

**ABEngineering LLC**  
Design, Controls, Engineering Services  
117 Hanon Drive, Williston, VT 05495-8851

At the request of Alpine SnowGuards we tested the roof mount base plate using the apparatus and methods described in ASTM D1761-06. The ASTM test was modified as required to accommodate multiple fasteners.

These tests determined the maximum pullout or lateral force the roof mount base plate would sustain in a given material. The actual performance of the roof mount base plate in a given installation may be different.

The roof mount base plate (Figure 1) as tested was made of an unpainted stainless steel with two countersunk bosses for stainless steel 5/16" flathead socket cap screws. These screws are welded on the backside to prevent rotation in an installed roof mount base plate. There are eight 5/16" diameter holes for attaching the base plate to the roof.

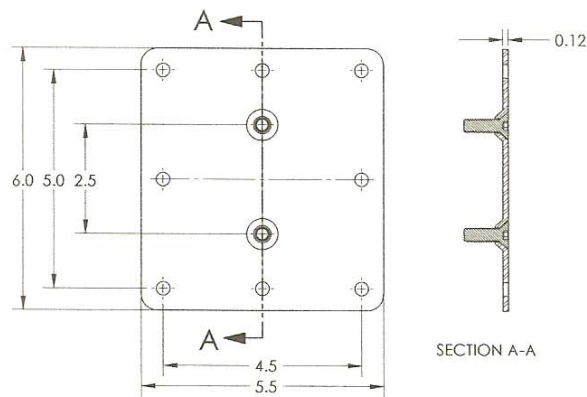


Figure 1 - Roof Mount Base Plate

The roof mount base plate was fastened to the decking material using 8 square drive #14 x 1.5" or #14 x 2" long screws from Triangle Fastener Company (Figure 2). A new roof mount base plate, screws, and test material was used for every test.



Figure 2 - TFC #14x1.5" Screw

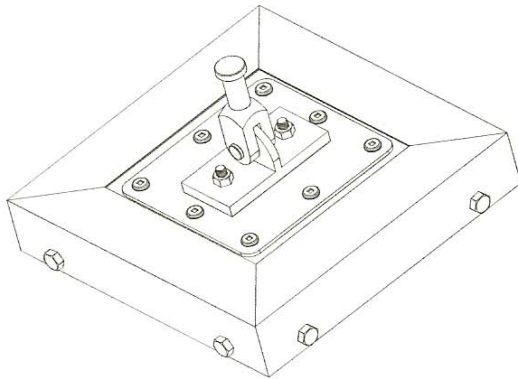


Figure 3 - Pullout Test Fixture

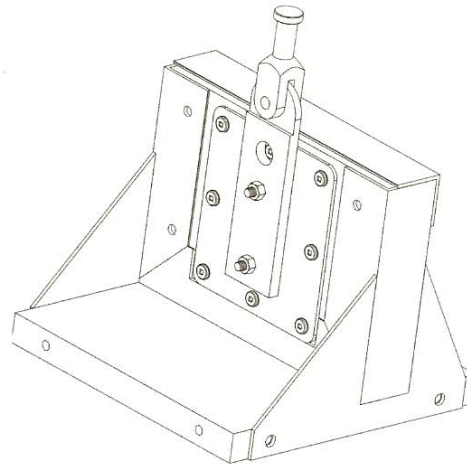


Figure 4 - Lateral Test Fixture

Representative samples were tested for pullout and lateral strength using fixtures shown in Figure 3 (pullout) and Figure 4 (lateral). Loads were applied slowly, a typical test pullout test would take 5 minutes from first load to failure. Pullout testing was performed using 4 samples and the results averaged. Lateral testing was performed using a single sample. Tests were performed on a recently calibrated Tineous Olsen testing machine. The table below lists the resulting maximum load.

Material	Screw Size	Maximum Tensile Load lb (kN)	Maximum Transverse Load lb (kN)
7/16" OSB	#14 x 1.5"	1343 (6.0)	4290 (19.0)
5/8" OSB	#14 x 1.5"	2176 (9.7)	4810 (21.4)
1/2" CDX Plywood	#14 x 1.5"	1963 (8.7)	4590 (20.4)
5/8 CDX Plywood	#14 x 1.5"	1850 (8.2)	5020 (22.3)
3/4" CDX Plywood	#14 x 1.5"	2263 (10.0)	5300 (23.6)
2x10 Spruce	#14 x 2"	3465 (15.4)	6126 (27.2)
22 ga Steel	#14 x 1.5"	1625 (7.4)	2520 (11.2)

The typical pullout failure mode was a progressive failure of each fastener in the decking material. The applied force would reach a maximum value and one fastener would fail, followed by local bending of the roof mount base plate and pullout or failure of each additional fastener at a progressively lower load (Figure 5). While somewhat deformed by the test, the roof mount base plate was still in a serviceable condition.

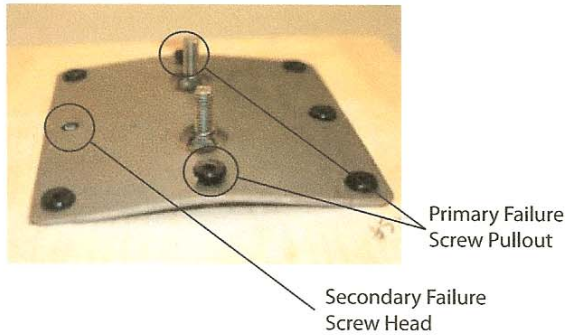


Figure 5 - Typical Pullout  
Test Result

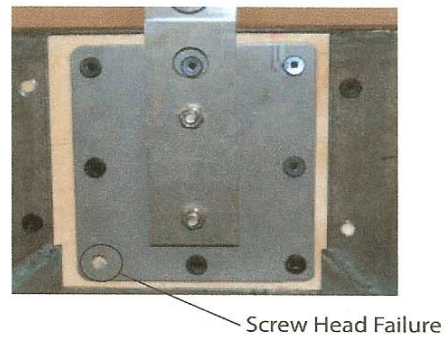


Figure 6 - Typical Transverse  
Loading Test Result

The typical transverse failure mode was slipping of the plate relative to the base material, followed by localized crushing of the base material around the fastener, and ultimately failure of the fastener due to bending forces on the head of the fastener. Again, the failure was progressive and as the applied load reached a maximum value, one fastener would fail, followed by the of each additional fastener at a progressively lower load. (Figure 6). The roof mount base plate had slight marking of the steel around the screw holes due to the hardened screw threads and was in a servicable condition after the test.

