HIPERTECH™ #5

HIPERFIRE® Trigger Families

Powerful MIL-Grade Hammer Strike

Introduction

We began our commentary on HIPERFIRE triggers with Bulletin #1, where we discussed this AR15/10 trigger design goal: provide lower pull weight without compromising hammer strike power. Many AR15/10 after-market trigger products feature lower weight pulls compared to the MIL-spec standard, but at the cost of light strikes, or failure to fire, FTF. HIPERFIRE was challenged to remedy that shortcoming with its own design paradigm. HIPERFIRE was able to reduce trigger pull weight significantly by introducing novel the Cam-Over Toggle Engine™ and Radical Sear Mechanics™ technologies as presented in Bulletins #1 and #2, respectively. In this bulletin, we present the data that confirms our bias, that we could reduce trigger pull weight without compromising hammer fall power. We also confirmed that some other after-market trigger products compromise hammer strike power with lower pull weights.

We found that gathering these study results was very gratifying because it confirmed our bias that low trigger weight and heavy hammer fall were NOT necessarily mutually exclusive AR15 features. Now the shooter has more excellent product options in the marketplace that can give him the best of both worlds, low pull weights, and hard hammer strikes.

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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Powerful MIL-Grade Hammer Strike

Hammer fall power can be measured in many ways using sophisticated electronic instrumentation that employ various sensors to measure acceleration, force, and physical strain. The use of electronic instrumentation may seem very "scientific," but it's over complicated and unnecessary. All that is required is an experiment to calibrate the depth of the firing pin indent in a primer of standard hardness to correspond to that hammer strike that always assures primer ignition, or that light-strike, which always prevents ignition. The Sporting Arms and Ammunition Manufacturers' Institute, SAAMI, developed an experimental test protocol to standardize primer ignition requirements for manufacturers of ammunition, i.e., standardize primer cup ignition deformation. HIPERFIRE employed that standard to measure hammer strike power, comparing that copper crusher indent depth to the SAAMI standard.

The copper crusher test involves placing a piece of known copper purity into a cartridge fixture that fits into the gun's chamber and striking the copper as if it were the primer of a chambered ammunition round with the gun's firing pin. The depth of the dimple that the firing pin makes in the copper can be measured to indicate the impact power of the firing pin, the impact power of the hammer on the firing pin, or the required resistance of the primer cup to accidental dimpling for safety or reliable ammunition propellant ignition.

Why is the copper crusher test a good one? First, it does use copper, a unique copper, whose mechanical deformation properties are very consistent from sample to sample. Secondly, the copper is fixtured in a firearm for firing pin indentation the same way as chambered ammunition. Thirdly, creating the firing pin indent and the magnitude of its depth in the copper, i.e., how hard the firing pin strikes, is the same process that causes the dimpling of the ammunition's primer by the same firing pin dynamics. Since these factors are the same, the test results comparing various AR15 triggers' hammer strike power are valid.

The copper crusher testing of HIPERFIRE triggers and many other aftermarket upgrades followed the SAAMI indent protocol documentation, "V7 – Firearms - CF RIFLE Firing Pin Indent Abridged," received as a courtesy from SAAMI.

Appendix A contains photography that captured some equipment and process highlights during copper crusher testing. We collected three indents per fire-control product. Three measurements were made to improve the small sample sets' statistical veracity, then plotted as bars in the figures further below.

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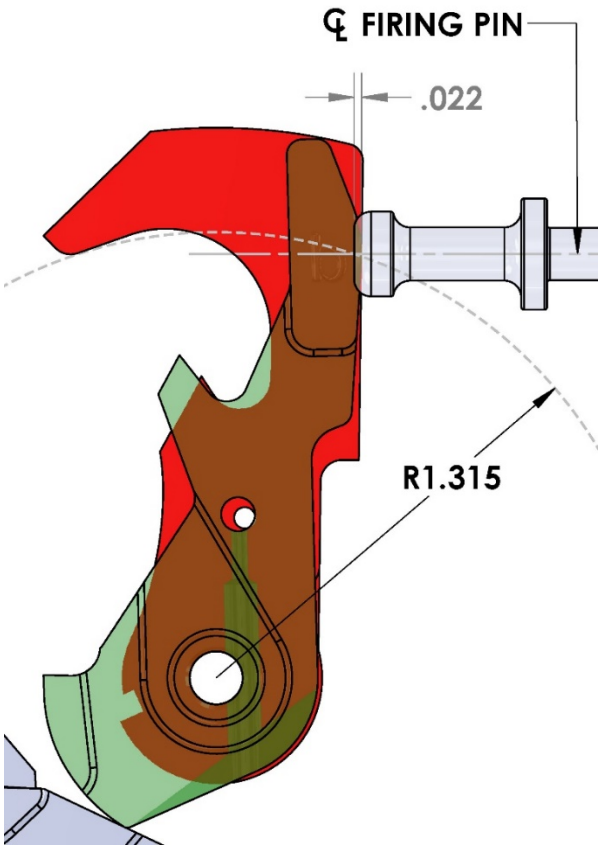

Figure 1. Compare the MIL and EDT SS hammers, where they first make contact with the firing pin and their positions when the copper crusher indent reaches a hypothetical .022" depth.

Figure 1 shows an EDT Sharp Shooter hammer superimposed over a typical AR15 MIL-spec hammer. It illustrates hammer to firing pin orientation after the hammers have contacted the firing pin, then swinging further and driving the firing pin to cause a .022" copper crusher indent. The hammer needed to strike the firing pin nearly in line with its central axis. The EDT off-axis strike displacement is no different than the MIL-spec. That's true for all of HIPERFIRE's fire-control hammers as its rotational axes, and hammer faces are geometrically the same. The other triggers tested were presumed to have the same result.

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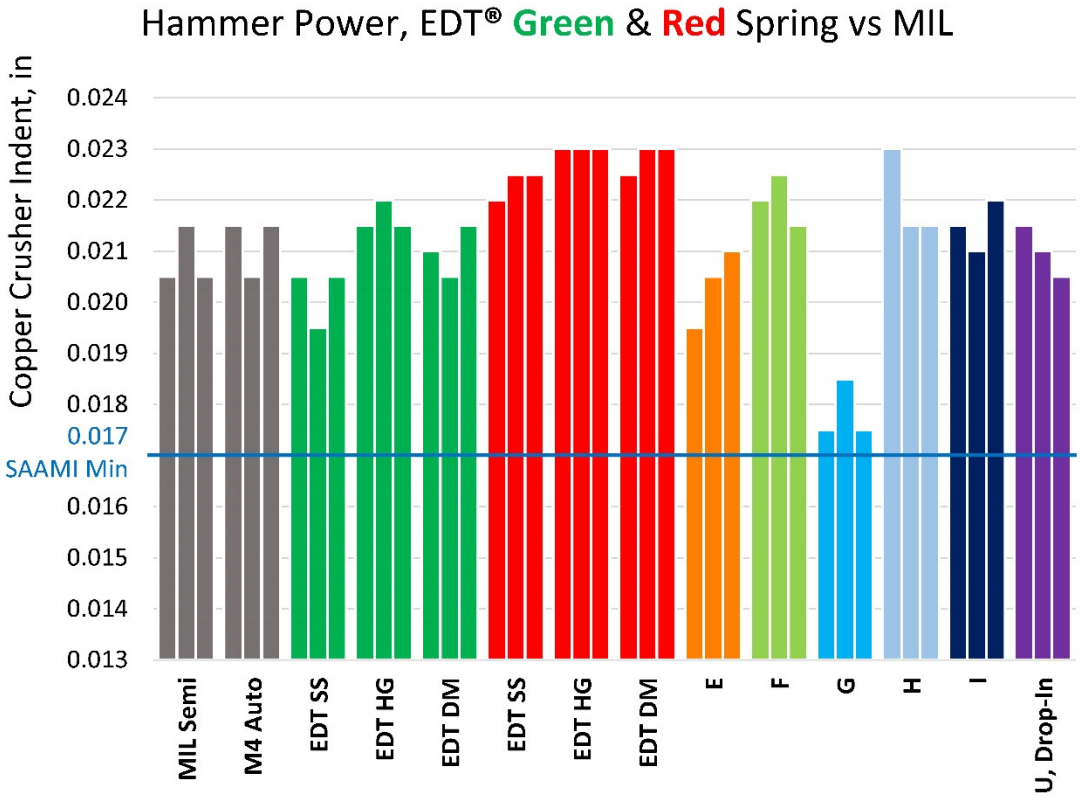

Figure 2. Compare copper crusher charted data for HIPERFIRE EDT triggers with the green and red hammer spring installed to MIL-type trigger products.

See Figure 2 for EDT test and MIL-type copper crusher test results. The minimum SAAMI copper crusher indent depth is .017" to "ensure against misfires chargeable to the firearm." The blue horizontal lines in all the charts highlight this .017" PASS/FAIL threshold depth.

All the EDTs with green (green bars) and red (red bars) hammer springs providing pull weights of approximately 4½ lbs. and 5 ½ lbs. respectively, demonstrate MIL-spec hammer impact power, while most of the others are a little more and the “G” trigger sample less, but all still meeting the standard.

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The EDTs with the red hammer springs not only exceeded the SAAMI primer impact standard but exceeded the MIL-spec impact power baseline. The EDTs employing the Radical Sear Mechanics (RSM) design feature to reduce pull weight attained MIL-spec hammer strike power quite well (see HIPERTECH Bulletin #2 for RSM details).

The reader should notice that the EDT SS (Sharp Shooter) trigger with both green and red hammer springs tested slightly lower than the other two EDTs. The Sharp Shooter's hammerhead is less massive than the other two EDTs, so it carries less momentum into the firing pin for slightly less impact power. However, the small hammerhead compared to the EDT Heavy Gunner and Designated Marksman, as a tradeoff, reduces lock-time significantly, and that is the topic of a future HIPERTECH article.

Figure 3 below shows copper crusher data for the HIPERTOUCH triggers with green (green bars) and red (red bars) toggle springs installed to provide pull-weights of approximately 2 and 2½ lbs. and trigger pull weights of 2½ lbs. and 3½ lbs. depending on the model compared to 2-stage after-market products. All the triggers well exceeded the SAAMI test threshold except for averaged values of trigger "R" bars. The data appears to be less consistent for "J," shown by the more significant bar height disparity compared to the others. However, given the small sample size, it would be impossible to explain why with any statistical certainty. The red springs indicate a slight increase in hammer power across the board.

HIPERTECH Bulletins #3 and #4 discussed the trigger pull weights and energies of the products tested here. We see that in the HIPERTOUCH cases, hammer strike power is affected slightly by choice of toggle spring pair. However, we find that the MIL-spec triggers do not follow this pattern, i.e., they show the same hammer strike energy, while the pull weights and pull energies are quite different. Why is that? It is probably due to slight differences is sear design or sear finish, and hardness, i.e., those other factors that contribute to friction discussed in earlier HIPOETECH Bulletin #1 that does not affect hammer fall.

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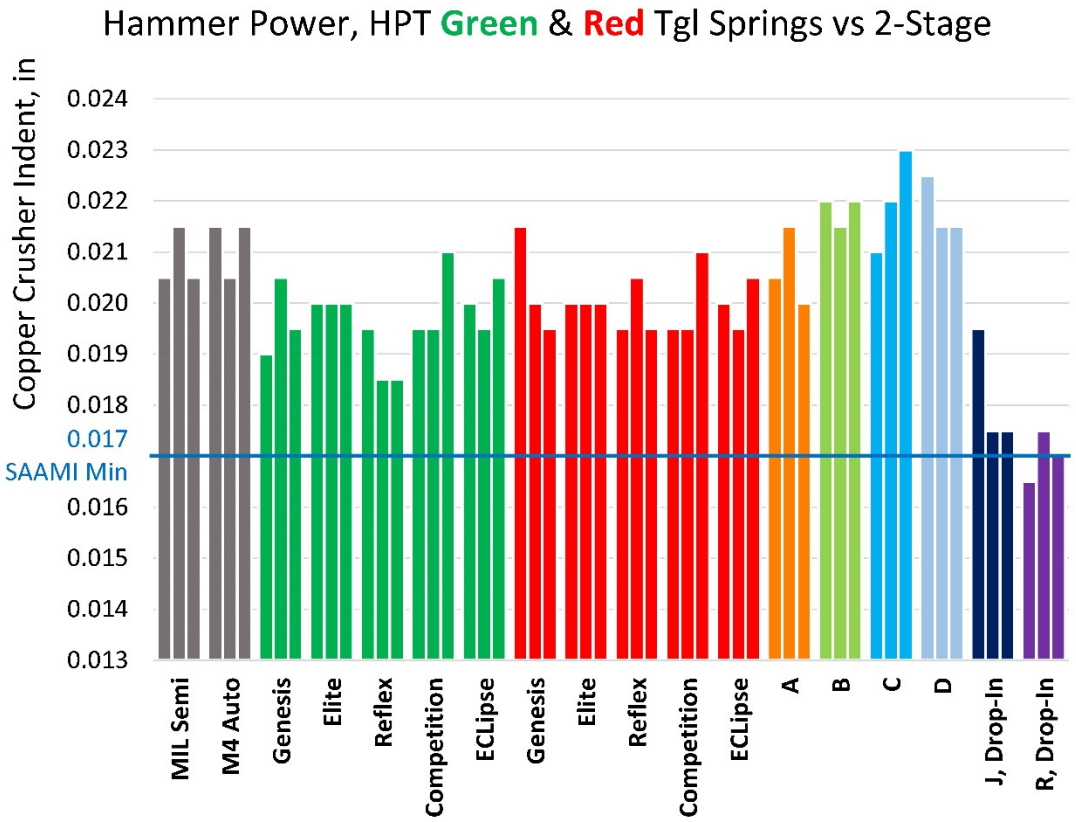

Figure 3. Copper crusher charted data is shown for HIPERFIRE HIPERTOUCH triggers with the green and red toggle springs installed versus MIL-spec and 2-stage trigger products.

Figure 4 shows HIPERTOUCH compared to after-market drop-in triggers. Here, we see that triggers with low pull weights FAIL SAAMI's copper crusher standard, which indicates the triggers' hammers do not strike the firing pin with enough power to ignite SAAMI specified primers reliably.

The drop-in triggers that meet the SAAMI minimum threshold, or even exceed it, generally have moderate to high pull weights. So, when choosing drop-ins, it's a mixed bag among pull weight and hammer power compared to either EDT, HIPERTOUCH, MIL-type upgrades, or 2-stage product offerings.

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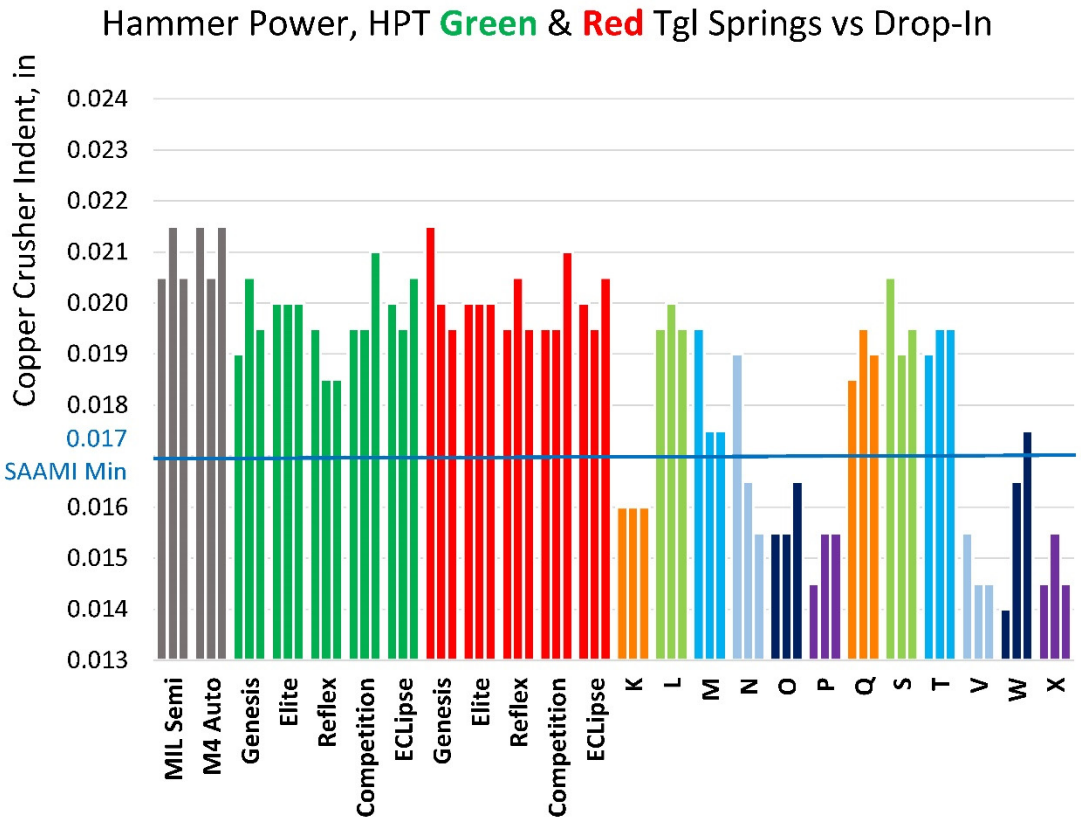

Figure 4. Compare copper crusher data for HIPERFIRE HIPERTOUCH triggers with the green and red toggle springs installed to MIL-spec and drop-in trigger products.

Consider that some of the discrete measurements in the figures could be "outliers," that is statistical anomalies. For example, the "Elite" with red springs and "M," "P," "V," and "X.". Stylus seating artifacts, like copper crushers that fully seat only after the hammer strikes, could produce the outliers. Or setting the vertical gauge to zero incorrectly would artificially increase or decrease crusher indent. If the axial initial firing pin positioning was variable or other subtle differences manifested from trigger to trigger and not attributable to sear friction effects could also contribute to outliers. Yet, the apparent outliers only occur in the drop-in set of triggers. Could this contradict the drop-in's perceived high reputation for precision manufacture in these cases? That's hard to say, given the small sample size.

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Conclusion

Light primer strikes are not an issue for HIPERFIRE triggers. The HIPERFIRE measurements indicate repeatable performance well above the .017" primer indent threshold specified by SAAMI. These results are based more or less on consistent high inertial-energy hammer strikes, which are direct functions of hammer swing mass (moment of inertia), high terminal strike velocities, and hammer spring torque. Other primer detonation related issues in the field that do exhibit are not related to hammer strike, but rather primer and ammunition manufacturing quality as related to this and other SAAMI standards.

Some 2-stage and drop-in triggers exhibited dismal hammer power. These triggers do not provide 100% ignition reliability; buyer beware.

Anecdotally, HIPERFIRE has learned that some of the other triggers referred to herein do light-strike even though our testing shows that they PASS the SAAMI copper crusher test. We employed a firing with tip geometry on the low end of the SAAMI spec that would show statistically deeper indents, i.e., skew the test results in favor of meeting the SAAMI spec. In any case, we accept that the .017-inch indent threshold is a minimum that results in a majority of primer strikes causing cartridge ignition, but not all. Or, we could conclude based on our results, the standard should be increased from .017 inches to .018 inches, for example, or the firing pin tip diameter have a tighter tolerance. If that were the case, the HIPERFIRE triggers should still satisfy SAAMI requirements.

Some US-manufactured ammunition, like Hornady steel-cased ammunition, can present ignition problems with slightly harder primers, which undoubtedly leads to light-strikes among the products tested above that exhibit low strike power. Then we have the case where cartridge primers do not follow SAAMI requirements, for example, 7.62X39 ammunition commonly made to Russian standards. These primers are hard. HIPERFIRE HIPERTOUCH triggers will exhibit problems delivering 100% ignition with these. For that scenario, we offer a hammer spring and toggle spring set that still provides a 3¾-4 lbs. trigger pull, but delivers the much-needed additional hammer strike power.

Consult **Appendix B** showing the trigger feature chart updated with this latest information.

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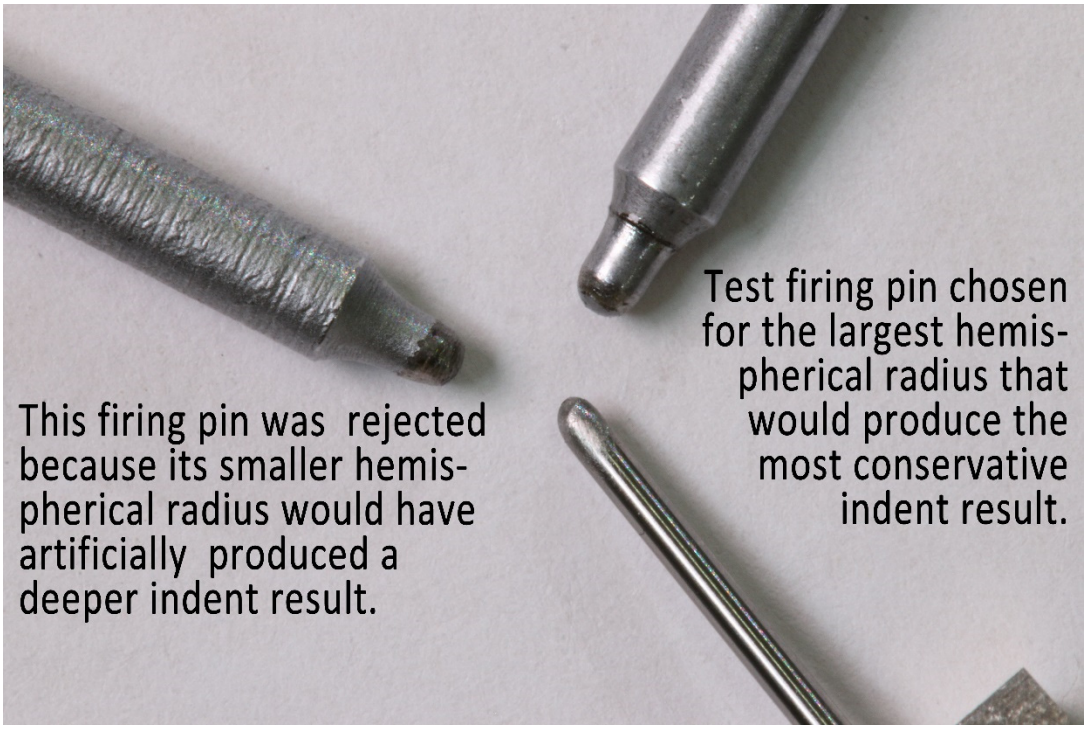
Appendix A

Test Photography



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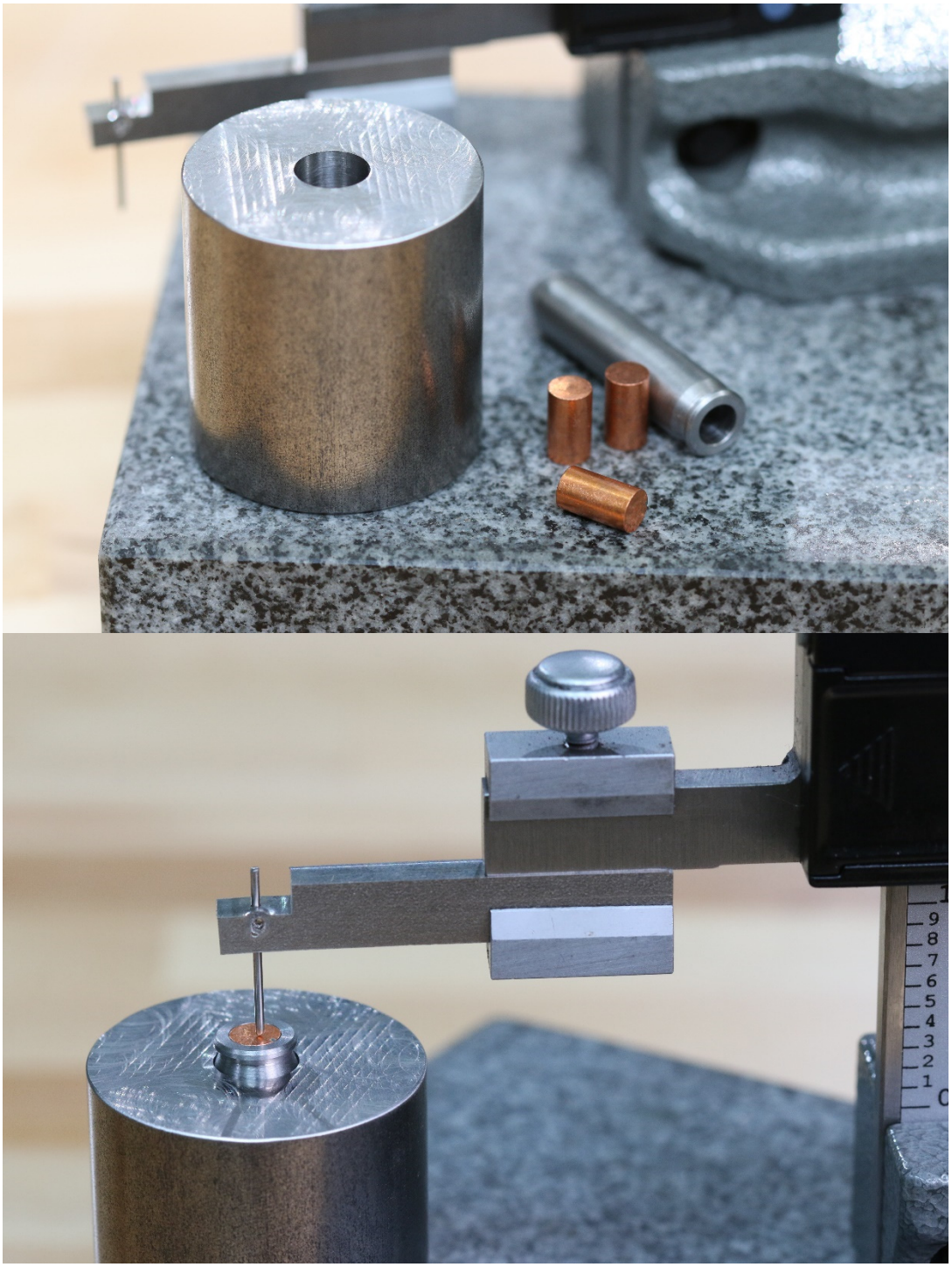

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Appendix B Green Means Column Feature Criteria Satisfied

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									
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P									
Q									
R, Drop-In									
S									
T									
U, Drop-In									
V									
W									
X									

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