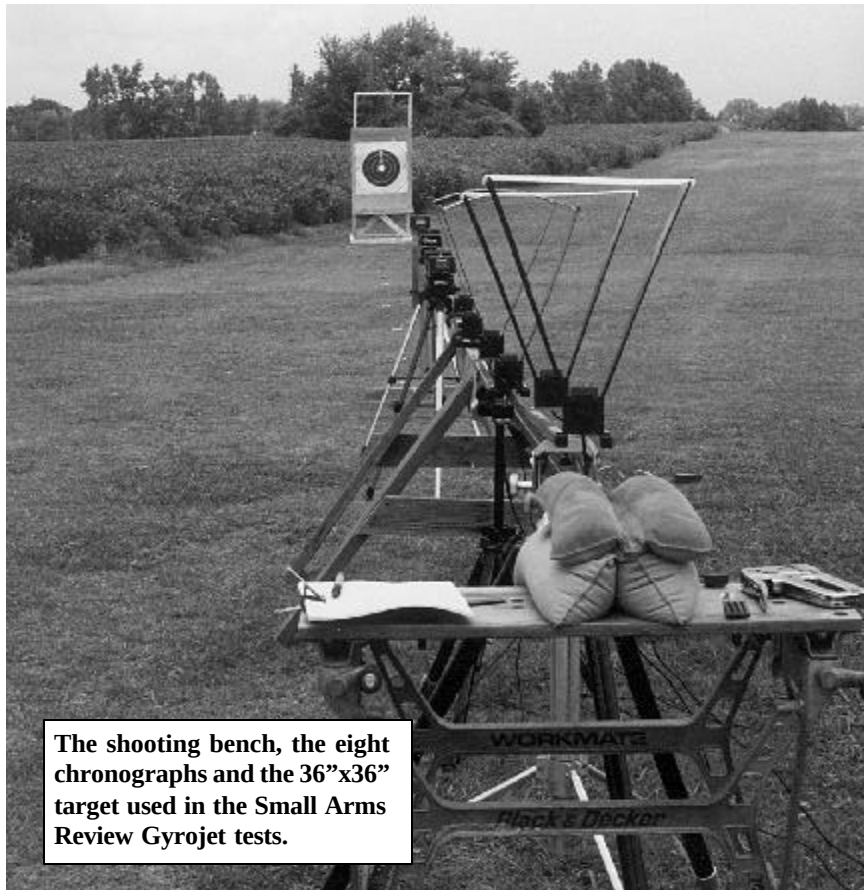




The shooting bench, the eight chronographs and the 36"x36" target used in the Small Arms Review Gyrojet tests.

Testing the Gyrojets

by Captain
Monty Mendenhall

Thirty-five years ago, when Gyrojet rocket pistols were new, several firearms oriented magazines printed glowing reports about them. Only one magazine, *The American Rifleman*, said anything negative about the Gyrojet system. The purpose of this story is to describe the recent *Small Arms Review* Gyrojet tests and to make a fair evaluation of the MBAssociates' Gyrojet claims.

Only a relative few people have ever fired MBA Gyrojet rocket guns. Moreover, most of those who have fired them did so thirty or more years ago. Time has surely dimmed their recollections, but recollections are all that most have today of Gyrojets.

A Well-known Gyrojet Owner

The MBA Gyrojet was far from a commercial success. Few were sold to people who actually intended to shoot them. Most were sold to collectors who fired them rarely, if ever. The name of one of the collectors who fired his MBA Gyrojet is very recognizable, Ronald Reagan.

In 1977, while Ronald Reagan was still the governor of California, the commercial supply of 13mm Gyrojet rockets was pretty well exhausted. Unable to get more through normal channels, Reagan contacted Robert Mainhardt by phone, requesting more ammo for his rocket gun.

Mainhardt sent the following letter to the

future president:

*The Honorable Governor
Ronald Reagan
1660 San Onofre
Pacific Palisades, CA 90272*

Dear Governor Reagan,

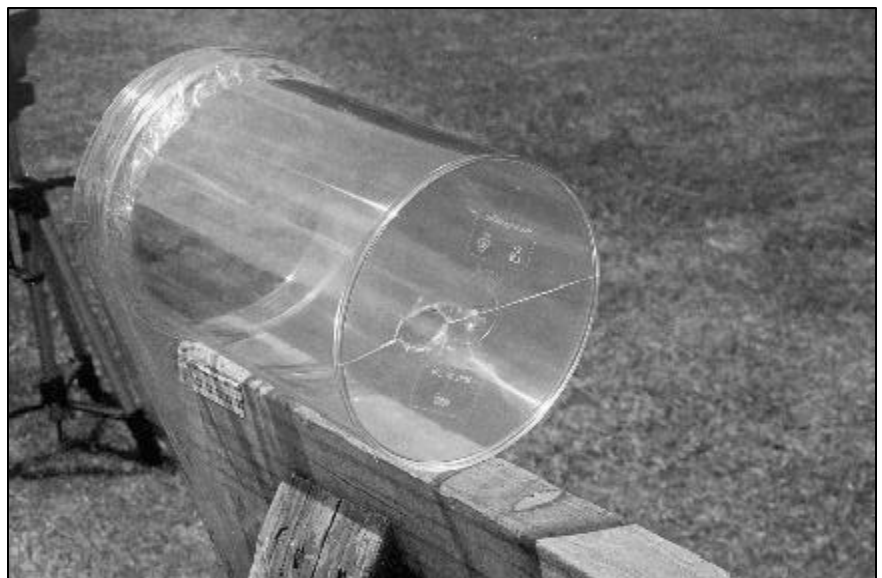
I am sending you under separate cover

twelve rounds of "precious" 13mm Gyrojet ammo.

We all have a great deal of respect and admiration for you - and for these and many other reasons, I have broken into my special stock pile of ammo.

*Respectfully (signed) Bob
ROBERTMAINHARDT*

The clear plastic container that was placed at the Gyrojet's muzzle in a futile attempt to capture a spinning Gyrojet rocket. You can easily see the hole at the end.



Ronald Reagan graciously replied:

Dear Mr. Mainhardt:

I didn't realize that you'd be reducing your own personal supply. You were very kind to do this. I am more grateful than I can say.

Thanks, too, for the literature on MBA. I enjoyed reading of the many products although at times I felt I was in a science fiction world.

I'll guard my gyro-rockets carefully and, again, my heart felt thanks.

Sincerely, (signed) Ronald Reagan

Military Users?

The author is unaware of any authorized use of Gyrojet rocket guns by military personnel. At least two are reported to have been used in Viet Nam though. One was used by Army Lt. Douglas G. Magruder, who died there. Among his returned personal effects, was his Mark II Gyrojet. It was engraved with his name. The second Gyrojet user returned home safely. His name was David Kirschbaum and his full story is available on the Internet at <http://www.classicfirearms.org>. Portions of Kirschbaum's story are excerpted below.

David Kirschbaum Speaks

"As a Recon man I liked the weapon just fine: light, quiet, low-maintenance, and a hell of a punch. It was not silent, not like the true silenced .22 Hi-standards we often carried. But it was quiet, made a sort of "Pssssst!" It sounded like air escaping from a truck tire, maybe a half-second long. I fired it in camp several times, demonstrating it, never got any attention at all."

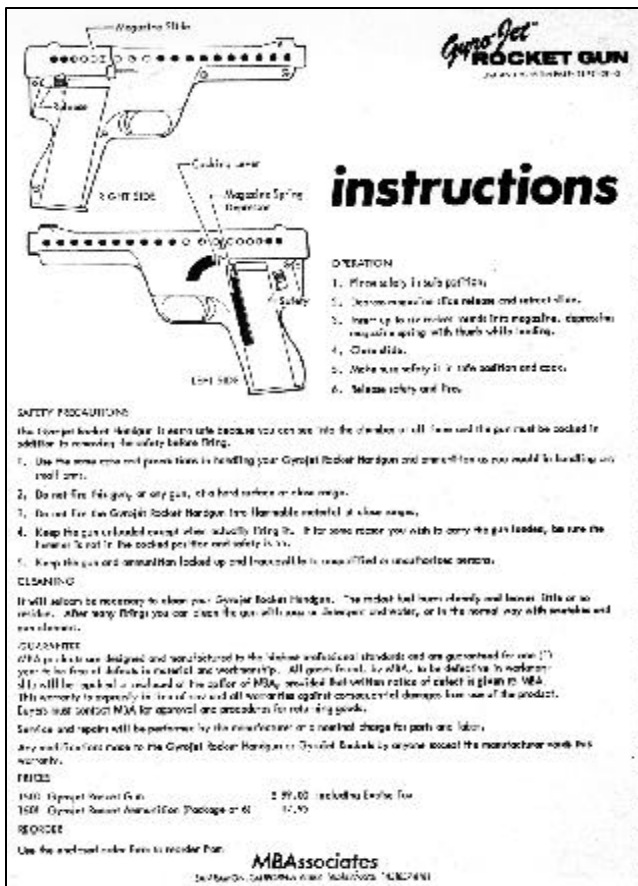
"The biggest problem was the feed design. The rockets all pushed down into the handgrip of the pistol against a spring and follower. Then, while holding that last rocket down, you slid forward this cover on the top of the "receiver" that held them all in place. Fine and dandy if you were going to just shoot them. But shame on you if you had a misfire

(although I never did) or a jam, which I did once. To clear a jam, you'd have to slide back that slide, meanwhile holding all the rockets down with your thumb, and then they'd all want to come springing out! The design really REALLY sucked. It should've had a magazine like a regular automatic, instead of everything being integral. Impossible to clear in combat, and a real PITA to reload too. Never the less, I liked the pistol just fine."

Not Everyone Was Enthusiastic

Ernest Perkins traveled the southeastern United States during the late 1960s, selling firearms to gun stores. He often demonstrated Gyrojets. He remembers that Gyrojets made little noise and had negligible recoil. Perkins stated, "Everybody wanted to shoot my Gyrojet, but nobody wanted to buy one."

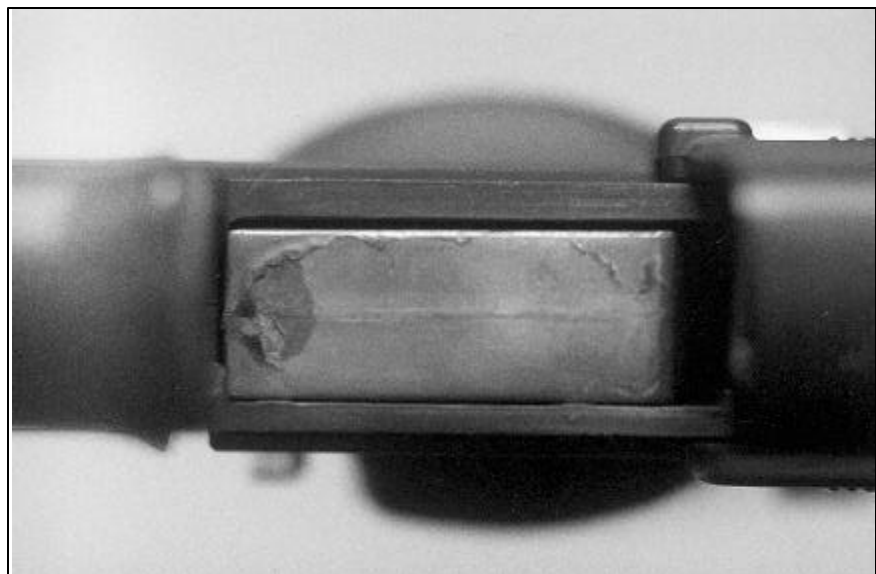
Perkins also related a story that seems improbable in light of what we know about Gyrojet rockets. The author has known Ernest Perkins for over thirty years and knows him to be a man of his word so his personal recollection is included here.

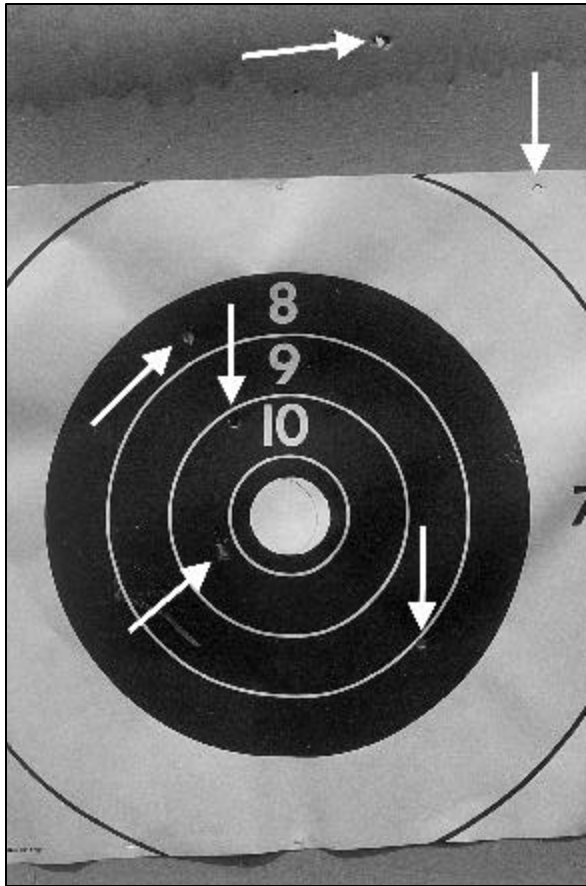


"One afternoon I was down by the river shooting the Gyrojet. I aimed at an old stump. The Gyrojet rocket got stuck in it but bored its way through and popped out of the back a minute later."

Since a Gyrojet's fuel is supposed to burn out in .1 second, the author has no explanation for how this could have happened. Yet, Ernest Perkins is truthful and this is his story as he remembers it.

Right: View of the Gyrojet's magazine follower. This photo was taken after firing 12 rockets. You can see the chrome plating has been partially burned away.





The 36"x36" target was placed 100 feet from the sandbagged bench rest. There are four hits in the black, another in the white at 2 O'clock and another in the cardboard target support at 12 O'clock.

Gyrojet's Advantages

Robert Mainhardt stated that Gyrojet rocket ammo has several advantages over conventional cartridge type ammo. The first is its near absence of recoil. Recent tests verify this. Lack of recoil would enhance both the speed and the accuracy of the second and succeeding shots.

Mainhardt also stated that Gyrojet rockets produce little noise and that there is no muzzle blast. About half of the rounds that were fired in recent tests sounded like a 'bottle rocket' being launched. The other half though, produced a loud supersonic 'crack.' There was no doubt that a weapon had been discharged.

MBA promotional literature states that most of the

Gyrojet's combustion pressure is contained within the rocket body. This means that there is little pressure inside of the launch tube. For this reason, no great strength is required for the launcher and consequently, lightweight launchers are possible.

A Gyrojet launcher can be quite simple to manufacture. Since the high pressure is contained within the rocket body, no reciprocating bolt is required. Because the entire round (rocket) leaves the tube, there is no need for an extractor or an ejector either.

Since Gyrojet launchers do not need a bolt, a strong barrel, an extractor or an ejector, they can be made with low-tech production methods. Gyrojet launchers, either semi

auto or a full automatic, can be simple, lightweight and inexpensive. Low cost die-casting or stamped assembly is sufficient.

Due to its unique method of operation, Gyrojet launchers need no lubrication. For this reason, greater cold weather reliability is claimed for the Gyrojet launcher.

The flash produced by the Gyrojet's rocket engine can be hidden inside of the launcher. After the rocket leaves the launcher, its flame is only visible when viewed from behind. According to Mainhardt, the burning rocket will not reveal the location of the shooter. Though the flame is visible to the shooter, it is not an effective tracer. The propellant burns out at about sixty feet downrange.

Most of the Gyrojet rocket's combustion takes place outside of the barrel. For this reason, barrel heating and fouling is negligible. This permits a very high rate of fire without overheating the launcher.

The design of the Gyrojet launcher permits the user to tell at a glance if it is loaded and to see how many rockets remain in the grip/magazine.

Negative Qualities

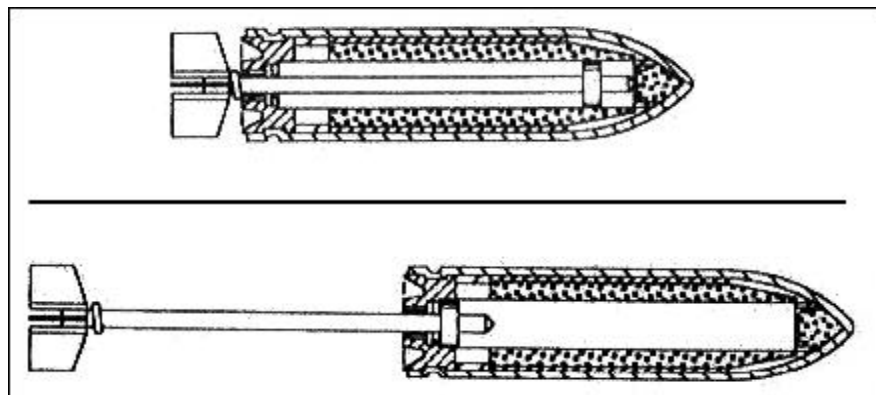
Gyrojet ammo never cost less than \$1.35 per round. There were hopes that there would be major cost reductions when Gyrojet rockets were produced in large quantities. That never occurred though. Gyrojet ammo is rare and expensive today. When it can be located, it is priced at \$50.00 per round or higher.

Initial MBAssociates testing of Gyrojet rockets reported a 10% rate of failure. After improving production quality control, MBA claimed a 99% reliability for its Gyrojet rockets. Few people though, would wish go into harms way armed with a handgun that had a

Matt "Mongo" Bright's experiences with a Gyrojet occurred only ten years ago. Like Perkins, he recalls little noise or recoil. He also recalls a failure rate of about 50%. "Mongo" remembers that some of the defective rocket rounds traveled only a short distance before falling to the ground and spinning about until their fuel was exhausted. The Gyrojet ammo that "Mongo" shot was at least twenty years old though and it had been stored under undetermined conditions.

Since the Gyrojet ammo was of undetermined quality, "Mongo's" bad experiences with Gyrojets may be due only to poor storage conditions. Even brand new Gyrojet rockets did fail though. *See the accompanying interview with Tim Bixler in this issue of Small Arms Review for details.*

Right: Drawings of the experimental 13x53mm spin/fin stabilized Gyrojet rocket. On top, the fins are retracted. On bottom they are extended. The retractable rod that supports the fins also appears to serve as a long firing pin to reach the primer inside the nose of the rocket.



1% rate of failure.

Assuming that a Gyrojet user had no backup weapon, if a rocket failed to ignite, there were only two options (not counting running away). The first was to recock the hammer and to try to ignite the rocket again. If that failed, then it would be necessary to open the 'slide' to remove the failed rocket. Opening the slide also put the user at risk to injury in the event of a hang fire.

If the user did not open the slide carefully and restrain the rockets with his thumb, then all of the rockets would be ejected by the follower spring. Not a good situation when your life is on the line!

A fully loaded Gyrojet contains six rockets. It does not have a detachable magazine. It is necessary to load the launcher from the top, one-round-at-a-time, through the open 'slide.' If the user expended the Gyrojet's six rockets during a 'fire fight,' reloading the rocket gun would be both time consuming and impractical.

Though it is probably not as likely to start a fire as an ordinary round of tracer ammo, Gyrojet rocket ammo is a fire hazard. This is primarily true at close range, before the propellant burns out. However, the Gyrojet propellant burns at 5000f. If it impacts into flammable material, a spent Gyrojet rocket round might be hot enough to start a fire.

Testing Gyrojets in 2001

Except for a brief test that was done by *The American Rifleman* magazine thirty-plus years ago, no scientific tests of Gyrojet ammo have been conducted independently of MBA's research. Recently twenty-four rounds of very expensive, collectable, 13mm Gyrojet ammo were purchased by *Small Arms Review* for testing.

To maximize the knowledge gained from each precious round that was to be expended, and to confirm the acceleration rate of the Gyrojet rockets, eight chronographs were used simultaneously. The first set of chronograph screens was placed one foot from the muzzle. The next two sets were placed at three feet and five feet. The last five sets were spaced at eight, thirteen, eighteen, twenty-three and twenty-eight feet. After firing ten rounds of rocket ammo at these ranges, the original

test plan called for moving the chronographs to thirty-three, thirty-eight, forty-three, forty-eight, fifty-three, fifty-eight and sixty-three feet to measure the continued acceleration and velocity drop after propellant burnout. To duplicate the test conditions that MBA Associates used nearly forty years ago, a target was placed at 100 feet to test the Gyrojet's accuracy.

Assisting at the *Small Arms Review* 2001 Gyrojet tests were Jim Weaver, as the actual shooter, Wyatt Mangum, Norbert Smoot and Monty Mendenhall as statisticians, photographers and Range Safety Officers.

Before expending a \$50 round of Gyrojet ammo, the eight Chronographs were first tested by firing a round of .22LR across them to assure that all were working properly. Satisfied that everything was in order, Jim Weaver loaded \$300 worth of ammo (six rounds) and proceeded.

The first round was a 'hang fire.' Cautiously, Weaver kept the launcher carefully aimed at the target for several seconds. Suddenly it went off, producing a loud ballistic 'crack'. This indicated that the rocket had attained supersonic velocity at some point down range. Unfortunately, only the two chronographs that were located nearest to the muzzle recorded a velocity reading. The Gyrojet round missed the 36X36 inch target at 100 feet and impacted about six inches above it in the cardboard that supported the target. It is assumed that the lack of recorded chronograph information beyond three feet, was due to the Gyrojet rocket's failure to pass over the sensitive 'recording area' of the more distant chronograph screens.

The next nine Gyrojet rounds produced varying degrees of success. About half produced a supersonic 'crack' and the rest produced a bottle-rocket-like 'whoosh.' Four of the rockets failed to ignite on the first pull of

the trigger. The hammer was recocked each time and the trigger pulled again.

Just three of the Gyrojet rockets activated the first seven chronographs. The other six activated only the ones nearer to the muzzle. None of them activated the chronograph that was placed at 28 feet. Of the ten rounds fired, only five struck the 36X36 inch target. As stated previously, one more round impacted near the target.

The tests were halted after firing ten rounds. The researchers felt that in view of their inability to reliably obtain velocity data from the muzzle to 23 feet, and no data at all beyond 23 feet, more testing after moving the chronographs farther down range would only waste expensive, collectable Gyrojet ammo.

One more Gyrojet round was fired while trying to determine the rockets' penetration at the muzzle. Due to the Gyrojet's low muzzle velocity, it was hypothesized that the rocket could be caught in a clear plastic container. Three video cameras were set at varying points to record this. Still cameras were available to photo the spinning round if it were caught.

Pleading a desire to preserve his body parts as nature gave them to him, Jim Weaver declined to be the shooter for this phase of the testing. No one else volunteered either so Captain Monty assumed the role of shooter.

Based on data that was collected earlier, it was estimated that the Gyrojet's velocity would be 105 fps when it impacted the end of the plastic container. With a little trepidation, Captain Monty placed the Gyrojet launcher's muzzle into the clear plastic container and squeezed the trigger. The rocket was not captured. It broke a hole through the end.

An Acceleration Anomaly

Based on MBA's supplied data regarding the maximum Gyrojet velocity and the

Gyrojet Velocity, Acceleration and Energy As Determined by *Small Arms Review*

Range in feet	Velocity in fps	Acceleration per foot	Energy in ft/lbs.
1	105	70	5
3	192	64	15
5	290	58	35
8	421	52	73.....(equal to .22 Short)
13	566	44	132.....(slightly greater than .22LR)
18	787	44	254.....(Equal to .455 Webley)
23	985	42	398.....(Slightly greater than .45acp)

propellant's stated burn-time, the *Small Arms Review* researchers expected a Gyrojet rocket to accelerate linearly at the rate of approximately 21 feet per second, per foot of forward rocket travel. It was expected that the rocket would attain its maximum velocity of 1250fps at a point 60 feet down range.

Also based on calculations made from the MBA supplied data, it was estimated that a Gyrojet pistol's muzzle velocity would be less than 20 fps. The SAR tests revealed some surprising results (see the chart).

The Gyrojet rockets' initial velocities were much higher than expected. Instead of linear acceleration, the rocket's acceleration rate was fastest at the muzzle and then declined rapidly. At the muzzle, the rocket's rate of acceleration was 70 feet per second, per foot of forward travel. At 13 feet from the muzzle though, the acceleration rate had dropped to only 44 feet per second, per foot of forward travel. At 23 feet from the muzzle the velocity had reached 985 fps and the rate of acceleration appeared to be stabilizing at about 42 feet per second, per foot. Based upon the data that SAR obtained and assuming that the MBA supplied maximum velocity data is correct, the Gyrojet rockets reached their maximum velocity at about 30 feet from the muzzle.

It is unfortunate that the Gyrojet's accuracy was so poor that velocity data was unobtainable beyond 23 feet from the muzzle. That unobtained data might have shed more light on what was going on.

Did The *Small Arms Review* Tests Discover An MBAssociates Trade Secret?

To what can we attribute this 'higher than anticipated' rocket acceleration near the muzzle? The first thing that comes to mind is the fact that the Gyrojet rockets that SAR tested were over thirty years old. They could have been deteriorated by age and poor storage conditions.

Nothing is known about the conditions under which the Gyrojet rockets were stored. All were untarnished though. That alone proves nothing, but it does tend to indicate that they were not stored under conditions of high temperature or humidity. Additionally, the data that was gleaned from the individual rockets was consistent with the data that was obtained from the others.

If the Gyrojet rockets had deteriorated, the data that was obtained from each round would likely have been inconsistent with the data that was obtained from the others. The author believes that this consistency of data

indicates that the rockets that were tested were in relatively good condition.

Why then the unexpected fast, non-linear acceleration data? The author has a theory. Perhaps to protect their small rocket secrets, MBA did not reveal the true purpose of the sixth component of the Gyrojet rocket, the sensitive chemical 'initiator.'

The information supplied by MBA stated that the purpose of the 'initiator' was to receive the initial impulse of the primer and then the 'initiator' uniformly ignited the main charge of propellant. That might have been true, but the author feels that it was a 'cover' story to hide the real purpose of the 'initiator.'

Interpolating the MBA supplied data, if a Gyrojet rocket accelerated linearly (and there was no hint in the MBA literature that suggested that it did not), and reached its maximum velocity at sixty feet down range, then the rocket's acceleration rate would be about 21 feet per second, per foot of forward movement. At this acceleration rate, the muzzle velocity from a five-inch barrel would be only 10fps. Gravity and the slightest wind would have had a disproportionate effect upon an object accelerating that slowly.

The 'initiator's' real purpose, the author believes, was to give the rocket a faster initial acceleration rate for the first few microseconds of its flight and, thereby, improve its accuracy. Had the tested Gyrojet ammo been accurate enough to record velocity data beyond 23 feet from the muzzle, the authors' suspicions may have been confirmed.

The author's theory is just a speculation of course but unless Robert Mainhardt chooses to step forward with a better explanation, we will never know. SAR's tests have established that the published MBA data, though not untrue, did not tell the entire story.

A former employee of MBAssociates, Dan Golech, contacted SAR after reading part one of the Gyrojet story. He stated that he had helped to assemble the Gyrojet rockets.

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The former employee revealed that the composition of the initiator was similar to Thermite. Thermite is not a rocket fuel. It is a stable compound that burns at a very high temperature. It is composed primarily of aluminum, oxygen and iron oxide. It is fifty percent iron by weight.

Upon ignition, the temperature of the thermite reaction reaches 2200 degrees F., well above the melting point of iron. The oxygen in the iron oxide transfers to the aluminum, leaving molten iron as a byproduct.

The 'hot burning' Thermite initiator may have increased the burning rate of the Gyrojet's rocket fuel for the first few microseconds of the rocket's flight, momentarily producing increased thrust. Almost certainly however, the relatively heavy molten iron temporarily increased the specific impulse of the combustion gases it was forced through the rocket nozzles by the escaping gases. This temporary increase in thrust caused the Gyrojet rocket to accelerate faster initially and thus improved its accuracy.

An Experimental Finned Gyrojet Rocket

A drawing of an experimental Gyrojet rocket round was recently discovered. It is

spin stabilized like other Gyrojet rockets, but it also has retractable stabilizing fins. This drawing, and the existence of two experimental Gyrojet rockets of this type, may be a confirmation that MBA recognized the Gyrojet's unacceptable accuracy. The retractable fins appear to be an attempt to improve accuracy while maintaining the Gyrojet's ability to feed easily from a magazine.

The finned spin stabilized Gyrojet rocket is too long, however, to be fired in a standard Gyrojet launcher. Perhaps it was intended for use in the experimental launcher that Tim Bixler described in his interview that accompanies this article.

Little is known about the finned spin stabilized Gyrojet rocket. It appears from the drawing however, that the retractable rod, upon which the fins are mounted, also serves as a long firing pin. The drawing is not entirely clear on this matter, but the forward end of the rod is pointed and the primer seems to be located inside of the rocket, near the rocket's nose. If that is the case, then it would also appear that if a finned spin stabilized Gyrojet rocket was accidentally dropped on its fins, it would go off. That would be dangerous. A pistol or a rifle cartridge must fire in a barrel in order for the bullet to reach a lethal velocity. A Gyrojet rocket does not need a barrel to accelerate to a lethal velocity.

Only two examples of Gyrojet finned spin stabilized rockets are known to exist. This hints that the MBA finned spin stabilized Gyrojet experiment was not successful.

The Author's Evaluation

Disregarding for a moment the high cost

of its ammo, the Gyrojet system had three major shortcomings that doomed it to failure as a personal defense weapon (PDW).

First, the Gyrojet ammo never lived up to its accuracy expectations. The best accuracy that Robert Mainhardt ever claimed for Gyrojet rocket ammo was 2.5 mils CEP, or 30 inches at 100 yards. The recent SAR tests make that claim sound very optimistic. At other places in MBA literature, the average accuracy at 100 yards was reported to be seven feet. Recent SAR tests could not verify this latter figure either. Interpolation of the data that SAR recently obtained, placed the accuracy of 50% of the Gyrojet rounds at no better than nine feet at 100 yards. The *Small Arms Review* researchers have no idea of how far the other 50% of the rockets missed their mark.

The laws of physics partially explain some of the Gyrojet rocket's inaccuracy. Because Gyrojet ammo is a small rocket, most of its acceleration occurs after the rocket has left the launcher. Its muzzle velocity is quite slow. This is the chief reason for its poor accuracy. As it is being launched, the rocket is affected disproportionately by the slightest movement of the muzzle or a gust of wind. As an illustration, recall how difficult it is to take unblurred pictures while using slow shutter speeds and a telephoto lens. Additionally, the Gyrojet rocket must accelerate in free-flight through the turbulent transonic range of the speed of sound. This introduces random errors to its flight path, further degrading Gyrojet accuracy. For more information about the transonic speed of sound and its negative effects on accuracy, read *Small Arms Review*, Volume 5, Number 11. Back issues are available from Moose Lake Publishing.

Second, Robert Mainhardt never claimed a Gyrojet reliability factor of greater than 99%. Since there are many practical PDWs whose failure rate is almost nil, for those who must go into harm's way, a 1% failure rate is entirely unacceptable.

Even if 100% reliability and pinpoint accuracy could have been attained, the Gyrojet's third major shortcoming makes it dangerously unsuited for use as a PDW. Because Gyrojet ammo is a small rocket, most of its acceleration occurs after the rocket has left the launcher. This is the chief reason for its poor accuracy. According to MBA's published data, the Gyrojet rocket reaches its maximum velocity of 1250 fps, not at the muzzle, but at 60 feet downrange. At that point, a Gyrojet rocket has twice the energy of a standard round of .45acp ammo. Unfortunately, its energy at the muzzle is woefully sub-lethal (see the chart).

It has been stated that the average range of a confrontation with a handgun is seven feet. At seven feet, a Gyrojet rocket, whether launched from a pistol or a carbine, will have about the same energy as a .22 Rimfire Short cartridge. This is only marginal lethality at best.

Summary

Due to the laws of physics that govern a rocket's acceleration, even if the Gyrojet's reliability problems could have been overcome, the MBA small rocket system would still have been unsuitable at close range for use as a PDW. Since MBA Gyrojets never achieved their accuracy goals, a single round is of little use at longer ranges either. Due to their lack of reliability, close range energy and long range accuracy, what are Gyrojets are good for?

Though there may be much potential for using salvos of small rockets for saturating an area, in the author's opinion, Gyrojet rocket ammo is unsuitable for small arms use.

Thanks

Many people shared information and loaned equipment to SAR for use during these tests. Without their help, this story would not have been possible. Thanks so much to Tim Bixler, Howard Brown Jr., Craig Cooper, Tom Denall, Kevin Dockery, Leonard Yates and Jamie Vann.

This is a follow-up to an in depth article on the Gyrojet that appeared in Small Arms Review July, 2002 Vol. 5 No. 10.



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