CHAPTER 3. MARKING

30. PURPOSE.

Marking makes a structure more conspicuous to pilots during daylight hours. This may be accomplished by coloring the structure or by using suitable markers.

31. PAINT COLORS.

Alternate sections of aviation orange and aviation white paint provide maximum visibility of an obstruction by contrast in colors. (See paragraph 131.)

32. STANDARDS.

To be effective, paint should meet specific color requirements when freshly applied to a structure. However, all outdoor paints deteriorate with time. While it is not practical to give a maintenance schedule for all climates, surfaces should be repainted when the color changes noticeably or its effectiveness is reduced by scaling, oxidation, chipping, or layers of industrial contamination. Tolerance charts are available for determining when repainting is required. The color should be sampled on the upper half of the structure, since weathering is greater there. Color tolerance charts may be purchased from a supplier. (See paragraph 133.)

a. ***Materials and Application:*** Quality paint and materials should be selected to provide extra years of service. The paint should be compatible with the surfaces to be painted, including any previous coatings, and suitable for the environmental conditions. Surface preparation and paint application should be in accordance with manufacturer's recommendations.

b. ***Surfaces Not Requiring Paint:*** Ladders, decks, and walkways of steel towers and similar structures need not be painted if a smooth surface presents a potential hazard to maintenance personnel. Paint may also be omitted from precision or critical surfaces if it would have an adverse effect on the transmission or radiation characteristics of a signal. However, the overall marking effect on the structure should not be reduced.

c. ***Skeletal Structures:*** Complete all marking/painting prior to or immediately upon completion of construction. This applies to catenary support structures, radio and television towers, and similar skeletal structures. To be effective, paint should be applied to all inner and outer surfaces of the framework.

33. PATTERNS.

Paint patterns of various types are used to mark structures. The pattern to be used is determined by the size and shape of the structure.

a. ***Solid Pattern:*** Obstacles should be colored aviation orange if the structure has both horizontal and vertical dimensions not exceeding 10.5 feet (3.2m).

b. ***Checkerboard Pattern:*** Alternating rectangles of aviation orange and white are normally displayed on structures as follows:

1. ***Normal uses.***

(a) Water, gas, and grain storage tanks.

(b) Buildings, as required.

(c) Large structures exceeding 10.5 feet (3.2m) across having a horizontal dimension that is equal to or greater than the vertical dimension.

2. ***Size of Rectangles.*** Sides of the checkerboard rectangles should measure not less than 5 feet (1.5m) nor more than 20 feet (6m) and should be as nearly square as possible. However, if it is impractical because of the size or shape of a structure, the rectangle may have sides less than 5 feet (1.5m). When possible, corner surfaces should be colored orange.

3. ***Exceptions.*** Structural designs not conducive to standard markings may be marked as follows:

(a) If it is not practical to color the roof of a structure in checkerboard pattern, it may be colored solid orange.

(b) If a spherical structure is not suitable for an exact checkerboard pattern, the shape of the rectangles may be modified to fit the shape of the surface. (See APPENDIX 1. , FIG 2)

(c) Storage tanks not suitable for a checkerboard pattern may be colored by alternating bands of aviation orange and white or a limited checkerboard pattern applied to the upper one-third of the structure.

(d) The skeletal framework of certain water, gas, and grain storage tanks may be excluded from the checkerboard pattern.

c. ***Alternate Bands:*** Alternate bands of aviation orange and white are normally displayed on the following structures.

1. ***Normal Uses.***

(a) Communication towers and catenary support structures.

(b) Poles.

(c) Smokestacks.

(d) Skeletal framework of storage tanks and similar structures.

(e) Structures which appear narrow from a side view, that are 10.5 feet (3.2m) or more across, and the horizontal dimension is less than the vertical dimension.

(f) Wind turbine generator support structures including the nacelle or generator housing.

(g) Coaxial cable, conduits and other cables attached to the face of a tower.

2. *Color Band Characteristics.* Bands for structures of any height should be:

(a) Equal in width, provided each band is not less than $1^1/_2$ feet (0.5m) nor more than 100 feet (31m) wide.

(b) Perpendicular to the vertical axis with the bands at the top and bottom ends colored orange.

(c) An odd number of bands on the structure.

(d) Approximately one-seventh the height if the structure is 700 feet (214m) AGL or less. For each additional 200 feet (61m) or fraction thereof, add one (1) additional orange and one (1) additional white band.

(e) Equal and in proportion to the structure's height AGL. (See TBL 1) (See APPENDIX 1., FIG 1.)

Structure Height to Bandwidth Ratio

Example: If a Structure is:		
Greater Than	**But Not More Than**	**Band Width**
10.5 feet (3.2m)	700 feet (214m)	$^1/_7$ of height
701 feet (214m)	900 feet (275m)	$^1/_9$ of height
901 feet (275m)	1,100 feet (336m)	$^1/_{11}$ of height
1,100 feet (336m)	1,300 feet (397m)	$^1/_{13}$ of height

TBL 1

3. *Structures With a Cover or Roof.* If the structure has a cover or roof, the highest orange band should be continued to cover the entire top of the structure.

4. *Skeletal Structures Atop Buildings.* If a flagpole, skeletal structure, or similar object is erected on top of a building, the combined height of the object and building will determine whether marking is recommended; however, only the height of the object under study determines the width of the color bands.

5. *Partial Marking.* If marking is recommended for only a portion of a structure because of shielding by other objects or terrain, the width of the bands should be determined by the overall height of the structure. A minimum of three bands should be displayed on the upper portion of the structure.

6. *Wind Turbine Rotor Blades.* Each rotor blade should be marked, front and back, with three bands of orange and white paint beginning with an orange band at each tip. The bands should be approximately the same width as those on the tower. The remaining (inner) blade area may be any color. (See APPENDIX 1., FIG 10.)

d. *Teardrop Pattern.* Spherical water storage tanks with a single circular standpipe support may be marked in a teardrop striped pattern. (See APPENDIX 1., FIG 4.) The tank should show alternate stripes of aviation orange and white. The stripes should extend from the top center of the tank to its supporting standpipe. The width of the stripes should be equal, and the width of each stripe at the greatest girth of the tank should not be less than 5 feet (1.5m) nor more than 15 feet (4.6m).

e. *Community Names.* If it is desirable to paint the name of the community on the side of a tank, the stripe pattern may be broken to serve this purpose. This open area should have a maximum height of 3 feet (0.9m). (See APPENDIX 1., FIG 4.)

34. MARKERS.

Markers are used to highlight structures when it is impractical to make them conspicuous by painting. Markers may also be used in addition to aviation orange and white paint when additional conspicuity is necessary for aviation safety. They should be displayed in conspicuous positions on or adjacent to the structures so as to retain the general definition of the structure. They should be recognizable in clear air from a distance of at least 4,000 feet (1219m) and in all directions from which aircraft are likely to approach. Markers should be distinctively shaped, i.e. spherical, cylindrical, so they are not mistaken for items that are used to convey other information. They should be replaced when faded or otherwise deteriorated.

a. *Spherical Markers.* Spherical markers are used to identify overhead wires. Markers may be of another shape, i.e., cylindrical, provided the projected area of such markers will not be less than that presented by a spherical marker.

1. *Size and Color.*

(a) The diameter of the markers used on extensive catenary wires across canyons, lakes, rivers, etc., should be not less than 36 inches (91cm). Smaller 20-inch (51cm) spheres are permitted on less extensive power lines or on power lines below 50 feet (15m) above the ground and within 1,500 feet (458m) of an airport runway end. Each marker should be a solid color such as aviation orange, white, or yellow. (See paragraph 131 for color standards.)

2. *Installations.*

(a) *Spacing.* Markers should be spaced equally along the wire at intervals of approximately 200 feet (61m) or fraction thereof. Intervals between markers should be less in critical areas near runway ends (i.e., 30 to 50 feet). They

should be displayed on the highest wire or by another means at the same height as the highest wire. Where there is more than one wire at the highest point, the markers may be installed alternately along each wire if the distance between adjacent markers meets the spacing standard. This method allows the weight and wind loading factors to be distributed.

(b) ***Pattern.*** An alternating color scheme provides the most conspicuity against all backgrounds. Mark overhead wires by alternating solid colored markers of aviation orange, white, and yellow. Normally, an orange sphere is placed at each end of a line and the spacing is adjusted (not to exceed 200 feet) to accommodate the rest of the markers. When less than four markers are used, they should all be aviation orange.

b. ***Flag Markers.*** Flags are used to mark certain structures or objects when it is technically impractical to use spherical markers or painting. Some examples are temporary construction equipment, cranes, derricks, oil and other drilling rigs. Catenaries should use sperical markers.

1. ***Minimum Size.*** Each side of the flag marker should be at least 2 feet (0.6m) in length.

2. ***Color Patterns.*** Flags should be colored as follows:

(a) ***Solid.*** Aviation orange.

(b) ***Orange and White.*** Arrange two triangular sections, one aviation orange and the other white to form a rectangle.

(c) ***Checkerboard.*** Flags 3 feet or larger should be a checkerboard pattern of aviation orange and white squares, each 1 foot (0.3m) plus or minus 10 percent.

3. ***Shape.*** Flags should be rectangular in shape and have stiffeners to keep them from drooping in calm wind.

4. ***Display.*** Flag markers should be displayed around, on top, or along the highest edge of the obstruction. When flags are used to mark extensive or closely grouped obstructions, they should be displayed approximately 50 feet (15m) apart. The flag stakes should be of such strength and height that they will support the flags above all surrounding ground, structures, and/or objects of natural growth.

35. UNUSUAL COMPLEXITIES.

The FAA may also recommend appropriate marking in an area where obstructions are so grouped as to present a common obstruction to air navigation.

36. OMISSION OR ALTERNATIVES TO MARKING.

There are two alternatives to marking. Either alternative requires FAA review and concurrence.

Note–
PROPONENTS MUST ENSURE THAT ALTERNATIVES TO MARKING ARE COORDINATED WITH THE FCC FOR STRUCTURES UNDER ITS JURISDICTION.

a. High Intensity Flashing White Lighting Systems. The high intensity lighting systems are more effective than aviation orange and white paint and therefore can be recommended instead of marking. This is particularly true under certain ambient light conditions involving the position of the sun relative to the direction of flight. When high intensity lighting systems are operated during daytime and twilight, other methods of marking may be omitted. When operated 24 hours a day, other methods of marking and lighting may be omitted. (See paragraph 71; and CHAPTER 11.)

b. ***Medium Intensity Flashing White Lighting Systems.*** When medium intensity lighting systems are operated during daytime and twilight on structures 500 feet (153m) AGL or less, other methods of marking may be omitted. When operated 24 hours a day on structures 500 feet (153m) AGL or less, other methods of marking and lighting may be omitted. (See paragraph 61; and CHAPTER 10.)