

LSC Map Mount Instructions

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The Map Mount is:

10x2 dimensional pressure-treated lumber cut to 16" nominal length, with two centered 3/8" mounting holes exactly 13" apart, painted with brown Cabot Solid Acrylic Stain. The board weight is 4.29 lb if the lumber is pressure treated Southern Yellow Pine. Also see Map Board Manufacture below.

Recommended Mounting Fasteners:

3/8" lag bolt, length 3", 3 1/2", or 4" hot dipped galvanized
3/8" washer, hot dipped galvanized
3/8" lock washer, hot dipped galvanized

Recommended Mounting Method:

Use just the top mounting hole. Drill a lead hole first to the depth that the lag screw will penetrate the tree (1 1/2" - 2"). Drill sizes are 3/16" for evergreen (soft wood) trees and 1/4" for deciduous (hard wood) trees.

Use 3 1/2" or 4" long bolts unless tree bark is thin.

Use a regular washer next to the board and a lock washer between the regular washer and the bolt head. Tighten bolt so lock washer is only very slightly compressed. This will allow for 1 year typical tree growth (1/14" to 1/10"), the difference between a slightly compressed and a fully compressed lock washer. Check and adjust once or twice a year. Note that the lock washer is not used as it normally would be, but is instead used as a spring.

Tools:

cordless screwdriver/drill
1/4" drill bit (for 2" long 3/8" lag bolt lead hole)
3/16" drill bit (for 2" long 3/8" lag bolt lead hole)
9/16" bolt magnetic driver bit (for 3/8" lag bolts)
9/16" ratcheting combination wrench (for 3/8" lag bolts)

Notes:

- * The board is about 4 lb with a center of gravity 6.5" below the top mounting hole. Pendulum action is resisted by (1) the lock washer slightly pressing the board into the tree, (2) friction between the lag bolt shank and the sides of the wooden mounting hole, but this may be unreliable, or (3) putting a second lag bolt through the bottom hole under the map in the unlikely case that all else fails.

Map Board Manufacture:

Cut boards from 2x10 pressure treated wood. Avoid knots on sides of boards and in 3"x3" area at top and bottom where mounting holes will be. One side of board should NOT have knots where map fasteners might be placed around perimeter of laminated map.

Use a drill block or drill press to keep the two 3/8" holes perpendicular to the surface of the board. Sand corners and edges, and paint.

Some Data That Might be Useful for Evaluation of Design:

The screw length should account for 1 1/2" map board thickness, 1/2" bark and cambium layer (evergreen), 1/2" growth allowance (includes washers), 1/4" bolt tip taper, total 2 3/4". This indicates that 3" bolts are too short unless bark is thin.

The board weight is about $1/8 \times 3/4 \times 4/3 = 1/8$ cu ft $\times 34.34$ lb/cu ft (Southern Yellow Pine) = 4.49lb.

A 100 mph wind on the $3/4 \times 4/3 = 1$ sq ft face of the board generates a force of 114 Newtons ~ 26 lb. A 100 mph wind on the $1/8 \times 4/3 = 1/6$ sq foot side of the board generates about 4.33 lb.

NDS gives some guidance on the situation: see

<https://awc.org/codes-standards/publications/nds-2018>
Chapter 12: Dowel-Type Fasteners

Wood strength and hardness are measured by wood specific gravity G , Table 12.3.3A. For our kinds of trees, we have evergreen trees $G \leq 0.41$ (Eastern Spruce) and deciduous trees $G \geq 0.58$ (Maple). Our softest wood is $G = 0.36$ (Eastern White Pine).

Section 12.1.4 specifies lead hole sizes.

Table 12.2.A gives withdraw forces tolerated, which for our softest wood ($G = 0.36$) is 186 lb per inch, so if the lag screw is embedded in 1/2" of wood, the NDS withdraw force tolerated would be 93 lb.

To calculate NDS tolerated vertical sheer load we use the equations of Table 12.3.1A with F_{es} set to infinity, and for short values of l_m , in our case 1/2", equation 1_m dominates. As $R_d \leq 4$, we have $Z = 1/4 \times 3/8 \times 1/2 \times F_{em} = 3/64 \times F_{em}$, where F_{em} is $F_{||}$ from Table 12.3.3, which for $G = 0.36$ is 4050 lb/sq-in, so the tolerated vertical sheer is about $(3/64) \times 4050 \sim 190$ lb.

NDS is for kiln-dried wood with 19% moisture, and not for green wood, but NDS has a large safety factor ($\times 3$) that we do not need.

Bolts could be 3/8" or 1/4": both are mechanically sound. Map board need not be pressure-treated and could be Spruce Pine Fir.