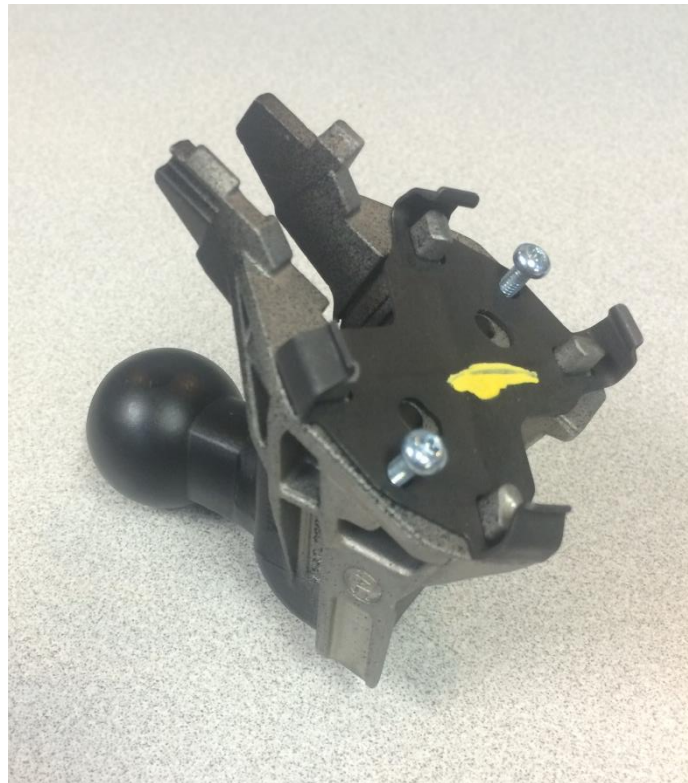




Applications Laboratory Testing Report

Performance Testing for Mirror Bracket



Project Number: 16024

Submitted To:

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Introduction

The ATF, Inc. Applications Lab, on behalf of _____ Corporation, initiated project number 16024. The objective was to compare the performance of P3088005 versus P3088005 applied with wax to determine the differences and whether the wax improves the overall performance of the screw and decreases the amount of screws breaking. The wax will be applied by hand, minutes before testing begins. The Mirror Bracket and Plate of the system were provided to ATF by _____. The screws for testing were provided by ATF. Drive and strip torque tests were conducted to determine tightening torques. The testing procedure, results, and recommendations from ATF are described in this document.

Parts Tested

Taptite II M3.0 x 0.5 x 7mm

- **ATF Part: P3088005**
- **Size:** 3mm diameter, 7mm length
- **Head Style:** Torx® Pan Head
- **Head Diameter:** 5.5mm
- **Drive Style:** T10 Torx® Recess
- **Wax:** Part two testing was hand waxed with 3M Quick Wax



Figure 1: Taptite II M3.0 x 0.5 x 7mm Torx® Pan Head with T10 Torx® Recess

Application

Mirror Bracket (Boss): Aluminum

Mirror Plate: Steel

ATF Screw: 1) Taptite II M3.0 x 0.5 x 7mm, ATF part number P3088005.

2) Taptite II M3.0 x 0.5 x 7mm, ATF part number P3088005 applied with 3M Quick Wax.



Figure 2: Mirror Bracket



Figure 3: Mirror Plate

Test Preparation

Drive & Strip Torque

Driving torque and stripping torque are important in determining a joint's safety of assembly. Drive and strip torque testing is conducted by driving the fasteners into the pilot holes of each boss with an Atlas Copco electric driver, turning at a free speed of 350 rpm, until the joint fails. The torque is measured continuously throughout the driving process. The measuring apparatus consists of an Atlas Copco Tensor S4/S7 running ToolsTalk PF3000 for data acquisition. The software then collects and translates signals from the transducer into a torque vs. rotation graph. This graph is interpreted to determine the precise maximum driving and stripping torque.

Tightening Torque

The tightening torque is the torque at which it is recommended the application be assembled. The tightening torque should be sufficiently high so as to fully drive the screw and generate clamp load, yet low enough to avoid stripping and long term boss damage. An adequate safety factor to compensate for the repeat accuracy of the driver system must also be considered.

Residual Torque

After a screw is driven into a hole, the material that forms around the threads settles, thus decreasing the clamp load and torque on the joint. Each fastener was tightened to a specified tightening torque and allowed to sit for 24 hrs. The remaining torque was then determined by tightening a digital torque wrench until it turned. The maximum torque was read and recorded.

Drive and Strip Torque Explanation

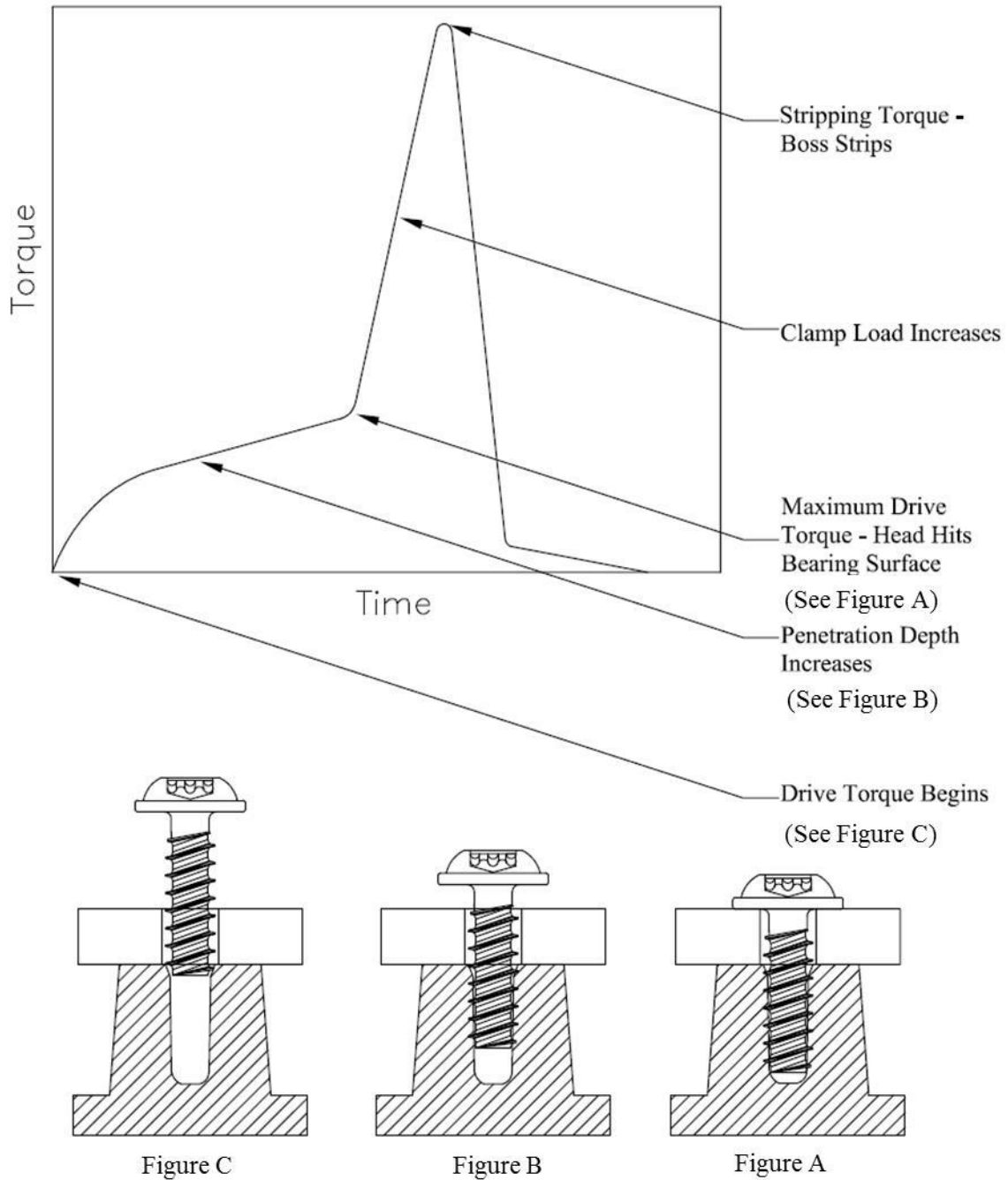


Figure 4: Drive and Strip Torque Explanation

Test Results

Boss and Screw Dimensions

Table 1 Boss Dimensions For Mirror Bracket

Part	Hole Size(mm)	Hole Length(mm)
1A	2.72	7.60
1B	2.70	6.40
2A	2.70	8.50
2B	2.68	7.82
3A	2.68	7.60
3B	2.68	7.00
4A	2.70	7.18
4B	2.68	8.17
5A	2.70	7.10
5B	2.70	7.47
6A	2.68	7.30
6B	2.68	7.50
7A	2.68	7.10
7B	2.68	7.00
8A	2.70	8.35
8B	2.68	7.75
9A	2.68	7.10
9B	2.66	7.50
10A	2.68	7.50
10B	2.68	7.52

Table 2 P3088005 Dimensions

Part	Head Diameter(mm)	Thread Diameter(mm)	Length (mm)
1	5.51	2.94	7.08
2	5.50	2.94	7.16
3	5.51	2.94	7.12
4	5.49	3.00	7.07
5	5.50	2.93	6.92
6	5.52	2.94	7.08
7	5.52	2.93	7.07
8	5.50	2.93	7.06
9	5.51	2.94	7.08
10	5.51	2.94	7.05
11	5.51	3.00	6.98
12	5.53	2.95	6.95
13	5.51	2.97	7.02
14	5.50	2.94	6.97
15	5.49	2.98	6.99
16	5.50	2.94	7.09
17	5.52	3.00	7.03
18	5.50	2.95	7.07
19	5.50	2.96	7.03
20	5.50	2.95	6.97
21	5.50	2.99	7.04
22	5.49	2.97	7.04
23	5.51	2.94	7.05
24	5.48	2.97	7.02
25	5.50	2.95	7.08
26	5.52	2.97	7.00
27	5.50	2.94	6.99
28	5.52	2.94	7.08
29	5.51	2.95	7.06
30	5.51	2.98	7.01
31	5.51	2.96	6.97
32	5.50	3.00	6.98
33	5.52	2.95	6.98
34	5.50	2.97	7.08
35	5.51	2.98	7.12
36	5.50	2.97	6.93
37	5.51	2.96	7.05
38	5.20	2.94	7.00
39	5.10	2.95	7.02
40	5.00	2.96	7.05

Drive and Strip Torque

Results for P3088005 Fastener

Table 3 Drive Strip Torque Values For P3088005

Part	Drive Torque	Drive Angle	Strip Torque	Strip Angle	Strip/Drive Ratio	.5TT Angle	.7TT Angle	FM
1A	1.04	2501	2.94	3004	2.83	2893	2952	SB
1B	0.89	2499	3.07	2928	3.45	2813	2866	SB
2A	0.89	2626	3.00	2969	3.37	2803	2840	ST
2B	0.79	2696	2.99	3000	3.78	2894	2945	ST
3A	0.98	2516	2.98	2931	3.04	2823	2890	ST
3B	0.90	2587	2.99	3021	3.32	2874	2935	ST
4A	0.73	2099	2.81	2767	3.85	2639	2693	ST
4B	0.79	2368	3.05	2822	3.86	2706	2761	ST
5A	0.80	2300	2.71	2986	3.39	2825	2878	ST
5B	0.97	2553	2.87	3040	2.96	2913	2980	SB
6A	1.13	2480	3.01	2893	2.66	2791	2860	SB
6B	0.91	2317	2.98	2894	3.27	2802	2857	SB
7A	0.79	2280	2.86	2910	3.62	2790	2840	SB
7B	0.81	2608	3.00	2966	3.70	2817	2870	SB
8A	0.91	2570	2.92	3054	3.21	2883	2962	ST
8B	0.85	2461	3.12	2877	3.67	2752	2800	SB
9A	0.85	2515	2.97	2946	3.49	2787	2843	SB
9B	0.87	2570	3.10	2947	3.56	2820	2875	SB
10A	0.59	2370	2.56	2767	4.34	2672	2709	ST
10B	0.70	2300	2.93	2715	4.19	2597	2650	ST
Average	0.86	2461	2.94	2922	3.48	2795	2850	10 SB
3s Max	1.22	2904	3.34	3204	4.76	3051	3121	10 ST
3s Min	0.50	2018	2.55	2640	2.20	2538	2579	
St Dev	0.121	147.8	0.133	94.1	0.426	85.6	90.4	

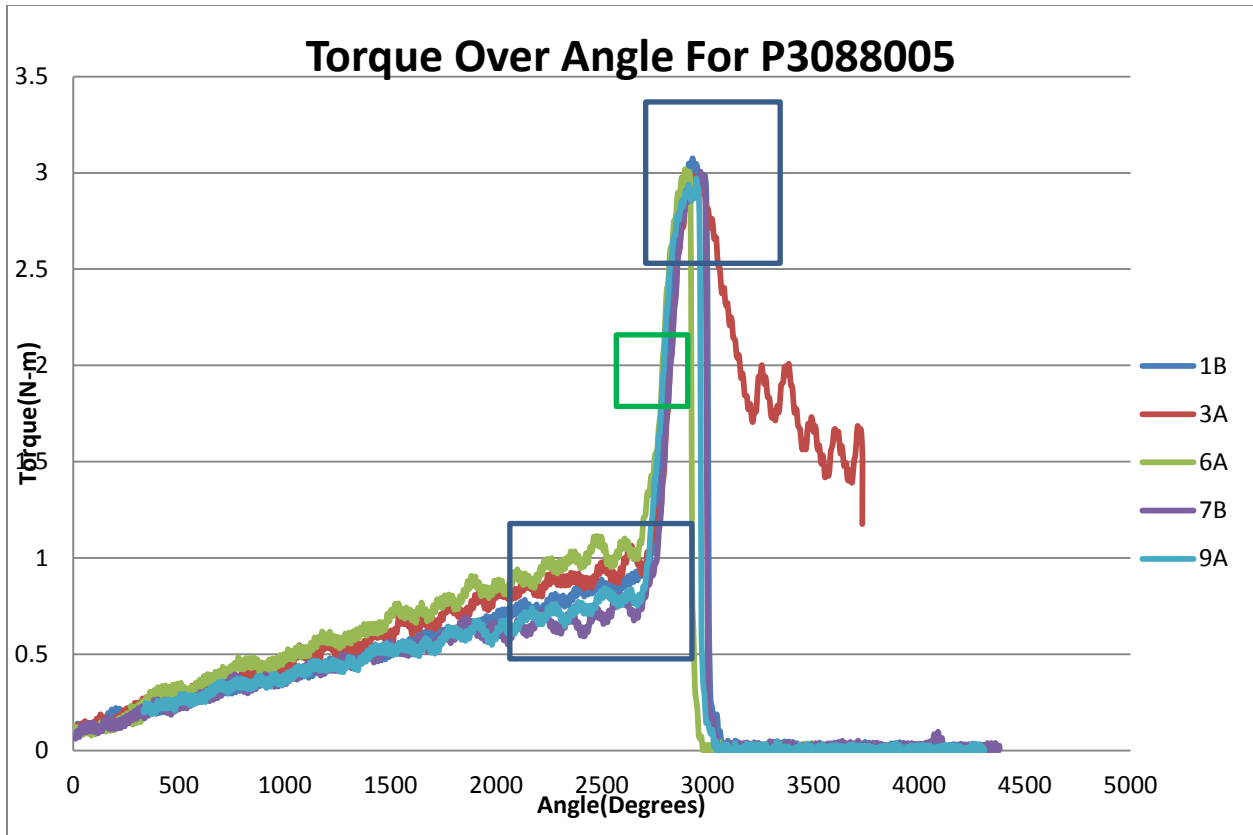


Figure 5 Torque Over Angle for P3088005

Results For P3088005(Applied with Wax) Fastener

Table 4 Drive Strip Torque Values For P3088005 W/Wax

Part	Drive Torque	Drive Angle	Strip Torque	Strip Angle	Strip/Drive Ratio	.5TT Angle	.7TT Angle	FM
11A	0.49	1825	2.71	2425	5.53	2323	2365	ST
11B	0.51	2410	2.89	2697	5.67	2578	2616	SB
12A	0.44	2102	2.72	2622	6.18	2480	2520	ST
12B	0.56	2407	3.00	2770	5.36	2460	2690	ST
13A	0.53	2025	2.89	2528	5.45	2411	2453	ST
13B	0.53	2260	2.99	2805	5.64	2680	2725	ST
14A	0.53	2407	2.87	2860	5.42	2746	2788	ST
14B	0.55	2695	2.87	3150	5.22	3017	3060	ST
15A	0.63	2262	2.89	2770	4.59	2616	2663	ST
15B	0.60	2515	2.89	2932	4.82	2830	2872	SB
16A	0.53	2607	2.60	2982	4.91	2820	2870	ST
16B	0.61	2517	2.92	2857	4.79	2737	2785	ST
17A	0.57	2297	2.68	2788	4.70	2693	2740	ST
17B	0.61	2510	2.83	2893	4.64	2780	2832	ST
18A	0.48	2302	2.60	2661	5.42	2517	2567	ST
18B	0.46	2422	3.01	2767	6.54	2643	2689	ST
19A	0.55	2623	2.85	2907	5.18	2813	2857	ST
19B	0.57	2352	2.76	2895	4.84	2777	2827	ST
20A	0.66	2477	2.79	3133	4.23	3015	3063	ST
20B	0.64	2604	2.79	3041	4.36	2935	2982	ST
Average	0.55	2381	2.83	2824	5.17	2694	2748	2 SB
3s Max	0.73	3026.88	3.19	3377.15	6.94	3271.34	3307.45	18 ST
3s Min	0.37	1735.02	2.47	2271.15	3.41	2115.76	2188.95	
St Dev	0.060	215.3	0.120	184.3	0.589	192.6	186.4	

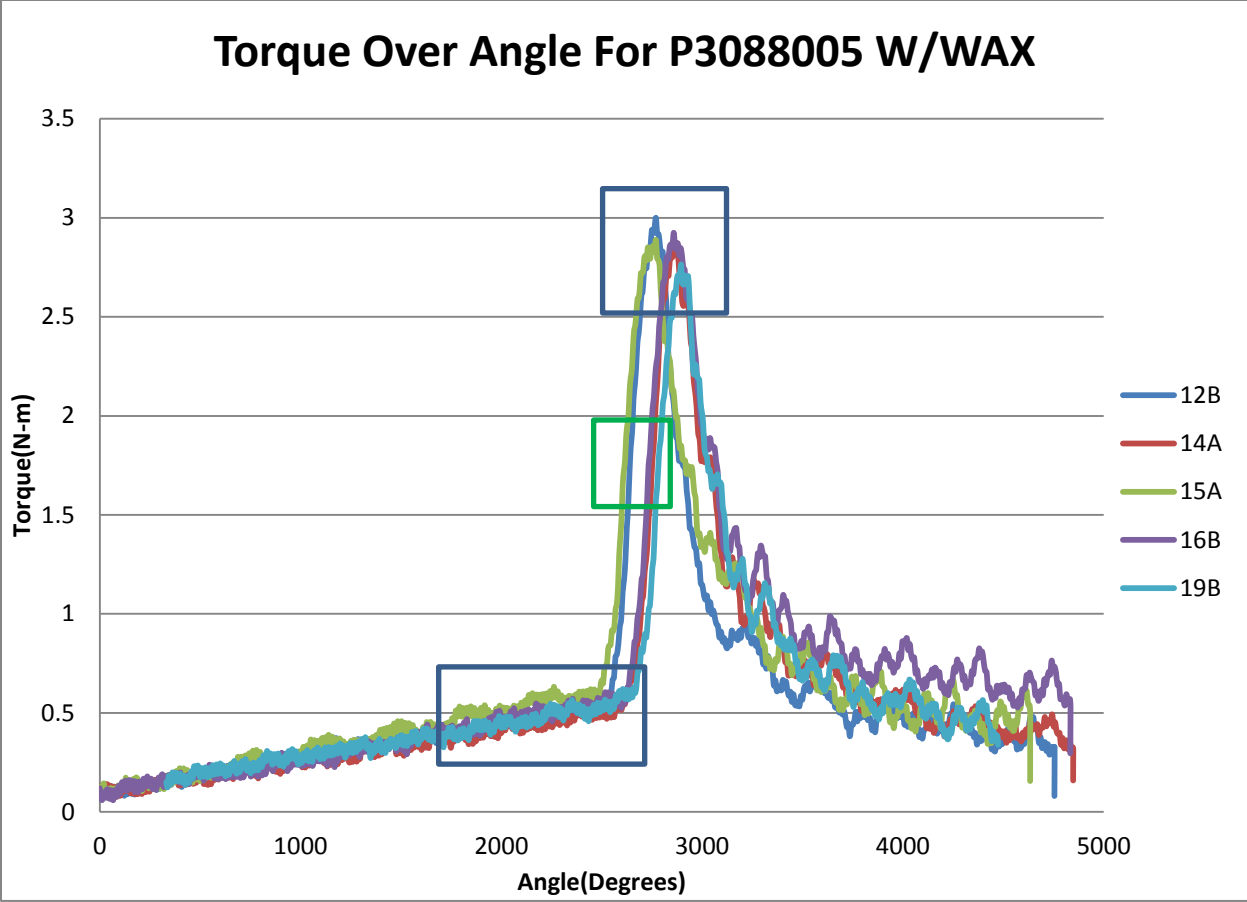


Figure 6 Torque Over Angle for P3088005 W/Wax

Results For P3088005(Applied with Wax and Left Out For 6 Days) Fastener

Table 5 Drive Strip Torque Values For P3088005 W/Wax Left Out For 6 Days

Part	Drive Torque	Drive Angle	Strip Torque	Strip Angle	Strip/Drive	.5TT Angle	.7TT Angle	FM
30A	0.908	2645	2.924	2898	3.22	3262	2823	ST
30B	0.790	2501	2.759	2879	3.49	2717	2782	ST
31A	0.954	2605	2.967	2895	3.11	2744	2817	SB
31B	0.880	2695	2.923	3057	3.32	2890	2920	SB
32A	0.840	2733	2.923	3071	3.48	2929	2995	ST
32B	0.760	2676	2.932	3003	3.86	2922	2922	ST
33A	0.650	2516	2.563	3132	3.94	3057	3057	ST
33B	0.677	2406	2.938	3019	4.34	2960	2960	ST
34A	0.815	2807	2.626	3151	3.22	3089	3089	ST
34B	0.620	2424	2.865	2804	4.62	2730	2730	ST
Average	0.79	2600.80	2.84	2990.90	3.66	2930.00	2909.50	2 SB
3s Max	1.22	2904	3.34	3204	4.76	3051	3121	8 ST
3s Min	0.50	2018	2.55	2640	2.20	2538	2579	
St Dev	0.113	134.516	0.143	116.687	0.513	174.536	119.545	

Residual Torque

At Recommended Tightening Torque

Table 6 Residual Torque for P3088005 and P3088005 W/Wax

P3088005	Initial	Residual
21A	1.88	1.61
21B	1.89	1.67
22A	1.88	1.68
22B	1.89	1.71
23A	1.88	1.63
23B	1.88	1.72
P3088005 W/Wax		
24A	1.49	1.36
24B	1.46	1.38
25A	1.49	1.45
25B	1.47	1.42
26A	1.48	1.38
26B	1.48	1.37

At Opposite Recommended Tightening Torque

Table 7 Residual Torque for P3088005 and P3088005 W/Wax

P3088005	Initial	Residual
27A	1.47	1.39
27B	1.48	1.45
P3088005 W/Wax		
28A	1.88	1.68
28B	1.88	1.64
29A	1.90	1.63
29B	1.86	1.66

Conclusions

The objective for this series of testing was to compare the performance of P3088005 versus P3088005 applied with wax to determine whether the wax improves the overall performance of the screw and decreases the amount of screws breaking. The results of the drive and strip test indicate that a greater value for the strip torque can be seen in P3088005 but also a higher driving torque. The P3088005 applied with wax had the lower drive and strip torques but also had a significantly lower amount of screws breaking instead of stripping out as you can see in the graphs and tables above. When the wax was applied and left out for 6 days the recommended tightening was exactly the same as if the wax was not applied at all. When this happens and the screw is still tightened to the recommended tightening torque of P3088005 with freshly applied wax, it could cause stripping or breaking of the screw.

Based on the performance of the screws, the ATF Applications Lab feels that optimal performance will be achieved if the recommendations stated in the next section are met.

Recommendations

Upon completion of all testing and analysis the ATF, Inc. Applications Lab has made the following recommendations based on 350 RPM installation speed:

Table 8: Final Tightening Torque Recommendations

Drive/Strip Average			
	P3088005	P3088005 W/Wax	P3088005 W/Wax Left Out For 6 Days
Tightening Torque Recommendation (N-m)	1.8834	1.5997	1.8834