HIPERFIRE® Trigger Families

Hammer Strike Power to Trigger Pull Energy Ratio™ (PER)

Introduction

In HIPERTECH #6, we introduce the Power to Pull Weight Ratio (PWR) as a measure, a figure of merit, or a metric to more accurately describe trigger performance as it relates to trigger pull weight AND hammer strike power. We were pleased with its overall better portrayal of trigger performance than using just pull weight alone.

In HIPERTECH #4, we introduced the idea of including creep into our assessment of trigger pull by directly tying it to trigger weight to yield a very seldom used metric defined as trigger pull energy, or the engineering term work. It's simply the product of the pull weight (pull force) and trigger displacement. This value is the "area under the curve" in the TriggerScan® produced data charts.

In this HIPERTECH bulletin, we improve on the hammer and trigger PWR performance metric by including creep. We call this characteristic attribute of any trigger the Power to Pull Energy Ratio (PER). You see, this provides a different and more discriminating view of any trigger's performance than PWR.

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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Hammer Strike Power to Trigger Pull Energy Ratio (PER)

HIPERTECH #6 provides valuable this context of this discussion.

For our purpose here, power again refers to the hammer's firing pin striking power indicated by the SAAMI copper crusher indent values we obtained in HIPERTECH #5 and the trigger pull energy of the various triggers derived in Bulletin #4. As in Bulletin #6 for PWR, we were using averaged copper crusher indent values and averaged trigger scans to calculate PER. The entirely new value we discuss here are triggers' hammer strike power divided by their respective pull energies, Power to Pull Energy Ratio or PER.

Let's see what PER looks like and whether it provides better insight into how triggers may feel and what they can do. We expect it to be better because pull energy is a better way to assess what the trigger feels when it pulls the trigger than weight alone because it includes creep. We recognized that creep per se is less critical if the pull weight is low, or let's say less distracting. Contrarily, if the creep is low, but the weight high, then the weight is more noticeable or distracting. By combining the two into that one metric, energy, the feel is better characterized, and we don't have to be as concerned by either weight or creep individually.

When we include energy in our PER ratio, weight, creep, and power becomes one figure of merit that generally informs us with more simplicity about how that trigger would feel when we want the gun always to go BANG.

We divide the data charts shown below into the same trigger groupings presented in previous HIPERTECH articles by EDT and MIL-spec upgrades, HIPERTOUCH, and 2-stage triggers, and HIPERTOUCH and drop-ins. We normalize the results to two MIL-spec triggers as the comparison baseline.

Figure 1 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) results in pull weight 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.

Again, as in Bulletin #6, the more positive bar values indicate better "feel" with some important qualifications discussed further below. Very low values, or

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even negative ones, are undoubtedly bad as they show either deficient hammer power leading to LPS, light primer strikes or high pull energy or both compared to MIL-spec.

All the charts include the SAAMI copper crusher data with the minimum PASS/FAIL firing pin indent depth adjusted to .018-inches instead of SAAMI's .017-inch specification. Because we know from many customers' experiences, triggers that PASS the minimum .017-inch threshold do light strike. The .018-inch threshold is more conservative and better indicates 100% primer ignition reliability. PER calculated with SAAMI copper crusher values below this new zero (0) indicate FAIL results as negative PER.

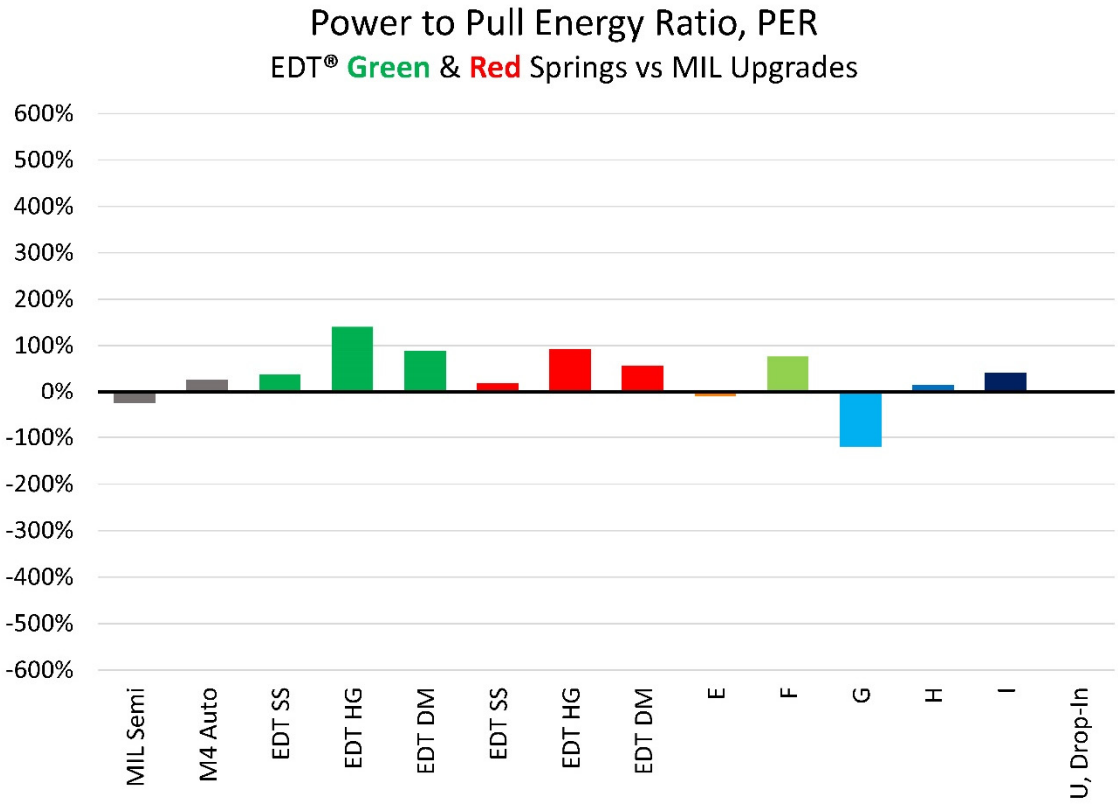

Figure 1. EDT triggers' Power to Pull Energy Ratio, PER, compared to MIL-spec upgrades.

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What do the numbers mean? The vertical scale compares the performance of all the triggers to a MIL-spec average taken as the baseline of 0%. A trigger whose bar is 100% positive is twice as good as MIL-spec in that the hammer strikes hard enough to PASS the SAAMI standard but takes halve as much energy to pull the trigger to break. In other words, it takes less work to make the rifle to go BANG compared to the MIL-spec baseline. The greater the magnitude of the bars, the better the trigger will "feel" relative to MIL-spec. More on this further below.

Importantly again, Figure 1 shows that the EDTs with the green spring as a group outperform the other component install triggers that are MIL-spec upgrades. 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 slightly shorter than those for green, while closer to the others as a group. The "G" trigger shows the most inferior performance because it failed the adjusted SAAMI copper crusher test for 100% primer ignition reliability. Figures 4-6 show this relationship to copper crusher indent more clearly.

Figure 2 compares the PER of HIPERTOUCH triggers to 2-stage triggers. HIPERTOUCH includes HIPERFIRE's Radical Sear Mechanics (RSM) and the 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.

Note that the vertical scales are identical in Figures 1-3. The HIPERTOUCH triggers show an increase in PER of almost three times (3X) compared to the EDTs. If 100% is twice as good as MIL-spec, then 400% is five times better. That is, it takes 20% of the MIL-spec effort to drop the hammer with a HIPERTOUCH ECLipse trigger, for example. Moving from EDT to HIPERTOUCH results is an approximately 250% easier pull compared to the MIL-spec baseline because we're now including creep in the calculation. The Elite's creep is about twice that of the Reflex, Competition, and ECLipse, while about half of Genesis' creep. Do you see what those various amounts of creep do to the length (magnitude) of the respective PER bars?

We see a disparity between 2-stage triggers and MIL upgrades moving from PWR to PER (Figures 10-12 show this more clearly). Again, creep does matter, but we always knew that intuitively. However, now we can measure its influence combined with hammer power. As we stated in another HIPERTECH, the 2-stage trigger's 1st-stage take-up is merely a euphemism for 1st-stage creep.

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Including all the creep in that single creep metric doesn't make it as attractive; at least it can no longer hide since it still takes energy to pull through it, energy the shooter feels as work. Again, the trigger class groupings represent the many preferences shooters have for triggers in the marketplace.

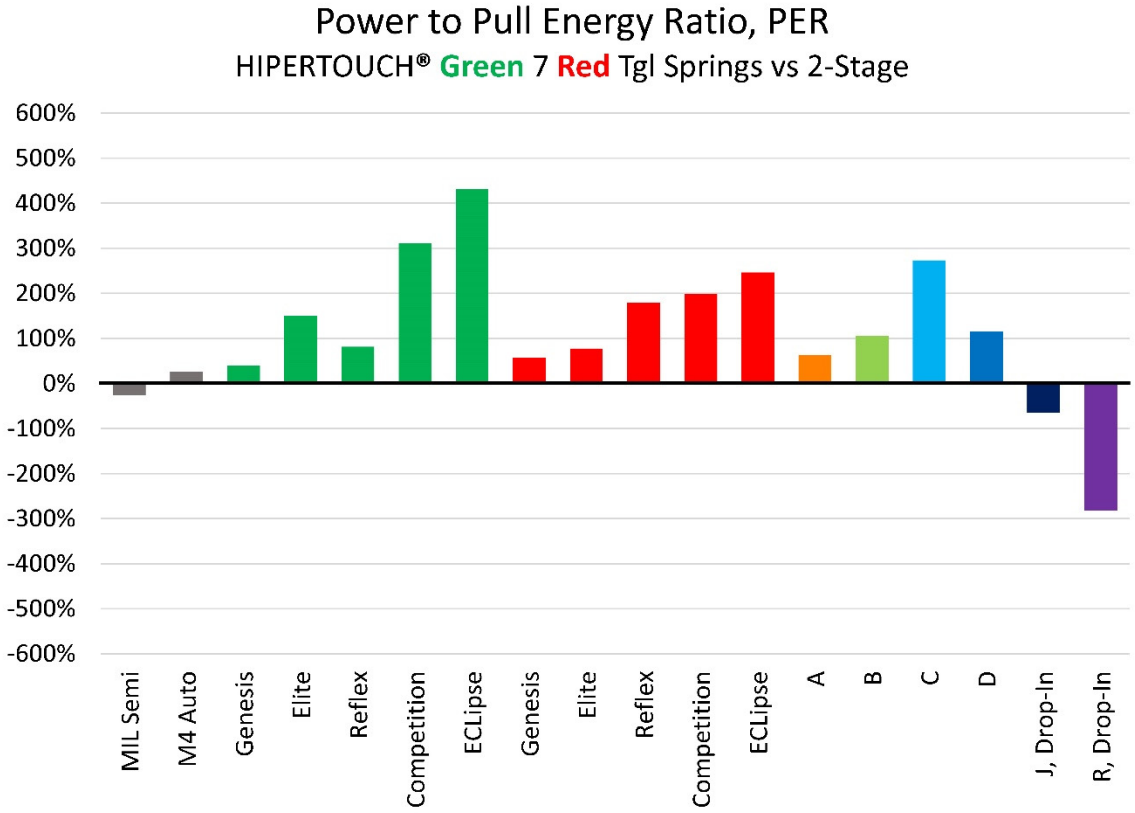

Figure 2. HIPERTOUCH triggers' Power to Pull Energy Ratio, PER, compared to MIL-spec and 2-stage triggers.

Figure 3 compares the PER of the same HIPERTOUCH triggers shown in Figure 2 to drop-in triggers (single-stage drop-ins). The vertical scale is still (-) 600% to (+) 600% to make scale comparisons between the three trigger groupings easier. It should be amply evident that drop-in offerings as a class underperform 2-stage triggers by the PER metric. Eight out of the twelve single-stage drop-ins FAIL the adjusted SAAMI threshold of .018 inches and will light strike. In Figure 2, both 2-stage drop-ins FAIL this standard; very interesting!

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Remember, these PER charts include creep in the metric, not just trigger pull weight and hammer fall power. As such, they now better compare what shooters value as important. We think it's time for new mental conditioning that informs the shooting customer what should matter in making a trigger selection beyond mere superficial preference based on low-weight or low-creep advertising.

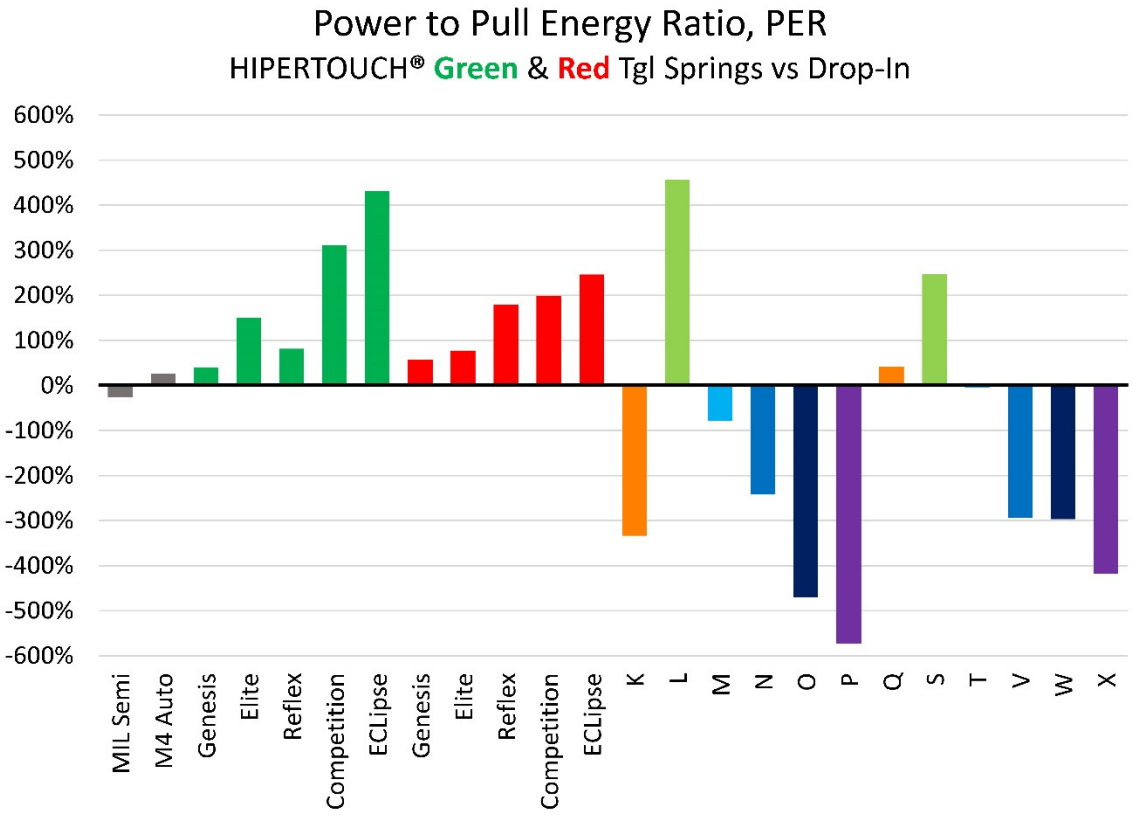

Figure 3. HIPERTOUCH triggers' Power to Pull Energy Ratio, PER, compared to MIL-spec and drop-in triggers.

Overall, EDT and HIPERTOUCH triggers compare well to the trigger competition having higher values of PER indicating more comfortable trigger pull. Two triggers stand out in comparison to HIPERTOUCH triggers, "L" and "S," based on the PER metric. Are they "better" than HIPERTOUCH by this metric?

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The short answer is "Yes." The long answer is "No." A future HIPERTECH will make the long answer that addresses qualitative factors when assessing trigger "feel" not addressed by measurement of weight and creep alone. This further analysis will point out the limitation of relying solely on measurable or quantifiable trigger differences. However, the reader should recognize the advantage that the PER parameter affords in making that first objective assessment of which triggers should feel better based on trigger weight and creep.

The following nine Figures show values of SAAMI copper crusher, trigger pull energy, and PWR data superimposed onto PER Figures 1-3 to help the reader better understand how that data influences the PER calculations. Follow the commentary below the Figures for some HIPERFIRE insights.

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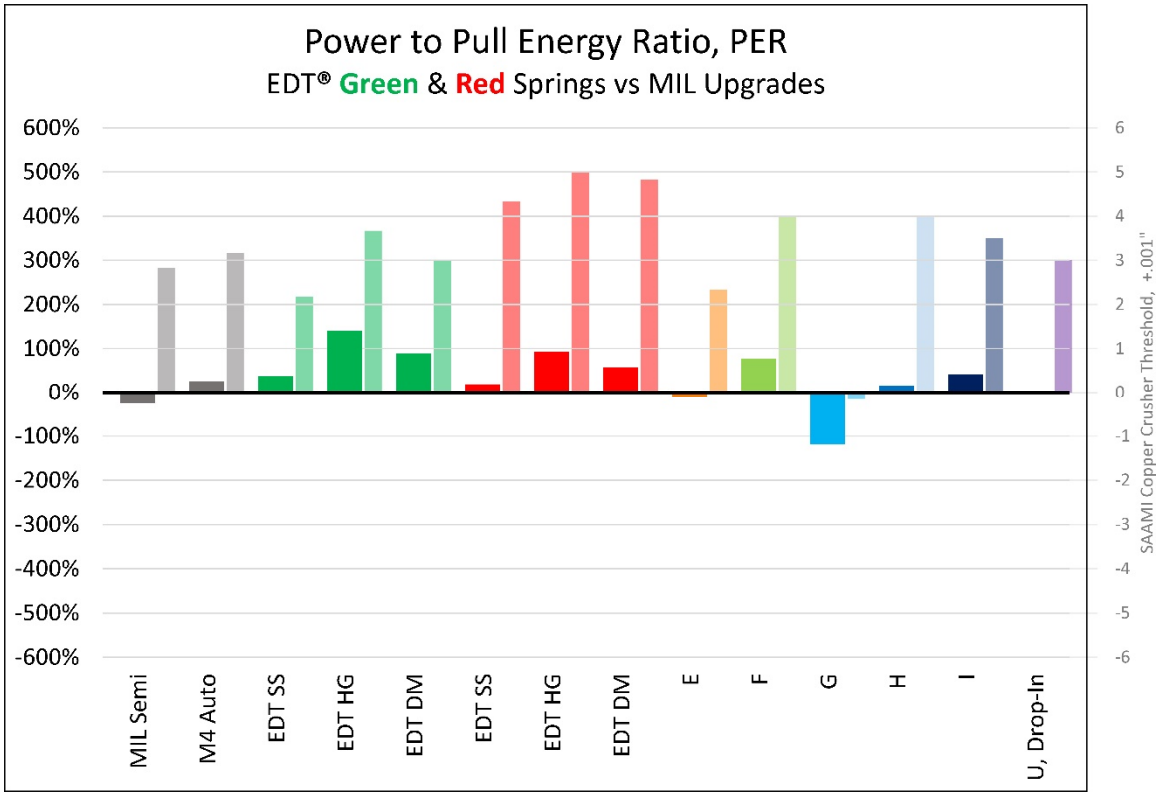

Figure 4. HIPERFIRE EDT triggers' Power to Pull Energy Ratio, PER, compared to MIL-spec and MIL upgrades with the SAAMI copper crusher data superimposed next to the PER bars to more easily assess its contribution to the PER calculation.

The superimposed SAAMI copper crusher findings scale well to the EDT PER data because the creep is so similar. The difference in scale magnitude is due entirely to the color hammer spring used. We see that the scaling for the other triggers in the group is not the same.

The "G" bar is negative because that trigger FAILs the adjusted SAAMI copper crusher threshold test.

Again, the more positive (+) the bar, the better the trigger's "feel."

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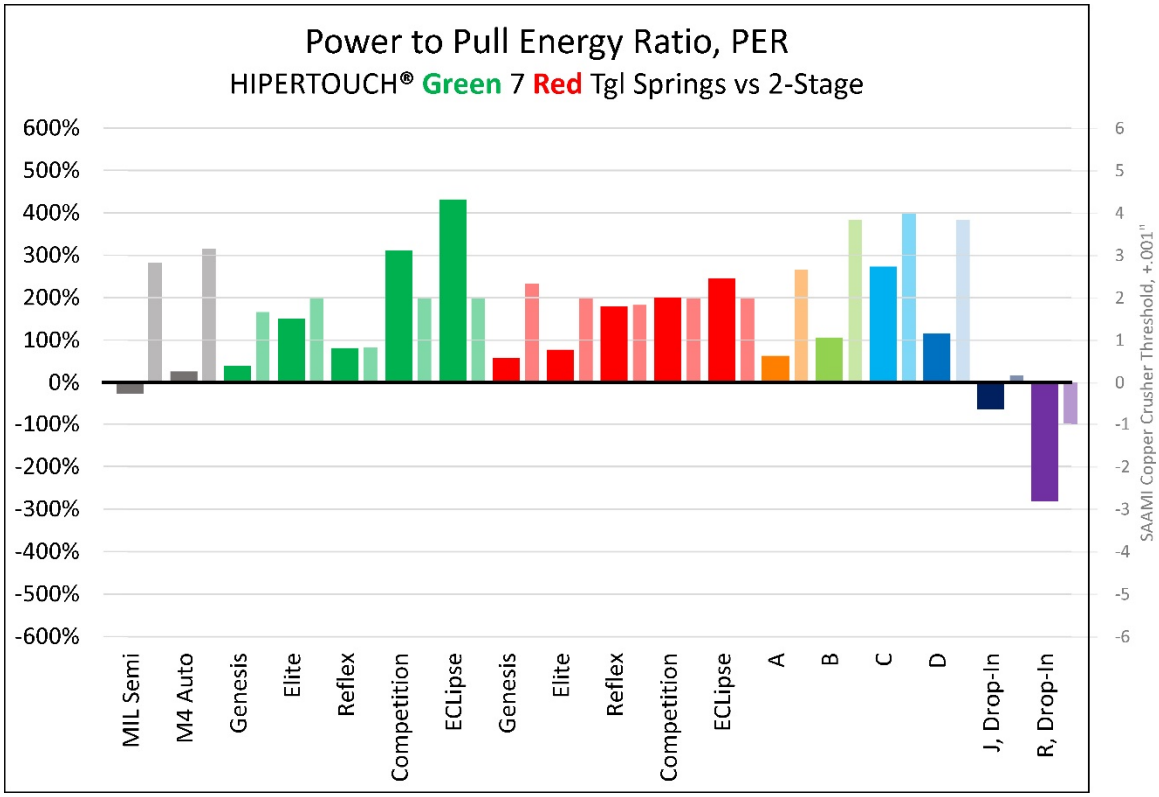

Figure 5. HIPERFIRE HIPERTOUCH triggers' Power to Pull Energy Ratio, PER, compared to MIL-spec and 2-stage triggers with the SAAMI copper crusher data superimposed next to the PER bars to more easily assess its contribution to the PER calculation.

Two 2-stage triggers' PER bars are negative: "J" because of too much creep relative to MIL-spec since it just passed the adjusted SAAMI copper crusher criteria; "R" because if failed the adjusted SAAMI criteria. Who would want a trigger that is prone to LPS?

The green bars show anomalous behavior for the Elite and Reflex triggers compared to the red toggle spring test results, probably the result of spring tolerance differences, because the same Elite and Reflex triggers were used for the green and red spring tests. We must admit that some of the other triggers may not show typically good or bad results. Let the reader understand that this is a consequence of the statistically small test sample size used for the data collection.

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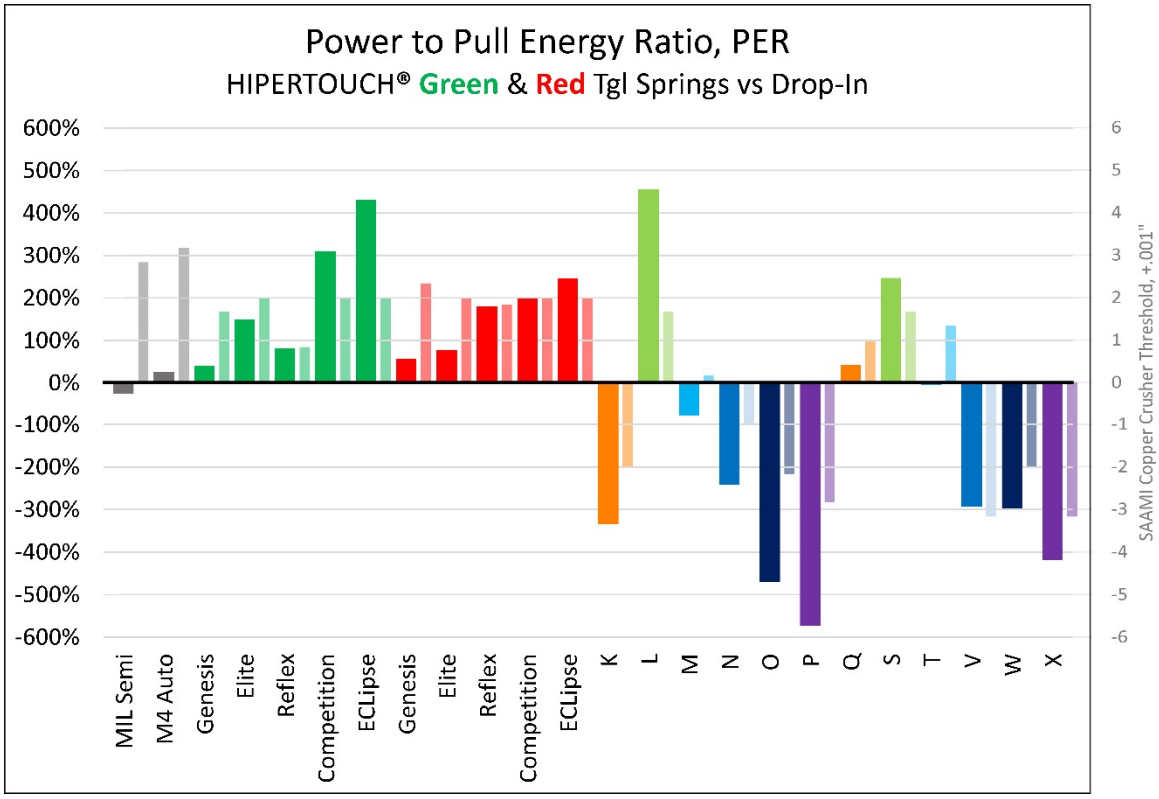

Figure 6. HIPERFIRE HIPERTOUCH triggers' Power to Pull Energy Ratio, PER, compared to MIL-spec and drop-in triggers with the SAAMI copper crusher data superimposed next to the PER bars to more easily assess its contribution to the PER calculation.

Eight out of twelve drop-ins FAIL the SAAMI copper crusher criteria and will light strike. Three of the twelve exceed MIL-spec as do the HIPERTOUCH against the PER performance metric. "T" is virtually equivalent to MIL-spec except that its hammer strikes harder than MIL-spec.

The PER metric does not account for the markedly different "feel" provided by the triggers that test above the zero (0) baseline. More information beyond PER is required to better discriminate between them.

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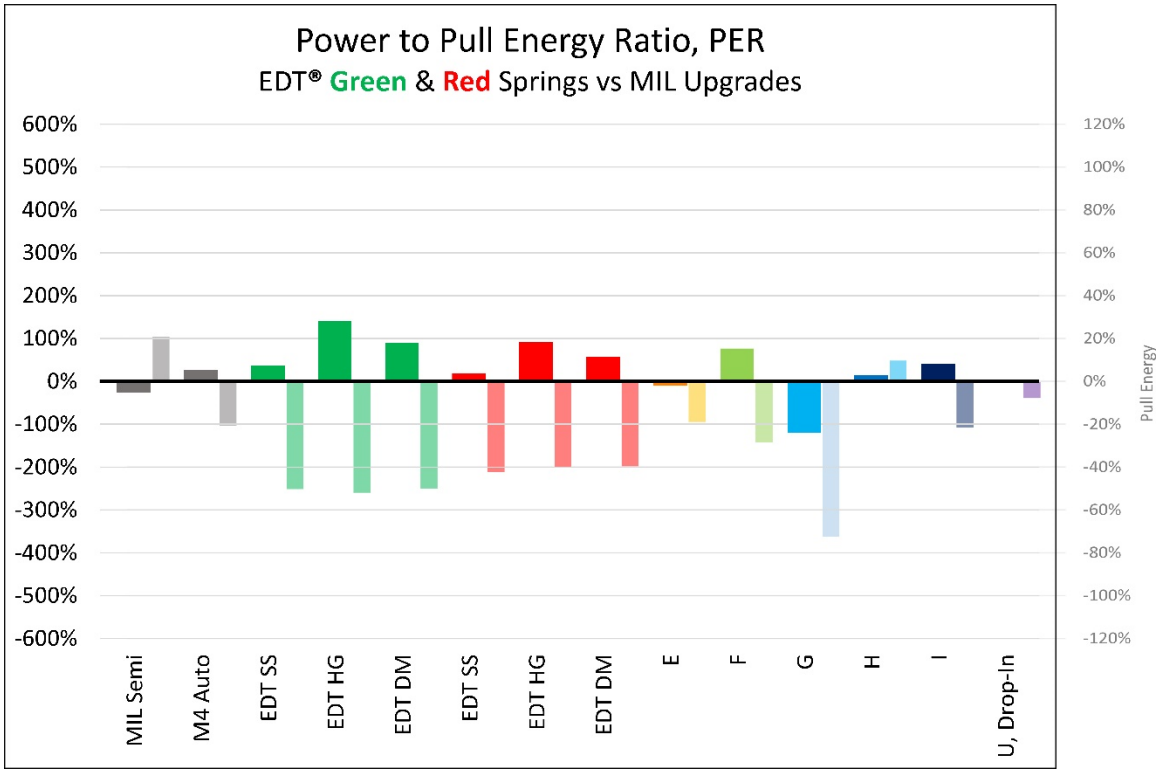

Figure 7. HIPERFIRE EDT triggers' Power to Pull Energy Ratio, PER, compared to MIL-spec and MIL upgrades with their respective pull energies superimposed next to the PER bars to more easily assess their contribution to the PER calculation.

The pull energy metric is the denominator in the PER parameter. Figures 7-9 show this half of the PER ratio. Figures 4-6 showed the SAAMI copper crusher denominator and its influence on the PER calculation.

It should be clear that the pull energy or the effort required to pull a trigger to break is a more significant contributor to trigger "feel" than hammer fall power. Of course, this is obvious since it includes trigger weight and creep. So, hammer fall power can be viewed most simply as a PASS/FAIL switch. If the hammer strike power results in a PASS, the magnitude of the passing grade is not as influential as the magnitude of the reduction in weight, creep, or both. If the primer is indented to ignition, hitting the primer harder does not make the bullet travel faster or more accurately. Enough indent is enough. Whereas, the weight and creep should be adjusted as low as comfortable.

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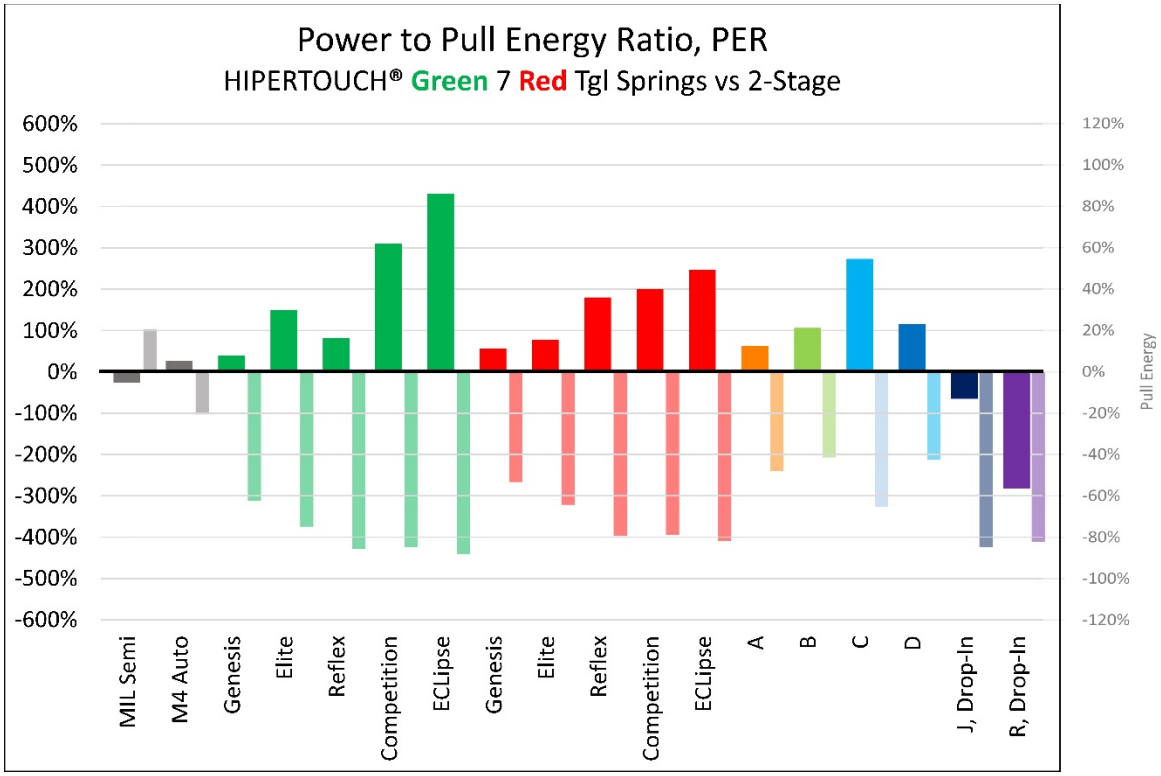

Figure 8. HIPERFIRE HIPERTOUCH triggers' Power to Pull Energy Ratio, PER, compared to MIL-spec and 2-stage triggers with their respective pull energies superimposed next to the PER bars to more easily assess their contribution to the PER calculation.

Even though 2-stage triggers have more total creep than single-stage triggers, the total weight is generally lower. It is a more favorable outcome when comparing component install 2-stage triggers "A" through "D" to HIPERTOUCH triggers. The drop-in 2-stage triggers FAIL due to SAAMI or pull energy deficiency even though the pull energies are acceptably low, which is the problem generally with drop-ins, namely LPS.

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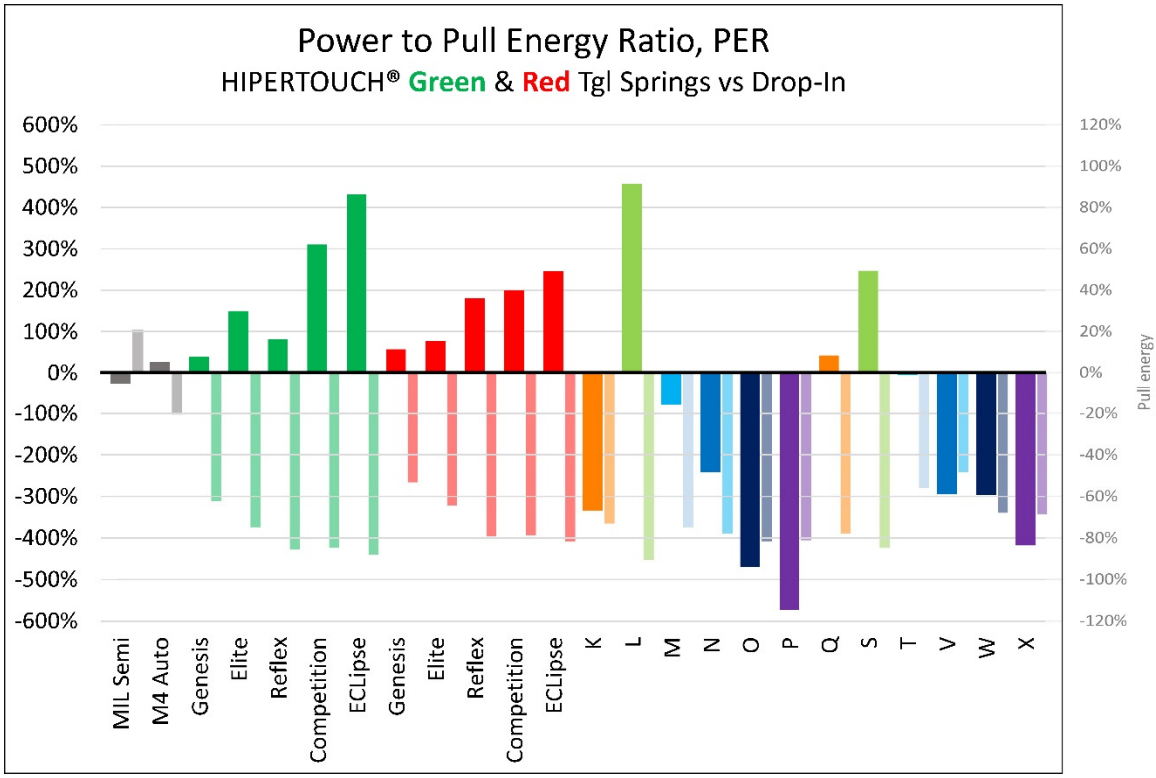

Figure 9. HIPERFIRE HIPERTOUCH triggers' Power to Pull Energy Ratio, PER, compared to MIL-spec and drop-ins with their respective pull energies superimposed next to the PER bars to more easily assess their contribution to the PER calculation.

Drop-in triggers as a class, whether single or 2-stage, FAIL the PER metric largely due to SAAMI copper crusher deficiencies. Of course, the pull energies are low because the hammer spring power is low. What advantage do these drop-ins have over non-drop-ins if their hammers light strike?

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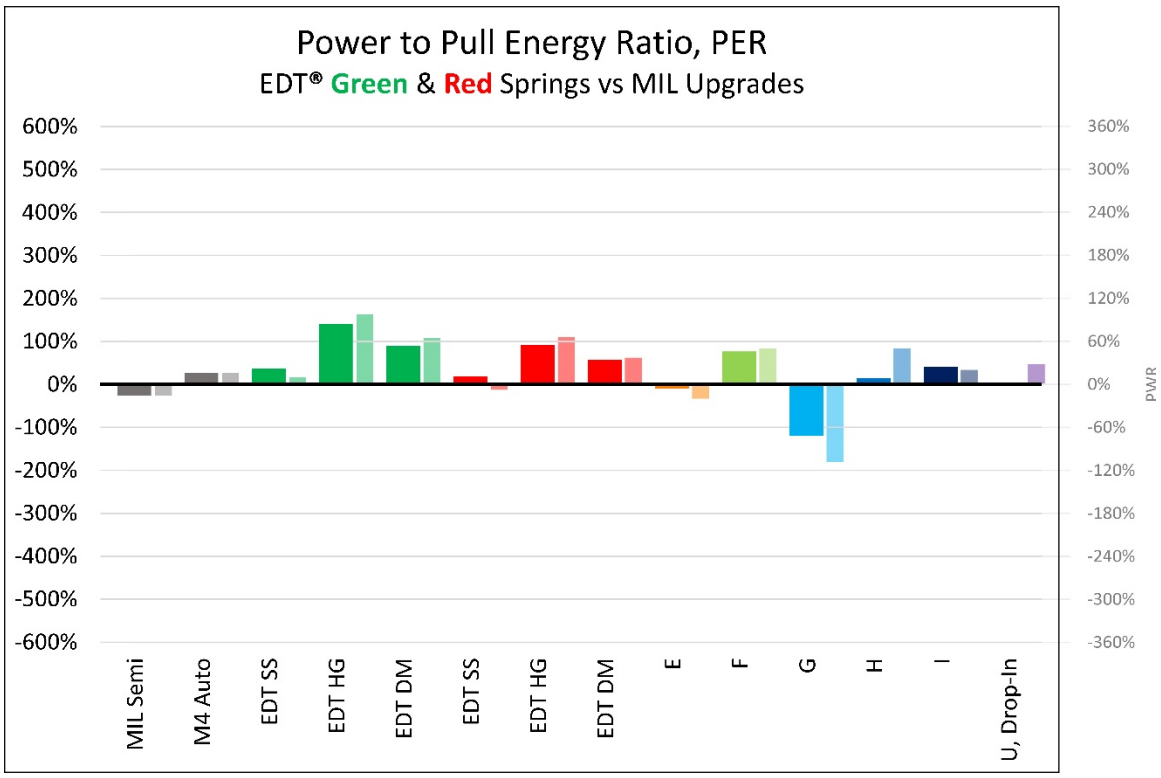

Figure 10. HIPERFIRE EDT triggers' Power to Pull Energy Ratio, PER, compared to MIL-spec and MIL upgrades with their respective power to pull weight ratios, PWR, superimposed next to the PER bars to more easily assess their contribution to the PER calculation.

If one compares Figures 10, 11, and 12 PER to the corresponding PWR as superimposed from HIPERTECH #6, a more significant distinctive difference is shown by PER that includes creep than PWR that excluded it. The EDTs still compare advantageously well for PER overall. The new PER indicator provides more complete and balanced information to us.

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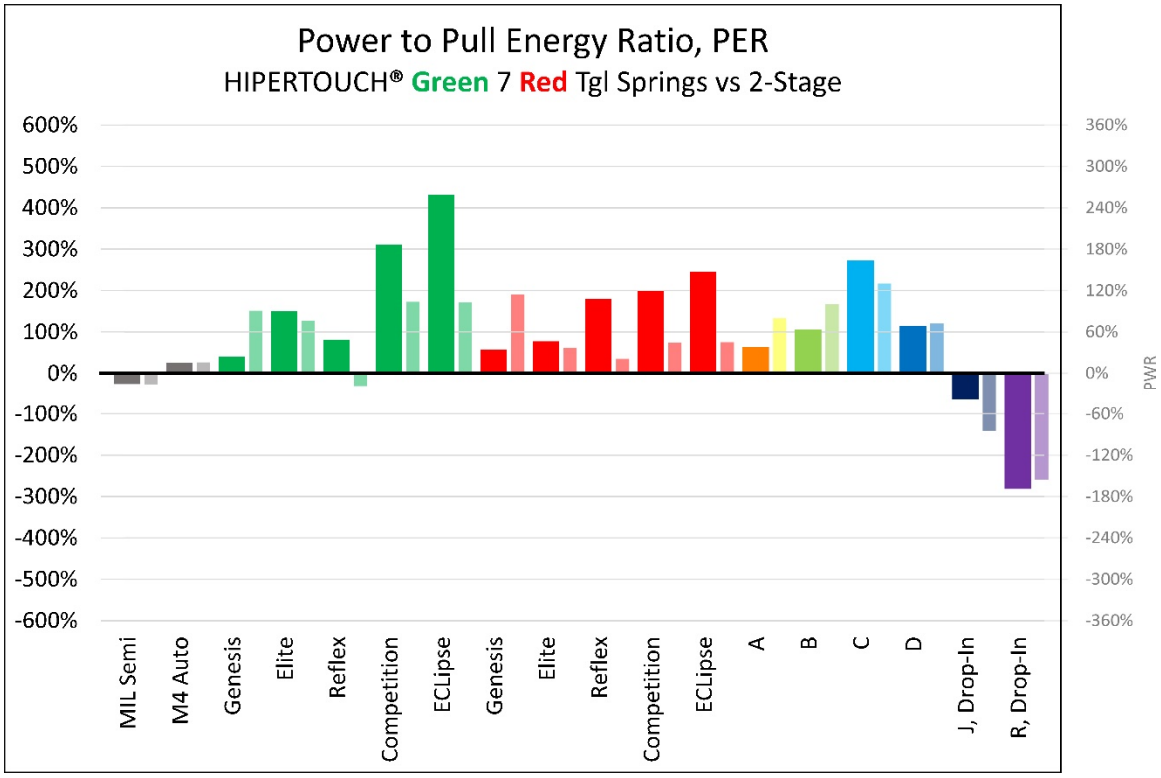

Figure 11. HIPERFIRE HIPERTOUCH triggers' Power to Pull Energy Ratio, PER, compared to MIL-spec and 2-stage triggers with their respective power to pull weight ratios, PWR, superimposed next to the PER bars to more easily assess their contribution to the PER calculation.

HIPERTOUCH PER values provide a more realistically accurate appraisal of pull than PWR, which only considered the pull weight. The contrast with MIL-spec employing PER is also more pronounced because they include creep, and we know that all the triggers, compared to MIL-spec, have less creep in most cases. So, we should not be surprised. Adding creep back into the calculation makes comparisons between all the triggers more rational and realistic. This metric better predicts what we feel when we pull the trigger.

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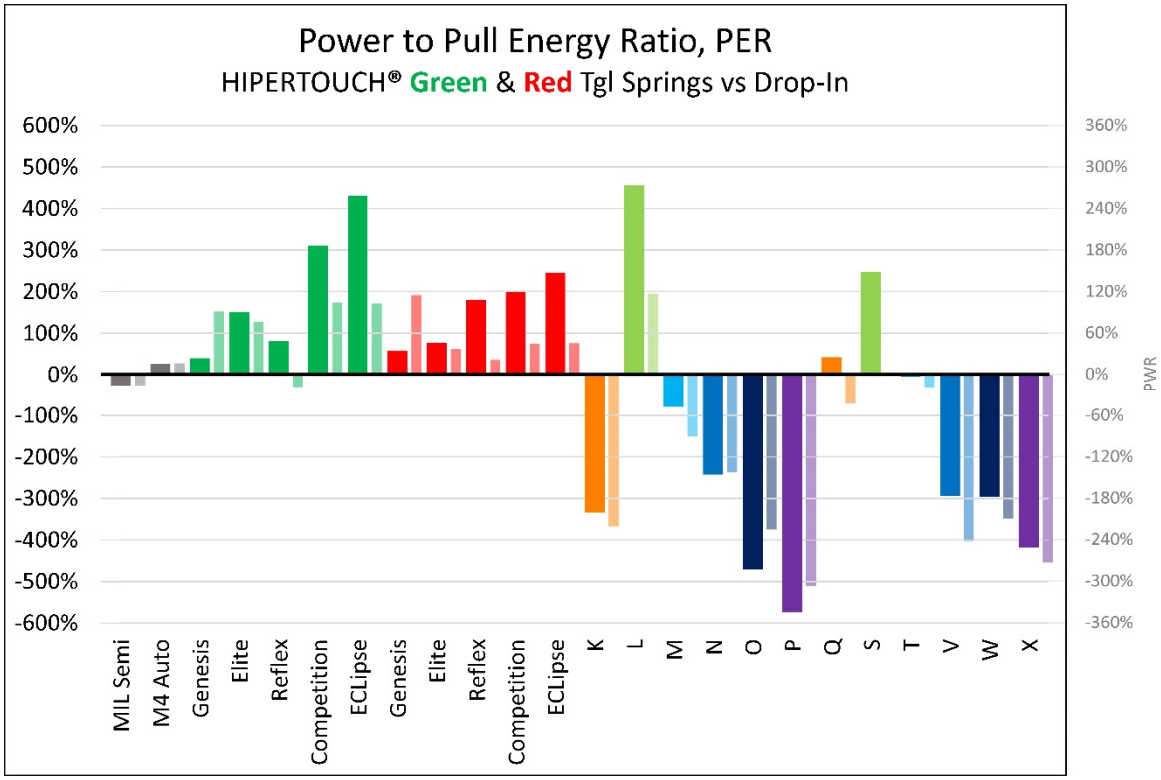

Figure 12. HIPERFIRE HIPERTOUCH triggers' Power to Pull Energy Ratio, PER, compared to MIL-spec and drop-ins with their respective power to pull weight ratios, PWR, superimposed next to the PER bars to more easily assess their contribution to the PER calculation

PWR does not include creep, PER does. It should be no surprise that PER provides a more dramatic shift in measurable advantage over MIL-spec for this reason. Of course, less creep does not provide any advantage to those drop-ins that show LPS.

Conclusion

HIPERFIRE prefers the PER metric over the PWR. It further highlights the advantages and differences among the HIPERFIRE trigger offerings and others in the marketplace to include pull weight, creep, and hammer strike power. "Is this PER metric a valid and fair measure of trigger performance?" If yes, then shouldn't the "L" and "S" triggers "feel" as good as HIPERTOUCH? That answer

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requires still more information and qualification beyond PER to make that judgment persuasively. We are almost finished with quantitative measurement and analysis. In future HIPERTECH articles, we address the qualitative issues associated with trigger "feel."

In any case, the PER is a much better metric than PWR as it now compares three seminal features that are very important to today's AR15/10 shooter and better highlights their distinctive differences or advantages in ONE single metric. PER is better than pull weight alone, or creep alone, or hammer power alone, or various combinations other than the PER. The PER metric is good enough to adequately describe and appreciate what many, if not most AR15/10 shooters, would want in a trigger. By this PER parameter, all of the HIPERFIRE triggers appear to be in the best-in-class category among the three different trigger groupings.

However, HIPERFIRE is still not satisfied even with PER during our development process; there had to more. Yes, we wanted even more criteria to assess trigger performance better. The bottom line: we wanted a better trigger.

We have made significant progress in our journey of discovering what we need to know to make better-informed decisions about trigger purchases. Remember, we all have our preferences, our bias. In fine, our purpose should be to help one another make the best choice for himself. Look for more useful information like this from HIPERFIRE in future HIPERTECH bulletins.

See **Appendix A** for another updated matrix of all the triggers, features, and the 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%	MIL PER > 60%	2-Stage PER > 150%	Drop-In PER > 150%
HIPERTECH Bulletin	6			7		
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						
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J, Drop-In						
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R, Drop-In						
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U, Drop-In						
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