

## Chapter 12. .49-Caliber Gyrojets

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*“The feasibility study and experimental research program initiated in July 1962, to investigate small-caliber microrocket projectiles, was concluded during the period. Under contract to ARPA [Advanced Research Projects Agency], MB Associates fabricated a test quantity of experimental .49-caliber microrocket pistols and projectiles. ... These weapons were subjected to engineer [sic] design tests at the H.P. White Laboratory ...”*

— ARPA Project AGILE Semiannual Report, 1 July-31 December 1963

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MBA’s monumental 508-page report, *Miniature Rockets, A Two Year Summary of Research and Development, Document No. MB-82*, was published in April 1962. It had a Secret classification, and only 200 copies were printed and distributed. It was later downgraded to Confidential, and then unclassified in April 1975. The report was used extensively and quoted often in the first 11 chapters of this book. It was MBA’s way of documenting what the company had accomplished in the field of miniature rockets and some of what it proposed to accomplish in the future. After the report was published, Mainhardt and Biehl asked, “*Now what?*”

During the spring and summer of 1962, it became clear that if MBA was going to be able to successfully market Gyrojets to the U.S. military, its prime target customer, two things would have to happen:

— A Gyrojet rocket suitable for *economical mass production* using the techniques refined during the company’s first two years had to be developed. The rocket would have to meet the same requirements (military specifications, or MilSpecs) for effectiveness, accuracy, and reliability that any other small arms ammunition adopted by the U.S. military had to meet. More importantly, it would have to perform significantly *better* than the then-current .45 ACP cartridge. Otherwise, what would be the point? Why would the U.S. military buy a new high-risk, small arms weapons system unless it was substantially better than what it already had?

— A pistol would have to be developed to fire the new Gyrojet rocket, and it would also have to be a significant improvement over the .45-caliber Model 1911A1. The Model 1911, improved to become the A1, had been the Army’s handgun for 50 years and it

was a traditional favorite. MBA realized that it would be extremely difficult to improve on the .45’s reliability, effectiveness, and accuracy; but its weight, recoil, muzzle blast, and manufacturing costs did offer opportunities for improvement.

The development of a Gyrojet pistol and ammunition for it was a considerable challenge, but MBA was anxious to get started as soon as funding could be obtained. The company did not have sufficient cash on hand to finance the project itself, so the decision was made to seek government support.

However, at this time the Army already had several fairly radical new small arms weapons systems in development. In 1958, the Infantry Board had recommended that the new Armalite .223-caliber AR-15 be adopted as the .30-06 M1 Garand’s replacement, a move that caused a great deal of controversy, some of which continues 50 years later. The AR-15/M16’s adoption was put on hold while various factions inside and outside the Ordnance Corps argued for or against it. In the meantime, the 7.62mm T-44/M14 rifle went into production at Springfield Armory, with the AR-15 being placed on the back burner, where it nevertheless continued to simmer.

During the same period, the Special Purpose Individual Weapon (SPIW) program was quickly moving forward with developmental ammunition and rifles being built and tested with encouraging results, at least to the SPIW’s proponents. Project SALVO had earlier (1956) proven the concept of multiple bullets being fired simultaneously from one cartridge case to dramatically increase hit probability at typical combat ranges. SPIW took the concept a step farther by launching a burst of very-high-velocity flechettes, each from its own cartridge case. In tests, a burst of five flechettes increased

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hit probabilities by up to 300 percent compared to a single bullet fired from an M14. The SPIW rifle would be lightweight, have very little recoil, and use detachable magazines with 40 or 50 rounds of lightweight ammunition. Some versions used plastic belts with triplex (three flechettes in one case) rounds.

In July 1962, while the AR-15/M14/SPIW dispute continued, Defense Secretary Robert McNamara created the new Army Materiel Command (AMC), which replaced the Army Ordnance Corps and other organizations. A subordinate command, the U.S. Army Weapons Command (WECOM), was established away from the Pentagon at Rock Island Arsenal, Illinois.

The point of this discussion is that the Army had all the new small arms development issues and turmoil it wanted, and it was understandably not very interested in taking on another new program, especially an unproven one. The Army knew about the Gyrojet—Mainhardt and Biehl were relentless in promoting and demonstrating it at every opportunity—but early test results had been unimpressive and did not give the Army cause to pursue the miniature rockets which, in the spring of 1962, didn't have a weapon to fire them. However, the Department of Defense Advanced Research Projects Agency (ARPA, then DARPA), created in February 1958, was also aware of MBA's work and its capabilities. ARPA was created soon after the Soviets launched Sputnik, the world's first man-made satellite, in 1957. Its mission was to promote new high-risk and high-reward technology, including weapons.

Dr. Herbert F. York was a co-founder of ARPA and he was its first Chief Scientist. York had been the first director of the Lawrence Livermore National Laboratory (LLNL) from 1952 until 1958. He met Mainhardt and Biehl there, and the three became close friends. ARPA's Project Agile was begun in the Spring of 1961 to provide research and engineering funds in support of friendly local forces in remote areas of the world engaged in or threatened by conflict.

The counterinsurgency conflict in Vietnam was an example of one such remote area where local forces could benefit from ARPA's assistance. In fact, it was ARPA which provided the first 10 AR-15 rifles to South Vietnamese forces in Saigon for testing. The diminutive South Vietnamese soldiers loved the easy-to-handle

lightweight guns and ammunition, and ARPA quickly provided 1,000 more to them for extensive field tests. These tests, including combat, were very successful, although not without controversy about the validity of some of the incredible claims of combat wounds caused by the .223/5.56mm lightweight bullet.

While the new AR-15 rifle seemed to be a perfect match for South Vietnamese forces, there was also a need for a cheap yet effective weapon for village rice farmers and other locals to use in defense against the Viet Cong, as discussed earlier in chapter 3. A similar concept had been used during WW II when the single-shot, .45-caliber FP-45 Liberator was designed and built almost overnight. One million of them were made at a unit cost of \$2.40 in 1942. In 1964, the CIA updated the concept with its "DEER" (a.k.a. "DEAR") Gun, a 9mm, screw-off-barrel, aluminum pistol that came with three rounds of ammunition. ARPA had the unique ability to support the development of new, nontraditional weapons and acquire them quickly, bypassing normal weapons-procurement channels.

It was in this environment that ARPA contracted with MBA, *"To investigate the potential uses of very-small-caliber microrocket projectiles in various weapons systems and to develop a very-low-cost, defensive handheld weapon suitable for use by local paramilitary or civilian forces."* The feasibility study and experimental research program was begun in July 1962, and the contract gave MBA the financial resources it needed to develop the new .49-caliber Gyrojet. Prior to the ARPA contract, MBA had been ambivalent about producing firearms. During our interviews, Mainhardt emphasized to me that, *"It was never our intent to make a gun out of this [miniature rockets]. Make that very clear [to you, the reader]."* He went on to explain that, *"Intuitively, we thought that with the rockets' eccentricities, they could never be as accurate as a gun. It [a Gyrojet] could never be as cheap as a bullet. ...We never thought of a gun."* In fact, at the time, MBA had no engineers or anyone else employed with any previous firearms design experience.

On the other hand, MBA's early consultant and friend, Dr. Harold Brown, asked, *"Why don't you make a gun out of this thing so everybody knows what you are talking about? You aim it and you shoot it and everybody knows what you are talking about."* Mainhardt and

Biehl eventually decided that Brown was right. If the Gyrojet was going anywhere, it had to be a round of ammunition fired from a gun.

### **.49-Caliber Gyrojet Rockets**

With the ARPA contract in hand, full-scale development of the new .49-caliber Gyrojet began. MBA had tried various case materials with earlier Gyrojets and rejected all but one of them for the new rocket. Aluminum and brass were too soft and weak, and reacted poorly to heat and stress. Stainless steel was strong, but expensive. In addition, stainless was not a very good conductor of heat, so it tended to burn and erode excessively.

Carbon steel worked best. It was a good heat conductor, was easy to work, and it was strong enough. And it was cheap. Since the reference size for the new rocket was  $0.4 \pm 0.2$  inch, Mainhardt and Biehl went to a local shop equipped with screw machines and said they would like to use common half-inch bar stock for their new Gyrojet. The shop had 1020 carbon steel round bar stock which was acceptable to Mainhardt. In fact, 1020 carbon steel worked very well and it was priced right. When the outside of the half-inch stock was cleaned up in a screw machine, a small amount of steel was removed, reducing the outside diameter from 0.50 inch to 0.49 inch, which is why MBA's first production Gyrojet rocket was .49 caliber.

*Note: I mentioned earlier in the book that MBA was inconsistent in designating the calibers of its Gyrojets. In some cases the inch was used, and in others, millimeters. In this book, I use whatever designation MBA used. In the case of the .49-caliber Gyrojet, there is an additional factor which can be confusing. After the .49-caliber Gyrojet was developed, produced, and tested, MBA changed the rocket's design significantly, producing a new 13mm rocket that was slightly larger at .51 caliber. In August 1958, the Army changed its caliber designations from inch to metric and after the .49-caliber rocket and pistol, MBA decided to adopt the metric designation for its Gyrojets.*

*Later, after the Gun Control Act of 1968 made anything larger than .50 caliber a destructive device, MBA reduced the size of the 13mm (.51 caliber) rocket and designated it "12mm," not .49 caliber. 13mm and*

*12mm Gyrojets, while based on the .49-caliber's basic design, are quite different from it. These will be covered in following chapters of their own.*

In determining the shape of the new .49-caliber rocket, MBA again took the easy and inexpensive way out. Some standard off-the-shelf screw-machine drill bits have a tip angle of 120 degrees. Although drill bits with any shape could have been made, custom bits were very expensive. So they were not used, even though a Gyrojet with a rounded ogive would have had much better ballistics than the truncated conical nose. At the time, keeping costs low was more important.

In order to contain the rocket's internal pressure, it was important that the combustion-section case-wall thickness forward of the nozzle be the same all over. Therefore, because the standard bit used to drill out the *inside* of the Gyrojet had a 120-degree conical tip, the *outside* of the Gyrojet was turned to the same shape, as shown below in Figure 12–1.

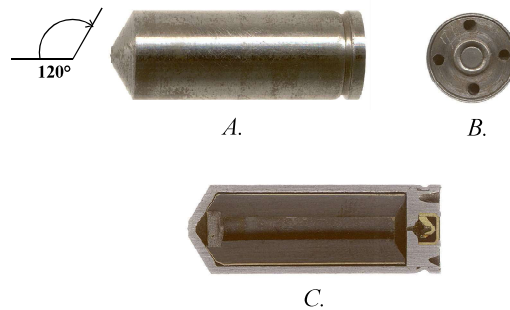


Fig. 12–1. .49-caliber (12.47 x 34.97mm) truncated-nose Gyrojets. (A.) Complete cartridge. Plain steel case and plain steel nozzle with a nickel-plated small pistol primer and four counterclockwise ports. Number 76 of a test lot of unknown size, with that number engraved on the nozzle. The propellant grain is inhibited, and the igniter is a pellet of  $\text{BKNO}_3$  placed in a cutout in the nose of the grain. (B.) Machined nozzle. (C.) Section of an identical cartridge, but with number 86 engraved on nozzle. Actual size.

Plain carbon steel corrodes readily if not sealed against moisture, and almost all of my plain steel specimens show at least some rust, which is not surprising after 45 years of exposure to the atmosphere. At this early stage of .49-caliber Gyrojet rocket development, there was no sealer used around the primer or inside the

nozzle to keep moisture from entering the rocket through the ports.

Initially during development of the .49-caliber Gyrojet, MBA saw little need to rustproof the rockets because there was so little time between when they were made and when they were fired. Instead, the company deferred the issue until later in the rocket's development when other more critical design elements, such as reliability and accuracy, had been dealt with.

Besides, MBA engineers were quite familiar with copper-plating, having used it to protect earlier Gyrojet cases, and they didn't see corrosion as a problem. They were wrong. Corrosion turned out to be a very big problem with production Gyrojet rockets, most of which had cases and nozzles made of carbon steel.

Rust was soon recognized as a serious challenge, and MBA tried several methods to prevent it. One of these is shown below in Figure 12-2. The rocket's case and nozzle are plated with what appears to be zinc, with a dull, frosty appearance. There is no evidence of rust on this cartridge, so the technique apparently worked well.

Since it's a dummy, it would never be fired and could be set aside to see what happened with corrosion over time. MBA also needed dummies to use in checking the functioning of the new .49-caliber Gyrojet pistol that would emerge as the Model 137.

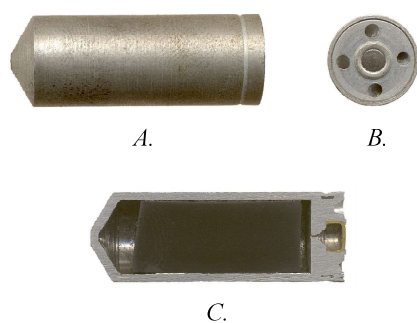


Fig. 12-2. .49-caliber (12.53 x 35.08mm) dummy Gyrojet. (A.) Complete cartridge, zinc-plated steel case and zinc-plated steel nozzle with a nickel-plated small pistol primer cup and four counterclockwise ports. (B.) Nozzle. (C.) Section of an identical cartridge showing rubber "propellant grain" and empty nickel-plated primer cup. Actual size.

Gyrojets produced for distribution outside the factory almost always had copper-plated cases, inside and out. However, steel nozzles remained plain until later, when they too were copper-plated.

Figure 12-3 below shows a standard copper-plated *production* .49-caliber Gyrojet taken from the prototype cardboard 18-round box. These rockets were very puzzling until I decided to take one apart. Three things bothered me: (1) the rocket apparently had no internal moisture seal on the inside of the nozzle, as most later versions do; (2) it had a nickel primer, which often indicates a dummy round; and (3) there was a slight rattle when the round was shaken.

To find out whether the rocket was live or a dummy, I cut one in half with a tube cutter. Examination confirmed the lack of any waterproofing inside the nozzle and that the propellant was live. When I touched a piece of it with a lighted match, it burned exactly as would be expected of a unconfined piece of double-base nitrocellulose gunpowder. I think the rattle was caused by the grain being exposed to air for 45 years through the four nozzle ports, drying out, shrinking a little, and separating from the inside of the case. In any event, it and the others in the box are live rounds.



Fig. 12-3. Production .49-caliber (12.55 x 35.82mm) copper-plated steel Gyrojet with plain steel nozzle and nickel-plated primer cup. MBA's first production gyrojet. Actual size.

On November 29, 1962, MBA filed patent application 240,784, which resulted in patent 3,212,402 being granted to the company on October 19, 1965. This is an extremely important patent for MBA Gyrojet collectors, because it shows a very early Gyrojet pistol design with a description of how it worked. Even though the pistol went through many important changes, the last model MBA produced, the Mark II Model C, used the same basic design. I doubt that the exact pistol shown in the patent was ever produced, but instead was just used to protect MBA's concept of the handgun it planned to manufacture.