



U.S. ARMY

Figure 0. SCAMP.

Why the SCAMP Is Now, and Always Will Be, King of the Hill

By Jay Bell

The manufacture of ammunition is a tricky business. For what other manufactured product do you have numerous manufacturing steps, and one might only discover a massive catastrophic failure at the end of the manufacturing process at the acceptance test for the product? Plus there is only one way to be 110% sure each product/round works, by pulling the trigger, which consumes the product in destructive testing. In order to make a cost-effective product, one needs to crank out ammunition in high volume. The high volume makes it more difficult to make a great product due to minor variations in the raw materials, tooling and equipment. Therefore, making tons of the highest quality ammo is exponentially more difficult.

The pinnacle of high-speed production and advanced manufacturing technology in ammunition manufacturing is the Small Caliber Ammunition Modernization Project (SCAMP). This successful government endeavor

for the U.S. Army was spearheaded by Gulf & Western Corporation (G&W) back in the late 1960s. The effort was started at Twin Cities Army Ammunition Plant near Minneapolis, MN. It was mothballed in 1975. By 1976 it was transitioned to Lake City Army Ammunition Plant in Independence, MO. G&W was the prime contractor and subcontracted out many pieces, including some of the machine fabrication by Bliss in Hastings, MI.

Back in the 1960s, the U.S. small caliber ammunition production was still being manufactured on World War I technology equipment, much of it developed before World War II. There were minor upgrades for World War II, like having individual motors to run the machine versus all the machines running off a giant line shaft (see *Figure 2*). A cartridge case line consisted of around 11 processes/steps that were conducted in a single station and single operation presses. For example, the first machine in the process was the First Draw of the cup, resulting in a

first drawn part. The standard machine was a Bliss 304 that would take a cup and perform the first draw. It did it 3 or 4 at a time (4 up) in 5.56mm at around 90 strokes per minute. Multiplying by 4 stations provided 360 parts per minute (ppm). The SCAMP line took nearly all of these operations and combined them into **one** giant machine with the added benefit of producing at 1,200 ppm. It accomplished this task by copying from the high-speed rotary beer/soda can technology with multiple turrets stations, each conducting one of the steps. Each turret is around 4 to 5 feet in diameter and contains 24 identical tooling sets, all performing the identical step. Therefore, feed a brass cartridge case cup in one end of the machine and come out with a nearly finished cartridge case at the other end of the machine. The cartridge case line is bigger than an 18 wheeler truck in length and width and has around 8 turrets. To round out the SCAMP line, there was a similar bullet manufacturing line and loading line

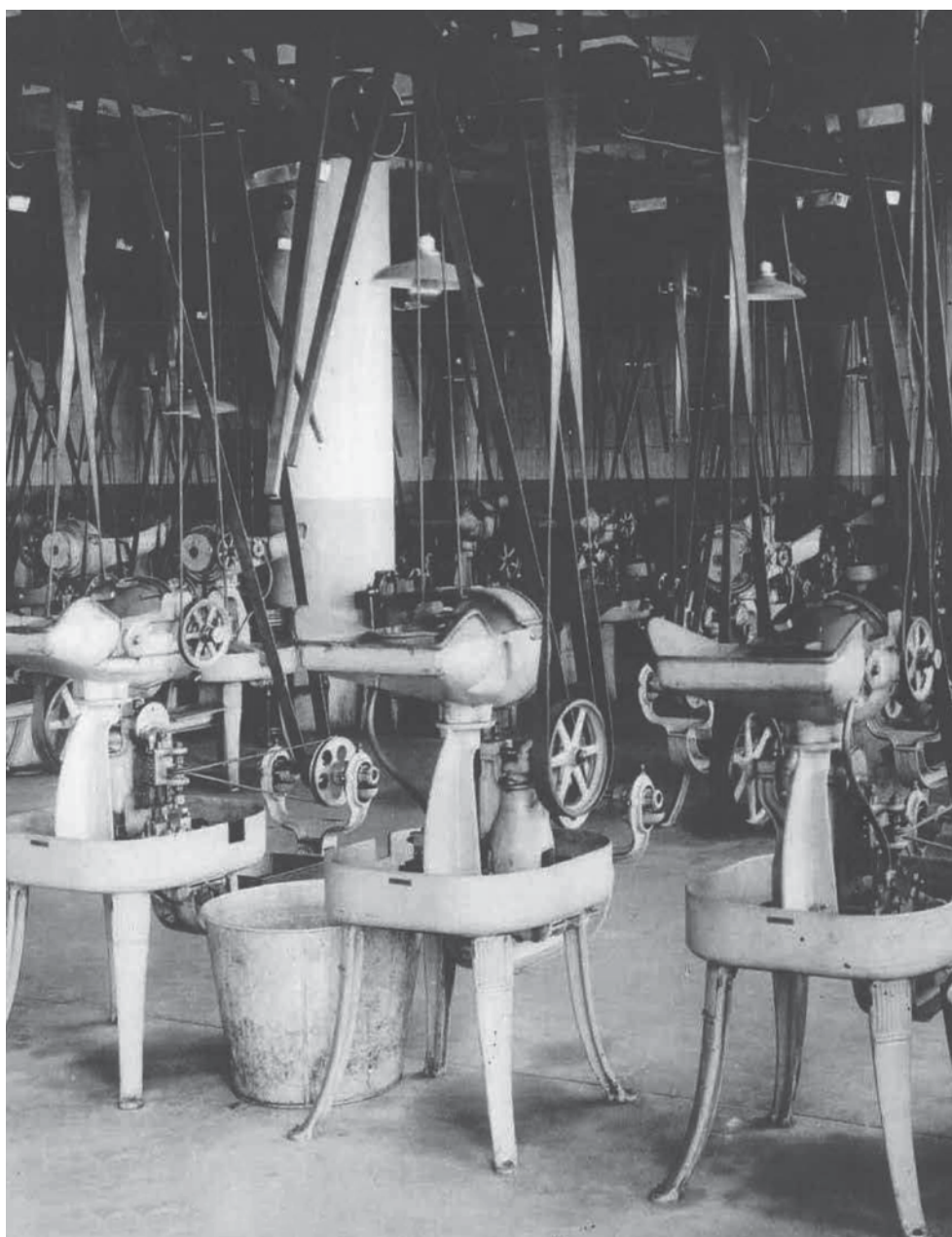
(see Figure 3).

The more amazing feature is that over 50 years later there is still no equipment that manufactures faster or in a lesser number of machines. The leading ammunition manufacturing companies in the world today only have machines that max out at around 250 parts per minute. Think about that for a minute. After all of the advancements in manufacturing in the last 50 years—3D solid modeling, CNC precision tooling manufacturing, programmable logic computer control—and we are no better or faster than 50 years ago! (See Figure 4.)

It would be unfair to say these manufacturers are not capable of making a competing product with the SCAMP. I'm confident they are very capable of meeting this task and probably improving upon it; however, the commercial market does not require a machine that can manufacture more than 250 ppm. If there was a need for 1200 ppm, they could just procure 5 of the machines and make 1,250. The four SCAMP lines at Lake City are capable of manufacturing over 1.5 billion rounds a year on three shifts. There are very few commercial or government organizations that need to manufacture that much ammunition—especially of one caliber. The only reason the Lake City SCAMP lines are still running might be the change back in the late 1990s to allow the operating contractor to fully utilize the excess production capacity for the global market to include commercial ammunition. That is correct—a large majority of the Winchester and Federal 5.56mm/.223 ammunition on the commercial market comes off the SCAMP line.

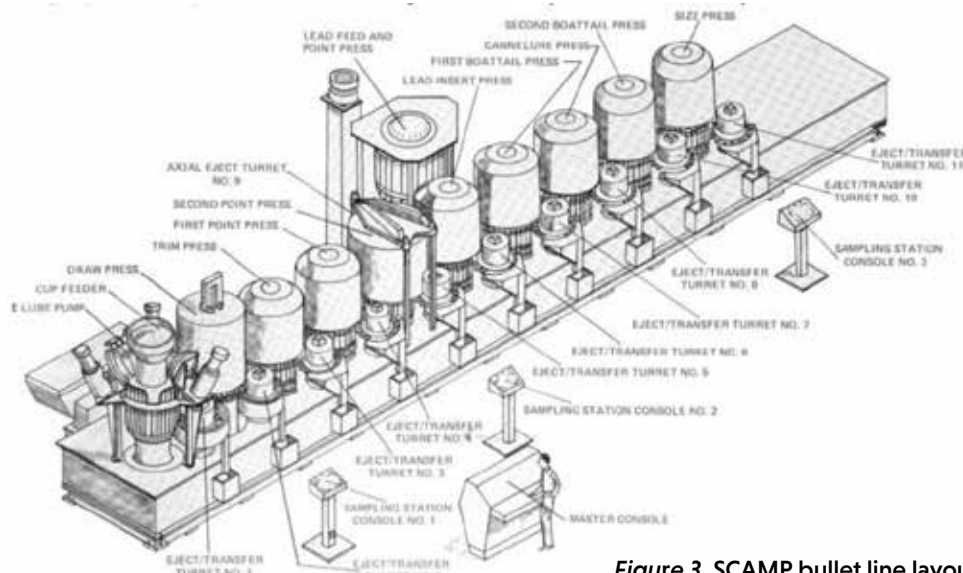
SCAMP is a development and manufacturing success and marvel, yet technically a commercial failure. What in the world do I mean? As discussed above, the output is so massive that very few organizations need the capacity. Modern equipment manufacturers have machines that are suited to their customer's exact needs. If the customer needs more than 250 ppm, just buy two or more of the machines.

It is estimated that there were 8-10 SCAMP lines manufactured. To the best of current information, Israel still has one upgraded line and a 9mm line. Taiwan had one, however it was recently in a flood, and Pakistan still has one. It is believed that PMC Korea had one at one time. There are rumors



BLISS

Figure 2. Bliss machines on a line shaft.



MANTECH JOURNAL

Figure 3. SCAMP bullet line layout.



Figure 4. SCAMP loader from control room.



U.S. ARMY

Figure 6. SCAMP bullet line and buggies full of bullets.

that a line was returned by the customer to Gulf & Western. There was also a line in 7.62x51mm NATO.

Bold Prediction

I predict that SCAMP will always be the biggest and highest-rate machine ever made for ammunition. My reasons are as follows:

1. Only a government needs and can afford the capacity of SCAMP speed lines.
2. Only a government can afford to keep it running, in the Trump Slump (2017-2020) any commercial entity would have shut it down, at least for a little while.
3. Most other governments would have trouble coming up with the funding needed to take on this task to create something faster than SCAMP.
4. Most governments now have a multitude of calibers they use, reducing the need for high volume in any one caliber.
5. The never-ending push for lightweight will add to manufacturing variability and uncertainty in the future "main" caliber.
6. Modern trends in manufacturing are the cellular model where you have multiple duplicate units, like the Setpoint lines at Lake City for 7.62x51mm and .50 caliber.

A Multitude of Calibers

As of right now, the U.S. government

(all services and all 3-letter agencies) use/procure approximately 12 to 15 calibers. Some of these are mentioned below. Here are all of the other major calibers procured around the world.

- NATO Pistol: 9mm
- NATO Rifle: 5.56mm, 7.62x51mm, .50 caliber, .30-06 Blank
- SAAMI Pistol: .380, .40 S&W, .45 ACP
- SAAMI Rifle: 6.5 Creedmoor, .300 Blackout, .300 Win Mag, .338 Lapua
- Non-Standard Domestic: .300 Norma Mag, .338 Norma Mag
- Non-Standard Eastern Bloc: 9x18mm, 7.62x39mm, 7.62x54R, 12.7x108mm, 14.5mm
- Experimental: 5.56mm Lightweight Small Caliber Ammunition Telescoping (LSAT)
- Next Generation Squad Automatic Rifle: 6.8 Case Telescoping from AAI/Textron, 6.8 True Velocity, and 6.8 SIG

If anything, this list will only continue to grow over time. As more agencies continue to get funding to procure the latest and greatest plus funding to develop new rounds and weapons. USSOCOM is pushing 3 to 4 calibers on their own right now. Those calibers that fall off the wayside in the future end up sticking around for a very long time, like the .30-06 Blank. Its sole purpose appears to be for ceremonial purposes. The last time the U.S. government made .30-06 ball ammo was in the late 1970s, yet the

blanks continue to be procured every couple of years. The rounds are usually produced by other countries. The 7.62mm Bottlenose blank is currently manufactured in Korea and the .30-06 Blank has been procured from Brazil for decades.

Modern Trends

In the 2010 timeframe, Lake City was going through one of its multiple "modernization" efforts. This particular effort was for the 7.62 NATO and .50 caliber cartridge case lines. I believe the thought process was along the lines of SCAMP—they wanted something **dramatically** different. The objectives were different than those for SCAMP. The objectives were modern, cellular, continuous flow, many commercial off-the-shelf parts, interchangeability of parts, precision and simplicity. The current list of major ammunition equipment manufacturers lined up for the business, however, it ended up going to an engineering firm that was known for making roller coasters. Setpoint of Salt Lake City was selected to make 4 each back end cells for both calibers, for a total of 8 cells. The price was originally around \$3.5 million dollars for 7.62 NATO and \$4.5 million for the .50 caliber. Unconfirmed stories have the total cost considerably more after numerous changes and unplanned facility upgrades. These lines took a part that was through 3rd draw and finished the part to go to priming and then loading. Therefore, the steps line were as follows: pre-pocketed the case, headed the case, head turned the case, performed a body anneal before taper, then tapered the part, trimmed the mouth and final mouth & neck annealed the part. Washing was integrated into the cell system to have clean-finished cases ready to move to the priming operation.

The Setpoint lines only run around

Back in the 1960s, the U.S. small caliber ammunition production was still being manufactured on World War I technology equipment, much of it developed before World War II.

35 ppm, however, the original objective was closer to 42 ppm. 35 ppm means that on 3 shifts they can theoretically run around 18 million per year, per cell. They do make some very consistent ammunition. Many people have said that the normal production is equal to the old match-grade cartridge cases. The key areas that are involved are base wall and neck wall minimal runout, consistency of head turn dimensions and consistency of annealing. The improved wall variation seems to come from the improved holding of the part through the draws. The head turn seems to come from better tool control from PLC and greater precision spindles. The induction anneal is a major upgrade. The parts drop one at a time through the coil and the new controls and better design make them near perfect.

The Setpoint team did make many leaps in technology from their experience in a wide array of manufacturing processes, from roller coasters to electric car battery assembly. One key development was induction anneal of cases for body anneal (before taper) and mouth and neck anneal to eliminate stress cracks in the necks. The traditional induction anneal was a long exposure of the parts marching past the induction coil. Typically, the parts rolled through a "tunnel" to try to get a consistent anneal. Sometimes parts would get hung up as they traveled. This might result in a part getting too much anneal on one side and not enough on another. Setpoint dropped the round through a single coil, which is much more consistent. The result is a much better case (see *Figure 7*).

The most interesting unplanned upgrade at Lake City was the upgrade in power requirements. The old presses had electric motors that powdered a giant flywheel, which powered the ram for the tonnage to move metal in the draws, pre-pocketing, heading and taper operations. The only surge in power was to start the flywheel from a complete stop, which did not hap-



SETPOINT

Figure 7. Setpoint's commercial case line.

pen all at the same time and typically only once a shift—if things were running like clockwork. Even if a machine was having massive issues, you still were not starting the machine flywheel but a dozen times a day. The Setpoint lines had multiple servo drives to move metal. The servos require huge amounts of power to stop and start the stroke of the ram. Each system had at least 3 servos multiplied by 8 systems for a total of 24 servos. Now multiple that by two for the stop and start of the stroke and there were 48 firings of the servos **each minute**. When multiple servos were fired at the same time the system had a power surge, and the lines would trip the electrical breaker fuse switch. The rumored cost was over \$10 million dollars for the power upgrades.

Initially, it took Lake City many years to get their arms around the Cellular Servo Lines. This is understandable. This is a different type of manufacturing. The old systems were chain drives, cranks, rams and huge flywheels and the new system was indexing dials, servos and electronics. In conversations with the people that were deeply involved in running these lines, they were not initially well regarded. Roughly 8 out of 10 said they would not recommend buying them again. However, as time progressed, they became more and more (at least) used

to the lines.

The other issue is the potential longevity of the Setpoint lines. The World War II vintage machines are heavy cast iron frames and giant flywheels. These machines have been fully rebuilt multiple times to like-new condition with replacement of the bronze bushings and re-scraping the gibbs and ways of the ram. They are also modernized with Programmable Logic Control systems to improve the machines to semi-modern standards. These machines can literally be rebuilt an unlimited amount of times. The servo cells are too new to know if they can last the 70-plus years of the old crank presses. The rumor mill indicates that there are currently more lines on order from Setpoint.

The global ammunition market lags behind other industries in terms of equipment technology. The Setpoint systems approach brought it into current times. There are numerous other trends where ammunition producers are going with more modern concepts. Time will tell if the trend continues or if there are to be another 50 years of stagnation. Outside of the SCAMP and Setpoint lines, the rest of Lake City and the U.S. ammunition base still uses a majority of the World War II surplus equipment—just rebuild it once every 5 or 10 years and it keeps on hammering out parts. **SADJ**