

About the Author/WAYNE WALLACE

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Leave Your Feeler Gage at Home

Independent Blind Tests of Squirter® DTIs Shows Accuracy Comparable to Turn-of-Nut Done in Controlled Laboratory

In the past three years, many millions of Squirter DTIs have been manufactured and installed, but for this period most of them have been inspected with feeler gages rather than using the squirt feature alone. Feeler gages are time consuming and potentially error-prone, and don't uncover an occasional DTI which has been incorrectly installed. The squirt feature was invented to replace the feeler gage, but we have held off recommending that the squirt feature alone be used for inspection. That is, until now.

Through the past three years, in our test lab, we routinely checked every production lot of Squirters to make sure the squirt feature can be calibrated to show about 1/8" of squirted silicone at a bolt tension about 15 percent above the minimum. Too little squirt signals a tension below what is needed, and too much squirt signals that more bolt tension has occurred than what was needed. Something right between these two extremes, usually about 1/8" of squirt, is just right.

So we know the squirt feature is right on, but we haven't proposed that the field inspectors go solely on squirt appearance — until now. Now we're telling them to leave their feeler gages at home — just go by the squirt.

As we and Squirter inspectors have become more and more confident in using only the "Squirt event" on which to base the level of bolt tension, we thought an independent series of Squirter tests were in order to compare to our own internal tests. So we chose three labs to do some blind tests:

1. The University of Idaho at Moscow, under the control of Dr. Ed Schmeckpeper, Civil Engineering Department;

2. Vermont Bolt, St. Albans, Vermont, under the control of their Director of Quality Assurance, Mr. Christian Dumas; and

3. The South Carolina Department of Transportation lab, under the direction of Mike Koon, Materials and Testing Manager.

Here's what we asked the three test labs to do: using a calibrated Skidmore, and new 7/8" bolts, nuts, and flat washers, install the Squirter DTI under the flat washer on the nut end of the bolt, then

1. Tighten the bolt to about 15% above the minimum, noting the silicone volume and appearance that has squirted out.

2. Repeat this test six times, and get a general impression of the silicone volume and appearance.

3. Cover up the Skidmore dial, and tighten 50 or 100 bolts to the same squirt appearance noted in Step 1 above, *without seeing the Skidmore dial*.

4. During these tests, the Skidmore tension is noted and recorded by an independent observer *without feedback to the bolt tightener*.

The summary charts of the data recorded in 100 tests at the University of Idaho, 100 further tests at the University of Idaho, 240 tests at Vermont Bolt, and 60 tests at the South Carolina state materials lab follow.

Conclusion: The summary chart shows that in 500 blind tests, aiming at 45 kips, judging solely by squirt, a mean bolt tension of 46.9 kips was achieved. The standard deviation achieved, 5 kips, a measure of the scatter in the results, compares favorably with that shown by Fisher, Struik, etc. in the "Guide," Figure 5.9, for laboratory turn-of-nut, of around 5 kips also. Only



No squirt



A little squirt



About the right squirt



More squirt than needed

3.4% of the squirter results were below 39 kips, less than would be expected by the turn-of-nut results reported in the "Guide." On the upper end, only 12% of the squirter results were above 55 kips, considerably less than the "Guide" reports for laboratory turn-of-nut.

Presto! Leave your feeler gage at home. Go for the squirt. You'll do it right more than 96.6% of the time. 🎯

Univ. Idaho First Tests 2003		
Two DTI Lots 50 Tests Each	Lot I5	Lot I36
Mean	51 kips	52 kips
Std Dev	6.5 kips	6.5 kips
< 39 kips	2	1
> 55 kips	14	20

Univ. Idaho Second Tests 2003		
One DTI Lot 100 Tests Total	Lot I36 Oper #1	Lot I36 Oper #2
Mean	43 kips	47 kips
Std Dev	4.5 kips	5.0 kips
< 39 kips	5	3
> 55 kips	0	1

Vermont Bolt Tests			
Three DTI Lots 240 Tests	Lot I36	Lot IA3	Lot I10
Mean	50 kips	46 kips	45 kips
Std Dev	6 kips	4 kips	5 kips
< 39 kips	1	0	2
> 55 kips	21	3	3

South Carolina DOT Lab		
One DTI Lot 30 Tests Each	Kelley	Koon
Mean	42 kips	46 kips
Std Dev	3.9 kips	3.8 kips
< 39 kips	1	2
> 55 kips	0	0

Blind Squirter Tests; Goal - 45 kips Compared to Turn-of-Nut ("Guide," Fig. 5.9)		
Four DTI Lots 500 Tests	Squirters	Lab T of N
Mean	46.9 kips	47 - 53
Std Dev	5.0 kips	~ 5 kips (12%)
< 39 kips	17 (3.4% results)	~ 5 - 6%
> 55 kips	62 (12% results)	~ 6 - 40+%