Article Contributed by: Mark Trope

Adobe PDF Downloadable Version of Article

Warning
This article addresses issues that deal with reloading firearm cartridges. The information presented is a result of careful experimentation and experience. We offer no guarantee or warranty of any kind on the information presented and you should proceed with caution if you choose to try the techniques or products that we present. Reloading is not an exact science; we have no control over what you do or what you use. Therefore, you assume any and all risk involved.

Often, when one starts thinking about using cast bullets, the first inclination is to use a bullet shape that mirrors a favorite jacketed number. And why not you ask? If a Sierra 168 grain boat tail makes nice tight groups, then a similar cast design should do well to, right? Wrong! The answer lies in bullet hardness. Jacketed bullets are about 100 on the Brinell scale. The hardest cast bullets are about 35 Brinell. Most cast bullets run less. Since cast bullets are softer then jacketed, they require positive guidance to keep them running concentric. There are three factors we must consider to get good performance from cast bullets. Bullet shape and bullet size are the first two. The last is barrel twist rate. However, before we discuss these factors, let's review how moulds are made and what's readily available.

Makers of bullet moulds produce moulds by either the "lathe bore" method; where the blocks are held tightly together and a series of different drills and cutters produce the cavity or cavities. Or, a single cutting tool called a "Cherry" is rotated and the blocks are moved in to cut the cavity or cavities. Producing a mould is an exacting process; either method will make a good mould, provided the best tools, machinery, operators and quality assurance inspectors are in attendance. The initial set up on a mould is expensive and time consuming.

Mould makers know different alloys will drop bullets at slightly different sizes and weights.

Pure lead will make the smallest bullets with the greatest weight. Linotype at the other end of the scale makes the lightest, but largest bullets. Production makers strive to have their moulds drop bullets about a certain size. They have their cavities sized to take into account various alloys.

The custom maker works a bit differently. The customer chooses a standard mould pattern from the custom makers catalog and specifies what alloy is to be used. Next, the customer specifies what sizes both body and nose of the bullet are to come out with that specific alloy. The customer maker produces a mould to meet those specifications. Custom makers supply top punches for their moulds to match for whatever Lubricator/Sizer the customer has. NEI, www.neihandtools.com, is one such maker. I have a NEI mould I acquired 20 years ago; it is a very elegant mould. The bullets drop from the mould exactly as I specified in my order.

Taking it one step further, the customer can totally design his or her own bullet shape from scratch, in addition to specifying both alloy and finished sizes. Needless to say, when one gets into the realm of custom moulds, things can get a bit pricey. However, considering one gets it *exactly as desired;* then price shouldn't matter.

Most use standard production moulds readily available from catalog companies. I have moulds from all the mainstream producers. They all put out good tools. Trying to pick a "best" mould maker is rather difficult. All the makers have their strong points.

Lyman, www.lymanproducts.com has some designs that have been in production almost 100 years. Originally under the name "Ideal", Lyman cast bullets have achieved legendary status for their ability to group. Many cast bullet records have been set with a Lyman bullet. Other makers have copied Lyman designs. Lyman recently updated their mould handles with a new, superior design. Lyman has an excellent Lubricator/Sizer; the latest version is a top-notch tool. (**See Note 1**)

RCBS, www.rcbs.com acquired the Lachmiller Lubricator/Sizer and mould line over 25 years ago. They have expanded the mould line with many fine designs and have excellent quality control. They also have some moulds available in their "limited production" line that are specialized, but cost less then custom moulds. I acquired one of their Lubricator/Sizer's over 20 years ago. It functions as perfectly today as it did when new. (**See Note 1**)

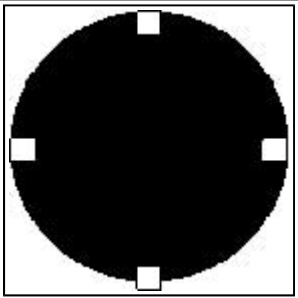
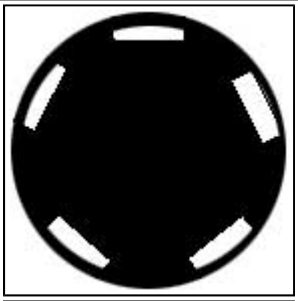
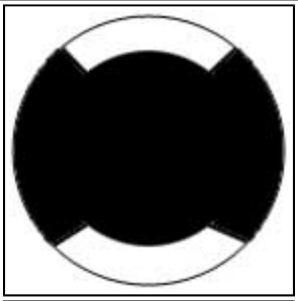
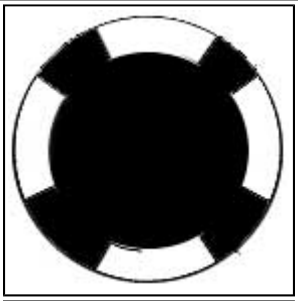
Lee, www.leeprecision.com, led the way with innovative ***aluminum*** moulds. Their cavity designs are time tested. They guarantee their moulds to be minus nothing to + .003. Lee moulds are easy to use and are the least expensive. Lee moulds have permanently attached handles. Lee will make custom moulds to customer specifications! When a mainstream production maker agrees to do a "One Off" mould, it takes a special set up, a lot of time, and there is almost no profit involved. This is a tribute to Lee's commitment and loyalty to their customers. Lee pioneered the "push through" sizer system that attaches to a reloading press. I've not tried it, however, I'm told the system extremely work well. Lee *does not* produce top punches for any of their bullet moulds. Usually one determines the closest matching top punch for their brand of sizer from one of the other makers. Example: I found a Lyman top punch to match a Lee 8mm mould.

Redding, www.reddingreloading.com, has the famous Saeco mould and Lubricator/Sizer line. (**See Note 1**) If I had to pick a favorite producer of ***ferrous metal*** moulds, it would have to be Redding/Saeco. To begin with, Saeco mould handles are a work of art themselves. Just handling a Saeco mould that's attached to the handles is a pleasure. Their moulds are of a special blend Pearlitic iron. It's very dense and distributes heat evenly. Even when filled cold, a Saeco Mould starts dropping good bullets after just a few castings. No matter which Saeco mould I use, there are always less rejects then with other brands of moulds. Saeco has an extensive list of moulds; with several design types available. They have many traditional designs, and some of the newest trends in mould thinking, I really like that. Saeco doesn't wed itself to just one school of thought in design.

Note 1: Lyman & RCBS sizing chambers and top punches are interchangeable. Lyman has the largest assortment of sizing chamber sizes. Lyman sizing chambers also seem to be a bit better quality then RCBS. Saeco Lubricator/Sizer sizing chambers and top punches are priority items. If you have a Saeco Lubricator/Sizer you have to use their sizing chambers and top punches. However, Saeco does make Lyman/RCBS style top punches for people who use Saeco moulds, but, lube & size on a either a Lyman or RCBS Lubricator/Sizer.

We previously listed the factors in cast bullet success. Let's begin with twist. Barrel twist rate is a vast subject, and really needs its own article. For the moment suffice it to say that Springfield, Enfield, Jap and Mauser bolt guns all have sufficient twist to stabilize cast bullets, With one ***exception,*** that being Swedish Mauser's. The twist rate of Swedish 6.5 Mauser's won't stabilize a cast bullet from most makers' moulds very well. However, cast bullets work well in a 6.5 Jap, they have a twist rate befitting cast bullets. I have heard there is one custom made mould that will work in the Swede, but I have no experience with it.

As stated before, pointy boat tails with a tough jacket perform well because they have hardness of about 100, and will travel straight in a barrel. Softer cast bullets require more thought to their shape to remain concentric on the trip down a barrel. There are few moulds that copy a jacketed profile. The problem is a long, pointy, ***unsupported*** nose of a cast bullet is too soft to stay centered. Without positive support, the nose will slump, causing the bullet to become eccentric. Once it leaves the barrel the bullet will continue to yaw causing large groups. Proper cast bullet design will allow for accurate shooting. However, to decide which cast bullet design to use requires the rifling form be known.

			
Springfield & Most Mauser Rifling: Lands	**Enfield Rifling: Grooves And Lands**	**Most Springfield 03/A3 Rifling: Lands**	**Persian Mauser & Some VZ24 Mauser**

occupy 1/8 The Area	**Of Equal Size**	**Occupy 5/8 Of The Bore**	**Rifling: Grooves And Lands Of Equal Size**

4 groove barrels, as seen in 0/3 Springfield's and some 03/A3's, Mosin's and almost all WWI & WWII era Mauser type rifles have small lands and wide grooves. (***See Note 2***) Generally, the best cast bullet form for these rifles is one with a *long,* groove sized (*or slightly wider*) body, and a *short,* bore sized (*or slightly wider*), nose. (**See Note 3**)

Lee 8 mm Bullet, type generally useful in narrow land barrels

Note 2: There are some wide-land, 4-groove Mauser barrels out there. Notably, Persian Mauser's, also, some VZ 24's were made with wide-land, 4 groove barrels.

Warning
All else being equal, if a jacketed bullet load developed in a rifle with narrow land rifling is fired in a rifle with wide land rifling, pressures will show a marked increase! The wider lands greatly increase friction, causing the bullet to exit the barrel later. The longer barrel time allows more pressure to build. Remember, each rifle is an individual, and loading must be approached from that standpoint.

There is one other type of bullet design that has been used in 4-groove barrels. Called the "Loverin design" after designer Guy Loverin. It is typified by a continual series of narrow lube grooves and narrow bands, *all being the same diameter*. It has almost no forepart. These bullets were designed in the day *before* modern alox/beeswax lubes. Personally, I have never found them to work as well as other types. They have fallen from favor somewhat in these days of high tech lubes. Some still swear by Loverin types though. The *most successful* cast bullets with a continual series of narrow lube grooves and narrow bands are tapered. That is; they get larger toward the back end. Such bullets cannot be sized. They must be hand lubed. Often called "Pope design" after Harry Melville Pope.

If one has a 2-groove 03/A3 Springfield, as produced during WWII, or a .303 Enfield, then

the proper bullet design is one with a short, groove sized (*or slightly wider*) body, and a long, bore (*land*) sized (*or slightly wider*), nose. The bore-riding nose will positively guide a cast bullet on the wide (*occupies ½ the barrel*) lands of either of these rifling forms. (***See Note 3***)

Note 3: The preceding paragraphs describe "the book" version of which cast bullet shape *should* work well in a particular rifling form. However, there is *always* an exception to the rule. I've seen enough rifles that obviously hadn't read the book! The most accurate cast bullet was one opposite of what was expected. That's exactly what happened in the subject rifle of this article. However, cast bullet success was achieved! Provided the barrel and chamber are in good shape, there is usually one cast bullet or another that will work, often better then jacketed bullets. That also happened in this case.

Cast bullets may work better in certain Mil-Surp rifles. Larger, odd sized barrels will often be installed at armories. Standard size jacketed bullets will run eccentric in such a barrel. After leaving the barrel, the bullet will continue to travel in an eccentric pattern. A fitted cast bullet will run true.

A quick & easy test to see if a cast bullet that is correctly designed for form *should* work in a barrel is to test the bullet for muzzle fit. Simply try the bullet in the barrel. If the forepart drops in with no felt resistance, then that bullet is to small. The barrel lands will not guide the bullet, and good grouping won't occur. This was the situation I found myself in with a recently acquired Australian SMLE No. 1, MK III, a desirable Lithgow made model.

Saeco .30 cal bullet, type generally useful in two groove 03/A3 and SMLE barrels

I tried a Saeco # 301 bullet in the muzzle. It dropped in right to the body. Actually, I expected this to happen. The 301 is a .30 caliber bullet, *not* a .303 bullet. However, *it is* the correct form for Enfield rifling. I then slugged the barrel using the procedure Ted and I outlined in the article; Slug, Measure & Match. The barrel measures .314/.303, this is normal for SMLE's. They reportedly run from .307/.300 to .314/.304. No wonder SMLE's are accused of not being as accurate as other Mil-Surps. .303 jacketed bullets run .3105 to .312, not a recipe for true accuracy in a .314 barrel. Of course I could simply buy another mould, but I felt there had to be a way to get larger bullets from the Saeco 301.

Nose of Saeco .30 cal bullet drops into muzzle of SMLE. This fit is too loose to be accurate!

Nose of Saeco .30 cal bullet measures 0.3005, too small for SMLE lands. No wonder it dropped right down muzzle!

Body of Saeco .30 cal bullet measures 0.3105, this is too small for SMLE grooves.

Of course, it begs the question, which is correct, exact size or slightly wider? There is some disagreement on this point. Some feel .002 or .001 over groove diameter is best. Others feel right at groove diameter is correct. Many feel a bullet's forepart should be right at or .001 over land (*bore*) diameter. Individual barrels will vary. Some barrels will have slight variations from one end to the other. That's the most likely explanation for the different schools of thought. Personally, I like the body .002 over and the nose .001 over. This seems to have given best service in a number of rifles. What everyone *does* agree upon is, the bullet should never, ever be smaller in either dimension, then a barrel. An undersized cast bullet *will* run eccentric and lead the barrel.

Moulds can be lapped out to larger sizes. This wasn't an option I entertained. First, it's permanent. The mould wouldn't be good for my .30 caliber rifles anymore. Second, if not done correctly, the mould would be irreparably ruined. For the last 4 years I've been corresponding with a fellow military retiree who also loves cast bullets. He put me on to the mould taping solution.

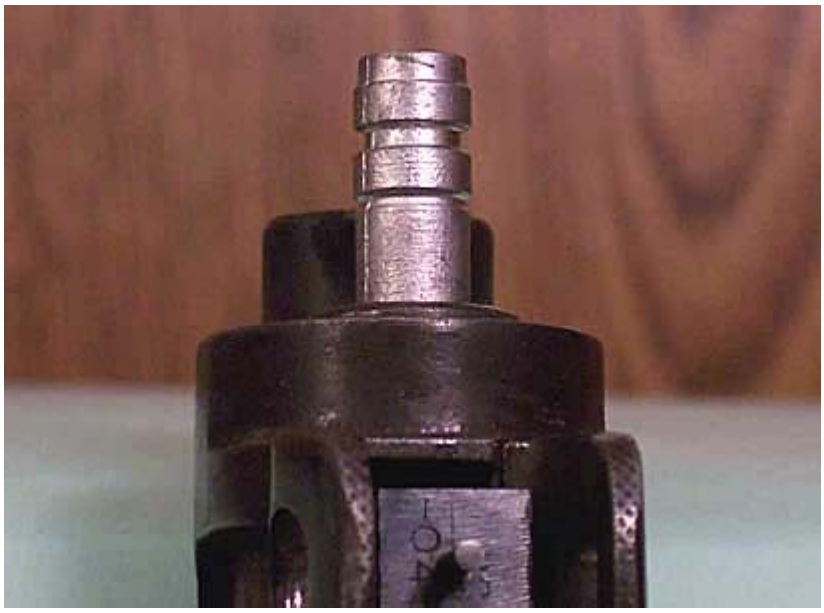
Acquire a roll of aluminum tape of the type used for ductwork from a home center or hardware store. Cut thin strips about 1/8 inch wide and affix them as shown in the picture.

Aluminum duct tape, NIE 180308GC mould, aluminum tape is on both sides of mould.

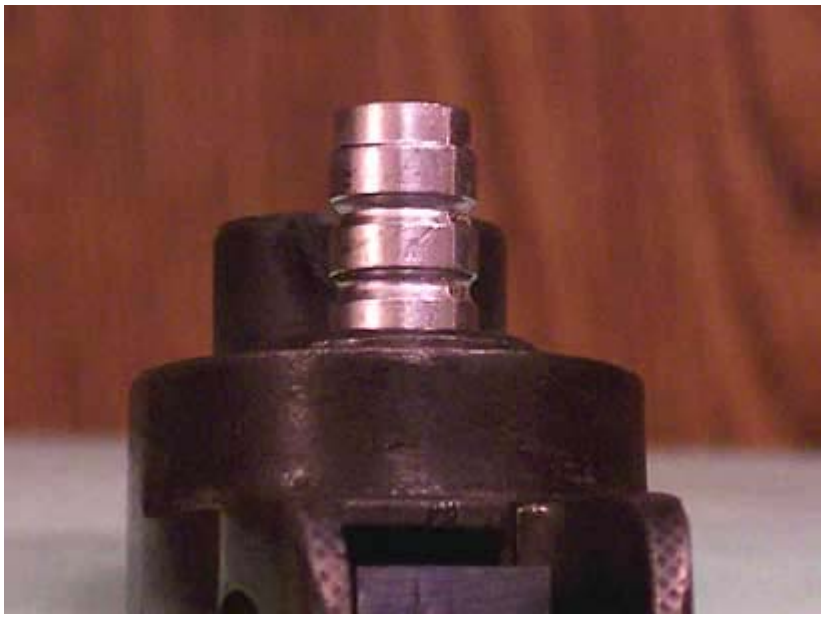
Simply put; this system works! Bullets came out of the mould larger, large enough to be used in the SMLE. The tape can easily be removed, a bit of spray brake cleaner will clean glue off the mould surface and it's ready to make .30 caliber bullets again.

After mould is taped, nose of Saeco .30 cal bullet now measures 0.304, correct for SMLE lands.

After mould is taped, body of Saeco .30 cal bullet now measures 0.3155, correct for SMLE grooves (bullet still didn't group well though).



Nose of Saeco .30 cal bullet now fits lands correctly.



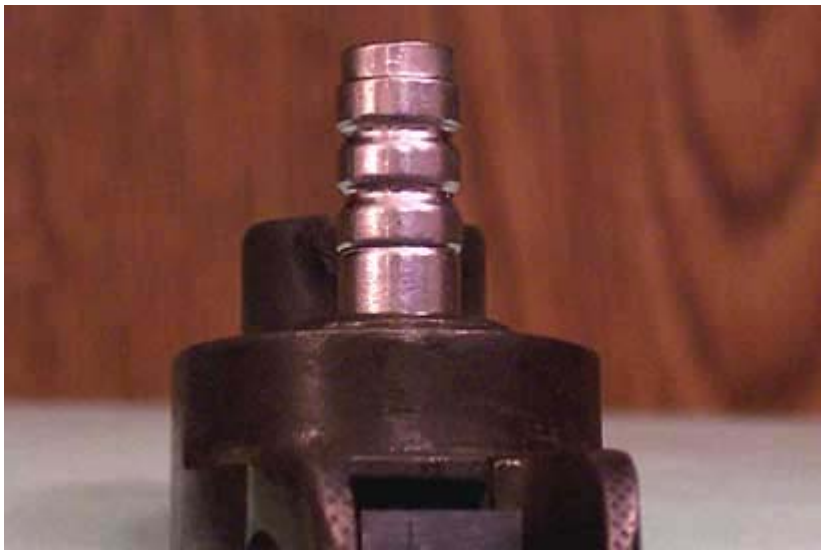
Nose of NEI .30 cal bullet drops into muzzle of SMLE. This fit is also too loose to be accurate!

Nose of NEI .30 cal bullet measures 0.301, it will not be supported by SMLE lands.

Body of NEI .30 cal bullet measures 0.311, this won't adequately fill SMLE grooves.

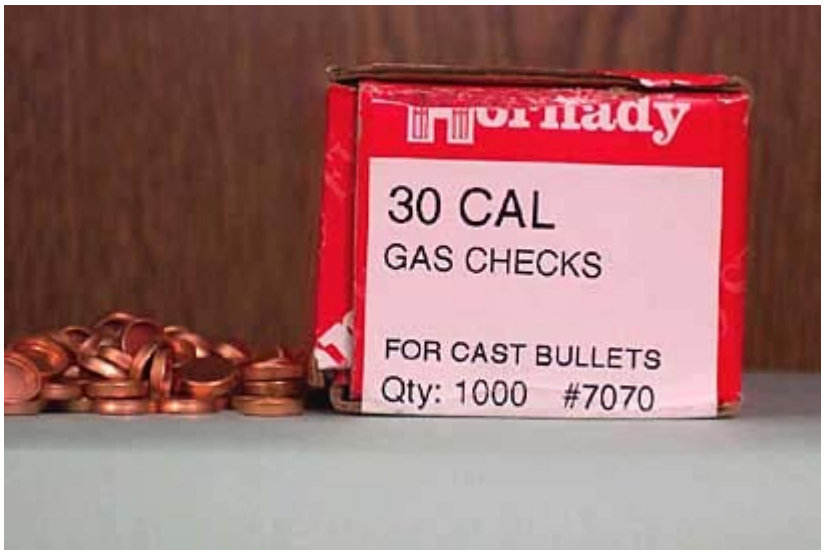
After mould is taped, nose of NEI .30 cal bullet now measures 0.3045; SMLE lands will support the nose and keep it running true.

After mould is taped, body of NEI .30 cal bullet now measures 0.315, correct for SMLE grooves.



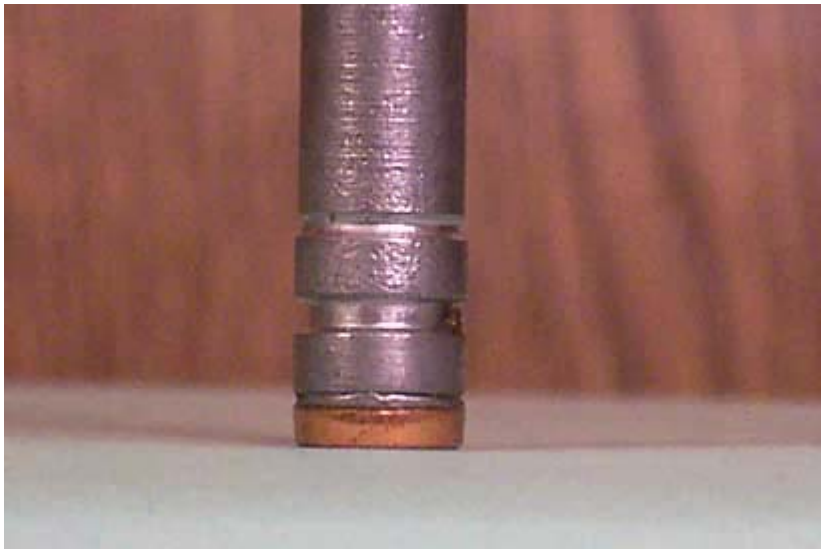
Nose of NEI .30 cal bullet now fits lands correctly. This bullet was successful!

Most cast bullets are designed to use a gas check. A gas check is a small copper or gliding metal cup that fits on the heel of the cast bullet. Hornady produces all gas checks now, though they may be sold under the Hornady, RCBS or Lyman brand name. Gas checks (*as produced today*) are all designed with a small, internal lip. The lip will bite into the heel when the bullet is sized and lock the gas check onto the bullet. In the past, Lyman gas checks were not of the lock on variety.



Hornady .30 cal gas checks.

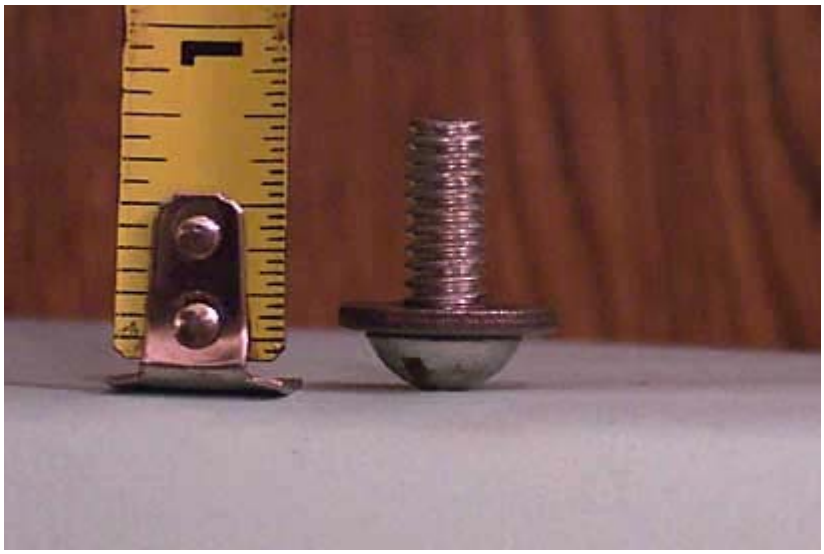
A mould with a properly designed bullet heel allows the heel to accept the gas check **without shaving any bullet alloy**. When a bullets heel shaves alloy, the check is seated eccentrically, and accuracy suffers. Since the taped mould was now producing wider bullets, the heel was also wider. The first group of bullets I put through the RCBS Luber-Sizer shaved alloy and failed to set square on the bullets heel. A bullets heel is the steering end, so, the gas check must be seated squarely.



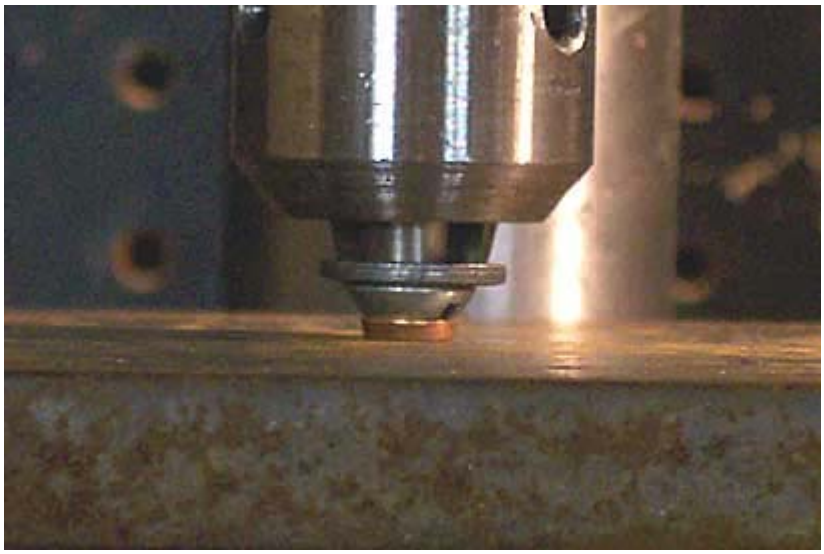
After mould is taped, gas check shank of Saeco .30 cal bullet is too large for standard sized GC's. GC was not seated square and bullet alloy was shaved. This is bad news!

Interior of standard size gas check.

Since gas checks are only one size, (within a caliber family) the fix was simple. I took a ¼-20 bolt with a round head and chucked it in my drill press. The drill press **was not** running; it simply acted as an arbor press. The round head bolt expanded the checks the .000000000000 necessary to insure clean, square seating. Lacking a drill press, one could simply use a small ball peen hammer to tap the bolt and expand the gas checks. I used Hornady crimp-on gas checks for the bulk of this article. However, I had some older production slip-on Lyman gas checks on hand and tried them, once expanded, they worked fine also.



¼-20 round head bolt and flat washer used in drill press to expand gas checks.



¼-20 round head bolt in drill press, expanding gas check.

Expanded gas check, plenty of room to correctly seat on large bullet.

Correctly seated GC, notice no alloy is shaved.

The proof is in the shooting. My trials with a proper fitting Saeco # 301 were disappointing. As I said before, not all rifles are willing to go *"by the book"!* I decided to tape the NEI # 308-180-GC. Its form is specified for narrow land barrels. I used the same brass, primers, powder, expanded gas checks, PSB filler, tools and loading procedures as with the other bullet. The large cast NEI bullet grouped right up!

Success! The wind was blustery, so I shot at 50 yards. However, the rifle cut its group dramatically, about 1/3 the size of original groups. A wind reverse got me a 9-ring flier, welcome to windy West Texas!

I'm very pleased with the mould tape system. Many SMLE's have a reputation for somewhat casual jacketed bullet accuracy due to bore & land size being greater then most bullets designated for the .303.

Here's another possible use for this system. Suppose you have Mil-Surp barrel that's now oversize due to excessive wear from firing, corrosion, or incorrect cleaning procedures. Such a barrel may not shoot jacketed bullets very well. Oversize cast bullets may well be

the answer to restore accuracy. I plan to try this on a 8mm Turk that has a very worn somewhat corroded bore. I knew the bore had seen better days when I acquired it, but it has a nice stock, all matching numbers, and a design form rather unique, even for a Turk! Other then the bore, it is in very nice shape. Right now the *best* it will do is hold the black @ 100 yards. I'm anxious to see if oversize cast bullets can shrink groups somewhat.

If you have a barrel that runs large on any Mil-Surp I can highly recommend trying a bullet from a taped mould. Since the tape isn't permanent, the mould won't be harmed, and if it doesn't work out in your rifle, the bullets can be remelted. You have nothing to loose except lackluster accuracy!

Adobe PDF Downloadable Version of Article

Article Contributed by: Mark Trope