

9mm ARCOLOGY: *Arch Contenders*

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Abstract: Certain pistols have their breechface machined by a milling process which leaves arched markings called arcs. The following paper describes the machining process which produces such markings and how the bench examiner can readily and logically determine the manufacturer of a single 9mm Parabellum weapon from fired evidence recovered from the crime scene.

Introduction:

Over ninety makes of weapons in the world have been chambered, and breechfaces cut, for the 9mm Parabellum cartridge. Of these, the most frequently encountered with breechface markings which conform to the term "arcs" are: Beretta, Taurus, Star, Browning Hi Power (FN), FIE Sites Spectre HC, Hungarian Arms Works (FEG), Marlin, and Helwan. Even within these few, some are clones of the others.

Question:

If the examiner receives fired 9mmP (Parabellum) casing evidence with "arcs" (or "arches") anywhere on the casing head, what chance does the bench examiner have in naming the manufacturer of the suspect firearm?

Procedure:

Using the accompanying pictures and charts (which are primarily derived from a published empirical study of 9mm Parabellum class characteristics) and, through the process of elimination, it is possible to differentiate one suspect arched weapon from all the others.

The most sweeping elimination process will occur if the arched casing evidence is accompanied by projectile evidence from the crime scene. A rifling parameter limits chart follows below which can effectively remove most "arch contenders", leaving just one. However, ignoring the projectile evidence can still narrow the choices to one pistol - although more sleuthing is required of the examiner.

Discussion:

Naming the manufacturer of a firearm can assist investigators. What would be conjured up in your mind should you overhear the detective's following interrogation?

"Where is Jimmy's *Beretta*?"

"After Trevor shot Vito in the stomach with his *Browning*, you shot Vito in the head with your *Taurus*, didn't you?"

"Your Honor, this search warrant is needed to recover an *FIE Sites Spectre HC* pistol from the apartment of the suspect's girlfriend."

The detective appears to be skillfully manipulating information from an outside informant, and he is - the bench firearms examiner. The bench firearms examiner is skillfully developing leads from breechface arcs - on 9mmP casing evidence.

Arcs are formed by a cylindrical, rotary machining tool which cuts (usually) a vertical 10mm notch in the slide's breechface using the cutter's side and/or bottom cutting surfaces. This breechface surface, of course, impinges upon the head of the cartridge as the cartridge is chambered. Firing the weapon leaves a series of "stacked arches" on the fired casing head.

Arches are most readily identified in the primer area, but excepting the discussed Marlin and FIE weapons, arches can appear over the entire casing head, dependant on individual specimen and/or ammunition manufacturer.

A caution: "End milling" (the arch-producing machine process) may not be the final breechface treatment at the factory. The breechface can still be broached, filed, sandblasted, tumbled and/or plated. The breechface can also accumulate such bulky residue as primer shearings, and primer sealer which obscure the arcs. Your evidence casing must have arches of some variety to be the subject of this "arcology" inquiry.

A sample rotary cutting tool appears below with an example of the neat stacks of arcs it characteristically leaves on the breechface and, by happy accident, on the casing.

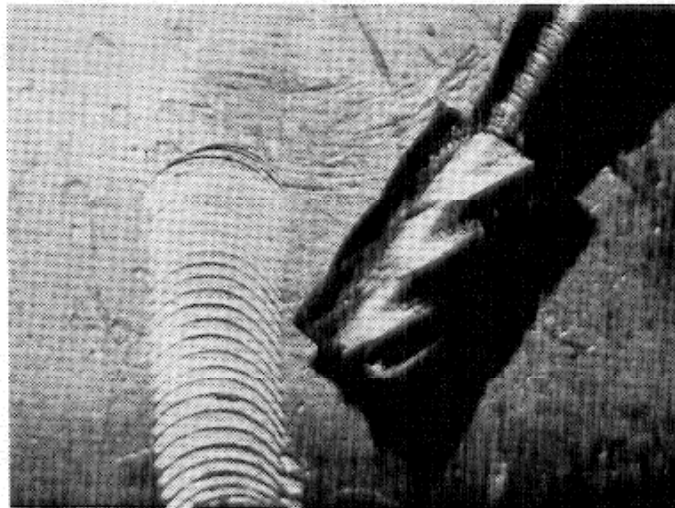


PHOTO #1 Sample "Arcs" and Rotary Cutter

Fired Beretta* casings are readily recognised by their even "arcs", their relatively smooth firing pin finish, and their smoothly radiused firing pin aperture. This is not a Browning type locked-breech design and will be missing a dragmark. Because of its ejector shape and location, it will be missing a "conventional" ejector mark. *Note: late Beretta models can appear with arcs and parallel breechface marks and solely with parallel breechface marks and conventional ejectors and ejector cutouts. Those Berettas' and, for that matter, all pistols without arcs lie, by definition, outside the scope of this study.

Close scrutiny of the breechface and careful measurement of accompanying projectile evidence, if any, **could** discriminate between the Beretta and its clone, the Taurus.

In the absence of definitive groove (land impression) widths of associated projectile evidence, the Taurus is more heavily marked with breechface arcs and firing pin concentric circles. The latest laboratory standards of Taurus have yet to show the combinations of arches and parallel lines which Beretta frequently show. Certain projectile evidence can assist in distinguishing one from the other by measuring the groove (land impression) width.

Beretta and Taurus are readily distinguished from the remaining arched breechfaced candidates through their ample, full, round, firing pin aperture craters and wimpy ejector marks. It is Browning and Hungarian Arms Works (FEG) which provide the greatest challenge, with Star also entering the discussion.

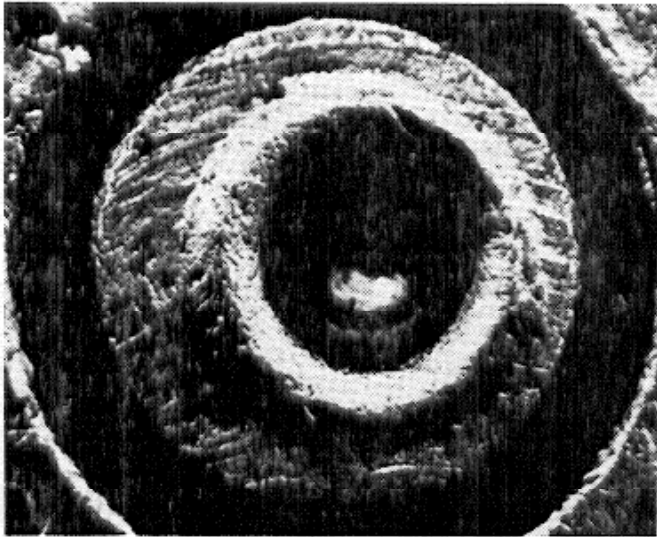


PHOTO #2 Typical Beretta Arcs

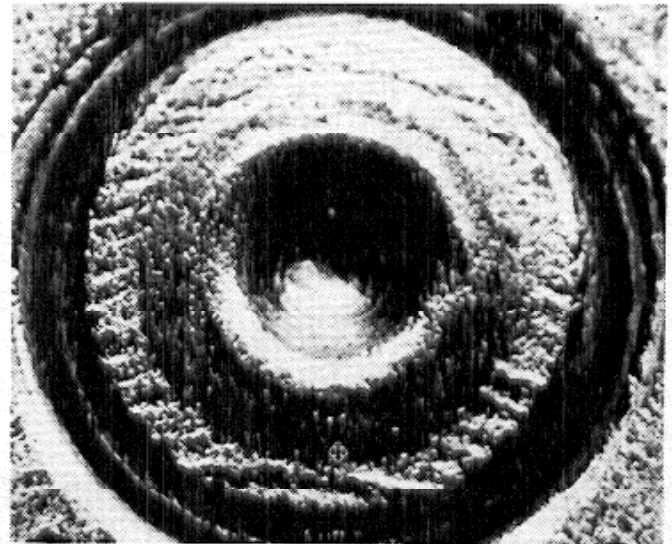


PHOTO #3 Typical Taurus Arcs

Hungarian Arms Works most often have sweeping, coarse arches crossing the entire casing head, a rarity among Drownings. Though coarse, the Hungarian Arms Works arches are definitive and well cut, whereas the Browning arches have a shimmering quality: light, sparse, and usually not well cut. Brownings are more likely to have vertical parallel lines with their arches, and Hungarian Arms are more likely to have an irregular firing pin aperture crater. Browning and Star arches are more alike than Browning and Hungarian Arms arches. If one has access to fired standards, looking at ejector marks will help greatly. Star arches and ejector marks are discussed below in this article.

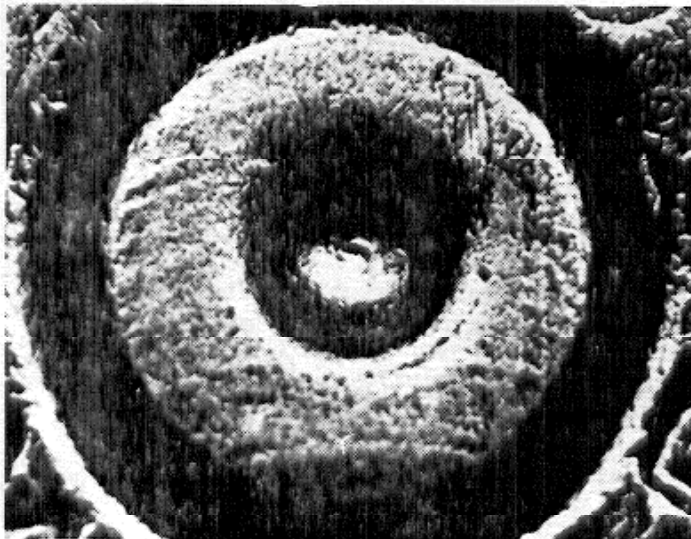


PHOTO #4 Typical Browning Arcs

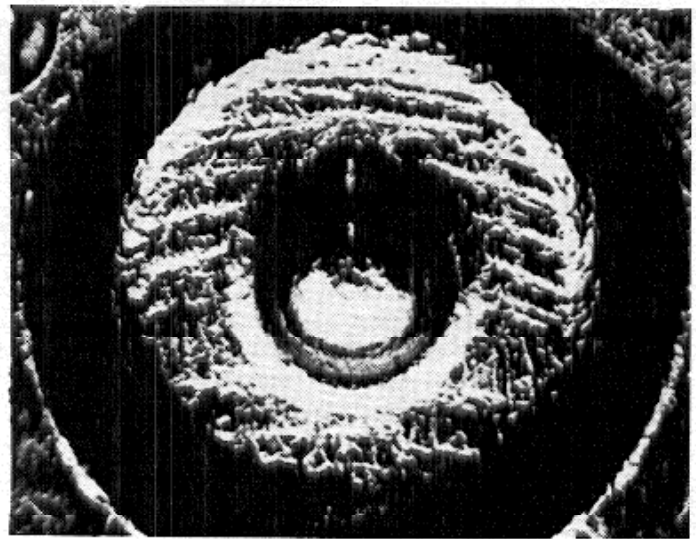


PHOTO #5 Typical Hungarian Arms Works Arcs

The Egyptian "Helwan" pistol is a copy of a 50's Beretta design, and is distinguished by Arabic numerals and letters on its exterior finish. Its breechface markings should be similar to the Beretta's, but are obviously cruder, intermittent, even "damaged" in the sense that the arcs are discontinuous. The appearance of some Helwan primer areas may be described as "lumpy". Consulting the RPL (rifling parameter limits) of Helwan puts the groove (land impression) width at .050"-.063", which would clinch this arched evidence exclusively as the Helwan-- but we have to visit Star pistols first.

Star pistols should be studied in two groups: early and late.

Note: Used Star pistols currently imported with a barrel marked 9mm Largo (not to be confused with 9mmL) can chamber and fire 9mm Parabellum (and 38 Super - eek!), but were not part of this study. Early Star models bearing single, double, or triple letters as their model designator (e.g., model A, BKM, AS) have rifling parameter limits which overlap the Helwan's. They are eliminated as suspect because their rough, vertical, hand-filed breechfaces predominate, with arcs a rarity. A prominent dragmark helps to eliminate or identify early Stars, as they have robust dragmarks.

Late, double action Stars have model designators beginning with a double-digit number and may have a suffix of a letter or two (e.g., 28, 30PK). These pistols, like Browning, exhibit nebulous arcs with occasional exemplars having a parallel striae component vertically crossing the arcs. Do late Star models pose a threat to our Helwan prognostication above?

Conventional dragmarks can't be counted upon for elimination purposes, but the Helwan does not have any because of its Beretta -type locked breech action. Dragmarks are profuse and, as above, robust among Stars, primarily early models. If you are unsure if your firing pin impression exhibits a dragmark, there is still an ejector mark to be examined. Late Stars especially, are very good about putting one to four fine horizontal lines at the 8:00 position. This feature alone waves a huge red flag in 9mmP casing evidence - it is that exclusive. Star pistols, primarily early ones have, well-marked ejector marks, but also have another gross class characteristic: "cat's ears". If the firing pin impression is viewed as the cat's "head", two sharp pointed "ears" extend upward from the "head". (The firing pin aperture protrudes slightly in these specimens and upon firing, the locked breech action cams downward, produces the "cat's ears" in the primer). This isn't exclusive to Star, but it is a very strong indicator.

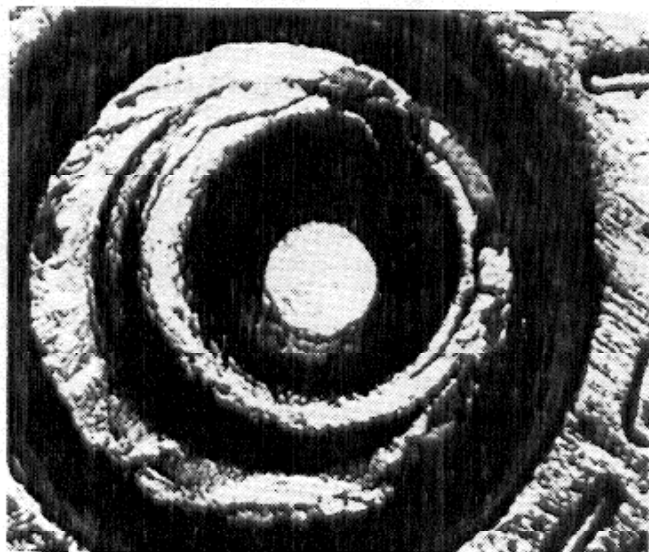


PHOTO #6 Typical Helwan Arcs

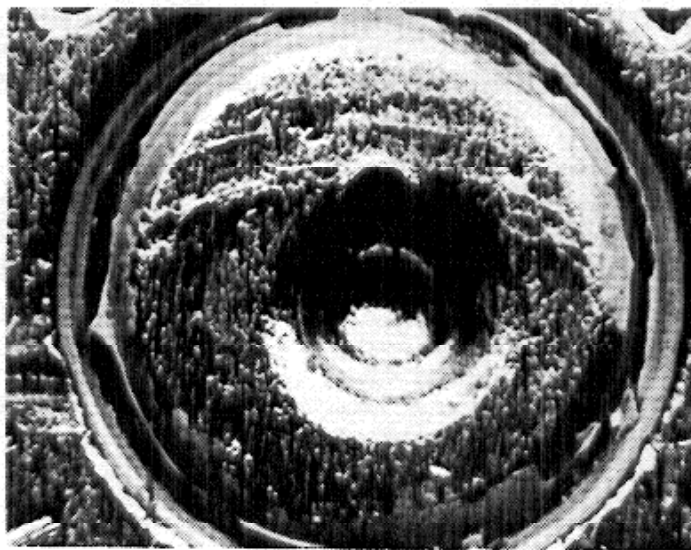


PHOTO #7 Typical Star Arcs

If you are fortunate to have projectile evidence associated with your arched casings, the following matrix may assist you in the determination of the suspect weapon. (Six - right rifling unless indicated otherwise).

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RIFLING PARAMETER LIMITS	.035-.045	.050-.063	.063-.074	.074-.078	.079-.081	.085-.086
Beretta	X		X	X		
Browning			X	X	X	X
FIE Sites Spectre HC	----- Sinusoidal-----					
Helwan		X				
Hungarian Arms Works			X			
Industria Argentina					X	
Marlin Camp Carbine	----- Rifled 12 Right-----					
Star		X				
Taurus	X					

Matrix for arched breechface 9mmP evidence

*Industria Argentina is a Browning copy, and due to the lack of specimens, will not be ruled out for arcs here. It is possible that this Browning clone was never milled to produce breechface arcs, but is included in this matrix because it is helpful through its unique groove width. AFTE readers with arced Industria Argentina standards are encouraged to assist with an update.

The above "sinusoidal" entry is from FIE Sites Spectre HC published literature. This is their own descriptor for its crude, peculiar, sine-wave, Glock-like, rifling. (The Spectre HC is a nicely machined -and heavy- pistol made in Italy). Arches on the Spectre's casing head are "skewed", and "lean off" to one side. Examination of the actual breechface reveals why: A rotary cutter **smaller** than the bolt face counterbore has been used to cut it away, making the arches unevenly stacked.

The Marlin "12-right" entry on the Matrix above is self-explanatory; however, in the absence of projectile evidence the Marlin arcs are characterised by computer machining passes from different directions-- not stacked at all. Failing that appearance, the shallow firing pin impression, which is polished, will appear inside a sharp-edged tiny square. At least two sides of the square are usually seen readily. Further confirmation will be found under the casing rim, here a neat, small, rounded, extractor mark will confirm that your suspect weapon is a Marlin.

In preparing your report, there are several options of reporting your findings. "Suspect weapons include the Hungarian Arms Works or Browning-design pistols chambered for the 9mm Parabellum cartridge" is a popular format. This permits other weapons to be suspect even though they are not mentioned. (No weapon is excluded). However, verbiage such as "however, any suspect weapon should be submitted to the laboratory for examination" can be added for personal comfort.

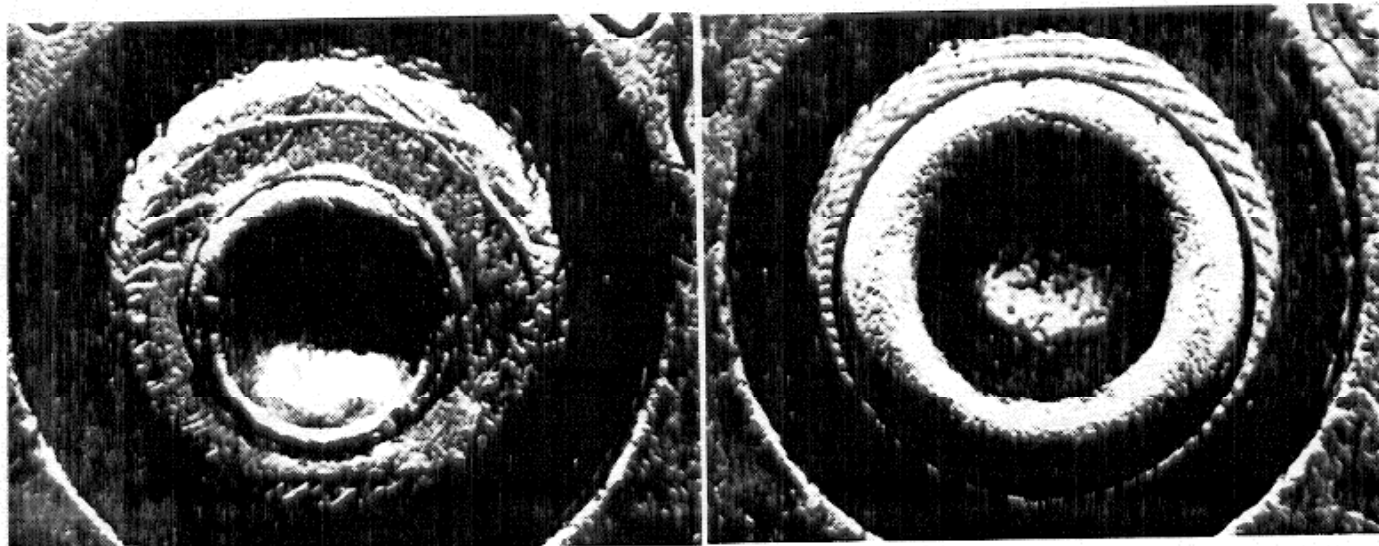


PHOTO #8

PHOTO #9

Typical Marlin (L) and FIE Spectre (R) Arcs

APPEARANCES OF ARCHES	VERY CRUDE	NEBULOUS	LEANING	WELL CUT	VERY EVEN	IRREGULAR
Beretta				X		
Browning		X		X		
FIE Sites Spectre HC			X		X	
Helwan	X					
Hungarian Arms Works				X		
Industria Argentina	----- Insufficient Sample (Not Observed) -----					
Marlin Camp Carbine						X
Star		X				
Taurus				X		

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Conclusion: It isn't possible to determine the suspect weapon of every arched casing because some fired cartridge casings are just not marked very well. Among well-marked specimens, however, the worst suspect weapon conundrum is to have casings which suggest a Browning (FN) or Star or Hungarian Arms (FEG) firearm question with no bullets as evidence. Projectile evidence **could** suggest Star exclusively, but if projectile evidence is absent, even this can be overcome by a inquiring look at the evidence.

UPDATE: Two new Intratec Cat 9 pistols have been examined since this article was written. They have very fine, even arcs which extend across much of the casing head. Groove width is .050".

References: Kennington, Robert H., *The Matrix: 9mm Parabellum. An Empirical Study of Type Determination*, C.E. Harrison Publications, Miami, Florida 1992 [Additional references cited within.]

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