ELIMINATE LEAK PATHS

PREVENT FASTENER BACK OUT AND REDUCE CALL BACKS

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METAL-PANEL ROOFS CONTINUE to be popular robust systems used on many types of buildings. Retail stores, storage units, offices, warehouses, schools and homes are a few of the many types of structures that use metal panels as their waterproofing membrane. However, designers should be aware that compared to a conventional roof metal roof systems have a larger amount of thermal movement during their service life, which is caused by temperature fluctuations throughout a day and seasons.

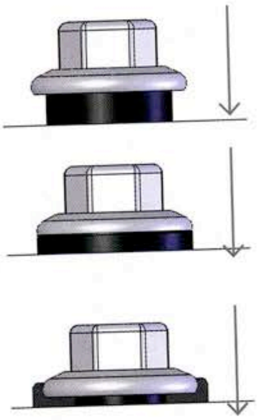
Although roofs start out being watertight, some roof systems develop leak paths early in their life cycle caused by thermal expansion and contraction of the metal panel pushing the fastener into a rotation following its thread force and thus unscrewing itself. As demonstrated by field testing, the cyclic thermal movement from daily and seasonal temperature fluctuations can cause a panel to expand and contract by 3/4 inch (19 mm) or more with an expansion force of 2,850 pounds (1293 kg). (For more information about this field testing, see *metalmag*'s February issue's "Roofs," page 68.)

Fasteners used as stitch screws or in standing-seam roof systems' ridge, eave, side-lap and end-lap applications have been shown to back out repeatedly. Designers are able to reduce the movement on the fastener by clip design and expansion allowances; however, there still remains some thermal expansion that a fastener must resist to ensure its seal washer remains secure against the metal panel.

Warranty providers, manufacturers and building owners continue to seek preventative solutions to fastener back out with fasteners that have a watertight washer seal that remains securely fastened to the metal panel and other metal details, keeping a roof and edge details watertight. A new anti-back-out fastener may be the answer.

THE IMPORTANCE OF WASHERS

Fastener washer assemblies are designed to lock out moisture from entering a building. However, for washers to seal against water penetration the fasteners must be driven to a depth that allows the proper compression and position of the washer and then must remain in place without experiencing back out. Underdriven fasteners will not compress the washer, leaving gaps for water to find leak paths. Overdriven washers become distorted and create leak paths. See the diagram above for details. The proper compression will allow the washer to compress up to the diameter of the head and perpendicular to the metal panel.



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For example, screw-down systems are attached to the supporting structure with fasteners through the panel into each purlin. As the panels expand and contract the fasteners are stressed and can back out. Shorter panel lengths have less movement than longer panels and create less potential for forcing the screw hole to elongate past the fastener washer diameter. If the elongated shape of the fastener hole is small enough to be covered by the fastener washer the leak will not develop until the fastener begins to back out from the cyclic thermal movement.

Another popular system is the standing-seam roof. This system utilizes clips that allow movement up to 4 inches (102 mm) in two directions, allowing panel expansion and contraction within these limits. The side and end laps still undergo the expansion and contraction cycle and expose the sealing fastener to the stress and movement, which contributes to their back out and loss of waterproofing and wind resistance.

Currently, when a roof or edge detail develops a leak from backed-out screws the repair work entails retightening the screw until its washer is fitted tightly against the metal surface. The leak is eliminated temporarily until the next batch of thermal cycles creates enough repetitive motion to unscrew the fastener again. This leads to a recurring ritual of going onto the roof to retighten the screws. In some cases the problem can be exacerbated further by this repetitive thermal expansion increasing the holes to a slot shape beyond the size of the fastener washer.

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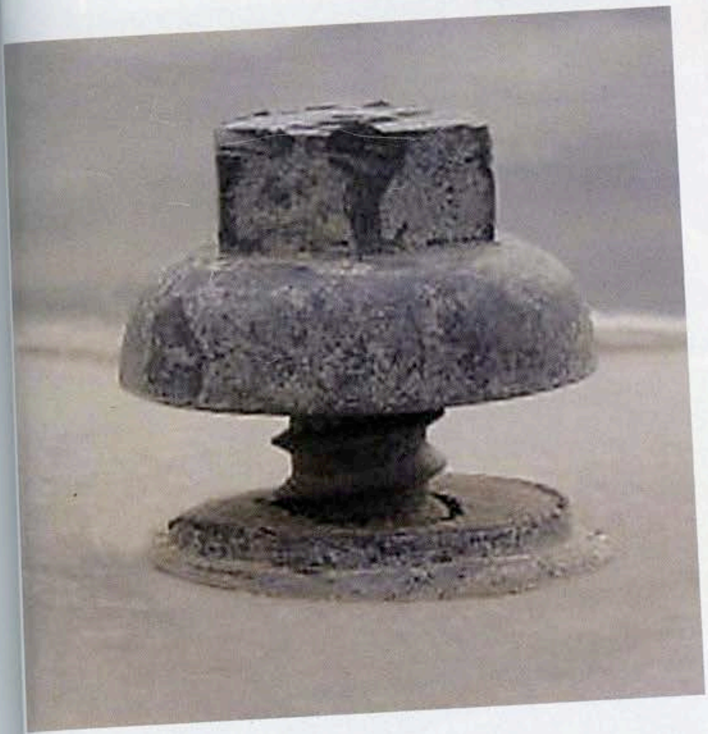

The Itasca, Ill.-based ITW Buildex Anti Back Out self-drilling screw resisted back out during all testing. The company added a patent-pending thread feature that prevents back out caused by thermal movement, keeping roof systems tightly sealed.

FASTENER TESTING

Because the industry needs an anti-back-out fastener, Itasca, Ill.-based ITW Buildex conducted testing on self-drilling and standard fasteners to obtain information that would lead to a fastener that eliminates back out during thermal expansion and contraction. Self-drilling fasteners with sealing washers are used in metal roofing applications to achieve weathertight, wind-resistant and corrosion-protected structurally sound constructed buildings. These fasteners are available in several configurations with varying head and thread diameters, washers, materials and coatings. Standard fasteners offered today for metal roof side lap, end lap and stitch screws are designed to securely fasten the assemblies; however, field examinations of roofs showed these screws are backing out after numerous thermal cycles.

ITW Buildex benchmarked fasteners made by different manufacturers and found lab results to converge with field results. The test method used was based on determining a process that would produce the same fastener back out as seen on existing rooftops. To ensure field correlation the test method was revised until the same fasteners that backed out in the field behaved the same in the laboratory testing.

The testing, conducted on an Instron 8801 servohydraulic fatigue system, simulated thermal fluctuations of metal roof panels. The testing setup for an end lap is shown in the photo, page 90. The apparatus applied tension and compressive forces, simulating the expansion and contraction movements of metal roof panels. A total of 4,500 back-and-forth movement cycles were completed for each testing sample to simulate approximately 12 years of thermal cycles though most screw back out occurred during the first several hundred cycles.

Screw applications in metal roof side laps (stitching two 26-gauge steel panels) and end laps (fastening two 26-gauge steel panels with a 16-gauge purlin) were simulated during the tests. Side-by-side testing was conducted to determine performance of new designs to standard products offered in the marketplace. The amount the screws backed out was measured to determine the screws that were resistant to backing out. Screw back-out torque also was checked before and after a test.

Several design concepts tested determined what feature or features had a positive impact on eliminating back out during thermal movement. Both back-out amount and back-out torque results indicated a new anti-back-out screw had much higher resistance to back out

Screw Back-out Test Results

Application	Side lap	End lap		
			Back-out Torque (inches per pound)	
Test	Back-out Angle (degree)	Back-out Angle (degree)	Before Test	After Test
Manufacturer A	132	20	12.9	10
Manufacturer B	182	27	9.5	10.7
Anti-back-out Screw	10	0	12.2	12.3