Chapter 9 Metal Jacketed Bullets

Early bullets were all lead, a lead alloy, or lead bullet that had a paper jacket. These were all successful but failed to perform well as smokeless powder, stronger cartridge cases, and improved rifles permitted higher velocities. A few solid brass bullets were tried; the French Balle D in 1898 and the Spanish Reformado in about 1898 but both were discontinued in favor of lead cored jacketed bullets. The Spanish Reformado was used during the Spanish-American War by Cuban forces and was thought to have a poison bullet. This was because the brass bullets would turn green with verdigris from the humidity in Cuba.

Metal jacketed bullets quickly were developed to meet the demands of a new era in firearms development. The simplest bullets had a lead slug, the core, inside of the jacket. More complex designs were tried. Some were successful and are still used today and some failed to produce the desired results.

To make a metal jacketed bullet a jacket is first made. Jackets are discussed in previous chapters. It will be necessary to discuss jackets again in this chapter but not in as much detail as in the other chapters. Once the jackets are ready a core is needed to put in them.

Bullet Cores

The filler that goes in the jacket is called the core. Bullet cores are most often pure lead but other materials can also be used. A lead alloy, such as a 6% antimony lead, is used almost as often as pure lead. A tin/lead core can be useful when making bonded core bullets but finding a source for such an alloy can be a little difficult.

Lead free solder is sometimes used when a lead core is not acceptable. Other materials such as bismuth, antimony, powdered copper, nylon powder, powdered iron are used, either individually, or more commonly mixed together to make a "green" bullet.

Powdered metals like tungsten, copper, aluminum, and iron are sometimes used to make specialty bullets. The use of these materials will be covered in the chapter on special bullets.

Cores can also be multipart. Quite often military full metal jacketed bullets (FMJ) will have a base core of lead and a nose core of aluminum or other light material. The primary purpose this two piece core is to cause the bullet to rotate when it enters tissue and thus cause a more severe wound than it would otherwise. Hunting bullets are sometimes made with a pure lead front core and a harder base core. The pure lead nose core will expand more reliably than a hard lead core would while the hard base core will help to insure good penetration.

Sometimes a lead base core will be used with a flash-bang explosive in the nose of the bullet. The small explosive charge will detonate with a bright flash when it hits the target allowing the shooter to quickly judge the effectiveness of his shot. Similar bullets may contain an incendiary compound, tracer compound, or may hold a true high explosive for use against lightly armored targets.

Armor piercing bullets can be made with a lead sleeve in the bullet and a hardened penetrator held in the lead sleeve. The lead sleeve holds the penetrator securely and provides a bit of "give" to the bullet to reduce chamber pressure and barrel wear.

But these types of bullets have little sporting use and other than being interesting examples of what can be done are best left to the military.

Plastic balls or other plastic pieces can be used to modify the balance of a bullet and in some cases can be used to improve the feeding of a bullet in auto loading arms. Plastic balls can also be used to aid the expansion of sub-sonic or low velocity ammunition. The bullet can be made with a huge open tip and a ball can be inserted into the tip of the bullet to provide reliable feeding while retaining good expansion.

Polymer tips, a better sounding way of saying plastic tips, can be used to improve the BC of a bullet, help to improve expansion, and improve the looks of the bullet. Plastic tips can be formed by machining them to shape, a rather costly method, or by injection molding the tips. Most plastics have a memory that causes the plastic to try to return to its original shape once a deforming load is removed from the plastic. Because of this it is not usually possible to swage a piece of plastic into a bullet tip. Injection molding actually melts the plastic during the forming process and so avoids the problems of the plastic returning to or trying to return to its original shape.

A variation on the plastic tip and a much older idea is to make the tip out of a soft metal such as bronze, aluminum, or lead free solder. The tips can be machined using a lathe or a CNC screw machine. Soft metal, like aluminum or solder, can be swaged into a tip. It should be noted that making a good bullet with a tip of some sort isn't as simple as it might seem. The tip must be very carefully inserted into a properly prepared bullet. If the process isn't done correctly the result will be an inaccurate bullet.

Sometimes going back in time will reveal interesting ideas that can be worthwhile to try again. Two examples of this are the Newton Protected Point bullet and the Hoxie Ball bullet.

The protected point bullet used a lead core that had a small hole through the length of the core. A small steel nail was placed in the core and the assembly was swaged into the bullet jacket. When the bullet was pointed up the point of the nail was just exposed at the tip of the bullet. The point of the nail prevented the bullet from being damaged in the rifle's magazine. The Newton Insulated Bullet and the Newton Protected Point bullet are now collector's items.

The Hoxie Ball bullet had a rather blunt ogive with a deep hollow cavity in the bullet. A small steel bullet was placed in the front end of the cavity. The idea was that the ball would be driven back into the cavity to force expansion at the velocities of the time. It was an interesting bullet that would be fairly easy to make if someone wanted to try it.

Bullet Cores

Now it's time to make some cores. The easiest cores to make will be made from pure lead. Pure lead is called Class C Lead or Chemical Lead. Class C Lead is 99.9% pure. That's pretty pure but there is also a pure lead that is 99.99% pure. If you are a perfectionist by all means use the ultra pure lead but it is considerably higher in cost and has no advantage to the bullet maker.

For some bullets, especially boattail or rebated boattail target bullets, the use of 6% antimony lead is desirable but not required. The harder alloy seems to make a little nicer boattail bullet and bullets made with it seem to be just a touch more accurate. But the alloy is more expensive and whether the extra cost is worth the small gains is a tough question to answer. 6% antimony lead can be used in most core swaging dies but it can be a bit too much for dies that use the tiny 5/8" thread.

Another lead alloy that has some use in making jacketed bullets is a 6% antimony-2% tin alloy. This is harder than the 6% antimony alloy and isn't needed for most bullets but can be of use for a few special purposes. Like the 6% antimony it is considerably more costly than pure lead.

Wheelweight alloy used to balance automobile wheels is not suitable for making swaged bullets. Wheelweights are a mish-mash of various things and the alloy can change from lot to lot. Wheelweights are made to be a certain weight but consistency of the alloy is not as important as it would be for a precision bullet core. Wheelweights are too hard to swage easily and also lack ductility. Ductility is the ability of a material to deform under pressure. As the material becomes less ductile it takes greater pressure to form it into a desired shape. So the hardness and lack of ductility make it hard to swage the alloy into bullets.

Wheelweights can be swaged but with much better materials available why bother with something that is not well suited to the purpose and won't make as good of a bullet?

Exotic core materials will be discussed in the chapter on special bullets. Now it is time to make some cores.

A decision must be made as to whether to use lead wire and cut the cores from the wire or to use a mould and cast the rough cores. Of course both ways can be used if desired. Generally it is better to use wire, especially in diameters less than 5/16". It can be difficult to cast a good core in the small sizes and a roll of wire will make a lot of small caliber bullets. The wire usually has a much better surface finish than a cast core which makes it easier to make a good, uniform swaged core. Lead wire is always ready to be used if a bit of time is available to make bullets.

But it is possible to find good scrap lead like roofing or X-ray room shielding at a reasonable price. If a person has a lead pot and casting equipment, casting the cores can be a way to save a few dollars. For the commercial bullet maker using lead wire makes more sense, even though the cost of wire is higher than scrap lead. Remember that time is money and hours spent salvaging scrap lead is time that isn't spent making bullets.

A quantity of rough cores must be cut or cast. Casting is pretty much straight-forward and is done like bullet casting. The main difference is that a cast core will not be and does not need to be as precise as a cast bullet. Once the core is made the core swage die will make it uniform.

Cut cores will almost always have a chisel like ends. Lead is a soft, malleable metal much like salt water taffy. As the cutting process begins the core cutter will cut into the wire making a clearly defined sheared area on the wire, then the wire will begin to pull and stretch as the cutting proceeds, and finally the lead will fatigue and tear. So if the end of the cut lead core is carefully examined it will be seen that there is a sheared section, a section that is pulled, and a torn section. On large diameter cores these sections will be more easily seen but with small wire the sections will blend together and will be difficult to see.

The importance of this is that it isn't possible to cut a piece of lead wire with much accuracy. But no matter, that's what the core swage is for. The important thing is to cut the cores a little heavier than is needed. A little extra lead is needed to fill in voids, wrinkles, and other defects in the core when the core is swaged. Cores for large, heavy bullets might need to be as much as twenty grains heavier than needed but small cores might only need to be a few grains heavier. The best bet is to cut a few cores, swage them, and see how they turn out. If a good swaged core can be produced with a rough core that is five grains heavier than the swaged core then that's the setting to go with. If the swaged core isn't quite good enough, then make the rough core a bit heavier.

Perhaps the most important thing is to try to keep all of the rough cores about the same weight. This does not mean that the rough cores must be within a grain or two of each other but avoid large differences in weight. If one rough core weighs thirty-three grains and the next one is fifty-nine grains this difference will show up in the swaged cores, but to a lesser extent. The more variation there is between the rough cores the more variation there will be in the swaged core.

A little weight variation in the swaged cores will not hurt accuracy but if absolute zero tolerance is wanted the cores can be swaged twice. Swage the cores a little heavier than wanted and then swage them a second time bringing them to the desired weight. Double swaging will usually remove any inconsistency. Usually a tolerance of +/- 1% will be more than adequate and with heavy bullets the tolerance can be greater without harming accuracy. Also keep in mind what the bullet is to be used for.

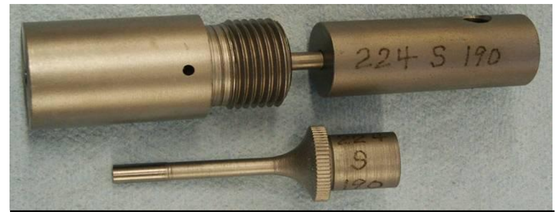
A 1,000 yard Wimbledon rifle will be able to use the tighter tolerance of a high precision bullet but an old and well used Norwegian Krag will be happy with a less precise bullet. If the rifle isn't capable of hitting the broad side of a barn if you are inside the barn, knocking yourself out making super bullets isn't necessary, unless you just want to.

Swaging the Core

Once the cores are ready to be swaged the core swage die and its internal punch are placed into the press ram. Follow the instructions that came with the press. The external punch will be placed in the punch holder in the top of the press.

The cores will need to be very lightly and uniformly lubricated with bullet swaging lube. Other lubes may not work as well so it is best to use the lube recommended by the maker of the dies. It is very important that the cores be lubricated. This will increase the life of the die and punches and will keep the bleed hole (s) in the die from becoming plugged.

The easiest way to lube the cores is to roll them over a lube pad that is saturated with swaging lube. They can also be lubed by simply putting a little lube on your fingers and rolling the cores as you put them in the die. But I think the lube pad gives the most uniform results. When the cores are lubed they are ready to be swaged.



Core swage die & punches. The punches and dies are marked with the caliber, S for core swage, and the diameter of the core made. Note the bleed hole in the side of the die.

Try to use the same amount of lube each time. If one core is dripping with lube and then next one has almost none then there will be some small variation in the weights of the swaged cores.

To swage the core raise the press ram a little and put the core in the die. Then raise the ram all of the way up to the end of the ram travel. It will be necessary to adjust the punch holder in the top of the press. The holder will either be too high and the core will not be properly swaged or it will be too low and it may be almost impossible to swage the core. If the core is too heavy move the punch holder down a little and try another core. It is a good idea to have a number of extra cores to use to set the die up. Adjust the punch holder up or down as needed to make the core and when the right weight is made snug up the locknut on the holder. Make another core to check the set-up and if all is well swage all of the cores.

Try to adjust the punch holder so that most of the work is done at or near the end of the ram travel. This is where a mechanical press will have its most power and where the least effort will be needed to swage the core. Always try to use the mechanical advantage of the press to do the work for you.

It is also a good idea to hold the pressure on the core for a second to allow the lead to flow. Lead will extrude through one or more holes in the side of the die but it takes a little bit of time for the lead to move. The main thing is to try to develop a uniform rhythm when using the press.

When the core is swaged a small lead wire will be extruded through a hole or holes in the side of the die. These little wires can be collected and cast into cores, used as cores for frangible bullets, or sold as scrap when there are enough of them.

I prefer to make the core swage die with a single hole as that lets the bleed hole be positioned so that the little wires can be collected in a container of some sort. A thin shim washer or washers can be used between the die and the press ram to position the bleed hole as wanted.

It has been claimed that dies that have more than one bleed hole make a more accurate core but I have never seen that to be true. If the bleed hole is sized correctly for the core diameter the core will be well made.

Occasionally it may be desired to use an alloy lead to make the cores from. Up to about a 6% antimony lead can be swaged in the same core swage die that pure lead is used in. As the hardness increases, and more importantly, the ductility of the alloy decreases it will be harder and harder to extrude the alloy. More and more pressure must be used. If too much pressure is used the die can be broken and if the pressure is applied too rapidly the die can break. When using a hand operated press it generally isn't possible to apply the pressure faster than the bleed hole in the die can relieve the pressure. When using a hydraulic press it is possible to apply so much pressure so fast that the lead alloy cannot extrude through the bleed hole quickly enough to relieve the pressure and the die can be broken.

The rule is to increase pressure slowly and see if it will be possible to extrude the harder alloy. If it works with a reasonable amount of force then all is well but if it seems that too much force is needed it is time to make a change.

Hard alloys can be swaged but the core swage die will need to have much larger and possibly more bleed holes to be able to extrude the hard lead. This core swage will then not be useable with pure lead or a softer alloy. The bleed holes will be so large that not enough pressure will be put on the core and it will not form pure lead properly. Two core swages will be needed. One for soft lead and one for hard lead.

The use of extremely hard lead alloy is usually not necessary with a metal jacketed bullet. It is sometimes tempting to use wheelweights simply because they might be available and are less expensive than pure lead. But wheelweights are a poor substitute for a good quality lead, or for an alloy lead that is of known and tightly controlled specs. Wheelweights are a mish-mash of various materials and the mix can vary considerably. They lack ductility as they are designed to be a non-deforming alloy, great for sticking on car wheels but pretty poor for making precision bullets.

Don't waste time trying to make good jacketed bullets out of wheelweights. Save them for cast pistol bullets.

Now that the cores are made they are normally degreased using a solvent like MEK, Acetone, or Naphtha. Solvents that leave an oil on the cores should not be used as this can cause the core to pop back out of the jacket after the core has been seated. Since the first bullet was swaged there has been a lot of non-sense written about loose cores in the bullet harming accuracy. Certainly, if the core is rattling around in the jacket accuracy would not be helped. But this is never the case if the bullet has been swaged correctly. Much effort and time has sometimes been spent insuring that the dreaded loose core is avoided but a little thinking and common sense will dispel the loose core myth.

The loose core advocates even sometimes go so far as to purposely cause the swaged cores to oxidize before swaging them in the jackets. The white powder that forms on the lead is lead oxide. Lead oxide is a deadly poison and carcinogen but it is also an excellent lubricant that, when mixed with oil, was called White Lead. Lead oxide and oil were used for all sorts of high pressure applications and were commonly used as a lubricant on a "dead" center on metal working lathes. Since the oxidized cores are covered with a very good lubricant exactly how does that help prevent the fabled loose core? It is simply one of the old silly techniques that never seem to quite die.

Most small hand operated swaging presses will develop around nine tons or more pressure. That's a lot of force to put on a soft piece of lead inside of a bullet jacket. The lead core is swelled out along with the jacket until the die prevents any further increase in diameter. Then, when pressure is removed from the core, the bullet jacket will spring back a small amount. This principle of always making the bullet slightly larger with each swaging operation was pioneered by Beihler and Astles of B&A fame. The final step in bullet making is to point the bullet up and here again the bullet jacket will spring back to tighten on the core. Throughout the bullet making process the core is tightly gripped by the jacket. On firing the bullet is subjected to intense pressure and has the rifling swaged into the bullet. Once more the jacket is tightened onto the core.

The possibility of a well made bullet having a loose core is almost none. However as mentioned earlier it is possible for trapped air or lubricant under the core to push the core out of the bullet jacket after the core is seated. This is a different problem from the loose core and is easily dealt with by removing the lube from the cores and by using a core that is a slightly loose fit to the jacket. Having the core a little loose allows air to escape from under the core before the core is pressed into the jacket.

One final note about loose cores is that several people have made bullets using cartridge cases for the jacket. The most common method of making the bullet is to fill the modified cartridge case with small lead shot. The shot is usually not seated in the jacket and is held in the jacket by a wad or bit of hot melt glue once the bullet is pointed up. Clearly the shot core is loose in the bullet. And yet most of these bullets shoot pretty well. If a loose core was as bad of a problem as claimed these bullets ought to just fly off of planet earth but groups fired with them prove otherwise.

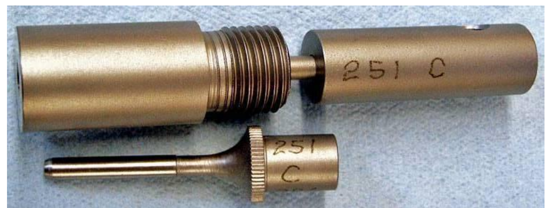
Bullets made without seating the core or lead shot will almost always have a tapered bearing yet they still shoot well. Seating the core improves the bullet but it is surprising how bad a bullet can be and still do its job.

Seating the Core

When the cores are degreased they are ready to be seated in the bullet jackets. At one time it was believed that the cores had to "rest" before they were seated. Perhaps playing some Mozart for them would have also helped. But once again this is just a practice from the olden days that isn't of any value. Perhaps this idea came from lead bullets used in muzzleloading target rifles or later on blackpowder cartridge rifles. Possibly there was some slight advantage to letting the bullets age before using them.

But we are dealing with modern rifles and modern metal jacketed bullets. Let the cores rest if you want to, it won't hurt anything, but it won't help either.

Now while your hands are clean place the cores into the bullet jackets. Then lightly lube the jackets with bullet swaging lube. Only a little is needed and the lube should be uniformly applied. Put the flat base core seating die in the press along with its internal punch. Now things get to be just a bit tricky.



Core seat die & punches. The die and internal punch are marked with the bullet *diameter* and the letter C for core seat. The seating punch is marked the same and with the diameter of the punch tip.

Various jacket types were discussed in an earlier chapter. It will be important to determine what type of jacket will be used. The core seating punch must be matched to the jacket used. If a jacket that has a straight wall is used only one core seating punch will be needed. The punch will fit correctly regardless of the length of the core used.

But if a taper wall jacket is used more than one seating punch will be needed. When different length cores are used in the taper wall jacket the seating punch will fit correctly only at one place in the jacket. Since the taper is usually very small each seating punch will be suitable for a small range of core weights (lengths). If the taper was very much, a large number of seating punches would be needed but this is seldom the case and usually two or three seating punches will be enough.

The tip of the seating punch must fit the jacket snugly at the point where the core will be after it has been pressed into the jacket. If the punch is too large in diameter the punch will pull the jacket down causing the jacket to buckle and wrinkle or the punch will cut into the side of the jacket weakening the jacket and harming the concentricity of the jacket. A punch that is too large will not put the correct pressure on the lead core which can result in undersize or tapered bullets after they are pointed up.

If the seating punch is too small the lead core will extrude up past the punch, remember backward extrusion discussed in jacket making? This can cause the jacket to be pulled apart where the punch meets the core and will also result in an undersized or tapered finished bullet. So it is very important to know what type of jacket is being used and match the seating punch to it.

There are also special seating punches that are designed to solve a special problem or to produce a certain type of bullet. Most seating punches will have a slight radius on the corner of the punch tip and will have a flat face. This works fine for almost all bullets. But sometimes a hollow cavity is needed in the core or a punch may be used that has a spire point tip in order to push the core up the side of the jacket to help keep the jacket from folding up when the bullet is finished.

To seat the core in the jacket the core seat die is placed in the press ram and the correct external punch is put in the punch holder. As with the core swage die the punch holder must be moved up or down as needed to set how much pressure is placed on the core during swaging. As always do as much of the work near the end of the press stroke so that the maximum power of the press is available to do the work.

How much pressure to apply to the core when seating the core is mostly a matter of trial and error. If too little pressure is used the core will not be seated properly and the jacket will not be expanded fully. If too much pressure is used the lead core might squeeze past the seating punch and can cause the jacket to break. It is also possible to break the core seating die and perhaps bend the seating punch.

When the correct pressure is used the jacket/core assembly, sometimes referred to as a seated core, will measure just under the bullet diameter. If thin jackets are being used the diameter of the jacket/core assembly will normally be about three ten-thousandths (.0003") less than the bullet diameter. If thick jackets are being used the jacket/core assembly may be five ten-thousandths (.0005") smaller than the bullet diameter and if really thick jackets are used the assembly could be a full one thousandth (.001") smaller than the bullet diameter. A thick jacket would have a wall thickness of between .030" to .060" and really thick jackets would be .065" or thicker. Thin jackets have a wall thickness under .030".

If a hard jacket material is used, such as the 90/10 alloy, then the diameter of the jacket/core assembly will need to be smaller than if a soft jacket material is used. In extreme cases two core seat dies may be needed to match the jacket thickness/hardness being used. One seating die would be used with the thin, soft jackets and the second die used with the very thick or hard jackets.

As the cores are being seated the jacket/core assembly can be measured using a good micrometer. Some import micrometers (mikes) are actually pretty well made but most are only useful for rough work. Dial calipers, however good, are not as good for measuring bullets as a quality mike but can be used. Don't be fooled by the specifications for digital mikes or calipers. It is common to read that the accuracy of the tool is listed to several places. If the fine print is studied it will be revealed that the super accuracy listed is only for the electronic read-out itself and not the accuracy of the caliper or micrometer. The read-out may be accurate to many decimal places but the tool is not any better than an ordinary mike or caliper.

The swaged jacket and core should be measured at the base of the jacket, in the middle, and where the core ends inside the jacket. If too little pressure is used the assembly will be the correct diameter at both ends but small in the middle. It may also be the correct diameter at the front but small in the middle and base. If this is the case the punch holder can be moved down a quarter to one-half of a turn and another assembly is swaged. This one can be measured and the process is repeated until the measurements are relatively uniform.

The measurements won't be of much help to determine if too much pressure is used although sometimes the swaged assembly may be very slightly larger than the bullet diameter. If this happens back the punch holder off a little and try again.

Another way to tell if enough pressure is being used to seat the core is to look at the bullet jacket after it has been swaged. The jacket should have a fairly uniform burnished appearance. If the jacket has a faint polished look on the front and back ends but not in the middle then more pressure is needed. If the correct pressure is used to seat the core the jacket will have a uniform appearance with the burnishing or polishing being pretty consistent over the length of the jacket where the core is.

This method usually works but some jackets may not show the burnishing as much as others.

There are two more things to look for when seating the cores. If the jacket has a very shiny, polished area just above the end of the core it may be that the seating punch is too large. The jacket is being trapped between the die and punch and is being thinned a little bit at that point. This accounts for the noticeable shiny ring on the jacket OD. A smaller seating punch should be used or a little heavier core may correct the condition. This condition is not necessarily bad but if too large of a punch is being used and too much pressure is used the jacket may break where the core meets the seating punch. This can occur with taper wall or straight wall jackets but more often happens when taper wall jackets are used.

The other thing to look for is to see if the lead core is creeping up the inside of the jacket. If the seating punch is too small or too much pressure is used the lead will extrude past the punch leaving an uneven smear of lead inside the jacket. In extreme cases the lead flashing will reach the jacket mouth and sometimes even extend beyond the jacket. But more often the lead flashing will be only a little above the lead core.

This condition can be cured by using a slightly larger seating punch or by reducing the amount of pressure used. Using a slightly lighter core in a taper wall jacket will also solve the problem.

If a jacket sticks on the seating punch it can be that the punch is too large for the core/jacket combination or it could be that the punch is too small. If there is lead leaking past the punch the lead can grip the punch and cause it to stick in the jacket. If the punch is too large it will press into the jacket wall and cause the jacket to stick on the punch.

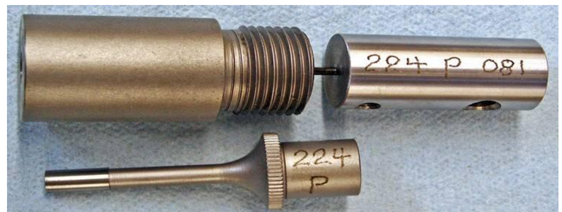
Change the core length or use a different seating punch. Sometimes just using a little more pressure to seat the core will cure the problem but more often a different punch is needed.

Once a few cores have been seated and everything is OK all of the cores can be seated and set aside, ready to be made into bullets.

Pointing the Bullet Up

Once the cores have been seated it is time to point the bullets up in a die most often called a point form die. This die is sometimes called a nosing in die. Unlike the core swage and core seat dies the point form die is a blind end die. A blind end die does not have a hole all of the way through it. Point form dies are not quite true blind end dies as there is a small hole opposite of the mouth of the die for the ejection pin.

There are different ways to make the point form die but most often the die will be one piece and will have a cavity in the die that is machined and polished into a bullet shape. A small diameter hardened spring wire is used to push the bullet back out of the die after the bullet is swaged. The spring wire pin is called the ejection pin or punch. Usually the term "ejection punch" refers to the complete part while "ejection pin" usually refers to just the pin wire but the terms are used interchangeably. Different diameter pin wire is used for different calibers and different purposes. The ejection pin wire is matched to the pin hole in the die. If a smaller or larger pin is wanted the die must be replaced as well as the ejection pin.



Point form die & punches. The die and punches are marked with the bullet *diameter*, the letter P for point form, and the ejection punch is also marked with the ejection pin diameter.

The point form die will come with an external punch that matches the base of the bullet and is used to push the bullet into the die.

The point form die is the most difficult die in the bullet swage die set to make. It has to be lapped and polished to a high finish, there can't be any tool marks or defects in the surface of the die cavity, the cavity in the die must be straight, and it must be the correct diameter. The cavity in the die might be larger or smaller than the finished bullet. There are several conditions that determine the cavity size but the only thing that matters is if the finished bullet is the correct diameter.

The point form die takes much longer to make than the other dies and whether a die will be good or bad is not known until the die is completely finished and tested. It is a time consuming, difficult die to make and make well so it is always more costly than a "straight through" die like a core seat die.

To use the point form die it is placed into the press ram according to the instructions that come with the swaging press. The jacket/core assemblies will need to be lightly lubricated but quite often the lube remaining after seating the cores will be enough. It only takes a little lube and too much lube will cause lube dents to form on the ogive of the bullet. Place the external punch in the punch holder in the press. At one time, long ago, the external punch was called a top punch but this is an obsolete term and isn't used with modern swaging tools.

The punch holder should be moved up some in the top of the press. The press ram is raised up some and a lightly lubricated jacket/core assembly is placed, mouth first, into the die. Then the press ram is raised all of the way up. If the punch holder is moved up high in the press the point form external punch will push the bullet most of the way into the die cavity but will not completely form the bullet. Lower the press ram slowly and the bullet should be ejected from the die. Sometimes if the bullet is only partly formed it may be hard to eject the bullet from the die. If it seems to be taking too much force or effort to eject the bullet stop and lower the punch holder a turn or two. Then raise the press ram up to swage the bullet again. Lower the ram and the bullet should come out. The idea is to close the tip of the bullet enough so that the ejection pin will push on the jacket tip instead of entering the jacket and pushing on the lead core.

Setting the punch holder correctly is a matter of trial and error. If the punch holder is too low the bullet jacket will be forced, extruded, into the ejection pin hole in the die. When the bullet is ejected it will have a small stem on the tip of the bullet. Back the punch holder up and swage another bullet. After a couple of tries the correct position of the punch holder will be found and the lockring on the holder can be snugged up if desired. Then go ahead and swage all of the bullets.

Sometimes the bullet will stick on the ejection pin when the bullet is ejected from the die. If this happens set the punch holder a little lower and try again. The stuck bullet will usually come off of the pin and be ejected. If the hole in the tip of the bullet is close to the same size as the ejection pin the pin can be forced into the bullet during the ejection cycle and the jacket will grab the pin. Pressing the bullet back into the die a little further will close the hole in the tip of the jacket and allow the ejection pin to press on the jacket mouth to eject the bullet.

Another cause of stuck bullets is if the core seat die is not matched to the point form die. If a die from another set is used with the point form die it might be a problem. If the core seat die produces a bullet that is a bit too large this can cause it to become stuck in the point form die. Likewise trying to reform a factory bullet in a point form die is almost sure to result in a stuck bullet. Anything that goes into the point form die must be about .0002” to .0003” smaller than the point form die. It is possible, sometimes, to “bump” a bullet in a point form die but the die and bullet must be right for the task.

.338 flat base, open tip bullet using a commercial jacket.

Should a bullet become stuck in the point form die the first thing to do is to raise the press ram up some and make sure that the ejection punch is not stuck in the bullet in the die. Be sure that the punch is all of the way down in the ram as it normally would be. Then put a bit of swaging lube in the die behind the bullet, lower the punch holder a little, and swage the bullet again. Usually this will result in the tip of the bullet being closed a bit more and the bullet can be ejected.

If the bullet refuses to budge take the die out of the press and remove the ejection punch. Put the die back in the press and swage the bullet once more without the ejection punch. The idea is to close the tip of the bullet tightly enough that the ejection pin wire will have something solid to push against. Now take the die out of the press and place the die in a vise or on a smooth hard surface like a steel plate or anvil. Make up a few pieces of ejection pin wire in two or three lengths. Make one piece fairly short, around one inch long, and the others longer in steps until there is one long enough to push the bullet out of the die. Then take a heavy hammer, place the shortest pin in the die and whack the short pin wire a good solid blow. Be sure to hit the wire straight down so as to try to avoid bending the wire.

A couple pieces of hardwood with a one inch hole drill down through them make a nice set of jaws for holding the die in a vise. Holding the die in the vise works better than holding it by hand and saves fingers.

If the bullet moves take the short wire out of the die and replace it with a longer one. Whack the longer wire, take it out, replace it with a longer one, and repeat the process. This will almost always remove the stuck bullet. The trick is to keep the wires short enough so that they will resist bending when hit with the hammer. Use a heavy hammer and use a good solid hit. If a light weight hammer is used along with a light tap the tip of the bullet will just be peened over and it will not move. But this isn't breaking rocks so a little caution is needed. Don't hit the die as the threads can be chipped.

If this doesn't get the stuck bullet out it can be drilled to remove some of the lead core and a little of the jacket material. An undersized drill is used, one that is just larger than the swaged core and the drilling must stop before the drill contacts the die. Usually watching the chips coming out of the die will show when to stop. When the drill begins to remove jacket material that's enough.

Then put the die in the press and repeat the process above. Drilling a bullet out is almost always successful but it is a risky procedure and can result in a ruined die if not done very carefully. A lathe is required to do it.

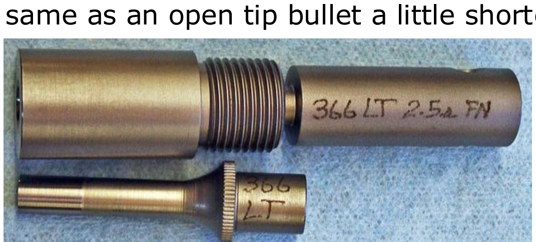
It is usually better to return the die to the maker and let the die maker remove the bullet. A die maker will have had lots and lots of practice removing stuck bullets and can do it safely.

Never, ever attempt to melt a stuck bullet out of a die. Most bullet swage dies will be hardened and then tempered to reduce brittleness. The tempering will be done at around 400 to 500 degrees Fahrenheit. Lead melts at around 800 degrees Fahrenheit. Melting a bullet out of a die ruins the temper of the die and can soften the die too much to be useable. The die may seem to still be hard and probably is but it will be too soft to resist swelling under pressure and will scratch more easily. Return the die to the maker if you can't get the bullet out.

A three die bullet swage set will make a flat base, open tip bullet. Note that an open tip is not a hollow point. The two terms are being used interchangeably but they are not the same. An open tip bullet is made by simply seating the lead core below the mouth of the jacket so that when the bullet is pointed up an air space is left between the end of the core in the jacket and the tip of the bullet. A hollow point has a cavity in the exposed lead core. A hollow point bullet might have be a soft point with the cavity in the lead tip or, like the Speer Gold Dot; it might have the lead flush to the mouth of the jacket with the cavity in the lead. Either way the cavity is in exposed lead. The open tip bullet does not have any exposed lead. It may sound a bit picky to worry about the terminology but the way the bullets are made is different and will affect how the die set is made.

Probably ninety percent of the bullets made could be flat base, open tips and do perfectly good work. A flat base is the most inherently accurate of bullets as there is simply less to go wrong with it. Rebated and standard boattail bullets are often used when there is no need for them but they do have an appeal that can't be denied.

Soft point bullets are the next step in bullet making. These are fairly easy to make but they usually require one extra step to make them. The cores are made in the usual way and seated in the jacket as usual. However the core will be seated closer to the mouth of the jacket than if an open tip bullet is to be made. Usually a little larger diameter core seating punch will be needed as the jacket ID will be a little larger where the core will be seated in the jacket. If the bullet weight is to be the same as an open tip bullet a little shorter jacket must be used.



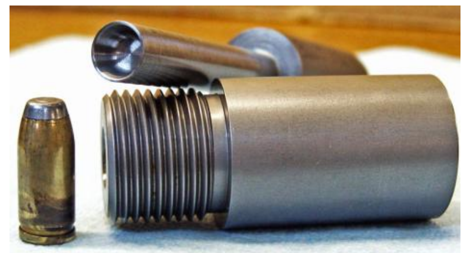
Lead tip die & punches. The die and external punch are marked with the bullet *diameter* and the letter L, sometime LT. The internal punch is marked the same and also with the ogive of the bullet.

When the bullet is pointed up the lead core in the jacket will move forward and extrude out of the tip of the bullet. This will take some adjustment to find the best jacket length for the core weight. The punch holder in the press will be adjusted up or down as needed to swage the bullet in the point form die so that the bullet is brought to a point with a bit of lead extruding from the bullet tip. The amount of lead beyond the jacket can vary to make the soft point larger or smaller but there must be some lead to be able to reform it in the lead tip die. Forming the bullet so that there is a lead stem about 1/32" long beyond the tip of the bullet will usually be about right. It is generally not desirable or a good idea to try to make too large of a soft point. The soft point does not need to be especially large to do its job which is to initiate expansion of the bullet on impact.

.323 soft point, flat base bullet. Made with a commercial .30 jacket.

Sometimes the lead tip will not be damaged by the point form ejection pin when the bullet is ejected from the point form die but it usually will be. Handgun bullets that are short for their diameter often will make nice soft points without the extra die but rifle bullets will almost always need the lead tip die to reshape the soft point.

Once all of the bullets have been pointed up in the point form die it is time to finish them in the lead tip die. Put the die in the press according to the press instructions. Put the external punch in the punch holder and lower the punch holder quite a bit. Be sure to use an external punch that matches the base of the bullet.



Lead tip die and internal punch. The cavity in the punch reshapes the soft point on the bullet.

Raise the press ram some and put a bullet into the die. Raise the press ram up slowly and try to feel when the bullet contacts the internal punch in the die. At this point the press handle should be roughly half way through its travel. With a vertical press like the Walnut Hill press the press handle will be about level with the floor in the shop. Then raise the handle up a bit and let it drop. This will bump the bullet in the die and form the soft point.

Another way to make the soft point would be to adjust the punch holder so that the very last movement of the press ram will form the soft point on the bullet. Try it both ways and go with whichever works best for you.

Eject the bullet from the die and inspect the soft point. If it isn't formed completely try bumping it a little harder or move the punch holder down a little to put more pressure on the tip as it is formed. Lead tip reforming takes very little pressure and if too much is used the ogive of the bullet can be deformed.

There may be a small amount of lead flashing that forms on the bullet jacket just below the mouth of the jacket. A rough rag can be used to wipe off the tip and remove any flashing.

With that the lead tip has been formed and the bullet is ready to be loaded.

As a general sort of thing a slightly rounded soft point will be easier to form than a sharp pointed one. It will work as well and will not be deformed in the rifle's magazine or by handling as much. If a harder core alloy is used, like a 6% antimony lead, the soft point will be stronger and resist deforming more. A lead tip can be used to increase the ballistic coefficient (BC) of a bullet much like a plastic tip would and it is easier to do as well as less costly than inserted tips.

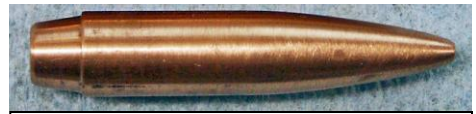
If soft point bullets are to be made and open tips are not wanted it is better to use an ejection pin diameter that is one size larger than for a target bullet. The larger ejection size will make a stronger stem on the soft point where it goes through the mouth of the jacket so that the soft point can't be knocked off if handled roughly. The larger tip opening will also expand more reliably than a smaller opening will.

A hunting bullet has different design needs than a target bullet. It is often a good idea to have two dies with differently sized ejection pins if both hunting and target bullets are wanted.

Rebated Boattail Bullets

The rebated boattail bullet is usually made by home bullet makers. There is little advantage or disadvantage between the standard boattail and the rebated boattail. Barrel life will be the same, accuracy is the same, ballistics are the same.

The reason for the rebated boattail is that the tooling that makes the bullet will last much longer and is not as easily damaged as that for the standard boattail. The punches that form the rebated boattail are enough stronger that they will be more forgiving of the occasional "oops". The rebated boattail is simply a much better design for home and small commercial bullet makers.



.338 RBT OT bullet made with a commercial jacket.

To make a rebated boattail (RBT) two dies and a special punch are needed. The first die is the BT-1 or B-1 die. This die forms an undersized standard boattail base on the bullet jacket. The second die is the BT-2 or B-2 die. This die reshapes the bullet from the BT-1 die into a slightly small bullet that has the RBT base. The punch is a point form external punch that has the RBT cavity in it.

Factory bullets and military bullets are usually made with jackets that are already formed into a boattail shape. The home bullet maker will have to use a flat base jacket and reshape it into a rebated boattail.

If the bullet jacket is relatively thin, such as J4 or Sierra jackets, a lead core is placed in the jacket and the core is seated in the jacket using the BT-1 die. This die is used much like a core seating die and is set up the same way as a core seat die. The bullet will be a standard boattail but will be undersize. The base of the boattail should be flat and there should be a small radius at the edge of the boattail. The edge or corner should not be sharp. Attempting to make a sharp corner will require too much force and can damage the tools.

If the jacket is thick, such as a .030" thick drawn jacket or a copper tubing jacket, the BT-1 die is used but hardened steel "perform" punch will be used to shape the jacket into a standard boattail. The perform punch is a long punch that has a tip that is shaped like a standard boattail. The punch will be marked with the bullet diameter, the word "pre" or sometimes "perform", and with the jacket it fits. Thick jackets will probably need to be annealed unless the jacket producer has already done that.

After the cores have been seated in the BT-1 die the BT-2 die will be put in the press. As usual the punch holder will be adjusted to seat the core properly. The core in the jacket will be seated a second time if the jacket is a thin one or if the jacket is a thick one the core will be seated for the first time. This will form the standard boattail into a RBT design.

The RBT base on the bullet should have the end of the RBT flat but with a small radius at the corner of the RBT. There can be a small radius where the boattail meets the bearing of the bullet but the radius should not be very large. There should not be a ridge where the boattail meets the bullet's bearing.

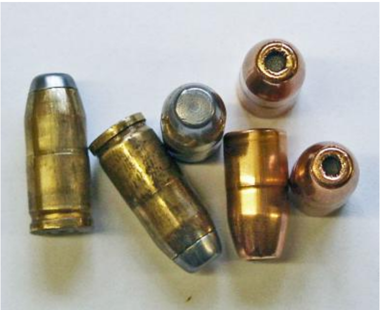
The last step in making the RBT bullet is to point the bullet up in the point form die. This is done in the same manner as any other bullet except that the special point form punch must be used. The punch will be marked with the bullet diameter, the letter P, with RBT, and with the BT angle if it is not standard.

Sometimes the BT-1 internal punch is made to be adjustable. Don't adjust it. The adjustment is done when the dies are made and tested. The punch cannot be adjusted to change the length of the BT or the size of the BT base. The adjustment is only used to match the punch to the die and should not need to be changed once it has been set.

Do not skip a step when making RBT bullets. It might be tempting to skip the BT-2 die to see what happens but usually what will happen is that the point form RBT external punch will be broken. **Do not use the point form RBT punch for anything other than pointing up bullets formed in the BT-2 die.** The punch simply supports the boattail base on the bullet to keep the base from being distorted as the bullet is finished. Using the punch for anything else will ruin it.

Dual Diameter Bullets

Sometimes it is useful to reduce the forward end on the bullet's bearing so that the bullet can slip into the rifling and rest on the rifling. Bullets that have a two diameter bearing are called dual diameter or bore riding bullets.



9.3 mm bullets made using commercial jackets and fired CF case jackets. Note the two diameter bearing of the bullets.

This can be a useful feature if the bullet needs to be seated out of the cartridge case as far as possible to permit a maximum powder charge or sometimes the ogive of the bullet is such that the bullet contacts the rifling too soon. Many African dangerous game bullets have very blunt ogives and a dual diameter design works very well in rifles with a short throat.

The dual diameter bullet also reduces chamber pressure some so that maximum loads can be used without pushing the pressure up too high.

To make a dual diameter bullet a dual diameter bullet sizer is used. This die looks like a core seat die or a lead tip die. The die will be marked with the bullet diameter, the diameter of the reduced section, and DDS. For example a die might be marked 375-367 DDS. The external punch would be marked the same. The internal punch will look similar to a lead tip internal punch and would be marked the same as the die and will have the ogive of the bullet marked on the punch.

The dual diameter die is put in the press ram along with the internal punch. The external punch is held in the punch holder. A lightly lubricated bullet is placed into the die and the press ram is raised all of the way up. Moving the punch holder up or down will control how far the bullet is pushed into the die. The further the bullet is pushed into the die the longer the reduced diameter section on the bullet will be. It usually takes very little effort to swage the dual diameter bullet so often the first try will result in the bullet being resized more than desired.

If so just move the punch holder up and try again.

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