline, Fiberglass, Pan Tray, EMI and Wire Mesh. Ladder is available with either 6", 9", 12" or 18" rung spacing. Both Channel and Trough are available with either solid, non-ventilated or ventilated bottoms.

6. Radius of Fittings

All fittings normally come with a 12", 24" or 36" radius in styles and material to match any tray selection.





Technical Information

Description and Selection

NEMA LOAD CLASSIFICATION

The National Electrical Manufacturers Association (NEMA) has standardized the classification of cable tray based on the load to be carried per foot, and the distance between span supports. The load per foot should include not only the cable, but additional load factors for wind, snow, ice, etc. For more information on loading, see page 14 in this section.

NEMA CLASS	SUPPORT SPAN (feet/meters)	LOAD (lbs./ft.) / (kg/m)
5AA	5/1.5	25/37
5A	5/1.5	50/74
8AA	8/2.4	25/37
8A	8/2.4	50/74
8B	8/2.4	75/112
8C	8/2.4	100/149
10AA	10/3.0	25/37
10A	10/3.0	50/74
12AA	12/3.7	25/37
12A	12/3.7	50/74
12B	12/3.7	75/112
12C	12/3.7	100/149
16A	16/4.9	50/74
16B	16/4.9	75/112
20AA	20/6.0	25/37
20A	20/6.0	50/74
20B	20/6.0	75/112
20C	20/6.0	100/149

MP Husky manufactures Cable Tray in accordance with the latest NEMA Standards Publication VE1 and CSA Standard C22.2 No. 126.1



CSA LOAD CLASSIFICATION

Maximum Design Load for Maximum Associated Support Spacing				
Class	Design Load		Design Support Spacing	
	lbs./ft.	kg/m	Feet	Meters
A	25	37kg/m	10	3m
C	65	97kg/m	10	3m
D	120	179kg/m	10	3m
D	45	67kg/m	20	6m
E	200	299kg/m	10	3m
E	75	112kg/m	20	6m

MP Husky is a charter member of NEMA and the Cable Tray Institute.



Our Quality Policy

At MP Husky we are committed to producing only the highest quality products that meet or exceed our customers' expectations and requirements. Our goal is to achieve 100% customer satisfaction by delivering the best products and services on time and defect free. We will achieve this individually and corporately through tested and proven processes and controls, in our Quality System, and with a constant focus and effort on continuous improvement.

Item	Standards
MP Husky Quality Program	• ANSI / ASQC Q9001-2000 (ISO 9001 Compliant) • ASME NQA-1-2004 • ANSI N45.2
-Quality Assurance -Manufacturing Standards	ISO9001 National Electric Code, National Electrical Manufacturers Association VE-1, Canadian Standards Association, American Welding Society, American Society for Testing and Materials
Certification	CSA Certified UL Classified for use and an equipment ground conductor
Load Test Standards	NEMA VE-1/CSA Tray Standards
Cable Tray Standard	NEMA VE-2
Grounding	UL, CSA, NEC
Welding	• AWS D1.1 (American Welding Society Structural Welding Code: Steel) • AWS D1.3/D1.2: (American Welding Society Structural Welding Code: Aluminum) • AWS C1.1/ANSI American Welding Society Recommended Practices for Resistance Welding • ASME QW 100.1 American Society of Mechanical Engineers • Welding Procedure Specifications (Procedure Qualifications Record) • Certified Welding Inspector—QC1-96 (On Staff) • 100% of MP Husky welders are AWS Certified.
Nuclear	• Audited every three years since 1977 in conformance with 10 CFR50 Appendix B - Nuclear Standards (U.S. Nuclear Regulatory Commission)



Nuclear Program

MP Husky is audited in conformance with 10 CFR50 Appendix B - Nuclear Standards by the U.S. Nuclear Regulatory Commission. Appendix B to Part 50--Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants - This appendix establishes quality assurance requirements for the design, manufacture, construction, and operation of those structures, systems, and components. The pertinent requirements of this appendix apply to all activities affecting the safety related functions of those structures, systems, and components; these activities include designing, purchasing, fabricating, handling, shipping, storing, cleaning, erecting, installing, inspecting, testing, operating, maintaining, repairing, refueling, and modifying.



- We have and continue to serve over thirty Nuclear plants around the world.
- MP Husky has been compliant for over 45 years.
- We are the ONLY Cable Tray manufacturer to be 10CFR50 Appendix B compliant.
- We are audited every three years by members of the Nuclear Procurement Issues Committee using the Nuclear Procurement Issues Committee Audit Checklist (NUPIC Audit Checklist).
- The scope of the audit is to ensure that our Quality Assurance Program (QAP) is compliant with ANSI N45.2 and 10CFR50 Appendix B.

Nuclear Clients & Partners

Duke Energy
 Duquesne Light Company
 Florida Power & Light
 Cincinnati Gas & Electric Company
 Gulf States Utilities
 PA Power & Light Company
 Consumer Power Company
 Long Island Lighting Company
 Illinois Power Company
 WA Public Power Supply Systems
 Commission Fed De Electricidad Mex
 Carolina Power & Light Company
 Texas Utilities
 Florida Power & Light Company
 Iowa Electric & Power Company
 Louisiana Power & Light Company
 Northern States Power Company
 Taiwan Power Company
 Public Service Electric & Gas
 Puerto Rico Water Res.
 Pacific Gas & Electric

SCANA
 Southern California Edison
 Southern Nuclear (Southern Company)
 Wisconsin Public Service
 Detroit Edison
 Baltimore Gas & Electric Company
 National Power Corporation
 Public Service of New Hampshire
 Florida Power Corporation
 Cleveland Electric Illuminating
 Boston Edison Company
 Georgia Power Company
 Houston Lighting & Power Company
 Jersey Central Power & Light
 Mississippi Power & Light Company
 Ohio Edison Company
 Power Authority of State of New York
 Public Service of Indiana, Inc.
 Public Service Company of Oklahoma
 Tennessee Valley Authority (TVA)

Materials & Construction

Cable tray systems are commonly fabricated from a corrosion-resistant metal or from a metal with a corrosion-resistant finish. The selection of the proper material is essentially an economic consideration.

Every cable tray installation places requirements on the mechanical properties of the material from which it is fabricated. These properties influence the spacing frequency of supporting members, and the ease of installation. The selection of the material may also be dependent upon electrical (conductivity), physical (appearance), or chemical (corrosion resistance) properties, according to the demands of the specific installation. Although there are numerous metals available which could satisfy the basic requirements, certain wrought aluminum alloys and low carbon steels meet these requirements most economically.



Wrought Aluminum Alloys

Pure aluminum is soft and ductile. However, most commercial uses require greater strength than pure aluminum affords. This strength is achieved by the addition of other elements to produce alloys which singly, or in combination, impart strength to the metal. These alloys have been classified into seven categories according to their chemical composition, and have been given numerical designations for each series of alloys of 1000 through 7000 by the Aluminum Assoc. In addition to alloying the pure aluminum, further strengthening is possible by heat treating.

Heat-Treatable Alloys—the initial strength of alloys in this group is enhanced by the addition of such alloying elements as copper, magnesium, zinc and silicon, and are designated as 2000, 6000, and 7000 series. Since these alloys singly, or in various combinations, show increasing solid solubility in aluminum with increasing temperature, it is possible to subject them to thermal treatments which will impart pronounced strengthening.

Non-Heat-Treatable Alloys—the initial strength of alloys in this group depends upon the hardening effect of elements such as manganese, silicon, iron and magnesium, singly or in various combinations.

The non-heat treatable alloys are designated as 1000, 3000, 4000, and 5000 series. As these alloys are work-hardenable, further strengthening is made possible by various degrees of cold working, denoted by the "H" series of tempers. Alloys containing appreciable amounts of magnesium when supplied in strain-hardened tempers are usually given a final elevated temperature "stabilizing" to insure stability of properties.

In determining the proper aluminum alloy for structural applications, such as ventilated cable tray systems, the design engineer should recognize the advantages inherent in using alloys that are heat-treatable and of being able to fabricate the structure from materials possessing known minimum values of yield strength.

Cable tray products are most widely formed from the 6000 series alloys. Alloys in this group contain silicon and magnesium in approximate proportions to form magnesium silicide, thus making them capable of being heat-treated. Major alloys in this series are 6061 and 6063, which are among the most versatile of the heat-treatable alloys. Though not as strong as most 2000 or 7000 alloys, the magnesium-silicon (or magnesium silicide) alloys possess good formability and corrosion resistance.

Basic structural members of aluminum cable tray systems can be made from 6063-T6 aluminum extrusions, a material which economically meets the requirements of the majority of installations. The 6063-T6 alloy has adequate strength and good corrosion resistance. It is light weight, maintenance-free, and because of the non-magnetic properties of aluminum, keeps electrical losses to a minimum.

MP Husky manufactures Cable Tray in accordance with the latest edition of NEMA Standards Publication VE1 and CSA Standard C22.2 No. 126.1.



Materials & Construction

Steel

Steel cable trays are used principally in environments which are relatively free from corrosive attack. They are available with various types of corrosion-resistant finishes; usually hot-dip galvanized. The main advantages of using steel in cable tray fabrication are its high strength and low cost. Its disadvantages are increased structural weight, poor corrosion-resistance, and low electrical conductivity.

The idea that all steels are the same, except for chemical disposition is false. Carbon steels may be produced with chemical compositions (carbon, manganese, phosphorus, sulphur and silicon) within the specified limits of a given grade and still have characteristics that are widely dissimilar. Each grade and quality variation has a useful place, depending upon the end use and the methods of fabrication.

Basic components of steel cable trays are normally fabricated from either hot or cold rolled steel strips of commercial quality. Steels in this category are ASTM A-1011 CS Type B (formerly ASTM A-569) and ASTM A-1008 CS Type B (formerly A-366). Pre-galvanized steel conforms to ASTM A-653.

Stainless Steel

Today, hundreds of different alloy combinations exist for the endless variety of applications which utilize stainless and heat resisting steels. The primary elements added to obtain the various properties required in the steels include chromium, nickel, manganese, silicon, molybdenum, and the stabilizing elements of titanium columbium and tantalum.

Stainless steel contains at least 10 percent chromium, along with other elements to develop specific properties. Depending on the quality of the elements present in a stainless alloy, it will have a metallurgical structure which will be characteristic of the basic stainless steel groups. Metallurgists refer to these groups as the martensitic, ferritic, austenitic and precipitation hardening stainless steels. All standard austenitic alloys are given numbers in the "200" and "300" series, while the martensitic and ferritic alloys are numbered in the "400" series.

MP Husky offers cable trays and accessories in both the 304 and 316 series. These austenitic alloys are remarkable in several respects. Unlike the other two classes, they contain nickel in quantities from 4 to 22 percent, while the percentage of carbon is kept relatively low. When chromium is increased for improved corrosion resistance, nickel must also be increased to retain the austenitic structure.

304 stainless steel has chromium and nickel increased and carbon lowered to reduce carbide precipitation and increase corrosion resistance. Lowering the carbon content also makes welding easier.

316 stainless steel has molybdenum added to improve corrosion resistance and high temperature strength. The carbon content is also lowered to improve welding performance.



If your job calls for stainless steel, please contact the MP Husky factory for assistance in determining the correct type for your specific application.

Materials & Construction

Typical Applications include:

Type 304	Type 316
Beer Barrels	Chemical Processing Equip
Chemical Equipment	Chemical Storage and Transportation tanks
Coal Hopper Linings	Food Processing Equip
Cryogenic Vessels and Components	Steam Cooking Kettles
Dairy Equipment	Oil Refining Equipment
Evaporators	Paper Pulp Digesters and Evaporators
Food Handling Equipment	Petroleum Refining Equip
Milking Machines	Pharm. Processing Equipment
Nuclear Vessels and Comp	Scrubbers and Environmental
Oil Well Filter Screens	Soap and Photographic Handling Equipment
Pressure Vessels	General apps in Textile Ind.
Sanitary Fittings and Valves	
Shipping Drums	
Steel Tubes	
Textile Dyeing Equipment	
Hypodermic Needles	
Feedwater Tubing	

Galvannealed

Galvannealed or Galvanneal, is the result from the combined process of galvanizing and annealing the steel. The galvanization is made through the hot-dipping (hot-dip galvanizing) process and gives a very fine grayish matte finish. Galvanneal does not flake off its galvanized coating when formed, stamped, and bent. The very fine matte finish acts like a primer and paint easily adheres to the tray. It is very rust proof, only white to dark grey marks appear if it comes in contact with water. Galvanneal sheets offers good paintability, weldability, corrosion resistance, and formability. It is extensively used in the automotive, signage, electric equipment, and other industries requiring good paintability and long reliable service life.

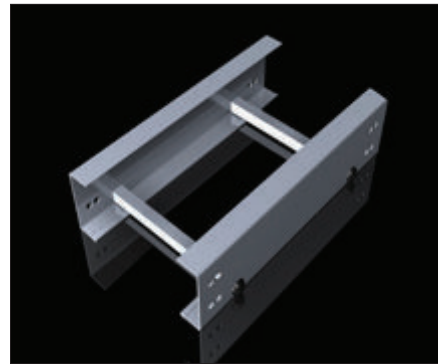
Husky Way is available in the galvanneal finish.



Fiberglass

MP Husky's Fiberglass Cable Tray systems are manufactured from glass fiber-reinforced plastic shapes and provides the load capacity of steel, plus the inherent characteristics afforded by our Pultrusion Technology: non-conductive, non-magnetic and corrosion-resistant. Although light in weight, the strength to weight ratio surpasses that of equivalent steel products. MP Husky's Fiberglass Cable Tray will not rust, nor does it ever require painting. It is available in both polyester and vinylester resin systems, manufactured to meet ASTM E-84, Class 1 Flame Rating and self-extinguishing requirements of ASTM D-635. MP Husky's Fiberglass Cable Tray comes in gray or blue (polyester resin) and beige (vinylester resin) but is available in custom colors upon request.

For more than 30 years, MP Husky's Fiberglass Cable Tray systems have been tested and proven in the harsh environment of the offshore oil and gas industry. Our tray has stood up to the test of being exposed to the corrosive conditions inherent in petroleum products, plus the daily punishment of exposure to wind, weather and salt water.



Husky Fiberglass Cable Tray is the perfect choice for harsh environments.





Corrosion Resistance

The underlying causes of corrosion are the same for all metals, all stemming from electrochemical phenomena. But the ways in which corrosion manifests itself are characteristic of each particular metal. Steel corrodes in the atmosphere with the formation of rust, which develops very rapidly on unprotected surfaces. In a clean atmosphere, aluminum slowly develops a white or silver grey patina.

Aluminum surfaces weather by a characteristic of pitting, and corrosion rates are often assessed by measuring the depth of the pits. The rate of pitting falls off after the first year or two, moving gradually to a standstill.

The strong, heat-treatable alloys of aluminum, with copper as one of the chief alloy elements, or certain fully heat-treated alloys with magnesium and silicon as major alloying elements, may manifest another type of attack, inter-crystalline in nature, which may cause more pronounced loss of strength if allowed to continue. Such materials may require protection by painting, cladding, or metal spraying, depending on the environment.

Several characteristic modes of corrosive attack may be distinguished as follows:

Simple Chemical Attack—the solution of a metal by an acid is an obvious example of simple chemical attack. Simple chemical attack occurs when sulfides are in contact with steel or copper. Ordinarily, aluminum is not subject to such attack. A classic example of such chemical attack is sludge retaining rainwater in the bottom of guttering. In this case, a corrosive solution is held in constant contact with the metal, and rapid attack may follow.

Electrochemical Corrosion—corrosion of a metal accelerated through contact with another metal in moist or wet conditions is known as bimetallic or electrolytic corrosion. This corrosion is due to the action of a simple voltaic cell. The presence of a conducting solution is essential to this phenomenon but the presence of dissimilar metals is not essential provided that a difference of potential exists.

In addition to the nature of the two metals, the extent of galvanic attack depends upon many other factors. Among these are:

- Nature of ions present in the electrolyte
- Polarization effects
- Effect of stable surface films on the metal
- Relative areas of anode and cathode
- The physical nature of the corrosion product
- Temperature variations

Each of these factors can influence the total resistance of the circuit. The following table is a compilation of solution potentials of metals and alloys with respect to a calomel electrode. It provides an initial guide to the possible effects of bi-metallic contact.

Galvanic Potential

Corroded End (Anodic or Least Noble)

- Magnesium
- Magnesium Alloys
- Zinc
 - Galvanized Steel or Galvanized Iron
- Aluminum Alloy 5052-H
- Aluminum Alloy 3004-S
- Aluminum Alloy 3003-S
 - Aluminum Alloy 1100-S
- Aluminum Alloy 6053-T
- Alclad
 - Cadmium
- Aluminum Alloy 2117-T
 - Aluminum Alloy 2017-T
 - Aluminum Alloy 2024-T
- Mild Steel
 - Wrought Iron
 - Cast Iron
 - Nickel Cast Iron
- Lead-Tin Solders
 - Lead
 - Tin
 - Brass
 - Copper
 - Bronze
- Copper-Nickel Alloys
 - Monel
 - Silver Solder
 - Nickel
 - Iconel
 - Chromium Iron
- 18-8 Stainless Steel
 - Type 304 (passive)
 - Type 316 (passive)
 - Hastelloy C
 - Silver
 - Graphite
 - Gold

Protected End (Cathodic or Most Noble)

Corrosion Resistance

The composition of the base metals has no measurable effect on the life of zinc coatings. However, the composition of the base metals is the major factor in the years to perforation.

The corrosion rate of zinc varies more with the type of atmosphere (marine, industrial) than does that of steel or iron.

The chloride content of sea air apparently has an accelerating effect on the corrosion of zinc coating.

Rainfall removes about 75% of the corrosion products from zinc surfaces if the results of tests in rural, industrial and marine exposures are averaged together. The residual corrosion products remaining on the surface become basic in character and exert a retarding influence on corrosion. In highly industrialized or polluted atmospheres, this basic film may not exist, a fact which helps explain the more rapid attack experienced in such atmospheres.

Indoor atmospheres correspond in a general way to that prevailing outside in a given locality. Variations in humidity and temperature are somewhat less extreme and there is no rainfall indoors to dissolve and remove soluble corrosion products. In general, it may be assumed that the protective life of zinc coatings indoors is at least five times greater than that of coatings of the same thickness exposed to the outdoor atmosphere in the same locality.

The indoor corrosion of zinc may be severe when moisture condensation is frequent and air circulation is restricted. This effect is particularly bad in humid, tropical locations with nightly condensation.

These conclusions indicate zinc coatings will in any event have an acceptable service life expectancy regardless of how the end point of failure is defined. However, it should be noted that whenever maintenance, such as painting, is neglected, it is unreasonable to expect galvanized steel to last indefinitely.

Finishes

Metallic

Cable trays fabricated of steel can be protected from corrosion by coating with another metal using one of the following methods:

- **Continuous Hot-Rolled Galvanizing**

ASTM Designation A653 Specifications for Zinc Coated Galvanized Iron or Steel Sheets, Coils, and Cut Lengths—This process applies a zinc coating to sheet steel prior to fabrication of the product (pre-galvanized cable tray) by passing the metal downward through a molten ammonium chloride flux bath, and then into the zinc and out again by means of rolls.

The MP Husky standard zinc coating designation is G90, which has an average zinc coating weight of 1.25 ounces per square foot of steel for an average coating on both surfaces of 1.06 mils.

- **Hot Dipped Galvanizing After Fabrication**

ASTM Designation A123 Specification for Zinc Coating (Hot Dip) on Assembled Steel Products—This process is used to apply a zinc coating to an already fabricated product. The product is first cleaned in a caustic bath, then further cleaned by a pickling acid bath. The article is then thoroughly rinsed and dipped in a bath of molten zinc. The nature and thickness of the coating depend largely on the immersion rate, temperature of the bath, immersion period, and withdrawal rate. The resulting coating consists of an outer layer of relatively pure zinc, and lower layers of iron-zinc compounds.

Generally, hot dip coatings are highly non-uniform, except on very simple shapes and are usually thickest at small recesses (unless these remain uncoated altogether). The advantage of this method is that the zinc applied is thicker than when applied by other processes. However, the protective characteristics of zinc coating under atmospheric conditions have been found to be equal, regardless of process: i.e. zinc coatings of the same weight have approximately the same service life.

- **Galvannealed**

Galvannealed or Galvanneal, is the result from the combined process of galvanizing and annealing the steel. The galvanization is made through the hot-dipping (hot-dip galvanizing) process and gives a very fine grayish matte finish. Galvanneal does not flake off its galvanized coating when formed, stamped, and bent.



Corrosion Resistance

The corrosive nature of sea water and of coastal environments is partly due to the low electrical resistance of salt solution. Similarly, the bad effects of industrial atmospheres on metals arise largely from the sulphur compounds, sulphurous and sulfuric acids, which are largely formed as a result of burning coal, and which dissolve in the moisture in the air or in the rain as it falls, or in films of condensed water on the metal.

To summarize, the extent and type of moisture is an important factor in determining the severity of galvanic attack. For indoor service, where wetting is infrequent, galvanic corrosion normally is no problem. Outdoors, attack may be relatively rapid in sea coast and industrial environments, where contamination, hence conductivity, of rain and condensed moisture is high. Several general rules can be applied in selecting metal combinations for use in corrosive environments. These are:

Select metals as close together in the galvanic series as possible. For the anodic protection of steel, metals above steel in the series should be selected, or the steel should be galvanized or otherwise protective-coated. Avoid combinations having a smaller area of the more anodic metal than of the cathodic, to avoid excessive current density on the anodic areas. Insulate dissimilar metals wherever possible to minimize galvanic corrosion.

Aluminum Alloys

The corrosion-resistance of aluminum alloys is due to the presence on the surface of a very thin protective film of aluminum oxide which has strong self-healing properties when damaged. The oxide film begins to form immediately on the surface of the bare metal exposed to air and grows rapidly for several days, then slowly for a month, when it reaches a thickness of approximately 0.0000002". Corrosion of aluminum can only occur when the oxide film is damaged or removed and conditions prevent its formation.

Substances which may come in contact with aluminum can be divided into three groups:

Those substances which attack the oxide film. These are most strong alkalis, mercurial compounds, and most strong acids.

Substances which cause localized breakdown of the oxide film (pitting) - and for which aluminum is suitable only under certain conditions, such as some natural fresh waters and aqueous solutions containing traces of mercury, copper, or other heavy metals.

Substances which do not attack the oxide film. The majority of substances fall in this group, including many industrial chemicals.

The majority of aluminum installations give perfectly satisfactory service, free from corrosion, and only in exceptional cases do problems occur. When problems do occur, they can be attributed to one or more of the following causes:

- Wrong choice of alloy
- Exposure conditions
- A bimetallic joint which causes galvanic corrosion
- Crevices
- Unwise location of the aluminum assembly, resulting in deposition corrosion
- Contact with aggressive chemicals

Among the heat-treatable alloys, the 6000 series has good resistance to industrial and marine atmospheres.

With the exception of certain corrosive chemicals, no corrosion at all will occur if water is not present. Thus, indoor installations that are not in actual contact with water or installations which are maintained in dry conditions, will not corrode.

Steel with Zinc Coatings

The data from which comparative performance of different types of zinc coating can be inferred, are generally obtained from comprehensive exposure tests in various atmospheres, such as those conducted since 1926 by the American Society of Testing Materials. From the results of these tests, the following conclusions can be made:

The corrosion rate of zinc on galvanized sheets is practically linear in industrial or rural atmospheres, and in a marine atmosphere that is polluted with industrial contaminants. Thus, in these atmospheres, a sheet with double the weight of coating than that of another sheet can be expected to last twice as long before rusting of the base metal occurs.



Loading

This section presents guidelines for classification of design conditions with respect to weather factors, methods of determination and application of various types of loadings encountered, maximum allowable working stresses and other pertinent considerations. This information will assist the designer in evaluating materials and product catalog information so that he can design a system which will achieve the desired strength and rigidity at the lowest possible installed cost.

Load Classification

Loads on structures are usually divided into three types:

- **Dead loads** that do not change their magnitude or their position during the life of the structure.
- **Live loads** that change their magnitude, their position and/or their direction during the life of the structure.
- **Dynamic loads** that are caused by the motion of the live load, or the movement of the structure.

Because of their general nature, these load classifications can be used for any structure. However, for the purpose of establishing a practical load classification for cable tray system design, it is necessary to create additional subdivisions and provide a guide for assumption of specific loads.

Thus, for cable tray system design, the three basic load types are also considered as follows:

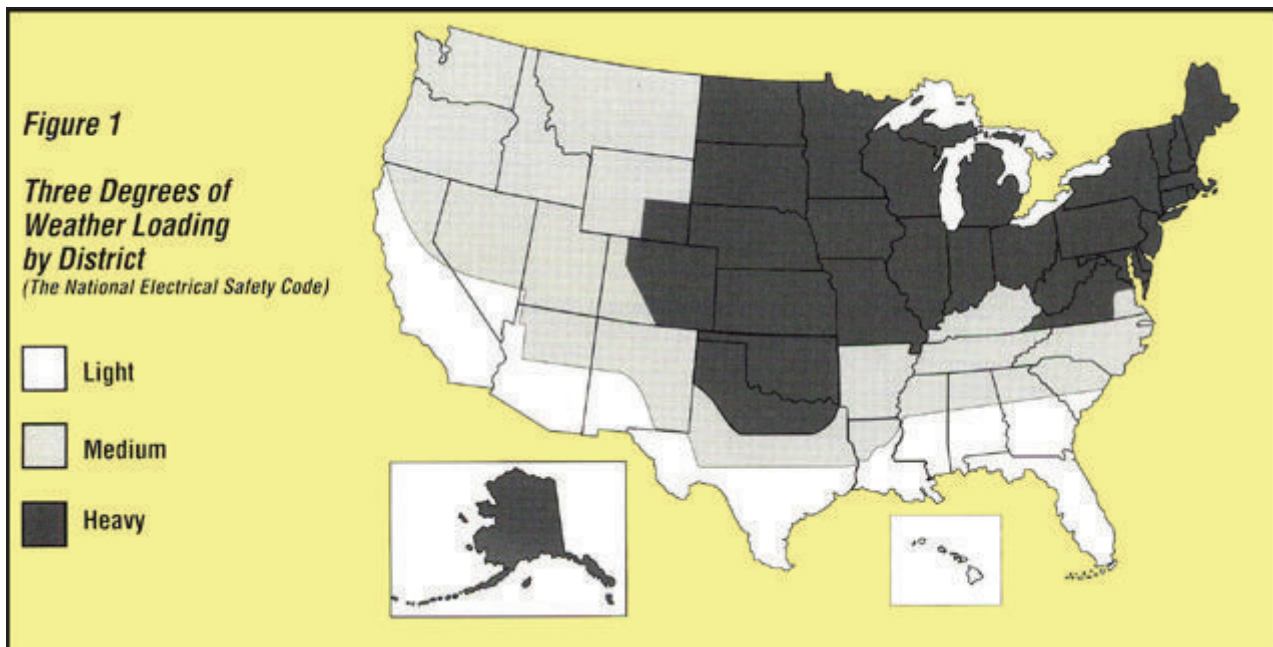
Dead Loads

Since dead loads are the weight of the members that make up a tray or tray support, they have a known value. A summation of the weights of the individual members is all that is required to calculate the dead load.

Live Loads

In cable tray design, dynamic loads are considered to be as follows:

- The design load is the weight of cables, cable tray accessories, and sometimes workers (which vary in both magnitude and position). Cable only design loads can be determined by adding the component weights of the system. Any provision for workers will require an assumption of magnitude and position—for practical purposes, an assigned weight acting at mid span of the tray.
- Parasitic loads such as ice, snow, wind, traction, and electromagnetic forces exist only because the tray exist. They are the most difficult to determine, and different assumptions can be made about their effect on the overall loadings. The following information will provide a general guide.





Loading

Three general degrees of loading due to weather conditions are recognized in the National Electrical Safety Code, and are designated as heavy, medium and light loading.

Districts in the United States in which these loadings are normally applicable are indicated in Figure 1. Values used in determining conductor loadings under these conditions for ice, wind and temperature are given in the Table 1—Degrees of Loading Due to Weather. However, modifications of these values are necessary when applied to cable tray systems, since the NESC is concerned primarily with the construction of overhead supply and communication lines. These modifications are:

Ice Loading

The NESC loading of 1/2" thickness is applied to both cables and cable tray. In applying loadings to interlocked armored cables, and bare stranded conductors or suspension cables, the coating of ice is considered as a hollow cylinder with an inside diameter equal to the outside diameter of the cable or strand. Ice is assumed to weigh 57 lbs. per cubic foot.

Snow Loading

The NESC does not consider snow loading, and in general this also applies to cable tray systems. However, in the case of a solid cover on a tray, the minimum load of 5lbs. per square foot should be used for outdoor installations where snow is a factor.

Wind Loading

The NESC loadings are modified as follows, in order to provide adequate protection against the maximum wind velocities encountered with consideration of the shapes of the various structures (not considered by NESC).

Wind velocity—in the loading tables, wind means horizontal wind. Wind velocity should be considered to be true wind speed, corrected for instrumentation errors. Any variation of velocity with height is not considered. All structures will be under 100 feet in height, and 100% of the ground velocity is assumed to be adequate.

Wind loads—the exteriors of all structures, with the exception of cylindrical structures, should be loaded with a wind pressure normal to the surface, having an intensity given by the formula:

$$W_p = C V_p$$

W_p = wind pressure in pounds per square foot

C = coefficient depending upon the size, shape, and position of the structure in the wind and having values specified in Table 2, Shape Factors

V_p = impact pressure = $0.00256V^2$ where V = the design velocity. Values of V_p may be obtained from Table 3, Impact Pressures

Wind direction and distribution—the allowance for wind pressure shall be made assuming the wind from any possible direction to be critical. Wind loads shall be considered uniformly distributed. Average annual tornado frequency, average wind velocities for different areas of the U.S. are shown in Figs. 2 and 3.

Traction Forces

Traction forces are caused by the cables starting and stopping during the cable installation period and they vary in magnitude and direction. They are of such nature, therefore, that no general assumptions can be made to provide for them. However, the safety factors selected for the basic design stresses should be conservative enough to provide for these forces when they do occur.

Table 1

Degrees of Loading Due to Weather National Electrical Safety Code Values			
Condition	Loading District		
	Heavy	Medium	Light
Radial thickness of ice (ins.)	0.50	0.25	0.00
Horizontal wind pressure (lbs./sq.ft.)	4	4	9
Temperature (degrees F)	0	15	30

Table 2

Shape Factors	
Structure	Shape Factor "C"
Isolated Structural Shapes	2.0
Trusses, Towers, Etc.	2.0
Wires, Cables, Etc.	1.2
Pipe Supports, Poles, Etc.	1.0

For trusses and towers the wind load is assumed to be acting on the projected area of the windward face only. For structures with circular cross sections, the affected area is the area projected on a vertical plane.

Loading

Electromagnetic Forces

These forces, caused by short-circuit current during a cable fault, vary in magnitude and position. It is impractical to make an assumption providing for them. Ordinarily, the safety factors selected for the basic design stresses will be adequate. However, in installations where these forces are of such magnitude that they become a factor in the design of the cable tray system, adequate provision must be made so that the design stresses are not exceeded.

(The Average Annual Number of Days with Thunderstorms for various areas of the United States are shown in Figure 4).

Dynamic Loads

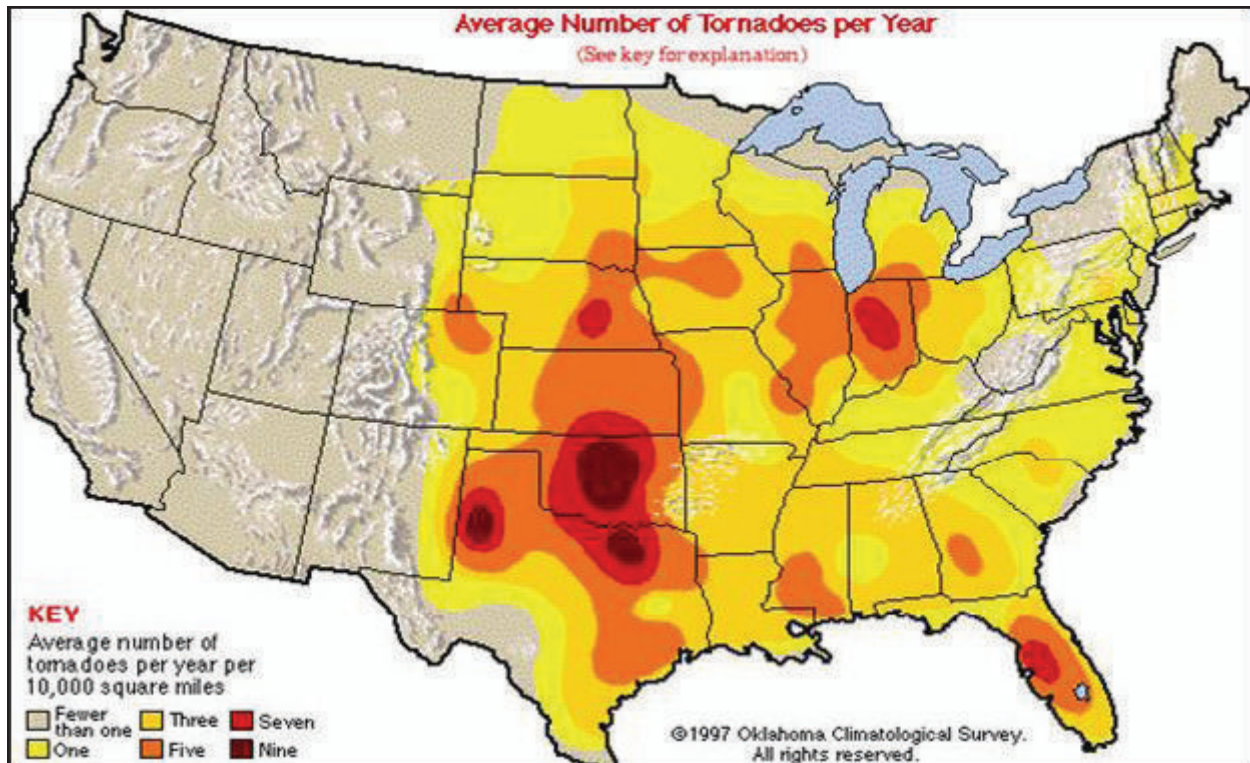
Impact loads which result because the live load is in motion, are loads in addition to the static weight of the live load. Such loads could be caused by cables being dropped onto it, or by workmen walking on it or climbing up or down a ladder leaning against it. These loads are provided for in the same manner as traction forces—the safety factors selected for the basic design stresses should be conservative enough to provide for these forces if they occur.

Table 3

V (mph)	Vp (psf)	V (mph)	Vp (psf)
15	0.58	85	18.5
20	1.02	90	20.7
25	1.60	95	23.1
30	2.30	100	25.6
35	3.13	105	28.2
40	4.09	110	30.9
45	5.18	115	33.8
50	6.39	120	36.8
55	7.73	125	40.0
60	9.21	130	43.3
65	10.80	135	46.6
70	12.50	140	50.1
75	14.40	145	53.8
80	16.40	150	57.6

These values are for an air density of 0.07651 lbs. per cu. ft. corresponding to a temperature of 60°F and barometric pressure of 14.7 lbs. per sq. in.

Figure 2





Loading

Inertia loads

Inertia loads are caused when the structure itself is in motion, such as may occur during an earthquake. It is usually considered that an earthquake gives the structure a horizontal acceleration, and the resulting acceleration and deceleration cause forces proportional to the mass and to the acceleration and deceleration. These loads represent special design requirements, and the design loading should be in accordance with the ASA's "American Standard Building Code Requirements for Minimum Design Loads in Buildings and Other Structures" or other suitable specifications. Seismic probability for various areas in the United States is given in Fig. 5.

Design Loadings

Basic cable trays are designed on the basis of maximum allowable stress for a certain section and material. Therefore, the allowable cable load will vary with span, type and width of tray. The design loadings for cable tray are given in the form of load tables. These tables appear in another section of the catalog.

The design loadings are to be used for designing standard supports, which necessitates assuming design loadings for the cable trays to be supported. If the design loadings of the cable trays exceed those listed, or if the assumptions for the loading of the open area or frame type supports exceed the conditions herein, standard supports cannot be used. Special supports must be designed on the basis of data for actual conditions.

Application of Loads

The application of all loads shall be to "conventional" or "simple" framing (unrestrained, free-ended), which assumes that the ends of the members are connected for shear only and are free to rotate under load.

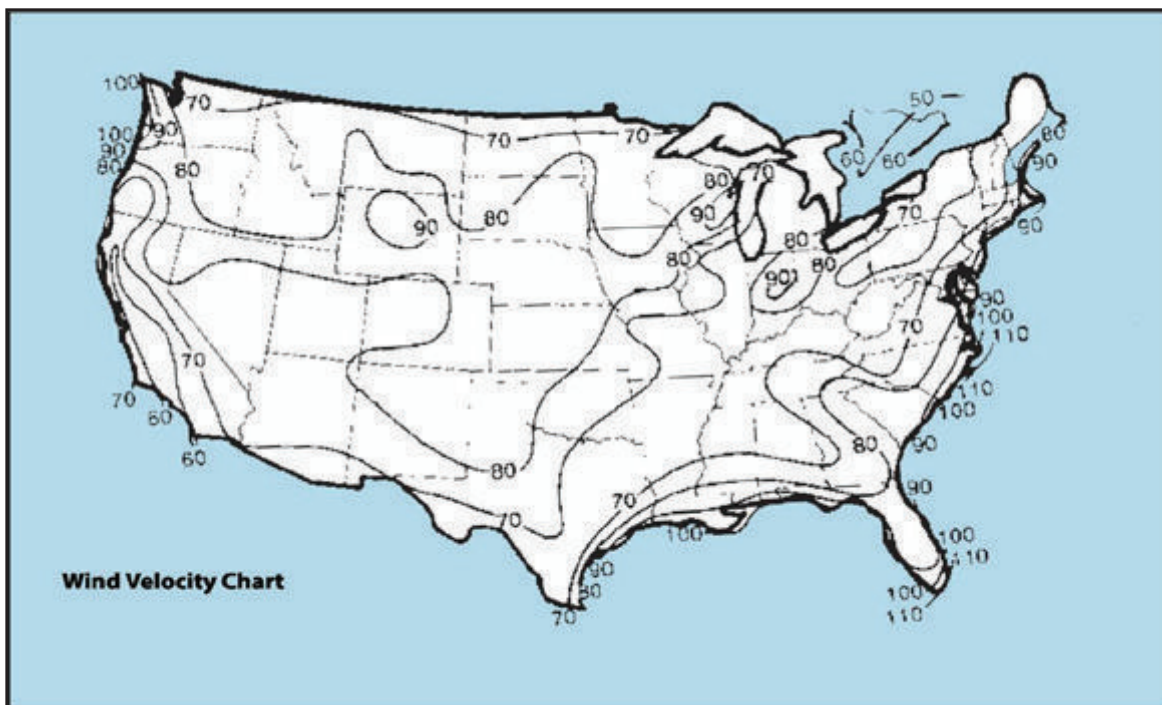
When calculating lateral strength, the lateral and vertical design loads shall be taken as acting simultaneously. It is assumed that maximum ice loads and maximum wind loads do not occur simultaneously.

When calculating longitudinal strength, the longitudinal design loads shall be taken without consideration of the vertical and lateral design.

When latticed structures are concerned, the actual exposed area of one lateral face shall be used in computing lateral and longitudinal loading.

Where a change of direction or suspension cables occurs, the loading upon the structure, including workmen, shall be assumed to be a resultant load equal to the vector sum of the lateral wind load and the resultant load imposed by the suspension cables due to their change in direction. In order to obtain these loadings, a wind direction shall be assumed which will give the maximum resultant load.

Figure 3





Loading

It is recognized that deformation, deflection, or displacement of parts of the structure, will in some cases change the effects of the loads assumed. In the calculations of stresses, however, no allowance shall be made for such deformation, deflection, or displacement of supporting structures.

Members subject to stresses produced by a combination of wind and other loads may be proportioned for unit stresses 33.3% greater than those specified for dead and live load stresses provided the section thus required is not less than that required for the combination of dead load, live load, and impact (if any). A corresponding increase may be applied to the allowable unit stresses in their connecting rivets, bolts, or welds.

Members subject to stresses produced by the assumed Class 1 tray lateral loading may be proportioned as specified for wind loads.

Determination of Design Loadings

The following procedures and values for design loadings have been established by MP Husky. The data is based on test results under various installation conditions, and the experience of practical application in the design of components and systems.

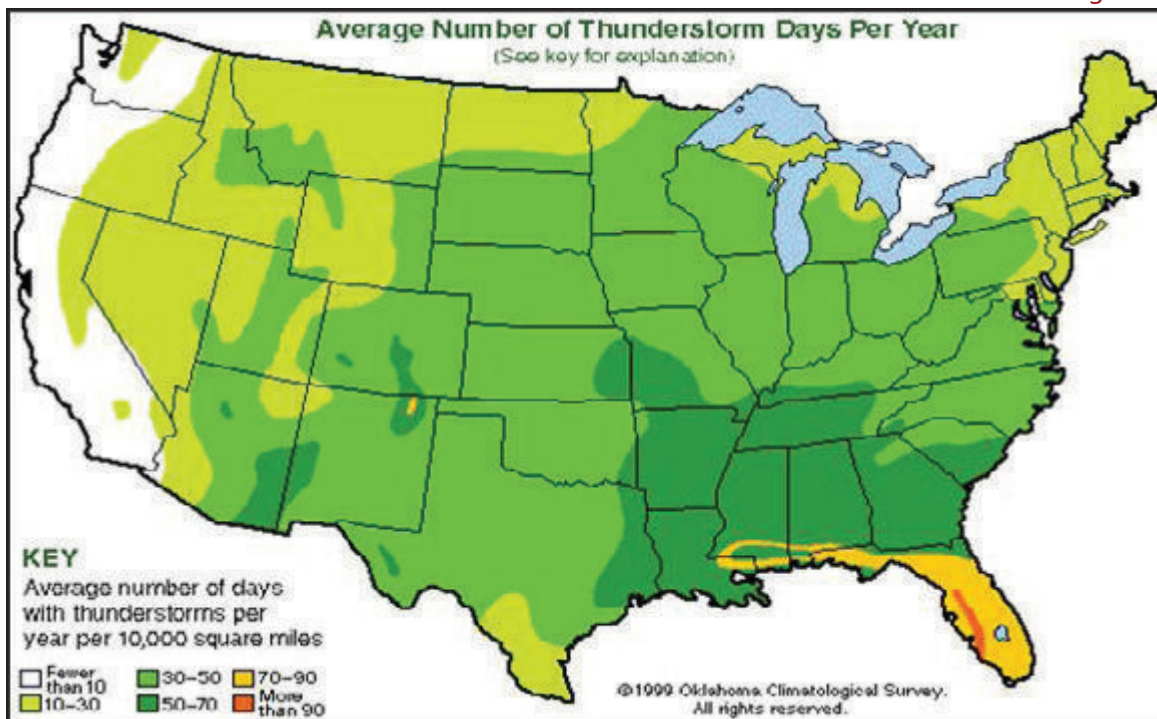
In each instance, the loadings are given for three classes of design conditions as shown in Table 4, Design Conditions.

These classifications have been established from modifications of the National Electrical Safety Code's "Degrees of Loading Due to Weather Conditions".

Table 4

Design Conditions			
Location	Class 1 Indoor	Class 2 Outdoor	Class 3 Outdoor
Wind Velocity (mph)	0	25.0	100.0
Wind Pressure (psf)	0	1.6	25.6
Ice (in)	0	0.5	0.5

Figure 4





Loading

Cable Tray Loading (tray in horizontal position)

Vertical Design Loading

CLASS 1

The loading shall be a uniformly distributed load of 40 lbs. per foot, equivalent to the vertical load per foot of the cables, tray and accessories.

CLASS 2

The loading shall be a uniformly distributed load of 52 lbs. per foot, equivalent to the vertical load per foot of ice-covered cables and tray. The weight of ice computed on the basis of 1/2 inch thickness and 57 lbs. per cubic foot density.

CLASS 3

Same as for Class 2. Values established for the above (lbs. per linear foot)

Class 1: 40 Class 2: 52 Class 3: 52

Lateral Design Loading

CLASS 1

The loading shall be a uniformly distributed load of 120 divided by span length (in feet) lbs. per foot, equivalent to a 50lb ladder leaning against the tray at an angle of 75° with horizontal plane and 200 lbs man at mid span. (A position of the man on the ladder shall be assumed which will give the maximum resultant loading on the tray.

CLASS 2

The loading shall be lateral, horizontal wind pressure of 1.6 lbs. per square foot upon the projected area of a 4 inch deep ice-covered tray multiplied by a shape factor of 2.0, or the design loading for Class 1 if it is greater.

CLASS 3

The loading shall be a lateral, horizontal wind pressure of 25.6 lbs. per square foot upon the projected area of a 4 inch deep tray without ice-coating multiplied by a shape factor of 2.0. Values established for the above (in pounds per linear foot)

¹²⁰
Class 1: $\frac{120}{sp}$ Class 2: 1.33 Class 3: 17

Longitudinal Design Loading

CLASS 1

Same as Class 3.

CLASS 2

Same as Class 3.

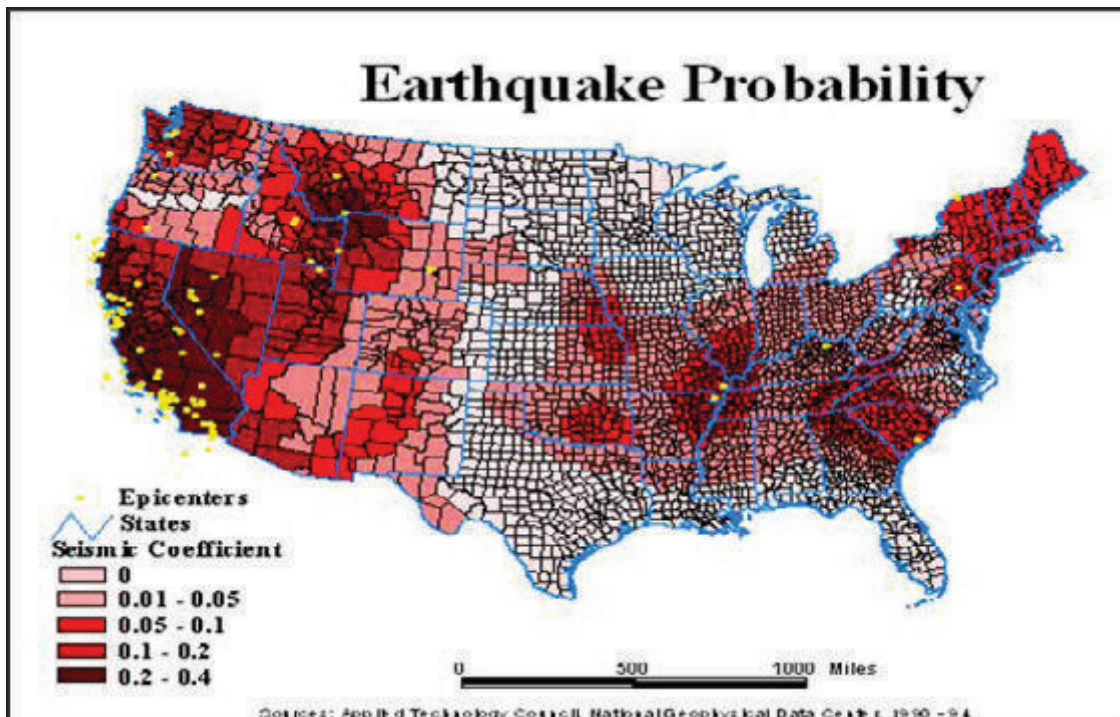
CLASS 3

The loading shall be a lateral, horizontal wind acting against the tray at an angle of 45° to the longitudinal axis and on the projected area of a 4 in. deep tray (without ice-coating) with a pressure of 25.6 lbs. per square foot multiplied by the shape factor of 2.0. Longitudinal design Loading as above will insure adequate provision for traction forces when they occur.

Values established for the above (lbs. per linear foot)

Class 1: 12 Class 2: 12 Class 3: 12

Figure 5





Loading

The concept of “**Cables in Free Air**” for power distribution and control cables has been adopted primarily for economic reasons. Cable tray support systems should be designed, whenever possible, for minimum installed cost. In order to achieve this objective, the engineer must bear in mind that the general design rules established for aluminum and steel structures are not always compatible with design rules for a cable tray system. This is particularly applicable in the case of restrictions on deflection.

Since the most economical cable tray system uses heat treated aluminum alloys, or high strength steels with long spans, any limitation on deflection which will not permit the best utilization of material and design will increase the cost. By limiting the maximum fiber and shear stress used in the design the adequacy and safety of the structure is assured.

Why Limit Deflection?

The primary reason to limit deflection in cable tray systems is appearance. Engineers and owners take pride in the appearance of their installations. So rigid restrictions on deflection of cable trays installed at eye level or in a prominent location are common. However, it is neither economical nor good engineering practice to restrict deflection of a cable tray system in less prominent areas.

Methods of Decreasing Deflection

There are various ways to limit deflection of a cable tray. If the objective is minimal installed cost, they should be considered in this order:

- **Decreasing stress by decreasing the bending moment.** This can be accomplished by introducing restraining moments at the end of a span in the form of a rigid support. The deflection in a continuous beam, with negative bending moments at the intermediate support points, is only a fraction of the deflection in a simple beam.
- **Increasing depth of the tray.** Deflection in any location can be reduced by increasing the depth of the load-carrying side members and/or by adding to their cross-sectional area. Adding to the depth generally utilizes the material most economically.
- **Increasing modulus of elasticity.** Since the modulus of elasticity of steel is 29×10^6 psi, and that of aluminum alloys is only 10×10^6 psi, greater deformation of aluminum alloy trays is to be expected at any given stress level. Under its own weight, an aluminum beam will deflect the same amount as an identical steel beam, since not only the weight, but also the modulus of elasticity is only one-third that of steel. However, under the same applied load (disregarding the beam's own weight), aluminum will deflect almost three times as much as steel.

- Therefore, consideration must be given to the choice of material for any one location, for an isolated run or for an entire installation.
- **Decreasing span length.** For economic reasons, this method of reducing deflection should be a last resort, since it increases field labor considerably. However, it can be an effective means to improve the appearance of an installation when the number of spans to be reduced is small in comparison to the number in the entire installation.

Deflection Criteria Applied to Cable Tray

Design rules and specifications developed for steel should not be applied to aluminum alloys since this would not permit the most economical use of these materials. Deflection criteria which apply only to steel, and should not be used when the most economical system is desired include:

- **Span-deflection ratio** - Example: Deflection is limited to 1/300 of the span by the National Electrical Manufacturers Association specifications for structures supporting air switches. While very important in that instance, as even slight deflection could cause misalignment in the operating mechanism and result in binding and difficult switch operation, the application of this specification to a cable tray is uneconomical and not recommended.
- **Depth to span ratio** - Example: The American Institute of Steel Construction, in the specifications for buildings, specifies the depths of beams and girders in floors to be not less than 1/24 of the span, or not less than 1/20 of the span where shock or vibration may be encountered. This specification ensures a certain rigidity and levelness of the structure which is important in that instance, but cannot be justified for cable tray systems because of the higher cost involved.
- **Deflection constant** - Example: Deflection is limited to a certain amount by an engineering company for a tray system. While such specifications might make a system using 8-foot spans look better, it prohibits the use of more economical designs with longer spans which have a much greater deflection and still look acceptable. Such a specification increases the cost of the tray system unnecessarily, especially if the trays are to be installed well above eye level.

Summary

As a guide, a span-deflection ratio of around 1/200 satisfies most owners. This ratio provides an allowable deflection of 0.6" in a 10-foot span, 0.72" in a 12-foot span, and 1.20" in a 20-foot span under the actual loads encountered. Data for calculating deflection is presented in Table 5, **Constants for Beam Deflections**.



Deflection

Table 5



Constants for Beam Deflection

		2 Span	3 Span			4 Span		5 Span			
r	Free Beam	Span 1 Span 2	Span 1 Span 3	Span 2	Span 1 Span 4	Span 2 Span 3	Span 1 Span 5	Span 2 Span 4	Span 3	Fixed Beam	r
0	0	0	0	0	0	0	0	0	0	0	12
1	2.94	1.490	1.800	-0.363	1.680	-0.155	1.71	0.251	0.337	0.190	11
2	5.79	2.780	3.360	-0.311	3.180	0.078	3.24	0.389	0.804	0.691	10
3	8.03	3.970	4.640	-0.078	4.400	0.544	4.37	1.710	1.810	1.23	9
4	9.75	4.450	5.500	-0.181	5.220	1.020	5.10	2.570	2.200	1.77	8
5	10.88	4.570	*5.910	-0.389	5.530	1.350	5.65	3.130	2.450	2.14	7
6	11.31	4.490	5.860	-0.449	5.470	1.620	5.56	4.150	2.720	2.25	6
7	10.88	3.980	5.360	-0.389	4.970	1.640	4.88	3.320	2.450	2.14	5
8	9.75	3.160	4.480	-0.181	4.110	1.360	4.19	3.200	2.200	1.77	4
9	8.03	2.080	3.270	-0.078	2.930	1.030	3.01	2.590	1.810	1.23	3
10	5.79	1.180	2.090	-0.311	1.830	0.640	1.89	1.850	0.804	0.691	2
11	2.94	0.285	0.804	-0.363	0.657	0.147	0.70	0.838	0.337	0.190	1
12	0	0	0	0	0	0	0	0	0	0	0

*Maximum Deflection for Continuous Beams up to and including 5 spans.

$$\Delta = C \frac{W_c l^4}{EI} \quad \text{where}$$

Δ = Deflection (inches)
 W_c = Carrier Load (lbs/ft)
 l = Span Length
 E = Modulus of Elasticity (psi)
 I = Moment of Intertia of Carrier Stringer (in⁴)
 C = Values shown in table

Example: A cable tray with specified load has a simple beam deflection of 1.92 inches at mid-span. Find the deflection for the fifth span of the 5-span installation. From the table above, the maximum constant in the free beam columns is 11.31. Note that this is the center of the span. For the 5-span installation, the maximum constant in the 5-span column is 5.65, which is not in the center, but 7/12 of the span length from the support between spans 4 and 5. The maximum deflection of this fifth span is given by:

$$\Delta = 1.92 \times \frac{5.65}{11.31} = 0.96 \text{ inches}$$

Electrical Equipment & Grounding

A cable tray system must provide protection to life and property against faults caused by electrical disturbances, lightning, failures which are a part of the system, and the failure of equipment that is connected to the system. For this reason, all metal enclosures of the system, as well as non-current carrying or neutral conductors, should be tied together and reduced to a common earth potential.

This includes the structural steel of a building, all piping for water, gas, steam, and sewers, tanks, well casings, down spouts, gutters, siding and roofing. There are two distinct divisions to the grounding problem:

System grounding and Equipment grounding.



Electrical Design & Grounding

The following explanation gives the reasons for grounding, and how to provide for it.

System Grounding

The purpose of system grounding is to drain off any excessively high voltages that may accidentally come on the tray system. If the system is properly grounded by means of a low-resistance conductor of sufficient capacity, the current will be carried off to earth immediately with a minimum danger of fire or shock. In a grounded system, an accidental grounding of one of the current carrying conductors will result in a short circuit, and cause a fuse or circuit breaker to open.

Equipment Grounding

Equipment grounding means the connection to earth of all exposed, non-current carrying metallic parts of the components of the distribution system. The purpose of this ground is to prevent a voltage higher than earth potential on cable tray or equipment. Grounding thus reduces the danger of shock or fire in the event a live conductor comes in contact with these conductive parts.

Methods of Grounding

Effective grounding must be permanent and continuous, and have ample capacity to safely conduct any current likely to be imposed on it. It should also have impedance sufficiently low to limit the potential above ground and to facilitate operation of over-current devices in the circuit. A continuous, underground metallic water supply system is acknowledged to be the best electrical ground. Other suitable methods of grounding include continuous metallic steam and gas piping systems, the grounded metal framing of the building,

or an artificial electrode such as a driven steel pipe, galvanized or otherwise protected from corrosion, or a buried metallic plate.

The tray system and equipment ground connections should be made to the same electrode at the service entrance, on the supply side of the equipment used for disconnecting the service. Equipment should be solidly tied in with the system ground. It is also important, that wherever multiple grounds are used, they be tied together in order to avoid any difference of potential between the various parts of the tray system.

Complete rules for grounding are contained in Article 250 of the National Electric Code.

Electrical Properties of Cable Tray

MP Husky has always recognized the importance of electrical design, as well as structural design, to provide positive, safe protection to personnel, facility and equipment. Thorough testing has proven that the cable support system must be electrically designed for maximum carrying capacity, in that: power cables may have short circuit capacity from 5000 to 150,000 amperes, and the division of fault current places considerable burden on the support system, even though adequate grounding has been provided. Table 6 shows the division of fault current determined by tests of an aluminum and a steel interlocked armored 3-conductor 4/0 cable on a MP Husky aluminum cable ladder.

It is not the purpose or intent that the support system be used for a continuous ground, but to provide extremely high one second current carrying capacity as a safety feature. The entire system should be grounded at periodic intervals to keep the potential at or below 100 volts in case of a cable fault. MP Husky cable trays are classified by Underwriters Laboratories® as to their suitability as an equipment grounding conductor only.

Division of Fault Currents

Table 6

	Steel	Armored	Cable	Aluminum	Armored	Cable
Fault Current Path	% through armor	% through ground wire	% through ladder	% through armor	% through ground wire	% through ladder
Armor and Ladder	50	--	50	23	--	77
Armor, External Ground Wire and Ladder	50	23	27	17	37	46
Armor, Internal Ground Wire and Ladder	5	74	21	9	54	37



Electrical Design & Grounding

UL Grounding

Table 7

Electrical Properties of Cable Trays						
Product			Resistance Across One Foot of Rail (Microhms/ft)	Resistance Across Splice (Microhms)	Resistance of 12ft. Length with Splices (Microhms)	Copper Equivalent (MCM)
SHA	S()HA		234	57	1461	83
SJ2	S()J2	S()B2	230	68	1448	94
SKC	S()KC	S()FC	163	69	1047	108
SY	S()Y	S()C	144	59	923	160
SY1	S()Y1	S()C1	103	40	658	222
SYA	S()YA	S()CA	182	58	1150	129
SYD	S()YD	S()CD	163	75	1053	143
SM61	S()M61	S()P61	110	40	700	128
SM14	S()M14	S()P14	89	31	565	160
SMC	S()MC	S()PC	108	39	687	110
SMD4	S()MD4	S()PD4	124	38	782	133
SX	S()X	S()E	116	44	740	203
SX1	S()X1	S()E1	88	43	571	283
SXB	S()XB	S()EB	111	35	701	155
SXC	S()XC	S()EC	98	35	623	193
SXD	S()XD	S()ED	93	32	590	215
AJA	A()JA	A()BA	27	12	174	712
AJB	A()JB	A()BB	27	12	174	712
AY	A()Y	A()C	19	11	125	1024
AY1	A()Y1	A()C1	18	11	119	1305
AYA2	A()YA2	A()CA2	31	12	206	819
AMC	A()MC	A()PC	23	8	146	944
AX	A()X	A()E	18	8	116	1268
AX1	A()X1	A()E1	14	7	91	1499
AXA	A()XA	A()EA	26	13	169	981
AIXB	A()IXB	A()IEB	19	16	130	1282
AIXC	A()IXC	A()IEC	17	11	113	1539
		A()I6	15	6	96	1835
SG-4			121	50	776	160
SG-6			68	33	441	203
AG-4			26	22	178	1024
AG-6			24	9	153	1268

Note:

For electrical properties of pre-galvanized cable trays, refer to the electrical properties given above for hot dipped galvanized cable trays of the same style.

Example: For electrical properties of PHA cable tray, refer to SHA in the above table.

Sizing

Sizing Trays for Multiple-Conductor Cables

Section 392.2 lists the requirements for installing multiple-conductor cables in ladder, ventilated trough, solid-bottom, or ventilated channel type trays.

For ladder or ventilated trough trays, the diameter of all cables No. 4/0 and larger must be added together and the total must not exceed the width of the cable tray. Cables must be placed side by side. Table 392.9, Column 1 is used for cables less than 4/0. These cables do not have to be placed side by side. Table 392.9, Column 2 is used for a combination of cables rated larger than 4/0 and smaller than 4/0.

The total cross-sectional areas of the cables in trays with an inside depth of 6" or less, containing control and/or signal cables must not exceed 50% of the cross-sectional area of the tray.

For solid bottom trays, the diameter of all cables No. 4/0 and larger must not exceed 90% of the cable tray width. Table 392.9, Column 3 is used for cables smaller than 4/0. Table 392.9, Column 4 is used for a combination of cables rated 4/0 or larger, or less than 4/0.

For trays with an inside depth of 6 inches or less, containing control and/or signal cables, the total cross-sectional areas of the cables must not exceed 40% of the cross-sectional area of the tray.

For ventilated channel type trays, the total cross-sectional areas of all cables must not exceed 2.5 square inches for 3 inch wide trays or 3.8 square inches for 6 inch wide trays.

Sizing Trays for Single Conductor Cables

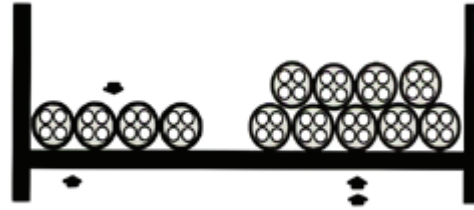
For ladder or ventilated trough trays, the total diameter of all cables 1000MCM and larger must not exceed the width of the cable tray. Table 392.10, Column 1 is used for cables smaller than 1000MCM. Tables 392.10, Column 2 is used for a combination of cables rated 1000MCM and larger, and smaller than 1000MCM.

For ventilated channel type trays, the total diameter of all cables must not exceed the inside width of 4" or 6" wide trays.

Problem:

What size ladder-type cable tray is required for nine multi-conductor smaller than 4/0 and four multi-conductors larger than 4/0? The total diameter (in inches) for the 4/0 and larger cables is 12.6" and the total area for cables rated less than 4/0 is 22 sq. in.

Cable tray width must be selected from Table 392.9 and be based on the calculation in Column 2.



Note: Square inch area of cables obtained from manufacturer.

Step 1: 392.9 (a) (3)

Sq. in. of cables smaller than 4/0 = 22 sq. in.

Diameter of cables larger than 4/0 = 12.6 in.

Step 2: Table 392.9

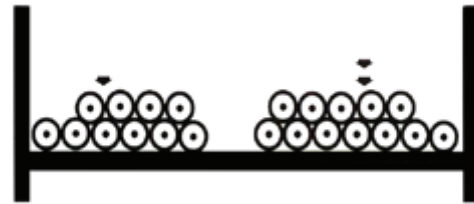
22 sq. in. + (12.6 x 1.2) = 37.12 sq in.

A 36" tray has 42 sq. in. area

Answer: The inside width of the cable tray must be equal to 36".

Problem:

What size tray is required for ten No. 250 MCM RHH RHW copper conductors and twelve No. 750 MCM RHH RHW copper conductors laid in a ladder-type tray?



Cable tray must be selected from Table 392.10, Column 1 based on square inch area.

Step 1: 250 MCM = .554 sq. in.

750 MCM = 1.286 sq. in.

Step 2: Table 392.10 (a) (2) Table 392.10, Column 1

.554 x 10 = 5.54 sq. in. + 1.286 x 12 = 15.43 sq. in. = 20.97 sq. in.

Step 3: Table 392.10, Column 1

18" wide tray = 19.5 sq. in.

24" wide tray = 26.0 sq. in.

Answer: The inside width of the cable tray must be equal to 24".



Formulas & Conversions

Convert a Concentrated Load to Pounds per Linear Foot:

$$\text{Formula: } W_e = \frac{2 \times (\text{Concentrated Load})}{\text{Span (Ft)}}$$

Where

Concentrated Load = 200 pounds

Span = 20 feet

W_e = Converted Load in pounds per linear foot

$$\text{Calc: } \frac{2 \times 200}{20} = 20 \text{ lbs/ft}$$

Formula: Concentrated Load times 2 divided by the support span.

Example: A 200 pound concentrated load on a 20 foot span would be a load of 20 additional pounds per linear foot. This load can be added to the uniform cable load for a total load and compared to a load shown in a load deflection table.

Convert a Load with a 1.5 Safety Factor to a Load with a 2.0 Safety Factor:

$$\text{Formula: } W_k \times \text{Multiplier}$$

Where

W_k = 100 pounds per foot

Safety Factor = 1.5

Multiplier 0.75 for 2.0 safety factor, 0.60 for 2.5 S.F.

$$\text{Calc: } 100 \times 0.75 = 75 \text{ lbs/ft}$$

Formula: Multiply the load shown with a 1.5 safety factor by 0.75 to convert the load to a 2.0 safety factor.

Example: A load of 100 pounds per foot with a 1.5 safety factor would be 75 pounds per foot with a 2.0 safety factor. The multiplier for a 2.5 safety factor would be 0.60.

Obtain a Deflection for a Load that is smaller than a Load Shown in a Load Deflection Table:

$$\text{Formula: } D_2 = \frac{W_2}{W_1} \times D_1$$

Where

D_2 = Calculated Deflection with smaller load

W_2 = 150 lbs/ft Smaller Desired Load

W_1 = 200 lbs/ft load in load table

D_1 = 1.5" Deflection for 200 lb load in table

S = 12 Foot Span in Deflection Table

$$\text{Calc: } \frac{150}{200} = 0.75 \times 1.5" = 1.125"$$

Formula: Divide the desired load by the load shown in the load deflection table and multiply the answer times the deflection shown for the known load in the load deflection table.

Example: If the load table shows 200 pounds per foot on a 12 foot span with 1.5 inches of deflection and you want to know the deflection for a 150 pounds per foot on the 12 foot span you would divide the load desired (150) by the load known (200) and multiply the answer (0.75) times the known deflection (1.5"). The answer would be 1.125" deflection at 150 pounds per foot on a 12 foot span.

Formulas & Conversions

Calculate a Load for a Shorter Span that is not shown in a Load Deflection Table:

Formula: $W_2 = W_1 \times L_1^2 / L_2^2$

Where
 W_2 = Calculated load for the 10' span
 W_1 = Tested 100 lb/ft load or load in load table
 L_1 = Tested 12' span or span in load table
 L_2 = Shorter 10 ft span not tested or in load table

Calc: $\frac{100 \times 12^2}{10^2} = 144 \text{ lbs/ft on } 10'$

Formula: Take the load of a known span times the span length squared and divide by the span desired squared.

Example: The load table shows 100 pounds per foot on a 12 foot span with a deflection of 1.5 inches. To find the load for a 10 foot span that is not in the table you take the load known (100) pounds times the span (12) foot squared then divide the answer (14,400) by the span desired (10) foot squared. The result is 144 pounds per foot on a 10 foot span. Do not calculate longer spans with this formula.

Part 2 Calculate the deflection for the new load of 144 pounds per foot on a 10 foot span:

Formula: $D_2 = \frac{W_1}{W_2} \times D_1$

Where
 D_2 = Calculated deflection for new load
 W_2 = 144 lbs/ft new 10' span desired load
 W_1 = 100 lbs/ft load in load table
 D_1 = 1.5" Deflection for 12' span 100 lb/ft load in table
 S = 12 Foot Span in Deflection Table

Calc: $\frac{100}{144} = 0.6944 \times 1.5" = 1.0416"$

Formula: Divide the new desired load for the 10 foot span by the known load for the 12 foot span and multiply the answer times the deflection for the known load on the 12 foot span.

Example: Take the load on the known span (100) pounds and divide by the new desired load (144) pounds. Take the result (0.6944) times the known span deflection (1.5) inches to get 1.0416 inches. The 144 pound load on a 10 foot span would have a deflection of 1.0416 inches. Catalog Deflections are based on simple beam support spans.



Request for Quote

For a working estimate, please provide the information requested below, along with a sketch of your system (optional) and fax both to MP Husky at (864) 234-4822. You will be contacted if more information is required. A completed estimate and proposal will be returned as soon as possible.

From:	Project Name _____
Name _____	Engineer _____
Company _____	Contact _____
Address _____	Location _____
Phone # _____	Bid Due Date _____
Fax # _____	Quotation No. _____
Email: _____	Agency Name _____
	Delivery Date _____

Required Information

Type of Tray	Type of Material	Radius of Fittings	Side-rail Height	Tray Width
☐ Husky Ladder (Flange Out)	☐ Aluminum	☐ 12 in.	☐ 3 in.	☐ 6 in.
☐ 9 ☐ 12 ☐ 18 Rung Spacing	☐ Pregalvanized	☐ 24 in.	☐ 4 in.	☐ 9 in.
☐ Husky Ladder (Flange In)	☐ HDGAF	☐ 36 in.	☐ 6 in.	☐ 12 in.
☐ 6 ☐ 9 ☐ 12 Rung Spacing	☐ Stainless 304		☐ 7 in.	☐ 18 in.
☐ Husky Trough	☐ Stainless 316		☐ 8 in.	☐ 24 in.
☐ Solid or ☐ Ventilated Bottom	☐ Galvannealed		☐ 10 in.	☐ 30 in.
☐ Husky Channel ☐ 4" Wide ☐ 6" Wide				☐ 36 in.
☐ Solid or ☐ Ventilated Bottom				
☐ Husky Techtray ☐ Husky Centray Depth _____ Centray—Bottom or Top Rung? _____ Rung Spacing ☐ 3 ☐ 6 ☐ 9 ☐ 12 ☐ 18	☐ Husky Way ☐ EMI			

Support Span	Safety Factor	Covers	Other Specs
☐ 6 ft.	☐ 1.5 (Standard)	☐ Aluminum	NEMA Class _____ lbs./linear foot
☐ 8 ft.	☐ 2.0	☐ Steel	CSA Class _____ kg/mm
☐ 10 ft.		☐ Pregalv, HDGAF, Stainless (Circle One)	
☐ 12 ft.		☐ Flat	Load _____ lbs./linear foot
☐ 16 ft.		☐ Flanged	Conc. Load _____ lbs.
☐ 20 ft.		☐ Louvered	Deflection _____ in. with _____ lbs. loaded
☐ 24 ft.		☐ Hat Shapeed	
☐ 30 ft.		☐ Peaked	