HIPERTECH™ #6

HIPERFIRE® Trigger Families

Hammer Power to Pull Weight Ratio™ (PWR)

Introduction

The five previous HIPERTFIRE Bulletins discussed HIPERFIRE®'s goal of designing and testing AR15/10 triggers that gave shooters lower pull weights with less creep than what was offered by the so-called MIL-spec trigger and importantly, without compromising hammer strike power. Sadly many, if not most trigger upgrades, could only provide one or the other. It seemed that an inviolable law existed that made low pull weight and heavy hammer fall mutually exclusive AR trigger properties. HIPERFIRE found a way to break this law by developing its exclusive Cam-Over Toggle Engine™ (Bulletin #1) and Radical Sear Mechanics™ (Bulletin #2) trigger features. Next, we provided the HIPERTECH data that supported our findings and confirmed our trigger design intent (Bulletins #3 through #5). Through it all, as shooters, we were wrestling with, "What metric, or measurement figure of merit, can we apply to triggers that best describes how it feels and performs?" Weight alone doesn't answer the question, and no one wants to talk about creep or light-strikes. It seems we can only agree that all we know is that we don't like MIL-spec.

In this HIPERTECH bulletin, we suggest a metric that better indicates what we want to feel when we pull the trigger to drop a MIL-grade hammer and always make the AR go BANG.

The information provided is accurate to the best of HIPERFIRE's knowledge. Any experimental data presented has been collected and analyzed using commercially available test instruments, software, and products, subject to the application of the scientific method and engineering knowhow, so that anyone familiar with the art could reproduce and verify the results. The interpretation of that data is not necessarily definitive, but of HIPERFIRE's considered opinion.

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HIPERTECH™ #6

Hammer Power to Pull Weight Ratio (PWR)

Lower pull weight and MIL-grade hammer fall are important to shooters of the MSR (the Modern Sporting Rifle, the AR15/10 platform) for realizing its higher accuracy potential at speed and distance. As we learned in HIPERTECH articles #3 through #5, it is difficult to appreciate the trade-offs between trigger weight and hammer fall power among the many trigger products and types in the marketplace without their outright purchase and testing as HIPERFIRE has done.

Shooters have gravitated to low pull weight triggers when looking to replace their stock MIL-spec trigger, because they could exercise better control over their shot timing and placement. But they discovered that many of these low weight triggers often light-strike, called LPS for light primer strike, i.e., the trigger is pulled to break, the hammer falls, but the rifle doesn't go BANG. The products' technical specifications suggest only lower pull weight than MIL-spec, but not LPS. HIPERFIRE has successfully developed triggers with both low pull weight and MIL-grade hammer strike. We needed a new metric that goes beyond pull weight alone, beyond comments regarding creep, or even pull energy, to include the hammer's ability always to touch off the ammunition. That new metric is the familiar "power to weight ratio."

We know that fast cars, fast airplanes, and fast rockets have a high power to weight, or thrust to weight, ratio so they can get off the line faster, use shorter runways for takeoff, and escape earth's gravity. The ratio is a number calculated by dividing the vehicles' maximum engine power by the vehicle's weight. To make the number large, i.e., make the vehicle accelerate up to speed faster, either the engines are made increasingly more powerful, or the vehicles are made increasingly lighter, or both. This power to weight ratio is a familiar figure of merit used to compare various cars, planes, and rocket motors with one another. We are going to apply the terminology to triggers with a twist.

For our purpose, power refers to the hammer's average firing pin striking power. Three experimentally determined copper crusher indent values were generated by hammer strikes and presented in HIPERTECH #5. These three values are then averaged and presented herein that indicates that power. The weight is the various triggers' maximum pull weight averaged over five trigger weight versus displacement (creep) scans. So, the new figure of merit is a triggers' hammer strike power divided by its maximum pull weight, or its hammer power to pull weight ratio, or PWR.

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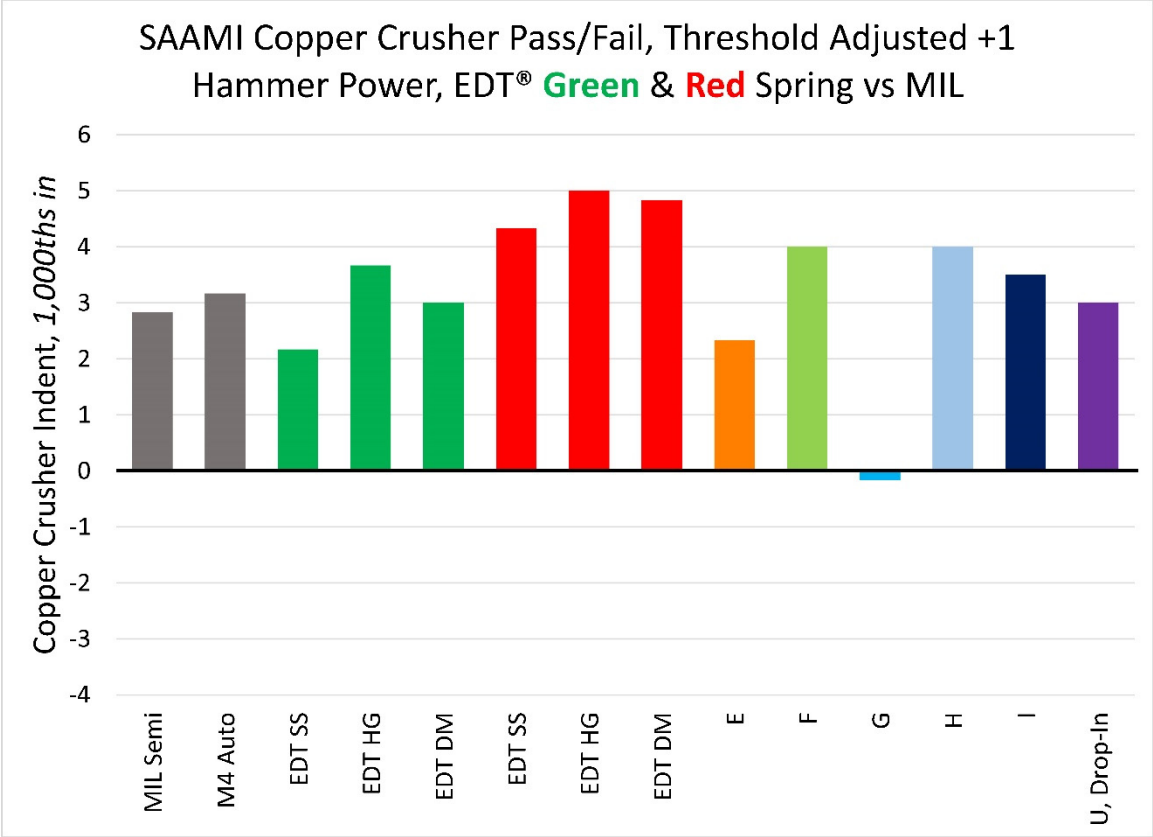

Figure 1. EDT trigger hammer power compared to MIL-spec and MIL-spec upgrades.

But first, we change how hammer copper crusher data is used that is different from what was presented in Bulletin #5. There, we plotted the firing pin indent depths among various triggers in bars compared to the SAAMI specification. We noted that the minimum depth that SAAMI specified for 100% primer ignition was .017 inches. HIPERFIRE has had many discussions with its customers complaining of LPS with many of HIPERFIRE's trigger competitors. We have tested many of those triggers and found that they meet the SAAMI test threshold of .017 inches for hammer power, but still occasionally light strike. That tells us that the SAAMI spec is indeed a minimum, but a more conservative standard is required to better indicate 100% ignition reliability. So, for the purposes of this bulletin, we have adjusted to the "minimum" firing pin indent depth to be .018 inches. We have replotted the Bulletin #5 SAAMI copper crusher data with this new standard. This new threshold is the zero (0) line in the plot above, and the

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two plots shown below for our three trigger groupings. Copper crusher data below the line (reflecting the adjusted copper crusher indent depth of .018 inches) now has a negative value, while those above zero (0) are positive. Please inspect the three figures below, showing the same data of Bulletin #5 presented in this new manner.

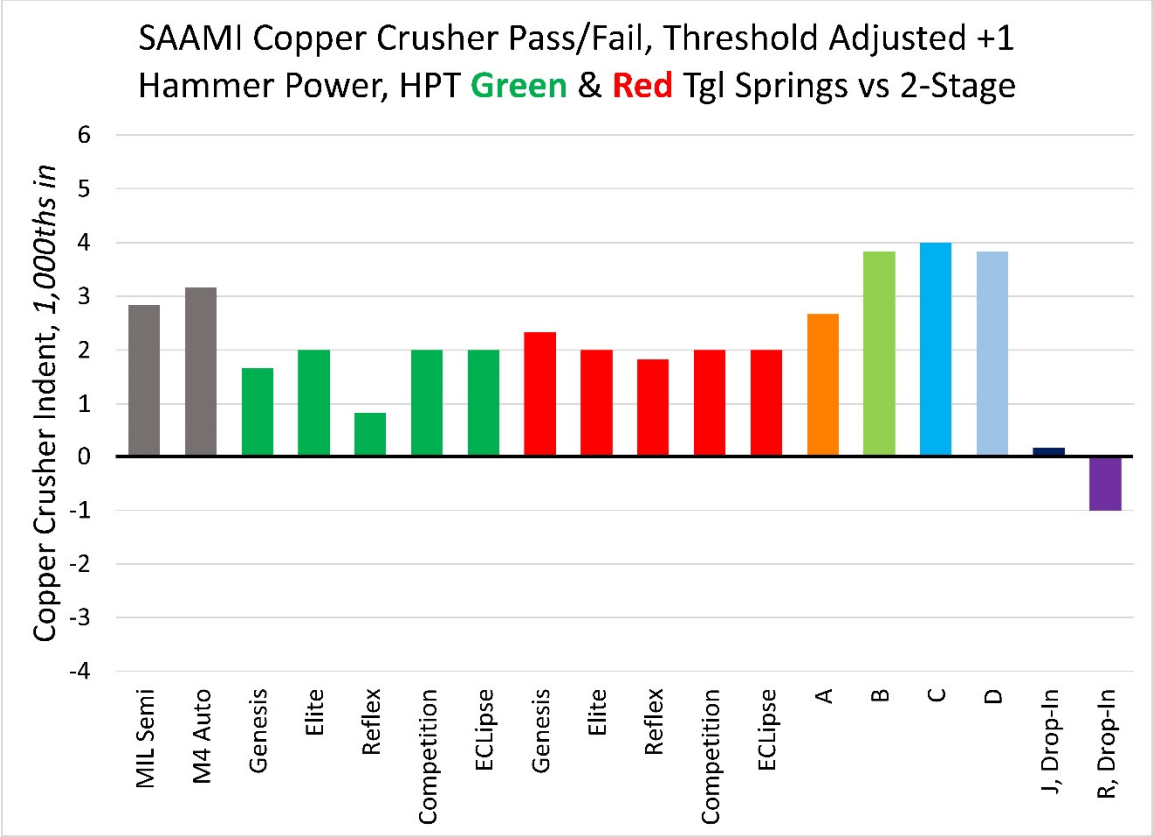

Figure 2. HIPERTOUCH trigger hammer power compared to MIL-spec and 2-stage triggers.

The vertical scale shows copper crusher firing pin indent depth in thousandths of an inch. The zero (0) line is the newly adjusted, more conservative SAAMI depth threshold of .018 inches. Values that plot above the line for any trigger indicates that those hammers strike harder than the threshold for 100% ignition reliability and the hammers whose values plot below the zero (0) line fail to meet the minimum threshold and will likely light strike, some, most, or all of the

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time (depending also on other factors like the specific primer from several different manufacturers). Who wants an occasional LPS? The vertical scales in Figures 1-3 are the same to make comparisons between the three trigger groupings easier.

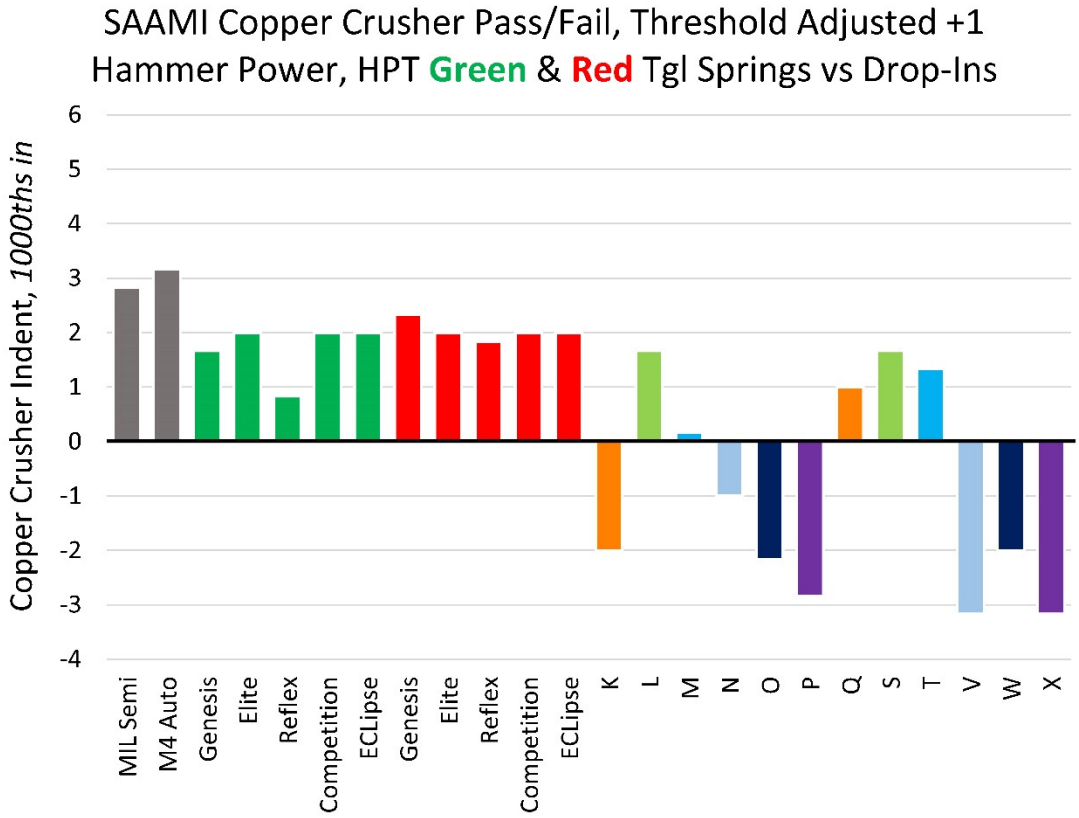

Figure 3 HIPERTOUCH trigger hammer power compared to MIL-spec and 2-stage triggers.

Now, let's see what PWR looks like and whether it provides better insight into how triggers may feel and what they can do. We divide the data charts into the same trigger groupings presented in HIPERTECH Bulletins #3, #4, and #5, by EDT and MIL-spec upgrades, HIPERTOUCH and 2-stage triggers, and HIPERTOUCH and drop-ins. The results presented in the figures below are normalized to the two MIL-spec trigger results as the baseline for comparison. Generally, values that plot below zero (0) indicates that the trigger failed the SAAMI

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adjusted minimum, firing pin, indent depth discussed above. So, even though the ratio is much higher or much lower than the MIL-spec baseline of 0%, indicating either heavy hammer fall or lower relative pull weight, or both, one can see that LPS is possible and who would want a trigger with LPS? In other rare cases, the value may plot negative (-) or below the line even though the trigger would not light strike. That is because the measurements plotted are relative to the MIL-spec baseline of zero (0).

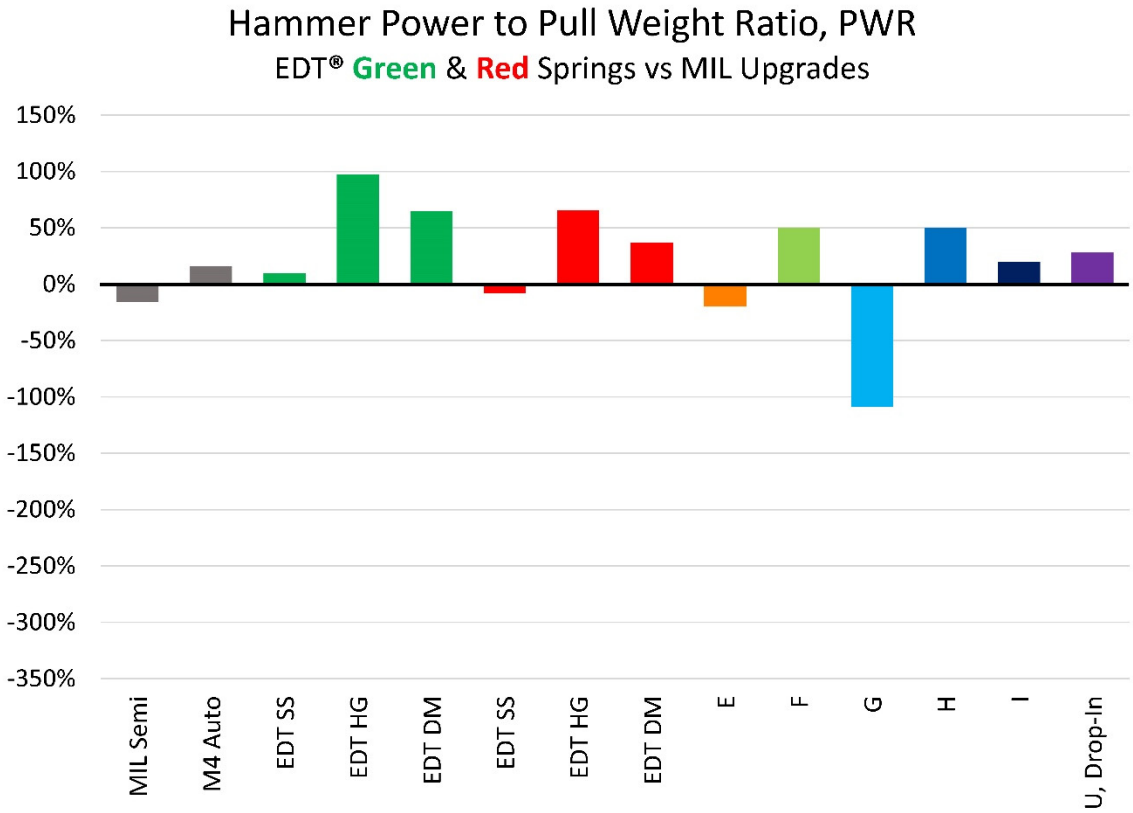

Figure 4. EDT trigger hammer power to pull weight ratio, PWR, compared to MIL-spec upgrades.

Please note that the data presented in Figures 4-6 (above and below) include hammer strike power and maximum trigger weight over the pull distance, that is creep. If the average pull weight, or the pull weight at break, were used, then the plotted bars would be slightly different. That is the difficulty, deciding on

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a consistent, reliable, and accurate indicator. Also, and very importantly, the calculated PWR values ignores creep. If creep is so important to shooters and to HIPERFIRE, it must not be ignored. In HIPERTECH #7, we include creep in a hammer fall power to trigger pull energy ratio. For now, we want to examine whether a metric based on hammer power and trigger weight alone is good enough to make trigger performance purchasing decisions. Here too, the vertical scales in Figures 4-6 are the same to make comparisons between the three trigger groupings easier.

Figure 4 above compares EDT triggers with both the green and red hammer springs installed to MIL-spec and MIL-spec upgrades. The EDT's green spring (green bars) result in pull weights of approximately 4½ lbs., the red (red bars) approximately 5½ lbs. These moderate pull weights (compared to MIL-spec) are a consequence of HIPERFIRE's exclusive Radical Sear Mechanics (RSM) discussed in HIPERTECH #2 for lowering pull weight without reducing hammer power.

Importantly, Figure 4 shows that the EDTs (on average) with the green spring outperforms all of the others on PWR. The EDT red hammer spring increased the copper crusher indent, but at the cost of increased pull weight, so that the red EDT bars are shorter than those for green while matching or exceeding the values for the others. Overall, the EDTs' relative performance is better by this PWR standard. The "G" trigger failed the adjusted SAAMI primer indent standard and would therefore exhibit LPS.

Figure 5 compares the PWR of HIPERTOUCH triggers to 2-stage triggers. HIPERTOUCH includes HIPERFIRE's Radical Sear Mechanics (RSM) and Cam-Over Toggle Engine (COTE) discussed in HIPERTECH #1. Here, HIPERTOUCH, with the green toggle springs installed (green bars), provides pull weights of approximately 2 and 2½ lbs., and with the red springs (red bars), approximately 3½ lb. pulls depending on the model.

HIPERTOUCH outperforms the MIL-spec triggers, and most of the 2-stage triggers because of HIPERTOUCH's much lower maximum pull weights, compared to MIL-spec or EDT. The HIPERFIRE trigger design goal was very low pull weight with a powerful hammer fall. However, the Reflex's green bar that plots below the zero (0) line does not indicate LPS. Instead, it indicates a ratio less than that for MIL-spec, not necessarily bad. Remember, creep is not included in the PWR metric. We learn what this means in HIPERTECH #7 when creep is included in the calculation.

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HIPERTOUCH's green toggle springs exhibit the best PWR metric performance overall. With red toggle springs, HIPERTOUCH is slightly below the 2-stage offerings on average of those that plot above the zero (0) line. The 2-stage triggers as a class outperformed MIL-spec. Trigger "J" and "R" fail the SAAMI copper crusher threshold and would likely light strike. Curiously, these two triggers are also drop-ins. More on drop-ins further below.

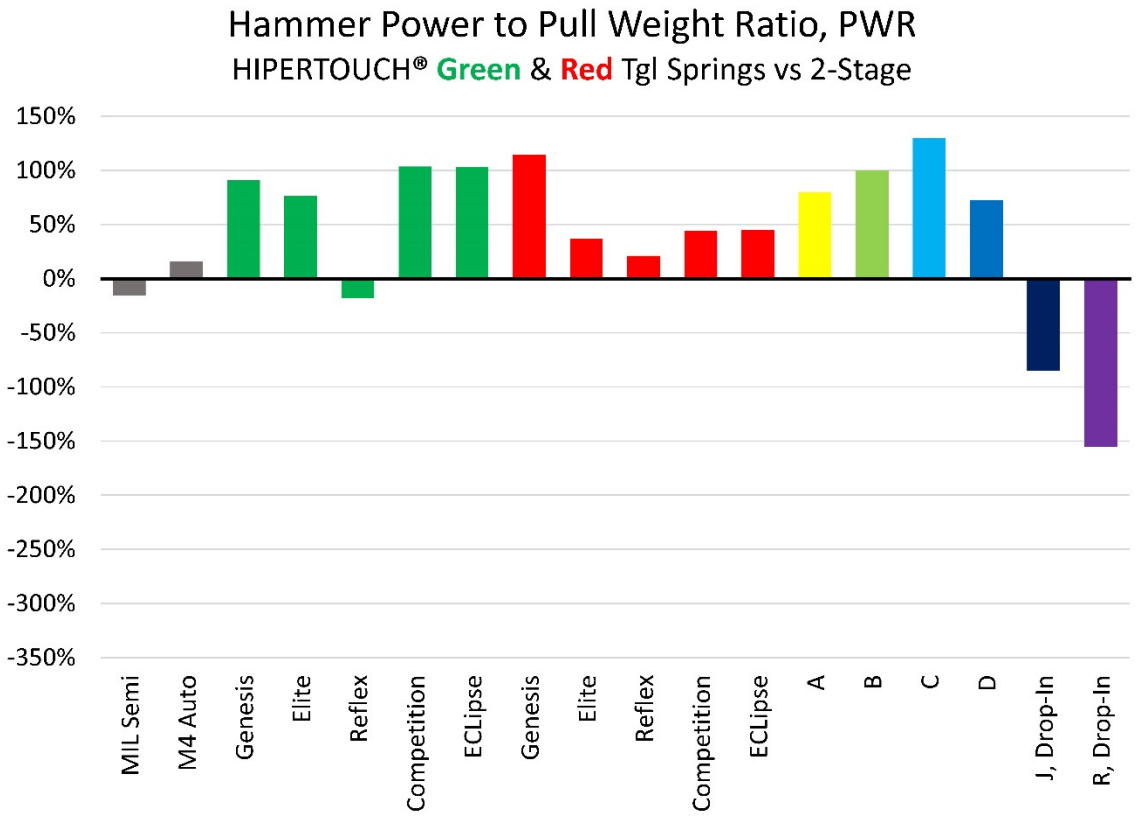

Figure 5. HIPERTOUCH triggers' Power to Pull Weight Ratio, PWR, compared to 2-stage triggers.

Figure 6 compares the PWR of the same HIPERTOUCH triggers shown in Figure 5 to drop-in triggers. It should be amply evident that component install 2-stage offerings as a class outperform drop-ins (of either single-stage or 2-stage design) for PWR because most of the drop-ins light strike. Again, why would an-

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yone want that? That's why we separated the triggers into classes to better associate their pull weight characteristics, among other things. Again, the trigger class structure represents the many preferences shooters have for triggers in the marketplace. Most of the drop-in triggers exhibit dismal performance by the PWR metric.

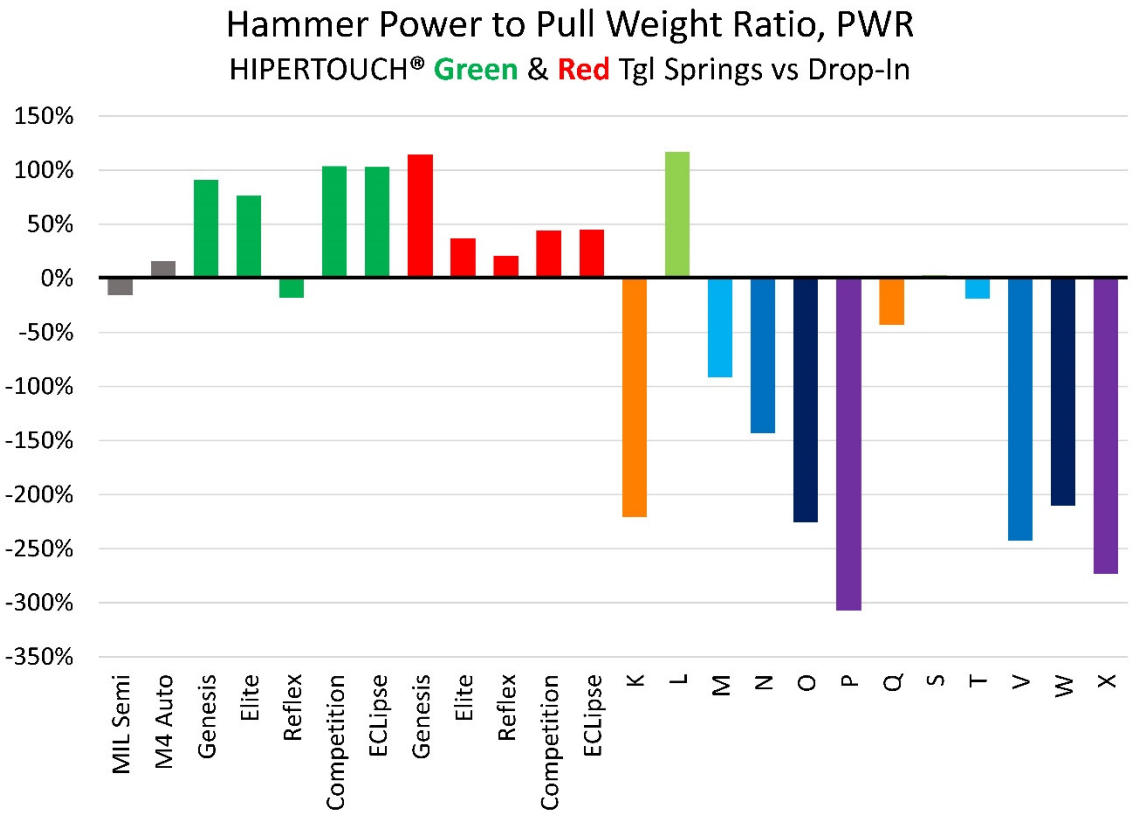

Figure 6. HIPERTOUCH triggers' Power to Pull Weight Ratio, PWR, compared to drop-in triggers.

Remember, these PWR charts do not include creep in the metric, only trigger pull weight and hammer fall power because most shooters think that pull weight best compares what is essential, if not most important; what's wrong with that? It's part of the mental conditioning that marketplace advertising performs and what reviewers think they know is important. Their collective bias is: low pull

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weight is good, mention creep only if its less than MIL-spec, and don't ever address LPS, period. All would agree that lower weight triggers feel better than higher weight triggers. But the pull weight metric that manufacturers cite is not defined. Is it the average weight over the entire pull, the maximum weight, or the design goal weight? These can be very different from what was experimentally measured. How do we know? We made the measurements and compared them to the advertising; we were amazed. We included hammer fall power to correct the misconception that pull weight alone is the best measure of trigger performance.

Conclusion

HIPERFIRE has an obvious bias in picking the PWR metric. It highlights the advantage that HIPERFIRE's trigger offerings have over its competitors in the marketplace by combining the metrics of hard-hitting hammers WITH lighter weights. Even so, HIPERFIRE asks, "Is this PWR metric a valid and fair measure of trigger performance?" If yes, then shouldn't the "L" trigger (shown in Figure 6) be the best trigger? That answer requires more information and qualification beyond PWR to be found in future HIPERTECHs.

The PWR is a good metric, at least better than weight alone, because it includes two features that should be very important to today's AR15/10 shooter, pull weight and hammer strike power, or primer ignition reliability. However, in HIPERFIRE's view, the PWR metric alone is not enough to fully or accurately describe what any shooter would want to know about a trigger. Again, what value do we use for pull weight if that weight varies markedly over the pull stroke? Again, we saw that PWR for a couple of HIPERFIRE triggers plotted too low and suggested inadequate hammer strike power as well as how they "feel." Which also applies to some of the other triggers reported. That quest for satisfaction is the subject of the next HIPERTECH Bulletin #7. We are nearing the end of an initial process to define a metric we can use to make our favorite trigger selection more meaningful and satisfying. Even given our bias, this does not necessarily point to HIPERFIRE triggers exclusively. Remember, we all have our preferences, our bias. In the end, our purpose here is to help you make better and more rational choices for yourself. Stay tuned.

See **Appendix A** for an updated matrix of all the triggers, features, and metrics we have discussed so far.

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Appendix A Green Means Column Feature Criteria Satisfied

AR15/AR10 Trigger	Single-Stage	2-Stage	Drop-In Single-Stage	Cam-Over Toggle Engine	Radical Sear Mechanics	Pull Weight Less Than 4lb	Creep Less Than .05"	Pull Energy Less Than -50%	Hammer Strike > SAAMI .018"
HIPERTECH Bulletin				1	2	3		4	5
MIL-SPEC Semi-Auto									
MIL-SPEC Full-Suto									
EDT Sharp Shooter									
EDT Heavy Gunner									
EDT Designated Marksman									
HIPERTOUCH Genesis									
HIPERTOUCH Elite									
HIPERTOUCH Reflex									
HIPERTOUCH Competition									
HIPERTOUCH Eclipse									
A									
B									
C									
D									
E									
F									
G									
H									
I									
J, Drop-In									
K									
L									
M									
N									
O									
P									
Q									
R, Drop-In									
S									
T									
U, Drop-In									
V									
W									
X									

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Appendix A -cont'd- Green Means Column Feature Criteria Satisfied

AR15/AR10 Trigger	MIL PWR > 0%	2-Stage PWR > 0%	Drop-In PWR > 0%
HIPERTECH Bulletin	6		
MIL-SPEC Semi-Auto			
MIL-SPEC Full-Suto			
EDT Sharp Shooter			
EDT Heavy Gunner			
EDT Designated Marksman			
HIPERTOUCH Genesis			
HIPERTOUCH Elite			
HIPERTOUCH Reflex			
HIPERTOUCH Competition			
HIPERTOUCH Eclipse			
A			
B			
C			
D			
E			
F			
G			
H			
I			
J, Drop-In			
K			
L			
M			
N			
O			
P			
Q			
R, Drop-In			
S			
T			
U, Drop-In			
V			
W			
X			

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