# The *Solution* for Inconclusives

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**KEY WORDS: Black Talon™, Drugfire™, "Electronic Spark Reduction", "Miami Barrel", Fry's reagent, cyanoacrylate fuming, "pass filters", polygonal rifling**

ABSTRACT

**Glock-fired bullets, with their scant and peculiar individual characteristics, produce a difficult microscopic environment for the bench firearms examiner. Complications can include bullet mutilation and bullet finish.**

**Winchester's Black Talon, a new and competent bullet design, has a unique black oxide finish which introduces an additional complication to Glock-fired bullets: the copper oxide "cloaking" of microscopic individual characteristics.**

**Experimentation with a proven enhancer, magnesium ribbon smoke, was tried in a criminal case. Further pushing the "enhancement technique envelope" has resulted in an astonishingly effective enhancement technique available and convenient to most laboratory bench examiners.**

Background:

It is readily apparent that projectiles fired from barrels whose bores are rifled in a polygonal shape are very different from those fired in conventionally-rifled barrels. It is likewise generally recognized that the appearance of certain polygonal projectiles (like those fired from Glock pistols) are different than other polygonal projectiles (like those fired in certain Heckler & Koch, I.M.I., F.I.E., Steyr, and the AFTE Journal-reported Kahr K-9 [1] pistols). Glock calls their barrel internal shape a "hammer-forged hexagon" - not a polygon. (Only Daewoo produces a similarly shaped bullet, in their latest 40 caliber pistol).

Given fair firearm quality and relatively intact evidence bullets, microscopic comparison of conventional bullets is usually not difficult. The same cannot be said of "hexagon"/polygon-rifled bullets. Those comparisons are usually very time consuming and frequently inconclusive.

If laboratory comparison analysis wasn't difficult enough, Winchester has produced a new bullet with an innovative satin black finish which effectively obscures what little individual marking remains.

Winchester, part of the Olin Corp., describes its 180 gr.SXT "Black Talon" S40SW (now "Ranger") bullet on the bottom of the box as follows:

> "Winchester Supreme7 Black TalonJ cartridges have been designed and manufactured with the most advanced technology available in the world today. The state-of-the-art patented bullet design ensures unsurpassed performance never before seen in handgun ammunition. Each cartridge is assembled from precision components, held to the highest standards of quality control. Nickel plated shellcases combined with the Black Talon bullet, resist corrosion and enhance the distinctive appearance of this product."

Winchester may be permitted its presumed hyperbole - this is an exquisite bullet in function and

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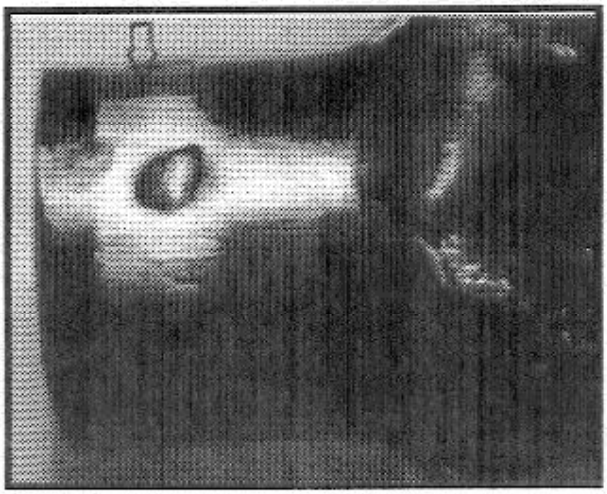
This innovative "Lubalox" finish, a black copper oxide finish, absorbs florescent, tungsten, and quartz/halogen lighting so effectively that identifications of Glock-rifled test Black Talon bullets are invariably doomed in new guns *even when indexed*. Conventional, "cut" rifling is much better at marking the "Black Talon" bullet, as the coating is relatively thin and readily cut through by conventional, and sharp, barrel lands.

NOTE: Occasionally, a Glock pistol will "self-enhance" itself by producing a copper "bullet-sheared" [2] crescent on its polygonally-rifled surface which can aid in identification (photograph below, at arrow).



**Graphic 1 :Fired Glock "Black TalonJ" bullet with "bullet shearing"**

**Case Report "A":**

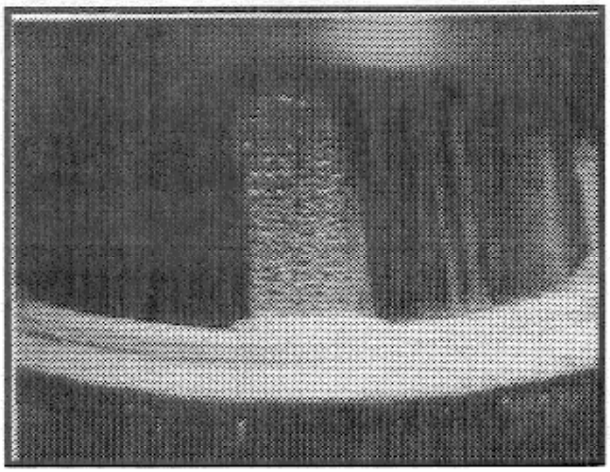
A large local municipal police department requested examinations of Glock-fired Winchester Black Talon/RangerJ bullets. The case was a recent police chase of four robbers which resulted in the escape of one robber, the wounding of another, and the shooting deaths of two of the felonious perpetrators by police. The above occasion was accompanied by expansive headlines and community notice. Five new Glock model 22 pistols were submitted, as were six projectiles taken from the two decedents and 31 cartridge cases.

Historically, this municipality (and its attentive news media) had many frustrating encounters with laboratory non-identifications (ours and others). Their previous issue handgun was the *9mm* Glock pistol, and the previous issue ammunition was the somewhat troublesome (for the laboratory) Winchester Silver-Tip bullet. When discussions with Glock came about for a new replacement pistol, Glock afforded extraordinary attention to this municipal department of 1200 officers.

Several samples of their soon-to-be-issued 40 caliber polygon-rifled pistol bores were electronically marked by the Glock factory just inside the muzzle to insure successful comparison identifications. Glock calls the process "electronic spark reduction" - ordinary "EDM" in the machining trade. Robert Gates, sales manager for Glock at that time, cited their "Miami Barrel" as having a "unique signature", and producing "barrels with no chance of duplication."

The photograph below shows one affected, "spark reduced", land area. (There can be more than one affected land). Coincidently, the photograph depicts well the slope-sided land surface of this unique bore configuration.

NOTE: Llama came close to this land shape with their proprietary "buttressed" rifling.



**Graphic 2: Glock factory muzzle "spark" marking of polygonal barrel land**

Our laboratory was invited to test the new "Miami Barrel" a year before the above robbery/chase case. A laboratory test of these "marked prototype" 40

caliber Glocks involved hundreds of test-firings and exhaustive comparisons. The testing revealed, in the concluding words of the report, "*no significant enhancement* of identifiability was made by the electronic spark reduction process" [3]. Upon receipt of this exhaustive study and comprehensive report, this municipality formally ordered the 40 caliber Glock pistol as their standard issue handgun for its police department!

NOTE: Twenty other examples of 40 caliber manufacturers were included in a parallel test and tested for their bullet-marking faculties. U.S.- and Brazilian-made weapons produced "readily identifiable" bullets. German/Swiss- pistols and Austrian-made pistols were *much less* "readily identifiable."

In the robbery case mentioned above, identifications were made readily of the 40 caliber cartridge cases; of course, these identifications could not definitively ascertain which of the shooters' bullets were "on target" - the crux of the requested examinations.

None of the bullets could be identified. Although the rifling surfaces of the "Black Talon/Ranger" bullets were remarkably undamaged, all of the examiners in the Laboratory, including this writer, agreed that no identifications could be made among the evidence bullets; moreover, no identifications could be made among the test-fired bullets!

**Technique 1:**

After some discussions an old standby technique was tried which was located in a 1977 issue of the AFTE Journal [5]. This technique, apparently long-known to the authors, involved holding the object (bullet or tool marked item) in the smoke just above burning magnesium ribbon. The procedure is outlined in the paragraph below.

This technique requires the burning of about one inch of a magnesium ribbon in an uncluttered fume hood with eye protection of m5 density (such as is provided for oxy/acetylene gas welding). Magnesium ribbon will not begin to burn from the heat of a match or candle. Minimally, either a bunsen burner flame or an common propane torch flame is required to ignite the magnesium. Fire control, hood and eye protection are not merely precautionary: magnesium burns with an intense, and very bright, hot, flame. Magnesium ribbon can, however, be extinguished by immersing in water. A vise or Vise-Grip tool is suggested to hold the ribbon.

From the five police Glock pistols, the full complement of thirty test fired bullets were "smoked" using this technique, as were the six evidence bullets.

NOTE: Magnesium ribbon is available from Fisher Scientific Company of Fair Lawn, New Jersey, as their catalog number M-8.

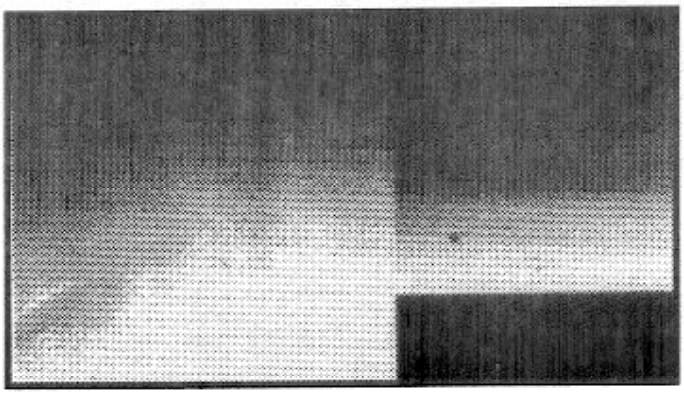
Room lights had to be extinguished in order to view the identifications directly; moreover, the identification had to be a "rolling" identification. A "rolling identification" is defined as one where the two bullets had to be rolled 360E on axis and *in phase* to fully perceive the identification.

The "smoked" comparison examinations finally disclosed five identifications; however, a test-to-test comparison accounted for two of those identifications! Ultimately, after all this preparation, two pistols were identified to three evidence bullets (of six).

The identifications were based on microscopic markings analogous to markings produced by conventional rifling and occasionally seen in some conventional rifling produced nearest the ogive of fired bullets. Photomicrographs of fired casework firearms evidence are not taken by laboratory policy, but since there were no criminal law considerations pending, the identifications were photographed -but with difficulty.

Photographing with the Polaroid-equipped comparison microscope produced dull, disappointing photographs. The identifications **were** photographed satisfactorily under a conventional microscope camera with fiber optics, and then again using the Drugfire screen. The Drugfire screen was tried because of its ability to improve detail through "contrast" and "pass filter" enhancement controls.

Results were disappointing using the Drugfire florescent lighting, so **that** light was turned off. and a small, but bright halogen flashlight was brought to bear at an extreme, oblique, distant, and *opposite* angle. (The picture below is *not* upside-down). All other lights were extinguished. The image was captured and appears below.



**Graphic 3**
**Drugfire display of enhanced Glock individual characteristics.**

Surprisingly, Drugfire "pass filter" enhancements failed to satisfactorily enhance the image, and were not employed in the below print.

Although the magnesium smoke coating amplifies individual markings, the magnesium smoke deposit has a texture best described as having a fine, and relatively even, composition. That texture excites the Drugfire "pass filters" into enhancing the coating texture *and* the individual markings. This "pass filter enhancement" merely darkens the image and *diminishes* the contrast. The separate "contrast" control, however, was used to good effect.

NOTE: "Pass filters" are electronic controls used to select information which lies outside the spectrum of interest in electromagnetic signals. *Drugfire* pass filters are used to improve the CRT-televised image and come in two "strengths" - 1 and 2. Pass filter 1 produces a stronger enhancement than 2.

After capturing the image, the poor ratio of resulting identifications was deliberated. Of the thirty test fired bullets, only five identifications were made, including two **known** Glock pistol test bullets! Since the 40 caliber Glocks were fairly new, no further testing of enhancement techniques was considered using the above Glock test bullets.

It was clear that Glock's electronic spark reduction technique was not up to the task of permitting "designer identifications" in these pistols. Glock's electronically-induced erosion damage to the bore was, however, still clearly visible at the muzzle of each weapon!

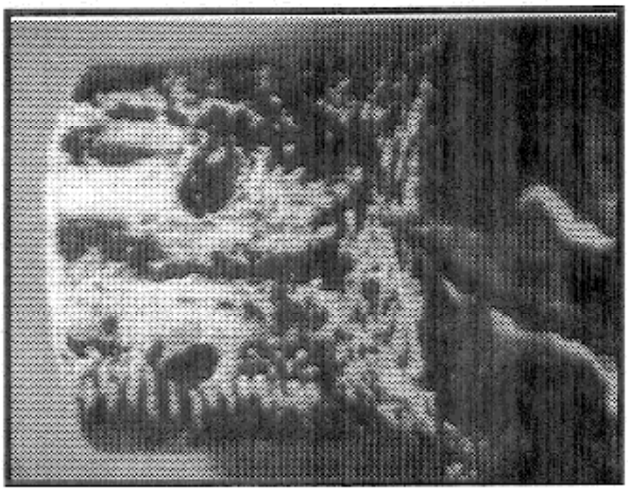
**Technique 2:**

Although the smoke from the magnesium ribbon allowed examiners to see detail which was ordinarily not visible on the Black Talon, the smoke deposits were fragile. The slightest touch to any surface would remove the coating, which appears like a thick white cake frosting under magnification. When comparing large numbers of fired bullets, this is a major complication.

Cyanoacrylate-fuming (supergluing) produces a very durable white coating, and imparting that coating to the Black Talon was attempted.

Six of the above test bullets were rubbed by hand, depositing the lipid/salt/amino acid groups which make up fingerprint deposits. Two examiners participated with separate test bullets to help diversify the deposits.

The tests were subjected to standard fingerprint cyanoacrylate development. After two hours, little development was noted. After twenty hours, it was noted that there was abundant, albeit patchy, development. The bullets were removed from the fuming tank. Although a white coating was produced, it was irregular, fragmented, and even thicker in places than the magnesium smoke deposit!



Graphic 4
"Superglued" Black Talon

**Technique 3:**

Thwarted by the failure of the fuming, it was decided that some chemical treatment of the finish could increase the contrast of microscopic viewing. New Glock-fired Black Talons were dipped into Clorox, ammonia, table salt solution, lacquer thinner, acetone and a nearby acid "cocktail" called Fry's reagent.

The effect of Fry's reagent on the black coating was immediate and striking. The black coating dissolved in seconds, prompting a rush to the sink to stop the reaction. In its place was a matte copper finish. Microscopic comparisons of known Glock fired Black Talon standards became almost effortless.

Note: Glock fired Black Talons which *could* be identified in spite of their copper-oxide finish tended to loose some of their identifiability after treatment. Those which *could not* be positively identified (or eliminated) benefitted from the treatment. In spite of a long water rinse of the bullets, the finish will change with time, becoming darker, slightly chalky, and less valuable for comparisons.

Like many innovations, this prompted more questions. Would this treatment aid the identification of regular (non-Black Talon) copper-finished bullets fired through Glocks rifling? Silvertip bullets? Brass or aluminum cartridge case breechface marks? Hardened padlock shackles? Lead toolmark standards? Lead bullets? Was the reaction chemical or physical? Is the bullet rifling harmed? Is the bullet being plated by this process? Is there a legal issue? Is this an irreversible reaction? Is this process viewed as analogous to the "cold blue" process hazard [7]? Could the bullets be "*re*-Lubaloxed?" Is there no point in restoring a "stealth" finish? Could this enhancement become a discretionary part of the Drugfire entry routine or the bolstering of "poor" breechface images [8] in Brasscatcher image acquisitions? Upon tentative testing of the above possibilities, the answer to most of these questions is yes.

Before mining these veins, it was decided to return to the original challenge. Standard, non-EDM-marked 40 caliber Glock pistols from the Laboratory's Reference Weapon Library were test fired using Winchester's Black Talon cartridges. Each test was index-engraved on the bullet ogive using the "W" of the "Winchester" head stamp as a 12:00 chambering guide. (Precision indexing can be done from the muzzle end of the barrel using the eraser end of a pencil). As part of the test, all but one (control) test for each weapon had its hollowpoint nose plugged. In a procedure developed here and reported in the AFTE Journal [4], a shortened bronze boat nail was tapped into the hollowpoint cavity.

NOTE: This process reduces fired hollowpoint expansion "repair" time, as well as the incidental damages which happen. Damage happens: deep dents in the rifled surface are a normal consequence following Black Talon hollowpoint expansion when firing into water. Concomitantly, this procedure terminates deep dent damage as well.

After recovering the test bullets from the water shoot tank, the tests were culled to remove those damaged from striking the inside surfaces of the tank. Microscopic viewing was accomplished of the remainder **without** treatment.

Although indexed, no identifications could be made. Using dilute Fry's reagent, the bullets were rubbed until the coating was just removed.

NOTE: Although the following is not viewed as an absolutely necessary step, the fired bullets were sprayed with G96J 1,1,1-Trichloroethane degreaser (Stock 1068, Jet-Aer Corporation, Patterson, NJ 07524) to insure a uniform treatment.

As noted above, better-marked bullets from older Glocks produced mixed results, with some improvement on surfaces not obviously well marked. When the robbery case bullets were treated (the new Glocks) identifications were made.

Actually, this process should have been discovered intuitively. Fry's reagent has been used for decades to enhance the *contrast* of grain structure in metals, hence its forensic use in serial number restoration. Although Fry's Reagent has not been suggested as suitable for use in alloys of copper -including brass- it is apparent from the above discovery that it works quite well in these alloys. Use on known, but scrapped, test bullet identifications and cartridge case identifications is imperative to determine suitability for, and time span of, applications in casework.

This enhancing technique is an aggressive procedure and probably should be used only when necessary. Because of the apparent persistence of Fry's in copper alloys, evidence should be assiduously preserved from the residual action of any remnant Fry's reagent. Cleaning, oiling, and coating the evidence with a oxide-

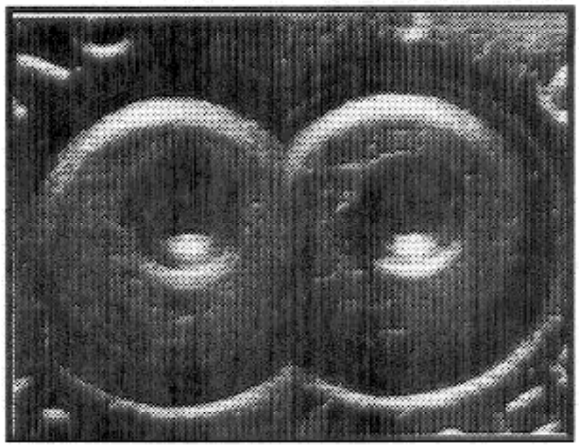
inhibiting grease, such as RIG, should complete the preservation.

**Case Report "B"**

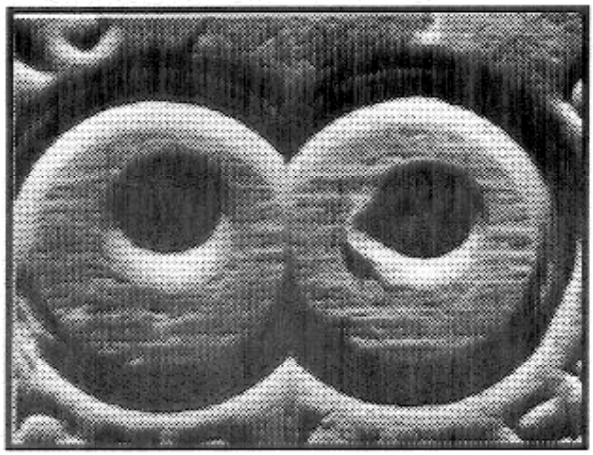
During this testing process, a "non-contact" police shooting occurred, which was assigned to this writer. Two 9mm pistols (one Smith & Wesson, one Beretta) were submitted as were eight fired *Federal* cartridge cases in near-perfect condition. A single mutilated and corroded brass *Winchester* cartridge case collected from the scene was immediately suspect as a scene artifact. (Police issued ammunition is the Federal Cartridge Company Hydrashok, renewed annually at qualification time at no cost to the officer).

Microscope comparison examinations suggested that this Winchester could not be eliminated, and even showed some commonality of individual class characteristics in the breechface/primer area. These were prime candidates for this new enhancer, and a "before" photomicrograph was taken.

The test and evidence cartridge cases were immersed simultaneously in full strength Fry's reagent for three seconds, rinsed, dried, returned to the microscope stages and photographed again.



**GRAPHIC 5: Test to Evidence Before Treatment**



**GRAPHIC 6: Test to Evidence After Treatment**

Each microscope at the Metro-Dade Police Department Crime Laboratory is equipped with florescent **and** fiber optic lighting. Both lightings were tested and the optimal comparison viewing was, in this instance, the fiber optic lighting. Both of the above photomicrographs were taken with fiber optic illumination, and each was appropriately angle-optimized for lighting.

**Discussion:**

It may not be necessary to use Fry's reagent on evidence. Merely Fry's-enhancing the *fired test* bullet or cartridge case may be sufficient to resolve an inconclusive finding.

When it <u>is</u> necessary to apply Fry's reagent to evidence it may not be necessary to process all the evidence, e.g., just process one of ten evidence cartridge cases previously identified to one another. A cast or photomicrograph could be taken of the treated evidence before treatment.

However, even if all the evidence is processed, say, the one and only evidence cartridge case, the justification for this low-tech process (pass filter 0.6?) is analogous to latent fingerprint development using super glue and the same as that for powder pattern development or serial number restorations.

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Few obliterated serial numbers could be restored **without the enhancement process of Fry's reagent!**

**Summary:**

Identification difficulties are described with evidence and test bullets fired through non-conventionally rifled barrels, specifically Glock pistol barrels.

During the somewhat desperate process of augmenting a known enhancer, a previously unapplied enhancer was discovered.

Used for decades in metallurgy and the restoration of obliterated serial numbers in metal, Fry's reagent became of particular value in the removal of Winchester's Black TalonJ copper oxide bullet finish which permitted higher contrast of latent microscopic individual characteristics. Its use to dramatically enhance brass cartridge case individual characteristics is also described.

**Acknowledgements:**

Robert P. Hart for the term "Unret.", critique (including the rejection of this paper's first title: "Smoking and Dropping Acid Produces Identifications"), the photograph of, and his work in, the "spark reduction" area on the "Miami Barrel".

**References:**

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**Author's Notes:**

All italics -and other emphases- are the author's.