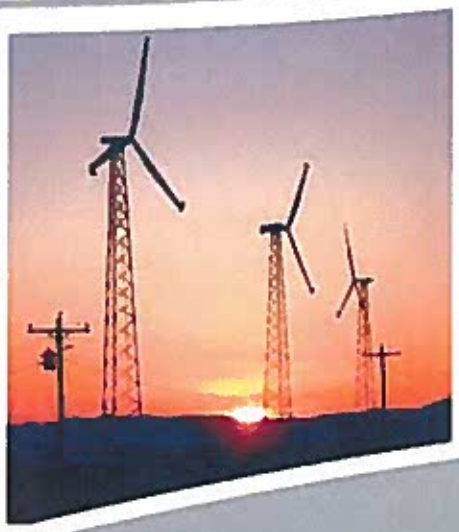
UNDERSTANDING TIA-222 - REVISION G



UNDERSTANDING TIA-222 - REVISION G

What is Rev G?
Rev G is the latest revision of the TIA-222 Standard "Structural Standards for Antenna Supporting Structures and Antennas". The previous version of the Standard was Rev F. Rev G is based on a 3-second gust wind speed and Rev F is based on a fastest-mile wind speed. The wind speeds are not directly comparable and it is very important to define the basis of a wind speed when specifying wind loading requirements. For a given location, the 3-second gust wind speed represents the peak gust wind speed whereas the fastest-mile wind speed represents the average wind speed over the time required for one mile of wind to pass the site.

Rev G presents additional factors to be considered in the design of new structures and for the modification of existing structures. These factors are briefly discussed below. The reliability requirements of a structure can now be accounted for by assigning a classification to a structure (Class I, II or III). The wind speed can also be adjusted based on the type of terrain surrounding the site (Exposure B, C or D) and if the site is located on a hill, ridge or escarpment (Topographic Category 1-5).

Many tower profiles in this catalog now include antenna loading capacities for both Exposure B and Exposure C terrain conditions located on relatively flat sites (Topographic Category 1). Antenna loading capacities in accordance with Rev F are also provided for many tower profiles in the catalog. Please refer to the design notes in the catalog for each tower model series for further explanations. The Class of structure is stated in the design notes. Conditions other than stated may require a different tower profile than illustrated in this catalog. Quotes may be obtained for a specific application by contacting your ROHN representative.

Classification of Structures
Allows for the adjustment of wind, ice and earthquake loading to match the reliability requirements for a specific application. Three reliability classes have been established based on the type of service provided and on the structure's potential hazard to human life and property. Wind, ice and earthquake loading progressively increase from Class I to Class III structures.

Class I: Structures used for services where a delay in returning the service would be acceptable and the structure represents a low hazard to human life and/or property. Example services would be: residential wireless and conventional 2-way radio communications; television, radio and scanner reception; wireless cable, amateur and CB radio communications. Structures of this classification are exempt from ice and earthquake loading.

Class II: Structures used for services that may be provided by other means or structures that represent a significant hazard to human life and/or property. Example services would be: commercial wireless communications; television and radio broadcasting; cellular, PCS, CATV and microwave communications.

Class III: Structures specifically designed for essential communications or structures that represent a substantial hazard to human life and/or property. Examples of essential communications would be: civil or national defense; emergency, rescue or disaster operations; military and navigational facilities.

What is EPA?
EPA stands for Effective Projected Area. It is a standard way to define the "size" of an antenna regarding wind loading. Many antenna manufacturers provide data sheets that specify the EPA of their antennas. The TIA standard also defines a method to calculate the EPA of an antenna based on the size and type of the antenna components.

Generally, the EPA of an antenna, mount or accessory is equal to the summation of the projected areas of its components times appropriate drag factors defined in the TIA Standard. The EPA values listed in this catalog for standard tower designs represents the maximum EPA that may be supported unless otherwise indicated.

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What is Exposure?
Exposure categories are used to adjust wind loading based on the type of terrain surrounding a site. Reduced wind loads are associated with rougher terrains that tend to slow the wind down. Three exposure categories have been defined based on terrain roughness. Wind loading is increased as the exposure designation changes from Exposure B (roughest terrain) to Exposure D (smoothest terrain).

Exposure B: Urban, suburban or wooded areas. The wind load at ground level is reduced compared to Exposure C. This reduction diminishes with height, making the overall wind reduction less significant for taller structures. In order to qualify for the wind load reduction, the rough terrain must extend in all directions from the site at least twenty times the height of the structure, but not less than one-half mile.

Exposure C: Flat, open country and grasslands.

Exposure D: Flat, unobstructed shorelines exposed to wind flowing over open water, smooth mud flats, salt flats and other similar terrain. The wind load at ground level is increased compared to Exposure C.

Topographic Categories
Topographic categories are used to determine increases in wind loading for sites located on hills and other elevated locations (other than buildings). The shape and relative height (topography) of an elevated site determines the increase in wind load. Although many elevated sites have their own unique features, the intent is to idealize these sites into one of the standard topography categories described below.

The height of an elevated site above the surrounding terrain must be specified in order to determine the increase in wind loading. Height should not be confused with the elevation of the site. As described below, elevations of the site and the surrounding terrain must be used to determine the relative height of a site. For structures supported on buildings, it is only necessary to specify the height of the building and the surrounding exposure category.

Category 1: Flat or rolling terrain with no abrupt changes in general topography. No increase in wind loading is required for this category.

Category 2: Sites separated from a lower elevation by a gently sloping terrain (escarpment). Wind loads at the crest are 2.0 times the wind loads for a flat site and diminish with height depending on the height of the escarpment.

Height for an escarpment is the difference in elevation between the upper and lower levels. Increased wind loads do not apply for structures located in the lower half of the sloping terrain or located beyond 16 times the escarpment's height from the crest.

Category 3: Sites located at the top or within the upper half of a hill. Wind loads at the top of a hill are 2.3 times the wind loads for a flat site and diminish with height depending on the relative height of the hill.

Height for a hill is the difference in elevation between the top and bottom of the hill. For sites surrounded by other hills, height is the difference in the hill elevation at the site and the average elevation of the surrounding hills (within a 2-mile radius). In other words, height is the projection of the hill exposed to wind. When there are other hills surrounding the site, increased wind loads do not apply unless the height of the hill at the tower site is at least 2 times the average height of the surrounding hills. (Refer to sketch above.)

Topographic Categories continued on next page.

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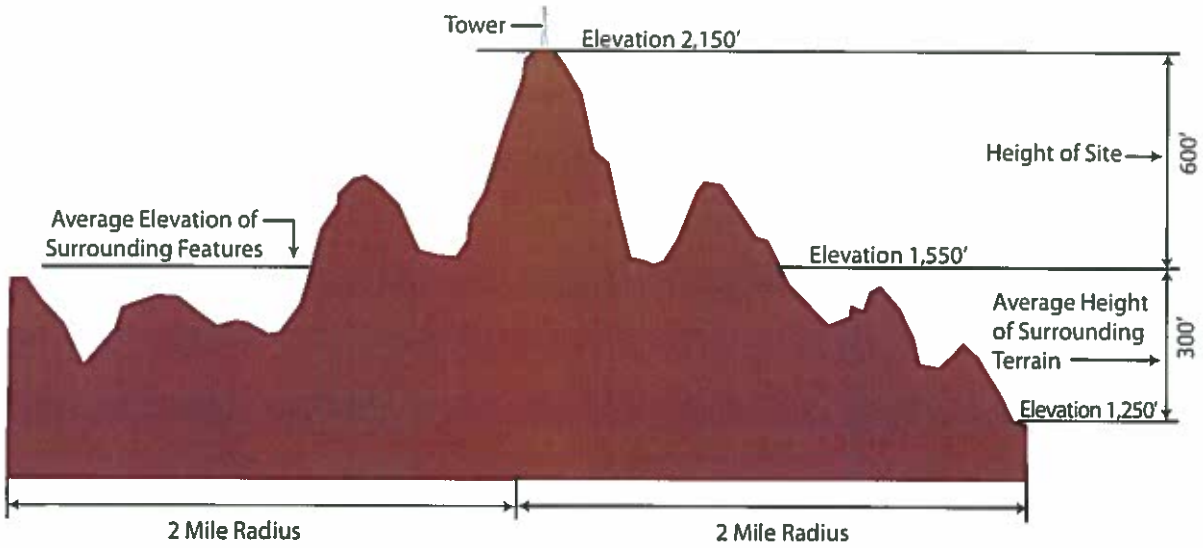

H = 2,150' - 1,550' = 600'

Wind speed-up must be considered when H exceeds 2 times the average height of surrounding features.

Category 4: Sites located on a ridge. Wind loads at the top of a ridge are 3 times the wind loads for a flat site and diminish with height depending on the height of the ridge.

Height for a ridge is the difference between the top and bottom elevations of the ridge.

Category 5: This category is reserved for sites where site-specific investigations are performed to determine wind loading. A site-specific investigation may result in either higher or lower wind loads compared to using one of the standard topographic categories.

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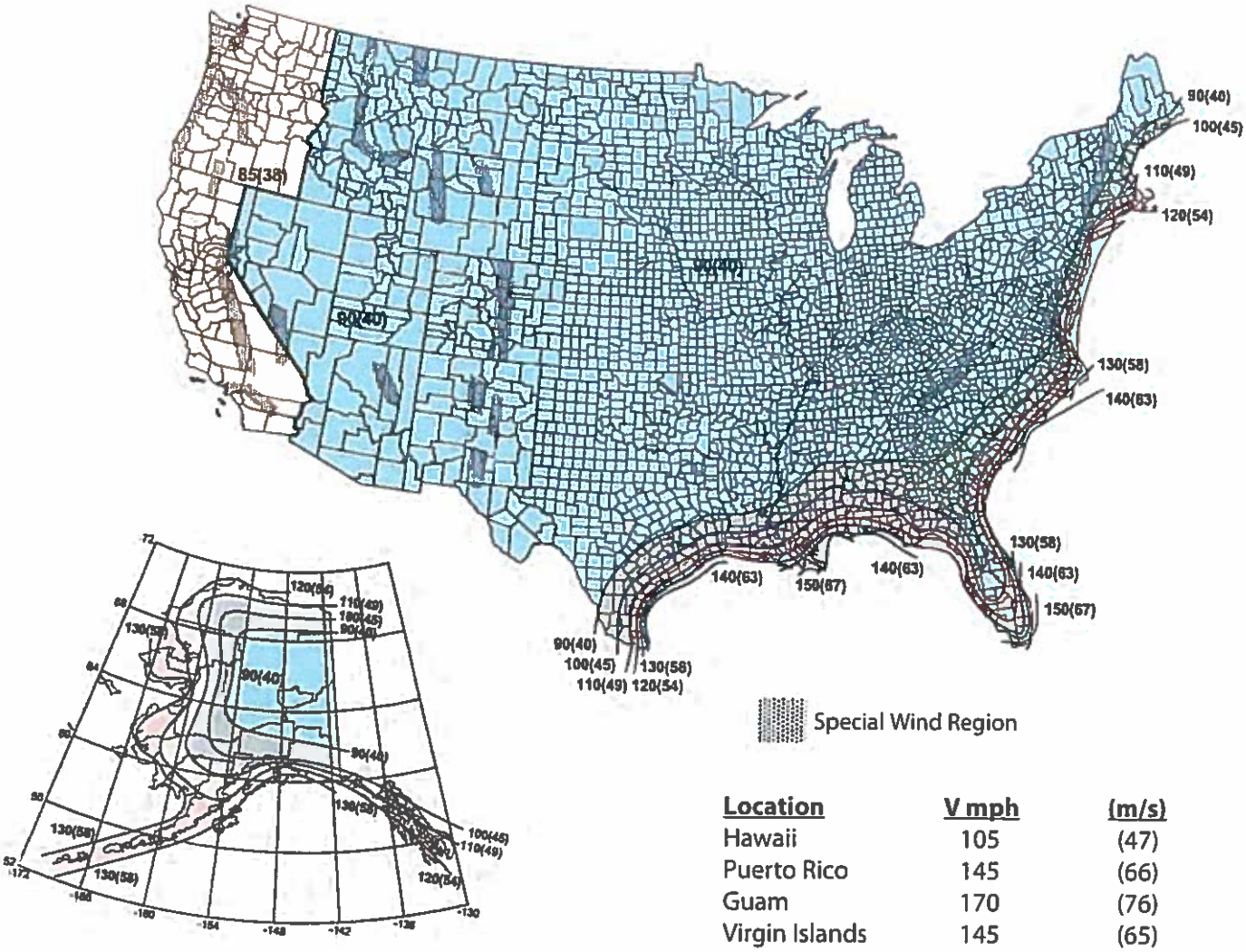
REV G 3-SECOND BASIC WIND SPEED MAP



Location	V mph	(m/s)
Hawaii	105	(47)
Puerto Rico	145	(66)
Guam	170	(76)
Virgin Islands	145	(65)
American Samoa	125	(56)

Notes:

1. Values are 3-second gust wind speeds in miles per hour (m/s) at 33 ft. (10 m) above ground for Exposure C terrain.
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside last contour must use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions must be examined for unusual wind conditions.

The basic wind speed map is being used with permission from ASCE. This material may be used for personal use only. Any other use requires prior permission of the American Society of Civil Engineers.

REV G WIND SPEEDS

The TIA-222-G Standard is based on the wind map published in the ASCE 7-02 Standard, "Minimum Design Loads for Buildings and Other Standards". The ASCE 7 standard is published by the American Society of Civil Engineers (ASCE) and represents the latest research and data available for wind speeds in the United States.

Subsequent to the release of the TIA-222-G Standard, ASCE has published 2 revisions to the ASCE-7 Standard. The first revision was published in 2005 and is designated as ASCE 7-05. There were no changes to the wind map. The second revision was published in 2010 and is designated as ASCE 7-10. There are changes to the wind map in this version.

The previous versions of ASCE 7 used a 50-year return wind speed map and relied on additional design factors to increase wind loads according to the reliability requirements of a structure. This resulted in structures being able to survive wind speeds of much higher return periods. The new wind maps in ASCE 7 -10 now include these design factors and now represent a much higher return period wind speed. A wind map is provided for each classification of structure. No additional factors have to be considered based on the classification of a structure when these wind speeds are used to calculate wind loads. The new maps can be thought of as "Survival" wind speeds, or in other words, wind speeds for which permanent deformation may occur in a structure, but the structure does not collapse.

The new ASCE 7-10 survival wind speeds can be easily converted for use with the TIA-222-G Standard using the following conversion table. If the conversion is not made, the design factors for determining wind loads will be "doubled up" resulting in much higher wind loads than intended. Eventually the TIA Standard and other similar structural standards will be upgraded to reflect the new ASCE 7-10 wind maps. Conversions for fastest-mile wind speeds used in Rev F and ASCE 7-93 are also included in the table.

Design Wind Speed Conversions, MPH

Rev F ASCE 7-93 (fastest-mile)	Rev G ASCE 7-02 & ASCE 7-05 (3-second gust)	Survival ASCE 7-10 (3-second gust)
71	85	110
76	90	115
85	100	126
90	105	133
95	110	139
104	120	152
114	130	164
123	140	177
128	145	183
133	150	190
152	170	215

Examples to determine appropriate Rev G design criteria:

1. Desire a 95 mph Rev F fastest-mile design. Use a 110 mph Rev G design.
2. Desire a 115 mph ASCE 7-10 design. Use a 90 mph Rev G design.

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REV G GROUNDING REQUIREMENT FOR STRUCTURES

Rev G made significant changes regarding the grounding requirements for structures. A prescriptive approach to grounding was used in Rev F where providing specific grounding leads and ground rods were considered adequate to protect a structure. Rev G adopted a performance specification approach that requires providing a grounding system that will result in a maximum 10 ohm resistance to earth. Rev G also requires minimum ground lead and ground rod sizes that are greater than the Rev F prescriptive requirements.

Another change is that Rev G does not require specific grounding materials. Rev F required the use of galvanized ground rods with tinned copper leads. Rev G only requires that the leads and connections be compatible with the ground rods from a corrosion standpoint (i.e. minimize difference between metals connected).

Rev G does provide default grounding arrangements for various types of structures that are intended to meet the 10 ohm requirement for a wide variety of soil conditions. In accordance with Rev G, the actual resistance of a default grounding system must be verified based on site conditions. Additional ground rods or special grounding systems may be required.

It should be noted that the TIA-222 grounding requirements are meant to protect the structure and foundation from high fault currents. Other grounding requirements are often needed for the protection of antennas, radio equipment and other appurtenances.

REV G STANDARD FOUNDATIONS

Rev G has taken a different approach from Rev F regarding standard foundations and the term "Normal Soil" has been eliminated. A new term "Presumptive Soil" has been introduced. Rev G provides for two different types of presumptive soil, sand and clay. Generally the strength of Rev G presumptive soil is lower than the strength of Rev F normal soil.

The intent is to provide default design parameters that can be used to design foundations when a geotechnical report is not available for a site. In accordance with Rev G, clay is to be considered the default presumptive soil unless more information is known about a site. The values for clay presumptive soil have therefore been used for the generation of the standard foundations contained in this catalog.

It should be noted that in accordance with Rev G, actual site conditions must be investigated prior to the installation of a foundation that was designed using presumptive soil parameters. Modifications to the standard foundations contained in this catalog may be required. It should also be noted that Rev G requires a geotechnical investigation for all Class III structures.

One common cause for changes to a standard foundation is due to frost depth. The frost depth for Rev G presumptive soil is considered to be 3.5 feet. The standard foundations in this catalog are based on this frost depth. Special foundations may be required for sites in locations where frost depths exceed 3.5 feet and the local soil conditions are susceptible to frost heave.

Presumptive soil also assumes that the water table is below the foundation depth. For this condition, there is no concern for buoyant conditions that can significantly reduce the uplift capacity of a foundation. The standard foundations in this catalog are based on dry soil conditions and do not consider buoyant conditions. Special foundations may be required for sites where the water table may rise above the base elevation of the foundation.

In accordance with Rev G, presumptive soils are also considered to be non-corrosive. When local soil conditions are corrosive, anchors or direct embedded poles that are in direct soil contact may require corrosion protection in addition to hot dip galvanizing. Rev G provides guidance on various alternatives to consider in these situations.

Presumptive soils are also considered to be non-expansive. Locations known to have expansive soil require special considerations for foundation design. Modifications to the standard foundations in this catalog may be required in these cases.

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REV G CLIMBING FACILITIES

Rev G has made significant additions addressing climber safety. Two classifications of climbers have been defined. An Authorized Climber (also called a Basic Climber) is an individual trained in climbing but may not have had previous climbing experience. These climbers are intended to be limited to climbing fixed access routes equipped with safety climb devices. A Competent Climber (also called a Skilled Climber) is a professional who is capable of climbing on structural members.

Rev G provides requirements for climbing facilities by defining two classes of climbing facilities, Class A and Class B. Class B requirements are similar to Rev F requirements and are intended for structures to be climbed by professional Competent Climbers. Class A requirements are more restrictive in comparison to Rev F and are intended for structures expected to be climbed by lesser qualified (Basic) climbers. In accordance with Rev G, Class B is considered to be the default climbing facility requirement for structures unless otherwise specified. Towers can be quoted to accomodate Class A climbing facilities when specified. All ROHN standard structures are intended to be climbed by Competent Climbers only.

Safety climb systems are now mandatory in accordance with Rev G for structures exceeding 10 feet in height that are intended to be climbed. Some structures are intended to be maintained by bucket trucks or other methods that do not involve climbing the structure. Safety climb systems, when required, must be ordered separately for all ROHN standard structures in this catalog.

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