MACLEAN POWER SYSTEMS

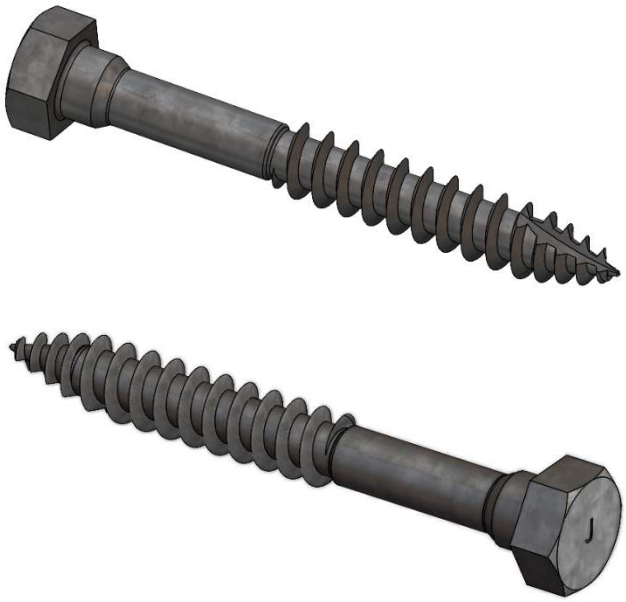
Engineering Test Report

C23P003

For Catalog Number:

J8754FX and J8753FX

Fast Lag Screws



Rev A. March 5th, 2024 - Initial Release

Rev B. August 1st, 2025 – Testing data update

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Reference: Project C23P003, LR-0524

Contents:

1. Abstract

The purpose of this evaluation is to prove an adequate, acceptable design of our new “Fast Lag” lag screw in accordance with industry standards (ANSI, ASTM, RUS) prior to production release.

2. Procedures/Tests

2.1 - Material Tensile Strength (ANSI C135.3, S5)

1. The lag screw is assembled in a testing fixture with a 10-degree wedge beneath the head of the bolt. The thread portion of the lag screw is held fixed via gripping jaws. *(See Figure 1)*
2. The part is then pulled in tension until failure.

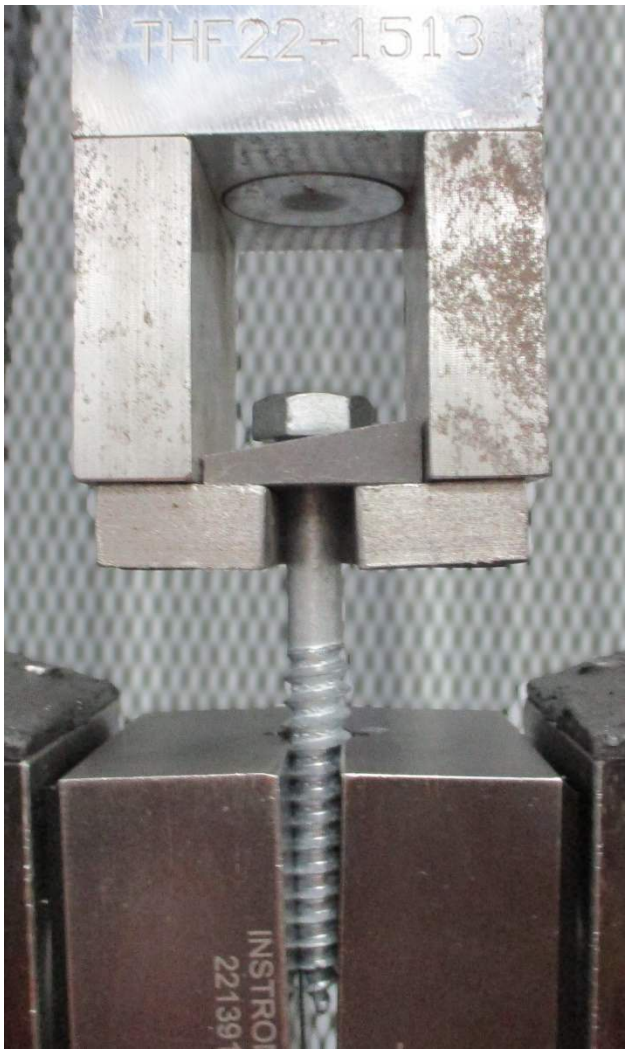

Figure 1 – Tensile Test Set-up

2.2– Cold Bend Test (ANSI C135.3, S5)

1. The lag treads were machined off the screw down to the root diameter. In the same manner, the head was also machined off the screw. *(See Figure 2)*
2. The part is then bent 180 degrees around a diameter that is equal to the diameter of the part. An example of the testing equipment is shown below. *(See Figure 3)*

Figure 2 – Machined Screw, post bend

Figure 3 – Testing Equipment

2.3– Lateral Strength Test (USDA Tech. Bulletin 597)

1. One 8.00” x 3.00” x 0.50” stainless steel cleat was fabricated with holes at opposite ends. *(See Figure 4)*
2. The cleat is then installed onto a section of utility pole utilizing the lag screw. Essentially, the cleat is fastened between the head of the lag screw and the utility pole. *(See Figure 5)*
3. A lateral tensile force is applied to the opposite end of the cleat via a horizontal tensile tester while the section of utility pole is held in a fixed position. *(See Figures 6a, 6b)*
4. Tension is applied until failure.

Figure 4 – Cleat

Figure 5 – Cleat Assembly

Figure 6a – Fixturing

Figure 6b – Cleat Connection

2.4– Lag Screw Retention (MPS Expectation)

1. The lag screw and pull fixturing are assembled into a utility pole section. *(See Figure 7)*
2. Tension is applied to the fixturing in the axial direction while the pole section is held fixed. Tension continues until the lag screw pulls out to the pole section.

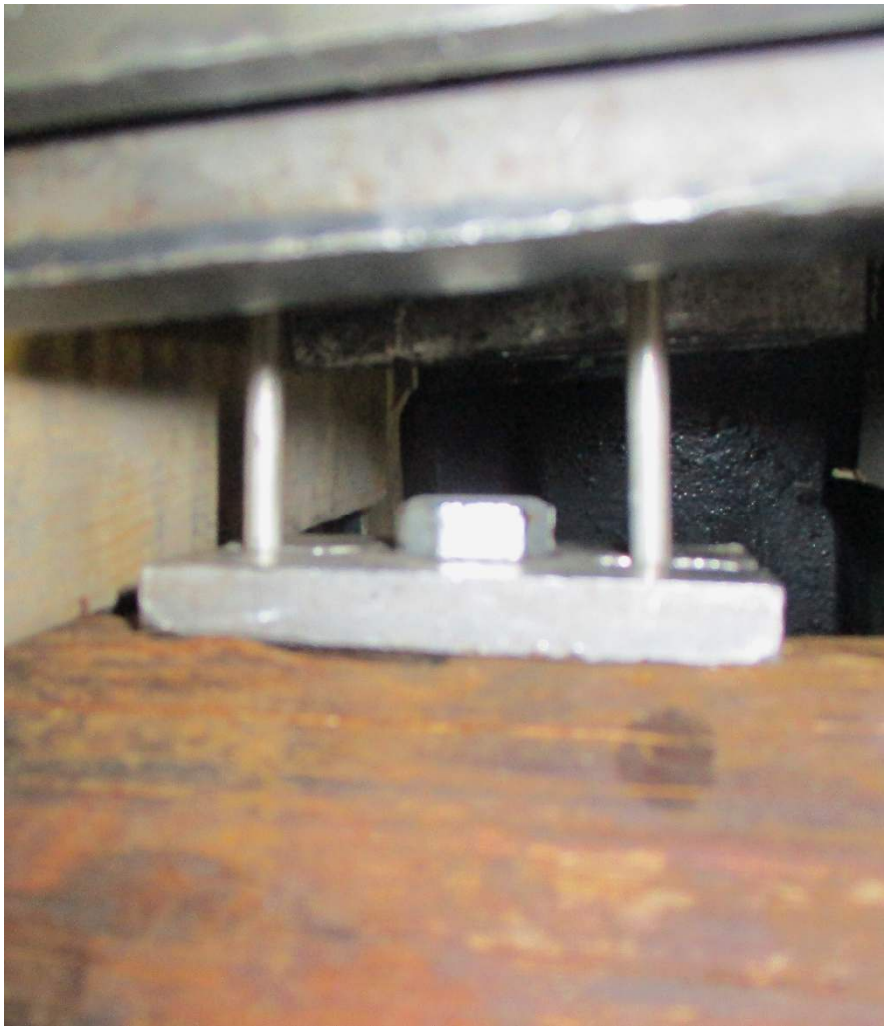

Figure 7 – Retention Pull Fixturing

2.5– Lag Screw Installation (MPS/Customer Expectation)

1. A section of utility pole is placed on its side onto a floor scale and the weight is zeroed. *(See Figure 8)*
2. The lag screw is placed into a ¾" socket coupled with a battery-powered impact driver.
3. The point of the lag screw is then placed in contact with the side of the utility pole section and the impact driver is actuated in with "forward" rotation. *(See Figure 9)*
4. Axial force is applied to the impact driver until the lag screw begins to pull itself into the pole section.

Figure 8 – Utility Pole Section/Scale

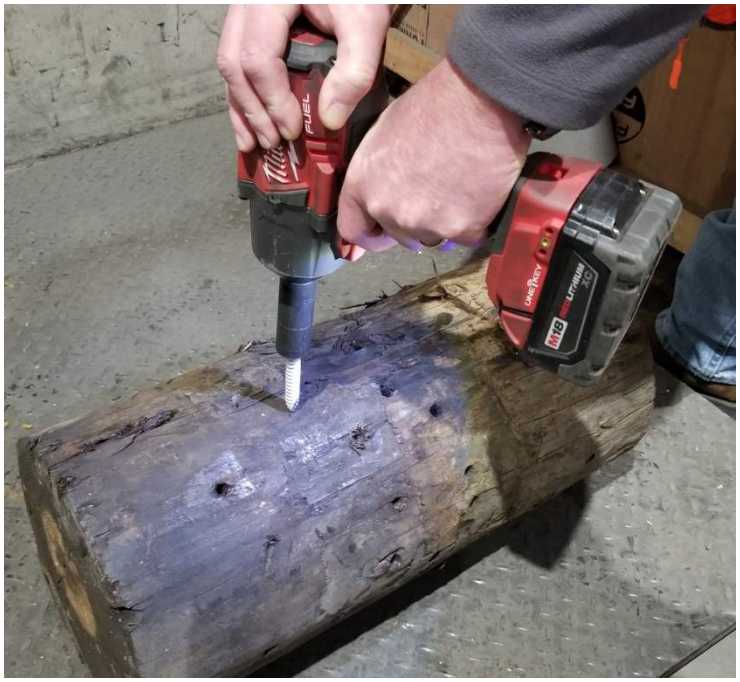

Figure 9 – Impact Driver Installation

3. Results

3.1 - Material Tensile Strength

The table below shows the ultimate tensile strength (lbs) and failure mode of the lag screws. See *Figure 10* for the physical lag screws that accompany these results.

Sample #	Requirement (lbs)	Actual (lbs)	Failure Mode	Results (P/F)
1	6500	13415	Broke in span	Pass
2	6500	13429	Broke in span	Pass
3	6500	13395	Broke in span	Pass

Figure 10 - Tensile Failure Mode

3.2 – Cold Bend Test

The table below shows the results cold bend testing performed by an A2LA accredited laboratory. See *Figure 11* for the physical lag screws that accompany these results.

	1	2	3	4	5	6
Bend Degree	180	180	180	180	180	180
Mandrel Radius	1D	1D	1D	1D	1D	1D
Bend Results	Pass – No Defects	Pass – No Defects	Pass – No Defects	Pass – No Defects	Pass – No Defects	Pass – No Defects

Figure 11 – Cold Bend Samples

3.3 – Lateral Strength Test

The table below shows the results of the lateral force (lbs) applied to the lag screw via the stainless-steel cleat. The testing was stopped during the first 2 trials after exceeding the requirement by 10x. For the last trial, force was applied until the tension cable broke. See *Figure 12* for the physical lag screws that accompany these results.

Sample #	Requirement	Actual	Failure Mode	Results (P/F)
Lateral St. 1	475	4,895	Screw Bent Stopped Test	Pass
Lateral St. 2	475	4,782	Screw Bent Stopped Test	Pass
Lateral St. 3	475	11,850	Screw Bent Broke Cable	Pass

Figure 12 – Lateral Strength Test Samples

3.4 – Lag Screw Retention

The table below shows the results of the axial force (lbs) required to pull the lag screw out of the side of a utility pole section. See *Figure 13* for an example of the typical failure mode of this test.

Sample #	Requirement	Actual	Failure Mode	Results (P/F)
Screw Ret. 1	N/A	3,610	Pulled out of pole	N/A
Screw Ret. 2	N/A	3,650	Pulled out of pole	N/A
Screw Ret. 3	N/A	4,070	Pulled out of pole	N/A
Screw Ret. 4	N/A	3,650	Pulled out of pole	N/A
Screw Ret. 5	N/A	3,095	Pulled out of pole	N/A
Screw Ret. 6	N/A	3,195	Pulled out of pole	N/A

Figure 13 – Retention, Typical Failure Mode

3.5 – Lag Screw Installation

The table below shows the results of the minimum axial force (lbs) required for the lag screw to self-start into the side of a utility pole section.

Fast Lag – Axial Drive Force Required for Self-Start	
Sample No.	Force (lbs)
1	24
2	26
3	31

4. Conclusion

Summary of the results shown in Section 3:

- Material tensile strength is recorded at an average of 13,400 lbs with a minimum of 13,395 lbs. The requirement is 6500 lbs. Safety factor of 2.0.
- Lag screw samples successfully passed the 180-degree cold bend test.
- Lateral strength of the screws proved to be more than adequate, achieving over 4,500 lbs min., with one sample carried to over 10,000 lbs.
- Lag screw retention into a utility pole resulted in a 23% improvement over MPS current offerings.
- The self-starting design of the lag screw proved to be functional and easy, with an average min. required axial force of 27 lbs for the screw to pull itself in. Gimlet lag screws averaged 54 lbs min. axial force to self-start. 50% improvement.

Based on this summary, and the *Comparative Physical Testing* **(Appendix)**, the new Fast Lag – Lag Screw (J8753FX & J8754FX) design is recommended for production.

5. Appendix

Comparative Physical Testing

MacLean POWER SYSTEMS	Comparative Physical Testing	PRV No.: C23P003 Model No./Part No.: J8753FX/F105948; J8754FX/F105949 Part Description: Fast Lag Lag Screw Value Stream: Distribution Hardware Vendor:	Engineering Originator: Justin Knott Issue Date: 11/28/2023 Completion Date: 8/1/2025 Engineering Mgr. Approval: 8/1/2025 (MG)

Item No.	Test Description	Acceptance Criteria	Test Method	Part Numbers	Test Date	No. of Samples	Test Results (avg.)	Notes
1	Material Tensile Strength	6500 lbs min. UTS failure must be on shank or thread, not in head/shank transition	tensile pull	F105949 (4" Fast Lag) F102338 (4" Gimlet) F614673 (4" Fetter Point) F614732 (4" Twist Point)	12/12/2023; 7/22/2025	3 ea.	F105949 = 13,414 lbs F102338 = 10,907 lbs F614673 = 11,539 lbs F614732 = 12,643 lbs	For complete testing information, see LR0524 and 7/22/25 material update Failure Mode: "Broke in Span" or "Slipped from Machine Jaws"
2	Screw Retention (in wood)	15% Improvement over existing offering	tensile pull	F105949 (4" Fast Lag) F102338 (4" Gimlet) F614673 (4" Fetter Point) F614732 (4" Twist Point) F614623 (4.5" Fetter Point)	12/15/2023	3 ea.	F105949 = 3,777 lbs (23%) F102338 = 3,080 lbs F614673 = 2,972 lbs F614732 = 3,220 lbs F614623 = 2,783 lbs	Wood Species = Southern Yellow Pine Pole Full thread must be installed into pole For complete testing information, see LR0524 Failure Mode: "Pulled out of Pole"
3	Lateral Strength (in wood)	475 lbs min. lag screw must not pull out of wood lag screw must not break/shear	tensile pull	F105949 (4" Fast Lag) F102338 (4" Gimlet) F614673 (4" Fetter Point) F614732 (4" Twist Point)	2/9/2024	3 ea.	F105949 = 10,000 lbs min. F102338 = 5,148 lbs F614673 = 2,997 lbs F614732 = 3,602 lbs	Wood Species = Southern Yellow Pine Pole 1/2" thick metal cleat to be utilized For complete testing information, see LR0524 Failure Mode: Fast Lag "Broke cable" Other Lags "Pulled out of Pole"
4	Initial Driving Force Required (Self Starting Tip Design/Aggressive Wood Screw Thread Profile)	full length installation to be performed without the use of a pilot hole or manual driving/hammering	installation with impact driver	F105949 (4" Fast Lag) (4" Gimlet)	2/13/2024	3 ea.	F105949 = 27 lbs (avg) Competitor Gimlet = 54 lbs (avg)	Wood Species = Southern Yellow Pine Pole Competitor gimlet point lag screws were sourced online Fetter point and twist point not considered, designed to be hammered in For complete testing information, see LR0524 & LR0335

Fast Lag Offerings – J8753FX & J8754FX