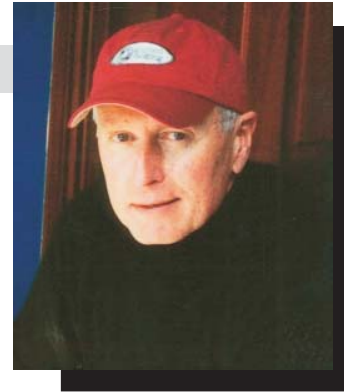


About the Author/WAYNE WALLACE

Wayne Wallace is the president of Applied Bolting Technology Products. The company provides bolting consulting services and manufactures direct tension indicating washers from its base in Rockingham, Vermont. Wallace is a member of the Research Council on Structural Connections, owner of several patents, and author of numerous papers on the practical aspects of quality assurance in structural bolting. He can be reached by phone at 800-552-1999, by fax at 802-460-3104, or e-mail at wwllace@sover.net.



M36 Euro Squirter DTIs- Cheaper, Better Than Torque

Squirter DTIs in diameters from 3/4", 7/8" and 1", have been blind tested and found to produce bolt tensions equal to or better than turn-of-nut done in a controlled laboratory. Until now, blind testing of the largest sizes of Squirter DTIs have not been reported. This study, done for the wind generator business on M36 "Euro" Squirter DTIs, is the first such data reported on the accuracy that can be achieved in true uncontrolled blind tests.

Blind tests simply mean that the bolts are tightened until the wrench operator judges the amount of squirted silicone is just right. At that point, the bolt tension is recorded but the operator does not see the bolt tension. After the tests are finished, the operator can see the results, but not before.

Wind Turbine Generator Shaft Bolts

The shafts supporting wind generators are large diameter tapered tubes



brought to the site in segments, and bolted together by rings of bolts connecting two heavy flanges.



The interior bolted flange splices in the shafts are substantial, and so are the bolts.

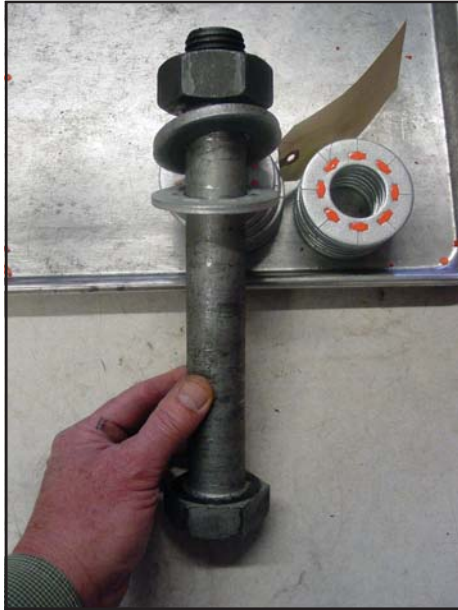


The bolts are typically DIN 6914 bolts and DIN 6915 nuts, galvanized, and in the M36 diameter size, are intended to be tensioned to 510 kN or a little higher.

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EURO SQUIRTER DTIs, from page

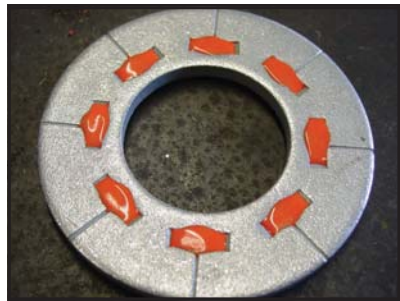
Until Squirter DTIs came along, "torque control" was about the only method used to try to achieve this tension.



However, the +/- 30% or 40% scatter in tensions resulting from using a torque value, either set on site or taken directly from the DIN specification, is thought to be unsatisfactory. In addition, the cost of all the labor needed to install bolts to a torque value is significant because daily or twice daily calibration is necessary to be sure the torque value is representative of the bolts being tightened.

M36 "Euro" Squirter DTIs

This diameter and strength of DTI was developed specifically for the DIN 6914 bolt, which is different from ASTM metric bolt strengths. Once we produced



the M36 Squirter and filled it in production quantities with silicone by PFD robot dispensers, we had a product that, in our opinion, was the very best that we could produce for

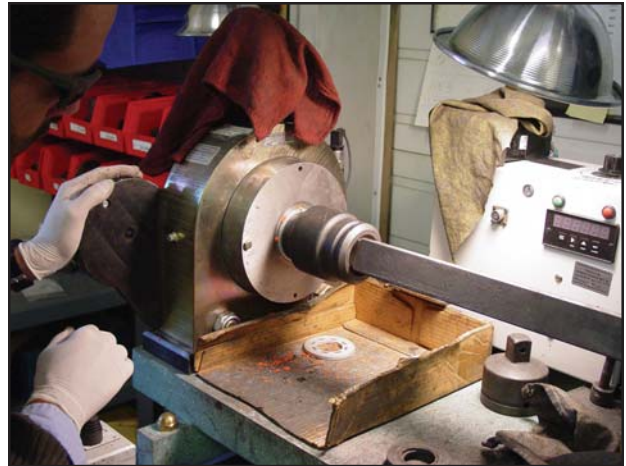
this application. By measuring the dispensed weight of silicone on average in each part we verified that the consistency of silicone volume, part-to-part, was right where we wanted it to be.

All we needed to do to prove the capability of the product was to undertake true blind tightening tension tests, where the installers were guided only by the silicone volume and appearance.

M36 bolts were tightened in a model 4100 Skidmore using a ten hp electric turning power, intermittently "stop-start" turned simulating the ratcheting action of a hy-

draulic wrench. The three operators each calibrated the squirted silicone volume as close to 535 kN (120 kips) as possible. Then, without any feedback, they each tightened 15 bolts to the position that, in their visual opinion alone, based on squirted silicone appearance, they felt the bolt was at or near 535 kN. A control technician recorded the tensions achieved in all cases without any feedback to the operators.

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The following pictures show too little, then just the right amount, and then too much silicone.



Left: Too little silicone

Right: The right amount of silicone



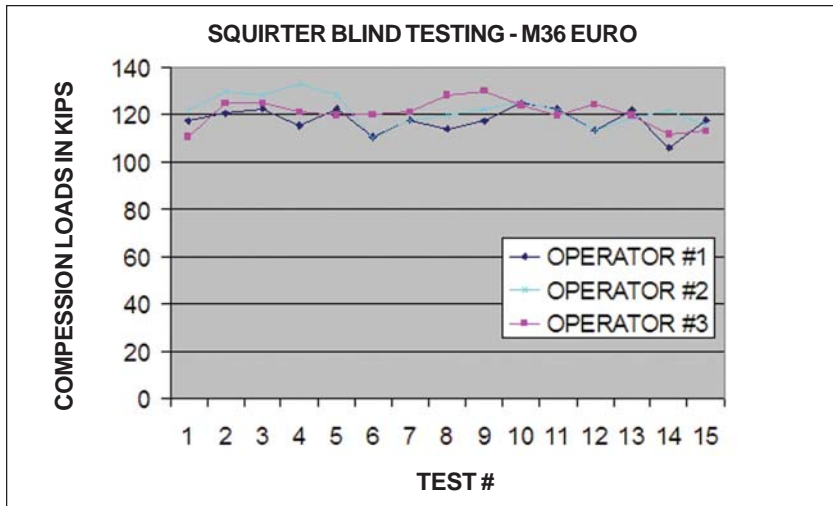
Left: Too much silicone



EURO SQUIRTER DTIs, from page

Here are the resulting tensions:

Mean tension desired—	120.0 kips
Mean tension achieved blind—	120.1 kips
Standard deviation—	5.77 kips (4.8% of means)



Conclusions

1. The mean tension achieved was almost EXACTLY what was wanted, viz. 535 kN (120 kips). Each operator acted independently, but each mean was within 2 kips of 120.

2. This 5.77 kip standard deviation (4.8% of the mean) is approximately twice as accurate as can be achieved by laboratory applied turn-of-nut, and FAR more accurate than the +/- 30 percent or more that is conventionally attributed to calibrated torque installation. ⚙