

***Tension Load Resistance Testing:
Anchor Products U-Anchor 2000
Roof Assembly Number 4***

***Nautilus Engineering
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Per the request of Anchor Products, Nautilus Engineering on August 14th, 2014 witnessed the full scale tension testing of the U-Anchor-2000 over fully adhered single ply roofing assemblies specified below.

Extensive brand specific testing of each roof assembly component was completed previously. Test specimens were included from all common US manufactured TPO and PVC roofing manufacturers. The testing was to identify which components demonstrate the lowest resistance under comparable loads. The materials demonstrating the lowest average force load capacity were included in the large scale test below.

Roof Mounted Equipment Attachment System: U-Anchor 2000 consist of a coated plate adhered onto a 15-3/4" x 15-3/4" thermoplastic membrane target that is compatible with the substrate roof membrane. The plate contains a welded on threaded bolt to allow fastening of roof mounted equipment. The target membrane has a 12" x 12" cover welded to the top side of the target membrane to encapsulate base plate.

Standards: Loading Schedule: **ASTM E330-02- (2010)** – *Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference* © **ASTM.**

Equipment: Loading Apparatus: Anchor Products' 10Ton Ball Screw
Load Cell Omega LC712-20K

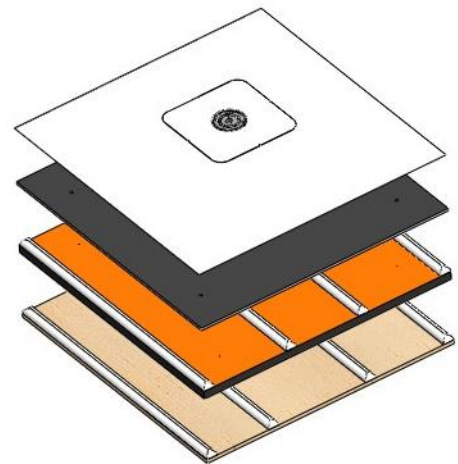
Attending Technicians: Anchor Products Gary Calderwood Nautilus Engineering Ron Farelman

1. Load Resistance: Tension.

1.1 Scope: Nautilus Engineering was retained to witness tension testing of the Anchor Products U-Anchor 2000 system to quantify load-resistance performance when secured to Fully Adhered 60 mill TPO and PVC roof membrane assemblies. (See test materials listed below.)

1.2 Test Materials:

- **Roof Assembly 4:**
- **Substrate:** Nominal Plywood 48"x 48" x 1/2"
- **Insulation Board:** Min. 1 1/2" Polyisocyanurate (ISO), 44" x 44", partially adhered with Low Rise Foam Adhesive to the center of the substrate in ribbons spaced 12" on center
- **Cover Board:** Min. 1/4" Gypsum Cover Board, 44" x 44" partially adhered with Low Rise Foam Adhesive to the center of the substrate in ribbons spaced 12" on center.
- **Roof Cover:** Fully Adhered 60 mill Single Ply TPO and PVC.
- **U-Anchor 2000 Roof top Attachment.**



Specimens were prepared in advance by Anchor Products and allowed to cure for 28 days. Specimen assembly components and methods were confirmed through visual review prior to testing and examination of testing materials after testing was completed.

1.3 Test Procedure: One U-Anchor 2000 is installed at the center of the roof assembly. The perimeter edge of the test assembly frame is clamped to the test frame. The U-Anchor bolt is attached to a motor driven ball screw with an inline 20,000lb load cell. A load of 50lbs is applied to the U-Anchor and held for 10 seconds. The load is then returned to zero and the specimen is left to rest for a minimum of 1 minute to a maximum of 5 minutes. This cycle is repeated with a 100lb force load and increased by 50lbs of force in each successive cycle until failure is observed.
In accordance with Loading Schedule: ASTM E330-02- (2010)



Review & Analysis:

On testing & analysis set forth herein, it is our professional opinion that the U-Anchor 2000 when installed in accordance with Anchor Products published installation requirements for Deck Assembly 4 listed above, passed the load cycle test at **650lbs**, failing on the rise to the 700lbs load-cycle. *(See Picture Below.)*

The mode of failure was delamination of the Dens-Deck Prime (Cover Board) facer from its gypsum core in the area beneath the U-Anchor.

Typical Failure: Delamination of Gypsum Cover Board facer.



Please contact Nautilus Engineering with any questions regarding these results.


Ron Farelman, P.E.