Corbin Handbook
of
Bullet Swaging
No. 9

Revised September 2012

by

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Published by:

Corbin Manufacturing & Supply, Inc.
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1. Introduction to Bullet Swaging

Good morning! I'm Dave Corbin, and for over 40 years I've had the second best job in the world: I help people make the state-of-the art bullets that you've read about in the gun magazines. Nearly every custom bullet maker started with equipment developed at the Corbin die-works. They have the best job in the world!

All you have to do is scan the pages of nearly any magazine catering to handloaders, and you'll see dozens of ads from our clients; the articles are constantly talking about the bullets our clients make, and the major ammunition firms are buying the bullets made on Corbin equipment for use in their premium ammo. There has been a lot more research and development that you don't read about, because it isn't intended for the general shooting public. I can now include a small amount of that information in this edition.

Corbin Manufacturing publishes an e-book called the "World Directory of Custom Bullet Makers" listing hundreds of individuals and firms whose names you may recognize if you are familiar with handloading. When I read the list, I remember someone's enthusiasm for the new business venture they were able to start, thanks to the power of bullet swaging.

Olympians and world champions in every field of firearms sports, from benchrest to air gun competition, using everything from paper-patched blackpowder bullets to custom fin-stabilized shotgun slugs, have come to the die-works where we have toiled for the last quarter century and into the first quarter of this one, some just to improve their already-outstanding achievements, and some to help others become better shooters by manufacturing new ideas in how a given bullet should look and be constructed.

Engineers from the Department of the Army, Air Force Armament Labs, Sandia National Laboratories, DuPont, Northrop, Lockheed, Martin-Marietta and other defense-related organizations have visited us over those years, sometimes sketching ideas on napkins during lunch. Tools and designs we worked on are in use today all over the world, wherever a long range, high precision projectile or a very special purpose bullet that could only be made efficiently by the high precision techniques of swaging, is needed for the job.

Whether it is protecting an important public figure at long range or picking a pine cone from the top of an experimental tree, whether it is surveying a dense mountain jungle with remotely launched flare projectiles designed for vertical firing stability, or stitching mirror-based bullets in an arctic ice sheet from a low-flying aircraft so a laser beam can measure the depth and estimate the strength of the ice to hold a transport plane, or whether it is the grim responsibility of instantly stopping a terrorist before he can take the life of another hostage—regardless of the purpose, we sat through many meetings pouring over blueprints, computer readouts, and sketches, helping design projectiles for visitors from the far corners of the earth.

Yet, this work is only the continuation of development begun by other pioneers of bullet swaging: people like Ted Smith, who founded the old SAS Dies in the 1950's; Harvey Donaldson, who experimented with some of the first dies to make .224 bullets from fired .22 cases; Walt Astles and Ray Biehler, who developed the principle of upward expansion and the two-die swage technique which replaced the RCBS single-die take-apart system; Charlie Heckman, a pioneer swage maker; and so many others whose names are probably unknown to modern shooters, but to whom all shooters owe a debt for their contributions to the perfection of bullets.

You may know that the RCBS company (initials of which mean Rock Chuck Bullet Swage) got started making bullet swaging equipment, but soon dropped it in favor of more easily produced reloading dies. You may even have heard Speer Bullets was started by Vernon Speer swaging .224 caliber bullets from fired .22 LR cases.

But bullet swaging played a much larger part than just that, in leading to the products and companies you use today: Hornady, Sierra, Nosler, Barnes, Swift and a host of other mass production operations owe their very existence to the concept of bullet swaging. Today, more than four hundred custom bullet firms—operated by people who probably differ from yourself only in having taken the step of putting their intense interest in firearms to work at a profitable and enjoyable occupation—produce specialty bullets. We call this field "custom bullet making", the elite corps of bullet manufacturing providing initial concept advances sometimes copied years later by the larger "mass production" bullet makers.

So, what is bullet swaging and how do you do it? What do you need to get started? How much does it cost? What are the advantages and drawbacks compared to casting or just buying factory bullets? Can you swage hard lead, make partitioned bullets, make your own jackets, make plain lead bullets or paper patched slugs?

I answer those questions a thousand times a week and I never get tired of it. But to save you a lot of time on the phone, I've written most of those answers here. If you read through this book and think I have left something out, you are absolutely right: I left out about seven more books of information! Those are available if you care to read further.

Swaging is so simple you can do it correctly after just a couple of tries. Then you'll see it's also extremely versatile and powerful: you can do one more thing, and then one more after that, and soon you will have the whole top of your loading bench covered with one-of-a-kind bullets, some of which no one in the world has ever made before. That's why it takes at least seven more books to make a dent in the vast array of things you might do, could do, if you wished. Only your imagination limits the possibilities.

A deeper study of the specifics of bullet swaging technique and tooling, including products made by people other than Corbin, can be found in the book "Re-Discover Swaging", so named because swaging was, in fact, discovered once before and then almost lost: during the period of 1948-1963 there were many die-makers who produced swaging equipment, but none of them offered a comprehensive enough range of products to insure their own survival, or that of the swaging arts.

Corbin Manufacturing was the first comprehensive effort to preserve and further the technology with information, supplies and tools from one source. Whereas other die-makers tended to be secretive and often died with their secrets of bullet making, Corbin began publishing information that would help advance the field, from our beginning days.

Bullet swaging, by the way, is pronounced "SWAY-JING" and rhymes with "paging". There is a blacksmith technique for pounding hot metal around a form that is called "swedging" but it is a different sort of thing altogether.

If you want to really dig into the subject and learn things most people never discover, then order the Book Package. You get another copy of this book free, with it. Give this copy to a friend. Who knows: maybe between the two of you, a new bullet making business may develop that rivals the fame of some of our other clients? It could happen: it has happened over 400 times so far!

Warning! While the majority of handloaders say that they enjoy reading the additional side trips that clutter my books, some have complained that I don't get "to the point" and just tell them 1-2-3 how to make a bullet. I agree that this would be a good idea, if only I had some way to know exactly which bullet they wanted to make.

You see, every bullet can be described with a step-by-step, cookbook approach, but there are tens of thousands of different styles and shapes you can make, and not all of them are made the same way! The same bullet may be made in slightly different ways with different presses and the dies which fit them.

Instead, I try to teach the principles involved. That way, you know the terminology and won't be confused by thinking a die is a punch or a punch holder is a die. You will understand that every swaging operation expands the components upward in size, so that you won't try to put a larger part into a smaller hole except when drawing down (which you will know is different from and opposite to swaging).

You will know that in a swaging press, the die screws into the ram and the external punch fits into the press top, in a floating punch holder, whereas in an ordinary reloading press used for swaging, the die fits the top and the external punch fits the ram. You will understand that a smooth, stepless ogive requires a set of dies that includes a point forming die, whereas a shouldered semi-wadcutter style bullet can be made in a single die.

All these things will be familiar to you before you start. You won't need to be told specifically how to make every possible bullet, because you will understand the basic principles and how to apply them to any bullet.

When we ship orders for dies, they come with specific, simplified 1-2-3 instructions that apply to the design you ordered. Sometimes these instructions are applicable to many calibers in a popular style, so we print the instructions on a form. Sometimes your bullet design needs specific, handwritten details and tips we discovered while developing the dies, and then we write special instructions for you. But in all cases, if you are prepared with a good background of general swaging principles, you can avoid damaging the tools and begin making bullets with higher confidence.

Swaging versus Casting

Everyone seems to be familiar with bullet casting (melting metal and pouring the molten liquid into a split mould, letting it cool and shrink, and then opening the split mould halves so that the frozen bullet metal can drop out).

Casting involves a lot of time and introduces quite a few potential sources of inaccuracy, but it works reasonably well within a limited range of capabilities. You have to have a lead pot and a supply of lead, a mould and mould handles, then a lubricator and sizer machine to prepare the bullets. The sizer machine needs sizer dies and base and nose punches to fit the shape and caliber of bullet. It also require lubricant to apply to the bullet.

The first thing you have to do with casting is to melt a pot of lead, flux it and stir it, make sure that the dross and dirt is cleaned from the lead, ventilate the room and make sure no moisture gets into the pot and blows the hot lead out with a bang. You need to be reasonably careful about fire and burns, and about potentially toxic fumes (no eating or smoking, plenty of good ventilation). After about half an hour of this melting and preparation, you are ready to start casting bullets.

The first few attempts usually make incomplete or frosty bullets, until the mould is warmed up. During the casting process, the mould contains liquid metal that is cooled to solidify on every single bullet made, so it is constantly changing diameter from thermal expansion.

When you open the split halves, part of the mould is exposed to room temperature air while the rest is protected from it, which cannot fail to slightly warp the roundness of the mould. The two halves of the mould cannot be put together with zero tolerance, as they would be far too hard to swing open and closed again, so there is some degree of "slop" in the fit of the pivot and the alignment pins. Add up all these factors and you can see that a cast bullet has a limit of roundness and diameter control based on physics, rather than skill or quality of manufacture.

In contrast, a swaging die runs at room temperature and does not contact hot metal. It flows the metal under tons of pressure, squeezing out all air pockets and voids. The bullet takes its shape and finish from the diamond-lapped hardened surface of the die. The die is not split, but is a solid tube or cylinder with thick walls to hold the pressure. The bullet material goes in one end, and is pushed back out the same way. Two precisely fitted punches seal both ends of the die. One moves in and out to load material, and the other acts as an ejector.

The problems associated with heat expansion, swinging split section alignment, and the time required to prepare are absent or minimized with swaging. In addition, the die can make a wide range of weights depending on how much material you put into it. A mould makes approximately one weight because you must fill it to make a bullet. These are just a few of the differences between casting and swaging.

There is one thing you can do more quickly and easily with casting than with swaging: you can form a lead bullet with grooves for lubrication. With swage dies, the bullet goes in and then comes back out the same hole in the die. If you think about that for a minute, you will understand that it would not be possible to swage a groove into the side of the bullet and then push it back out of the die. The die would have to be "split" like a mold. While this is possible, it is not cost effective. Fortunately, you can roll grooves into a swaged lead bullet with a grooving tool made by Corbin, or use better bullet designs or surface lubricants that eliminate the need for grooves. And you can swage jacketed bullets, so that separate lubricant is not required.

2. What is Bullet Swaging?

Before we talk about swaging a bullet, we need to make sure the concept of a bullet is clear. When we say "bullet", we mean the projectile or part of the cartridge that is propelled through the air. The news media and popular movies and magazines often refer to a "bullet" as the entire cartridge with powder, primer, bullet and case. Bullet swaging has nothing to do with the rest of the cartridge, but concentrates on the part that flies to the target. In some countries, shooters refer to the bullet as the "head" or the "bullet head" and call the entire cartridge a "bullet".

There is a good reason not to call the cartridge a bullet, as popular media seems inclined to do. The bullet is inert metal without any propellant involved, which means that it should be treated as a precise metal product, not some dangerous component subject to transportation restrictions and tariffs. A bullet is as safe as a writing pen, probably safer: people have been stabbed with uncapped ball-point pens. I accidently stabbed myself once, stupidly, reaching quickly into a coat pocket.

Finding a "bullet" in the possession of an airline traveller should be no more cause for alarm than finding a coin. Unfortunately, through ignorance and imprecise language, the term "bullet" causes problems where it should not. Some of them are of practical concern to those who show their products and must carry samples. More than one new bullet maker has run up against unrealistic insurance, business licensing and zoning problems because of ignorance about what a "bullet" actually means.

A bullet maker is a precision metal product manufacturer, who could just as well be making precision bearings or electronic fittings. But try to explain that to a bureaucrat who just found out you intend to make bullets in the home enterprise, or the hysterical airline security guard who scanned a couple of samples in your pocket, or the customs agent whose eyes widen as he reads your declaration of "bullet-making" equipment being taken into the country! Such a pity these things happen. The wise bullet-maker soon learns to discuss precision formed parts rather than bullets, around those who know nothing about the field.

Corbin equipment can swage bullets from .123 diameter up to about 1-inch diameter (.998-inch is the 4-bore blackpowder elephant cartridge, for example). The "bullet" can be an airgun pellet, a swaged round ball, a shotgun slug, a fragmenting shot or powdered metal filled jacketed pistol bullet, a partitioned or multi-jacketed projectile, and it can be made of pure lead, various lead alloys, powdered metals pressed together with or without a jacket, conventional jacketed bullets with a lead core with or without other inserts such as penetrators or light plastic fillers to shift the center of gravity and create fast, light but long projectiles. In short, just about anything that can be launched from a small arm, be it airgun, shotgun, rifle or pistol, and some kinds of machine guns and cannons, can be swaged and is considered a bullet.

Bullet swaging *(SWAY-jing, sounds like "paging")* is the process of applying extremely high pressures (from 15,000 PSI for soft, unjacketed bullets to as high as 150,000 PSI for solid copper bullets) to materials contained in a very tough, extremely well finished die, so that the material will flow at room temperature and take on the shape of the die and the ends of the punches.

A die is a vessel to hold the pressure. A punch is a rod that fits into the hole in the die and seals off the end. If you refer to a punch as a die and vice versa, you may cause some interesting errors when placing orders. One of the first things to learn is the right names for the basic parts involved in the swaging process. You wouldn't call a pistol a shotgun, would you? Probably not, or else you might get some odd-looking mail-order holsters!

A business that is good at making swage dies probably will be buried in orders, with long waiting lists. Waiting up to a year to get your "die" and finding out everyone thought you wanted the "punch" that you asked for may be frustrating. Use the right terms and avoid this problem.

In swaging bullets, you will always be putting a smaller diameter object (lead, jacket, or a combination of both) into a slightly larger die cavity or hole. Each step in swaging increases the diameter of the components, until they reach the final diameter in the last die. Swaging never reduces the diameter. You will only have stuck bullets and hard ejection if you try to push a slightly larger part into a slightly smaller hole. This is the difference between swaging and drawing. You never swage anything "down". You never draw anything "up".

In drawing, you do push a larger part through a smaller hole, to reduce the diameter. This kind of die is a ring, not a cylinder closed on one end. The jacket or bullet that you are reducing is pushed through the ring, and is decreased in diameter when it comes through the other side.

We use drawing to make longer, smaller caliber jackets from shorter, larger diameter ones. Also, within some narrow limits, it is possible to make a smaller caliber bullet from a larger one, although this degrades the quality of the bullet unless special conditions are observed. Usually the difference in diameters has to be within 0.006 thousandths of an inch when you reduce finished bullets by drawing. Jackets can be drawn *much* more than this, usually up to 30% smaller in one draw.

A jacket is the "skin" of a bullet, usually made of copper or a copper alloy with zinc (most commonly 5% to 10% zinc). Jackets can be used, or not, depending on the bullet design. A jacket isolates the lead core from contact with the barrel, and allows the bullet to be shot much faster without friction melting the core and smearing it in the barrel, which is called "lead fouling". Enough of that spoils the accuracy and is hard to remove. We'll discuss jackets in detail later.

Bullet jackets properly designed for home swaging are always made smaller than the finished caliber, then expanded by putting lead inside them and compressing it with a punch. The lead flows to fill the jacket, then pushes the jacket out a few thousandths of an inch to meet the die wall, which stops the expansion. One end of the die is sealed with a punch, which stops the end from popping off the jacket. If you try to use a jacket larger than the die hole, it can't spring back slightly when you release the pressure. In fact, if you push a jacket into a die that is too small for it, the jacket will be trying to spring back to original size, and thus pressing itself firmly against the die walls. This causes difficult ejection and is hard on the equipment.

The right way to swage bullets is to use jackets that fit easily into the die by hand, and lead cores which are small enough to easily drop into the jacket. Jackets of course have some wall thickness, generally from 0.015 to 0.035 inches (although there is no rule that says you can't make much thicker jacket walls if you want them). To determine the diameter of lead core which fits inside, you must subtract two times the wall thickness from the caliber, and then subtract an additional five to ten thousandths of an inch to allow for easy insertion, tolerances in the lead wire diameter, and the fact that you may have two or three steps with a small amount of expansion in each, to get to final caliber.

Basic swage dies

There are two basic designs of swaging dies made by Corbin. All the specific styles of dies are patterned after one or the other of these basic designs. One design is a cylinder with a straight hole through it. The other is a cylinder with a semi-blind hole, having the shape of the bullet except that at the tip, there is a tiny hole (.052 to .120 inches is a typical range) fitted with a strong piece of tempered spring wire.

The first design can be used for any sort of operation where two punches can form the desired shape on the end of the enclosed materials. An example would be a "Core Swage" or "CSW-" die, which takes in a piece of cut lead wire or cast lead pellet (the "core" of a bullet) and gives it a precise diameter with smooth flat ends and extrudes off whatever surplus lead there might be for the weight you desire. Three little bleed holes in the sides of the die, at 120 degree intervals, allow surplus lead to spurt out as tiny wires which are sheared off during ejection. Core swages are used to make the lead filling (*core*) a precise weight after it has been cast from scrap lead, or cut from a piece of lead wire.

This kind of die can also be equipped with a punch having the shape you want for the bullet base, and another punch, at the opposite end, having the shape you want for the nose. Both shapes will be in reverse: the bullet nose is formed in a cavity in the punch, and a hollow base bullet would use a convex or projecting punch. This is what we call a "Lead Semi-Wadcutter" or "LSWC-" type of die. That doesn't mean you have to make a particular shape that you know as a semi-wadcutter bullet; it's just a short-hand way of saying you *could* do that, or make any other shape that has the entire nose right out to the full bullet diameter formed by pushing the lead into a cavity in the end of the nose forming punch.

With most swaging dies, one punch always stays partly inside the die. It slides back until a ledge within the swaging press ram stops it. To eject the bullet out of the die, this punch is pushed forward toward the die mouth. It can be pushed by a pin or knockout bar incorporated in the design of the press (with a Corbin swage press), or it can be pushed by a plunger (with a standard reloading press). We call this punch the "Internal Punch" because it always stays in the die. It is "internal" or inside, and never comes out during normal operation. It merely slides up and down, a distance slightly less than the die length, and stops within the die so as to close one end for swaging. It has to move from this position to the die mouth, in order to push out the finished bullet.

The other end of the die accepts the material to be swaged. Obviously, that end has to be fitted with a punch that comes out all the way, or there would be no way to put the material inside. The punch which comes out, so you can insert material into the die, is the "External Punch". It is external to the die during the time you are placing the components in the die, and when you move the ram back to eject the bullet. The "Ram" is the moving tubular steel part of the swaging press that holds the die and the internal punch (in any Corbin press).

With Corbin swaging presses, the external punch fits into an adjustable "Floating Punch Holder" in the press head or top plate. This assembly is often mistaken for the swage die, because in reloading, a similar-appearing reloading die fits the head of your reloading press. Swaging is "upside-down" from reloading, for reasons that will be clear by the time you finish this book.

Again, the steel rods that push the material into the die, and seal the die against all that pressure during swaging, are called “punches”. The round cylinder with the hole in it is called the “die”. If you fit punches to a particular die, you have just made a “die set”, because it is a set of matching parts that work together. You can have several dies and punches in a given set, because all the various dies in that set are designed to work in succession, one after another, to yield a final bullet shape, weight, and construction.

The only difference between a “Core Swage” die, which we call a “CSW” die in the language of swaging, and a “LSWC” die, is the use of punches which have the final bullet base and nose shape machined on their ends, and of course the diameter of the die is made to form the final bullet diameter in the LSWC die. Usually the LSWC type of die makes either lead bullets, gas checked, or “Base-Guard” bullets (a superior kind of gas check that scrapes fouling out of your barrel with every shot fired). It isn’t used for bullets that have the jacket covering up the bleed holes in the die wall, which includes most jacketed rifle bullet designs.

The core swage die generally has flat punch ends and a diameter far less than the final caliber. It is used to prepare the lead core to fit inside a bullet jacket, in most cases (although you don’t have to use a jacket—you can just swage the lead core to final shape in the next die if you desire to make a high quality lead bullet, such as a paper-patched or Gase-Guard style). Lead bullets can be made either in one die (the LSWC) or in two dies (the CSW and CS types, or the CSW and PF types). Jacketed bullets generally require at least two and sometimes three or more dies.

When we make the die, we need to know what it will be used for. If you say you want a .308 core swage die, you probably do not want the hole to be .308 inches because a core swage has to make a core that fits inside a jacket, and the jacket will usually be about .3065 inches on the outside before swaging. The wall thickness of the jacket might be .028 inches at the base, so the core would have to be no larger than .3065 minus twice .028 (twice the wall thickness), or .2515 inches. So, we need to have a sample jacket or at least know what jacket you intend to use, or at the very least to know the diameter you really want for the lead core. If you supply a jacket, or specify one of ours, then we can determine the best core diameter to fit into it.

You can cast scrap lead in a core mould, or cut pieces from a spool of .247 inch diameter lead wire to easily drop into this .2515 bore die, swage them up to .2515 inch diameter, and then they’d fit nicely into the bullet jacket. Actually we use .250 inches for the core size to allow for an easier fit and avoid any trapped air in the jacket bottom.

There are two more steps to expand the core inside the jacket, blowing the jacket out like the skin of a balloon, and then form the ogive on the bullet to finish it. That is for flat base open tip bullets.

But if you wanted to make a lead .308 diameter bullet for a .30 Mauser pistol, then we'd make almost the same kind of die but we'd make it with a bore of .308 inches, and fit it with the right kind of nose and base punches. So you see that even if the dies look similar and work in a similar way, their purpose really makes them different dies. That's why we need two different names for them. It helps avoid a lot of unnecessary explanation and errors.

Perhaps you might order a .308 LSWC die, maybe with an "Auto-loader" nose and a "Cup Base". We would use the short-hand "AL" for Auto-loader, a sort of rounded semi-wadcutter shape, and "CB" for Cup Base, which is a shallow concave base form. To us, the term "semi-wadcutter" is a general description for a bullet style that can be made using a punch to form the nose, instead of a point forming die. The Target Wadcutter, Button-Nose Wadcutter, Keith, Auto-Loader, and even round nose SWC styles are all subsets of the semi-wadcutter group, since every one of these styles is made in the same die just by changing the nose punch.

Two other kinds of dies that are made with a straight hole and two full-diameter punches are the "Lead Tip" die and the "Core Seat" die. These don't have any bleed holes around their middle. The core seat die is also called a "Core Seater" and abbreviated "CS". The lead tip die is also called a "Lead Tip Former" and is abbreviated "LT". It is *not* the same thing as a point former or "PF" die.

The purpose of a core seat die is to expand the jacket, which is made slightly less than final diameter, and at the same time achieve a very tight fit between the core and jacket. You can use either a punch that fits into the jacket, to make open tip style bullets, or you can use a punch that fits the die bore, and thus make large lead tips. The use of a CS die to make lead bullets (after first swaging the lead core to exact weight in the CSW die) is a perfectionist's way to build lead wadcutter or semi-wadcutter bullets: it can be more precise because you separate the pressure needed to extrude surplus lead from the pressure required to form the edges of the bullet nose and base.

In a LSWC die, the pressure stops building when the lead begins to extrude through the bleed holes. Thus, some shapes of bullets with deep nose cavities or hollow bases and sharp edges may not receive enough pressure to fully take on the exact punch shape, if that pressure is higher than the pressure which causes lead to spurt out the bleed holes. By first using a CSW die to adjust the weight, and then using a separate CS die to form the nose and base, the pressure issue is resolved for all shapes and styles.

A punch with a cavity in the end makes the bullet with a semi-wadcutter shoulder (the edge of the punch must be in the neighborhood of .02 inches thick in order to stand the high swaging pressures). A core seating punch with a projection on the end, usually conical, makes a hollow point cavity in the lead core. Of course, you can use flat, domed, slightly convex, or highly pointed punch shapes to suit your desires, and make virtually any kind of base you want just by changing the punch. Often this will be the internal punch, but you can have the die built with the base punch being external if you wish. The reason we normally make the nose punch external to the die is because usually people change the nose shape much more often than the base, and it is easier to change the external punch in seconds without removing the die from the press ram. Technically it would not matter which punch made the nose and which made the base.

The purpose of the lead tip forming die is to finish the very end of a pointed (spitzer) bullet, and it isn't normally used for semi-wadcutter or large lead tip bullets. It looks just like a core seater, but the bore diameter is slightly larger than the final bullet size, whereas the core seater diameter is just slightly smaller than final bullet size. The internal punch of a lead tip die is designed with a cavity to reshape the extruded lead tip of a sharp-pointed rifle bullet so that it looks perfect. It cannot form the entire ogive because the edge of the punch, which must withstand tons of swaging pressure, cannot be paper-thin and survive.

We started this section talking about two general die designs, one with a straight hole through it, and one with a semi-blind hole. This second kind of die came about because, try as you will, there isn't a reliable way to make a straight-hole die form a smooth curve from shank to tip. (The bullet nose curve is called the "ogive", pronounced *OH-jive*, and comes from the French *ogee* which is the bullet shaped curve over a doorway). That punch with the cavity machined in the end must have some thickness at the edge, and this edge will impress itself on the bullet to make a shoulder.

There's even more to it than that: if you try to push a jacket into the cavity in the punch, the edge of the jacket will strike the edge of the punch. It won't reliably jump over that edge, but instead either the jacket or the punch will be crumpled up. In Corbin dies, the jacket is far weaker than the punch, so it folds up. So, that leaves the problem of how to make a typical rifle-style bullet, or a smooth rounded or angled bullet nose of any type, not having a lead tip from where the jacket stops to the end of the bullet.

The semi-blind hole die is used whenever the nose or base of the bullet has to turn inward, away from full bore diameter, without a shoulder or step. Conventional rifle bullets, boattail bullets, and modern jacketed handgun bullets with the jacket curving or angling smoothly inward from the shank to the ogive all require the use of this die design.

By “semi-blind hole”, I mean that the hole in the die is not straight through the die, but is shaped like the bullet itself. At the tip is a very small punch to push the bullet out by its nose, and this punch is retracted a short way up into its little access hole so there is no possibility of the bullet material pressing against it (which might otherwise bend the small diameter punch under those tons of pressure).

The “Point Forming” die, which we abbreviate “PF”, accepts either a lead core, or the seated lead core and jacket combination swaged in the core seat die. A full-diameter external punch shoves the material into the point forming die. The material is compressed inward in the small end of the die, giving the bullet its smooth curve or angled nose (the ogive). The pressure also expands the shank slightly to final diameter.

The bullet material follows the die wall, right up to the ejection pin hole and into it, if you push too far. This would put a little parallel “pipe” on the tip of the bullet, which means you need to back off the depth adjustment (the punch holder) just a little. The smallest tip which you can put on the bullet using the PF die is the diameter of the ejection pin. The smallest ejection pin that can be used is one that will withstand the ejection pressure without bending. If you happen to forget to apply swaging lubricant, or if the jacket is larger than the die cavity diameter, the pressure required to eject the bullet can go considerably higher than the design parameters. This means that the ejection pin needs a little extra diameter as a safety margin.

A typical ejection pin (the internal punch for a point forming die is usually called an ejection pin) for .224 or .243 caliber might be in the .062 to .081 inch diameter range, depending on the expected ejection pressures and the abuse expected for the die. Dies made for professional bullet makers, who know how to stop short of bending the punch if anything goes wrong and who won’t be upset if they do need to replace the ejection pin now and then, might tend to be closer to .062 inch; dies made for experimenters who will be exceeding the design limits frequently tend to have larger ejection pins, as do dies made especially for lead tip bullets.

If you make a round nose bullet, a truncated conical pistol bullet, or even a flat tip rifle bullet in the PF die, it works very nicely for either open tip or lead tip, depending on how much lead you put into the jacket. If you make a bullet with the jacket curved around to the diameter of the ejection pin, then the pin will press down against the end of the jacket and push the bullet out of a well-finished, diamond-lapped swage die with relatively low force. But if you want a small, sharp or rounded lead tip, the ejection pin spoils your plan by making its own flat circle on the very tip of the bullet.

To form a small lead tip on the bullet, you would need to leave a little extra lead projecting from the end, which the ejection pin will deform somewhat during ejection, and then use a "lead tip forming" die, or "LT" die, to shape up any extra lead. The lead tip die accepts the nearly-completed bullet from a point form die, so it has a bore diameter slightly larger than the finished bullet size. This works only because the pressure needed to shape the lead tip is so low that the bullet shank will not expand. In fact, since the lead tip die is just minutely larger than the point forming die, perhaps only .0005 inches, it can assure that the bullets will be more parallel and have almost no "pressure ring" at the base.

The internal punch of the lead tip die has a cavity that is shaped not exactly to the same outline as the bullet ogive, but with a slightly shorter radius. For instance, if the bullet had an 8-S ogive (we'll explain this in detail later, but the ogive radius is the length of the radius used to swing the arc that gives the bullet ogive its shape), the radius of the cavity shape inside the lead tip forming punch would be perhaps 7-S. That is a shorter radius.

The result is that the lead tip is formed and the surplus lead pushed down at a slight shear angle between the wall of the punch and the ogive of the bullet. If you leave the right amount of exposed lead, the punch will form a neat lead tip with a very slightly different ogive curve from the rest of the bullet. If the punch shape were made precisely the same as the point forming die, the edge of the punch would strike the ogive of the bullet and create a ring, instead of neatly reshaping the tip.

Bear in mind that the LT die is not used by itself, nor is it used *instead of* a PF die. If you use one at all, it would be to follow a point forming die. Remember, the jacket edge won't jump over the punch edge. If you already have a curved jacket, from the PF die, then the edge will slip past the cavity and let you shape the lead tip.

A LT die can also be used, in some cases, to help close the open tip of a jacketed bullet more tightly than could be done in the PF die alone. With care, a bullet maker can learn to push the open end of the jacket nearly closed, by gently using trial and error adjustment of the punch holder. Not every ogive shape or design lends itself well to this operation, but enough of them do so that it is worth mentioning.

Rebated Boattails

What about bevel bases or boattail bullets? Those also have the bullet smoothly angled away from full shank diameter. So, they also require a variety of the point forming die which is used to shape the base instead of the nose. The boattail bullet has largely been replaced in swaging circles by the superior "rebated" boattail, abbreviated "RBT" as opposed to the more conventional "BT" for boattail.

Why are most custom bullet makers using the RBT instead of the standard boattail base? There are three reasons:

1) A regular boattail bullet tends to act like the focusing nozzle of a water hose during the moment it emerges from the barrel. Hot powder gas rushes around that boattail angle, flow up the sides of the bullet, and continue in a smooth, laminar low pattern right around the front, where they break up into turbulent flow and make a fireball of gas—right in the path of the bullet! You can get up to 15% increased dispersion at the target just from the buffeting the bullet gets by shooting through this ball of gas. A flat base bullet deflects most of the gas in a circle of fire, expanding rapidly out from the bore with a clear space directly in front of the bullet. The edge of the flat base acts like a "spoiler" to break up the laminar flow before it can get started. And so does the sharp shoulder on a rebated boattail! How does a 15% improvement in accuracy sound as a benefit of using the RBT design?

2) The boattail bullet tends toward more bore erosion than the rebated boattail, because gas pressure on the boattail tends to peel it back away from the bore and let some gas up past the bottoms of the rifling grooves, where it cuts the bullet and the barrel like a hot cutting torch. The rebated boattail has a 90 degree shoulder that takes the pressure parallel to the bore, instead of at a compression angle away from it. How does increased barrel life strike you as a second reason for using RBT bullets instead of the regular BT style?

3) The tooling lasts longer, costs less to build, and is more easily built to high standards of precision. Corbin Manufacturing has perfected a method of using two dies, which we call the "Boattail 1" and the "Boattail 2" dies, as a set, to produce a virtually flawless and highly repeatable

rebated boattail. Instead of making the boattail angle so it can be higher on one side or at a little slope like some of the factory production you see today, this system guarantees that the boattail will start precisely at the same point on one side of the bullet as it does on the other, every time.

With all these benefits, there is hardly any reason to make standard boattail dies these days. The RBT has been proving itself all over the world for more than 30 years to those who are wise enough to give it attention. However, if you were to ask what base design I would generally recommend for jacketed bullets up to 250 yard range, I would be unhesitating in saying a flat base. Rebated or not, a boattail does not give you superior accuracy in and of itself. It gives you less base drag. Whether or not that translates into better accuracy than a flat base hinges on whether the increased drop or higher trajectory arc gives you any problem hitting your target, and whether there is much cross wind to push the bullet off course.

Usually at subsonic velocities, the rebated boattail gives you a much greater benefit in comparison to other drag factors, than it does at Mach I and above. The shock wave causes far more percentage of total drag at supersonic velocities, so making the nose more pointed produces more effect than streamlining the base. The best silenced, subsonic bullets for special ops have been rebated boattails with a blunt round nose (and other special features for expansion).

Bevel Bases

Bevel base bullets are made by seating the core in a special "point forming" die instead of the usual core seating die. The jacket is put into the die, and the lead is pushed into the jacket. The base of the bullet flows down into the short, beveled section of the die (it can't be a punch cavity, remember, because the edge of the punch would cut the bottom of the jacket). You could also seat the bullet in a normal core seating die, and then reform the base in this die, but it would be redundant.

A lead bevel base bullet could be made in two steps: swage the lead core using a rather large, almost finished diameter core swage, and then push the bullet into the special point forming die backward, using a nose punch as the external punch. Come to think of it, any lead bullet with a smooth ogive (no semi-wadcutter shoulder) can best be made by using first a CSW die to adjust the weight, and then a PF die to form the ogive. Without a jacket, you don't need the CS die, the purpose of which is to expand the core into the jacket and form a tight, parallel shank.

Dies Classified by Press Type

We've talked about the basic design of bullet swage dies, in regard to their function. There is another category for classification of swage dies, and that is by the kind of press used to operate them. Swaging dies can be designed to operate in a reloading press (with severe limitations on pressure and precision), or in a number of different models of bullet swaging presses, both hand and hydraulic-electric powered.

Years ago, we worked out a system of making standard parts for dies that would cover a wide range of calibers, and thus cut the cost of swaging through efficient use of what I call "semi-custom production". We designed presses and die sets so that we could build similar punch and die blanks for certain ranges of calibers and bullet lengths, and then choose among perhaps three die body lengths for every caliber from .12 to .458 in the hand presses, or from .224 to .998-in the dies for our big hydraulic presses.

We didn't have to design and build each die from scratch, because we built a standardized system for determining the minimum requirements of strength, die length, stroke length, punch geometry and strength, steels and heat treatment. We could run hundreds of blanks for each of the various presses, then hand-finish the cavities and hone the rough-finished punch blanks to a perfect fit during the custom phase of each order. It combined the economy of mass production with the flexibility and precision of custom tooling.

Corbin swaging dies are up to ten times less costly than competitive dies without any sacrifice in precision because of this semi-custom production technique, and the fact that we design and build several different presses to take full advantage of the kind of operations you might want to undertake.

The classification by press type also defines the die thread and diameter. The last letter in the catalog number identifies this classification. Dies with a catalog number ending in -R (such as the PRO-1-R) fit a standard 7/8-14 thread reloading press with an RCBS-type button shell holder ram. The die screws into the press head like a reloading die. The external punch slips into the T-slot of the ram. You do not also use a shell holder, since the punch base is made to simulate one.

Dies with a catalog number ending in -M fit either the discontinued Silver Press, or the current S-Press. They are being phased out of stocking status in favor of the -S dies, which are larger and stronger, and fit the current S-Press or its predecessor, the Series II press (discontinued). However, we will continue to make them on special order, just not as a stock item. The -M dies have a 3/4-inch diameter main body, a thrust-adsorbing shoulder, and a 5/8-24 threaded tenon. The die screws directly into the press ram, and the external punch is held in a Corbin floating punch holder in the press head. An example of an -M type die is the LSWC-1-M, a lead semi-wadcutter die.

The current type -S dies fit the discontinued Series II press or its replacement, the S-Press (Catalog number CSP-1). An example of a set of -S dies is the FJFB-3-S, a three-die set. The -S dies have a longer and larger diameter body than the -M type, being 1-inch diameter. By using the same 5/8-24 threaded tenon, the thrust shoulder is wider and thus spreads the force over a wider area (the top of the industrial chromed alloy steel ram in Corbin presses). This also means the S-Press can accept both the older -M dies and the current -S dies. A bench-type hydraulic powered version of the S-Press, called the "Hydro-Mite", also uses these -S dies.

Finally, the type -H dies are made to fit the Corbin Hydro-Press, or the Mega-Mite hand press. These dies are typically made in a 1.50 inch diameter, with a length appropriate to the maximum bullet weight to be produced (up to three inches). The thread tenon is made with a 1-inch 12 thread (meaning 12 turns per inch) to screw directly into the press ram. The external punch fits into the huge FPH-1-H floating punch holder, in the press head. A "positive stop" FPH-2-H punch holder is also available for extreme high precision weight control.

Dies for Other Presses

Special diameters of dies can be built to order, either to fit Corbin presses or other presses. Diameters of up to four inches with nearly any desired thread can be made. Usually it is best to use a standard die that fits one of the Corbin presses, rather than to spend very much on custom work to fit some other press. In the first place, the cost of special replacements and additions can quickly use up any savings in using an existing press versus buying a standard swaging press.

Often I have heard "I already have a press that I want to use" and the meaning is, "I don't want to spend money for another press." I agree, and would do the same, but only if the cost of building the custom dies and punches and making them work in this nonstandard press (for swaging purposes) is still less than just buying a regular swaging press. Often it costs more to fiddle around with special jobs than it does just to buy a standard swaging press. And then, from that point on, you don't have to worry about any special replacement parts, or additions that also have to be custom made (meaning both fairly long production delays and additional cost).

Usually, the design of a swaging press gives you a big advantage in speed, accuracy, and safety over using other kinds of presses. After all, a pants press, a wine press, a full court press, and a printing press all are variations on the term "press", and they are not suitable for reloading. Having said this, it is still possible to have custom dies built for just about any press you own. Just bear in mind that there is time involved in making working drawings, checking the stroke and ejection position, getting special thread taps and dies (sometimes), setting up the tooling for a one-time job, and other costs that have long been amortized over thousands of dies when you choose a standard production design instead.

Besides, we may have spent a couple of decades and tens of thousands of dollars in testing and improving our standard tools and presses. Building something for the first time in a different design often requires some investment in development, which may be a waste of your money if we've already done it a thousand times before in a different and better system, which would be yours if you just got the right platform to run it (the proper press). With a different, special tool, you get to pay for any unforseen development requirements. With our own products, we already paid for development and you get to benefit from that. It's usually a better deal.

Swaging Principles

1. Always swage "up", never "down". Swaging down is a contradiction. You "draw" down, by pushing something through an open ended ring die, like our JRD-1 jacket drawing die, or BRD-1 bullet reducing die. Drawing makes the part smaller in diameter and longer. It can also cause separation of the core and jacket if done to excess. Swaging makes the part shorter and larger, and tightens the grip of the jacket on the core.

2. Pay attention to the instructions. If there are special written notes with your die, they are important because they modify or improve the general instructions and replace them. If there is a difference between specific notes sent with your set of dies, and anything published in general (as in this book or in general printed literature), follow the special written instructions in any respect where they may differ. Swaging is partly an art, and various materials or sizes may react differently to the same general kind of operations.

3. Use the right terminology! I cannot stress enough how important it can be to read what you have before you start to use it, and order the right part numbers and names of parts. People call the external punch everything from a "pin" to a "ram" to a "die" to a "die punch". How are we supposed to know what you mean? If you order it wrong, you get to pay a restocking fee or, if it is custom made for you, then it may not be returnable. A die is the vessel or cylinder that holds the material. A punch fits into the end of the die and pushes on the material. A “pin” is part of the pivot system of the press, or the wire ejection pin that fits into a point forming punch. A “ram” is the moving steel drive component of your press into which the swage die screws. There is no such thing as a “die-punch” or a “punch-die”: putting terms together to suit yourself just confuses everyone.

4. Use the right materials! A set of dies made for a specific jacket, a certain lead hardness, or a certain alloy and size of copper tubing, may be able to work with other materials but probably not without adjustments to the punch and/or die dimensions and possibly not without developing differences in technique. Nearly all problems with broken dies and stuck parts or improper sizes comes from the use of materials other than those we used to develop the tools. Hardness, grain and dimensions make a huge difference in your success.

3. Bullet Swaging Secrets

Before I start telling you about the various kinds of swaging presses and dies that work with them, and why you might want to select a given type of press and die for a certain kind of bullet making, it would be useful for you to know some facts that have taken decades to figure out, and which most of the people who have figured them out wish to keep from you, since it might affect their own income if you knew.

If you don't care to wade around in the backwaters of history, skip this chapter and go on to the "How To" chapters that follow. It isn't absolutely necessary to be aware of all the misconceptions, phony physics, and junk science that is tossed about as if it were gospel. A lot of people make a good living based on these misconceptions, whether on purpose or because they believe it too, and it is not helping them a bit if you become aware of the errors in thinking that make this possible. But I suppose someone has to support those people: you can, if you wish!

The Myth of Exclusion

The most common misconception about bullet swaging is that only a few people really have the money and expertise to do it right—that equipment to make a good bullet is far too costly for you to buy, and the techniques are filled with "secrets" that only a few bullet-makers are smart enough to understand. In other words, stay away from swaging because (1) you are not smart enough and (2) you cannot afford the right equipment. Leave it to the "experts" who know best, in other words... the same "experts" who are eager to tell you this, and to scoff when you mention that you might have found a way to try it yourself.

The reason this myth is repeated in print every year is simple. Think about it: if you were making a reasonably good income from selling your own custom swaged bullets and someone asked you to tell a magazine audience all about your business, would you tell them "It's easy: anybody can do it with a little reading and a few hours of experimenting with moderately priced equipment!"

Or, would you be more likely to think about it and then say "Man, it's hard: the only equipment that works costs thousands of dollars and takes years to figure out. You guys are way better off just to pay me to do it for you and keep on buying my bullets!"?

Always remember to consider the source when you read anything, and follow the money trail. (Yes, I'm aware of the irony, but you already bought this book so I can afford to be honest in the writing of it!) It works in almost everything in life, not just bullet swaging. Before you read something, try to figure out who wrote it, who pays them, and why they might be influenced in their comments and opinions by the source of their income.

It's not a conspiracy: it's just how life works. Everyone has an interest in protecting their source of income. The more unusual the occupation, the less likely it is that the person will say anything that would encourage you to go into competition. Successful people learn early how to get good information from shaded stories without necessarily accepting everything at face value.

All this means is that when you read articles by or about bullet makers or their products, be aware that the products were made by human beings, not mythological Titans. Odds are pretty good that, given the right equipment and information, you could do the same thing. Or maybe, even better.

The Myth of the Shortcut

In a long and largely successful business career, I've found that the only reliable income is that generated from trading good information, services and products. Perhaps some have become wealthy by chance, or by trickery, or by other transient opportunities, but by and large what works is providing consistent good value. The surprise is that so many people think otherwise, and spend their lives looking for shortcuts. So much effort is expended in the search to avoid putting out any effort! It isn't fast or easy to build a reputation for good value, but the alternatives are too unreliable, even putting moral considerations aside.

This myth isn't just for bullet makers, but it seems to come up frequently in discussing a new bullet business with someone who wants to make back his investment in a hurry. "What's the hot item to make? What would make the most money in the shortest time?"

Well, here is where I could take a shortcut myself and make up some foolishness that would insure a quick or bigger sale. I could speak eloquently about whatever this client was sure to have seen on the covers of the latest gun magazines, and it would be easy to make a good case for whatever caliber, style, or gun was featured as the magic carpet one could ride to riches by making that particular bullet, or one for that particular gun. But unless it was true, I wouldn't do it, and while there is some truth to the idea of following the latest trends, it isn't likely to result in immediate riches.

There are not enough potential bullet makers to treat clients like used car buyers, even if I could somehow justify acting that way. Either my clients have to be successful, and continue to purchase equipment and supplies as they grow, or the swage die business will not work well enough to be viable.

After more than four decades of providing income for six families of Corbin employees, it's fairly obvious that there must be something reliable and long-term behind the ideas I am discussing here. It's not very likely that thousands of handloaders would come back, year after year, for products and ideas that didn't meet or exceed their expectations.

Many people do, in fact, make a good living using Corbin equipment to produce high quality custom bullets for other shooters. You see their ads every time you pick up a gun magazine. They start small, often just as a hobby, and their interest and business grows and expands to other equipment, which Corbin designs and manufactures. Our design and engineering work, as well as marketing help, is critical to the success of most of our clients (there are some who had everything figured out from the start, but not many).

Because a substantial part of our income and reason for our own success has been based on appropriate advice and honest dealing with our clients, your trust is a critical factor in Corbin's very existence. We continue to have backlogs for our work primarily because people know that they can trust in the essential facts that are spelled out in our books.

The myth that you can get there by some shortcut inspires countless other people to try, year after year, making a brief appearance and then disappearing forever. In their wake are abandoned and disgruntled would-be bullet makers, who may get such a bad taste for swaging from the experience that they never want to try it again. That is, of course, my main worry from a business point of view. It doesn't take too many shortcut takers to spread a bad feeling about what can be a marvelous technology when done correctly with well-made tools.

Shortcuts are what allows equipment to be made more cheaply, by using cheaper materials, taking less time to fit and finish the components, or skipping most of the tests and rework that might be necessary if a reasonable quality control procedure was in use. But a bullet-maker could forget the reason cheap copies of good equipment are cheaper, and think all such equipment is equally flawed. The same myth can affect the bullet-maker, even when he is wise enough to purchase good equipment. Taking shortcuts in the process of making bullets, in order to make them faster, can result in less satisfactory bullets. The custom bullet market is not interested in cheap bullets: it exists because of the need for bullets of superior performance.

Today, you can hardly pick up a gun magazine without reading something about one of my clients who makes a better custom bullet. Custom bullet making has been elevated by these people from a dark art to a serious, mainstream part of the firearms industry. But these bullet-makers, by and large, did not take shortcuts. They spent an average of 18 months building up to the point where they could show a profit. Some did it in less than a year, others took two or more years. They built a business, they didn't trick one into existence.

You might not care at all about the commercial possibilities for custom bullet making, but it affects you anyway. The mass producers have been forced to come up with their own premium lines of bullets and have often purchased bullets from my clients instead of trying to come up with their own. The fact that hundreds have turned to bullet swaging as a way to make a living, and thousands more use it as a way to make a little spare cash on a part-time basis, means that your bullet selection has improved vastly in the past few years.

Guns of a type that you might not have considered using for defense twenty years ago can now be put into service, since the bullets have improved their performance so much. Game animals that you might have wounded and lost twenty years ago can be cleanly taken without the suffering and without the long hikes to the bottom of canyons where the game was able to run and finally die a lingering death because of poor bullet performance. Hunting is more humane when the bullets perform flawlessly on the first shot.

Your scores at benchrest, metallic silhouette, IPSIC, and even blackpowder matches can be higher than they were "back then" because of the tremendous amount of research and testing done by all the custom bullet-makers. Laws have been passed or modified based on certain kinds of custom swaged bullets that did not come from any mass producer. If you don't think you have some interest in commercial swaging already, think again! None of this happened by taking shortcuts, either in the making of the equipment, or in the using of it.

The Myth of Carbide

There is a great deal of emphasis placed on the buzzword "carbide" at this time. Carbide is a rather generic term that covers a lot of ground, rather like the word "chlorophyll" back in the 1960's, or any other semi-technical term that is turned into an advertising catchword.

There is no such thing as a single kind of die material called "carbide", except in the minds of ad writers. When you heat any tool steel to a high enough temperature, some of the carbon in the material dissolves in the nearby iron, and forms a ferric carbide material which can be captured in the frozen matrix of the steel if the temperature is lowered quickly enough.

The ferric carbide trapped in the steel mixture is primarily what gives the steel its hardness. The structure also has a matrix of iron and other elements, which form complex compounds that give the steel ductility, ability to remain hard at higher temperatures, and corrosion and shock resistance. All hardened steels have "carbide" in them: that's what makes them hard.

If you systematically reduced the amount of iron and increased the amount of carbon that dissolved in the iron that was left, you would wind up with a very hard, but also very brittle material. It might be almost "solid carbide" but it wouldn't be very strong. By forming compounds of tungsten and other metals with carbon, the General Electric company (and others) developed commercially acceptable variations of "carbide" in a wide variety of grades. General Electric's trade name of "Carboloy" was applied to some of these.

The important thing to note is that there are variations that are nearly as soft as hardened tool steel, and others that are so brittle that they shatter like glass if force is applied incorrectly. Some carbide materials can handle high temperatures and some fracture when heated and cooled during use. Some make good tool bits, and some are only good for a thin coating on the surface of a hardened steel bit. Some are reasonable to machine accurately, and some cost a fortune to machine compared to making the same shape from a good tool steel.

If you were to be faced with the decision of a material from which to build dies for a high speed punch press, working at 40 strokes per minute or more, and making several million bullets, then one of these grades of carbide material could give you higher temperature operation and thus longer life than a tool steel die. Because the harder materials are more abrasion resistant, you would be able to run the dies for a longer time before replacing them.

They would still need to be lubricated: the idea that carbide dies need no lubrication is foolish. It is like saying that because your car engine might run 100,000 miles without changing the oil, you don't need to change the oil. It might run 250,000 miles if you did!

It is necessary to consider *value* to make a good decision about die materials. Value is the cost of the die amortized over the number of bullets you expect to make, considering the amount of wear which will take place before the bullets are no longer acceptable quality. It is somewhat subjective, since one person might consider a die "worn out" when the bullet diameter increased by 0.001 inches, and another might find that the 0.3090 bullet shot even better than the standard 0.3080 in his gun. The point where you no longer consider the bullet diameter acceptable determines the life of the die, for your application. Wear is related to heat and abrasion.

If you operate your dies in a hand-fed system of any type, it will be impossible to make more than five or six bullets a minute. At those stroke rates, any heat from friction would dissipate into the air before the next stroke. There would be minimal heat buildup, so that normal swaging lubricant (Corbin Swage Lube) would be sufficient to protect the die and the components from frictional abrasion not caused by dirty components or by polishing compounds embedded in the jacket material.

In a power-fed system, it is possible to stroke the press so fast that heat cannot radiate away into the air as quickly as it is generated, until the die becomes quite warm. It reaches a stable high temperature by radiating heat into the air, and into the frame of the press. Swaging lubricants may not stand this high temperature, so the metal surface needs to be made of something that will remain hard and resist abrasion without as much lubrication. Certain grades of carbides will handle the job.

Value is indicated by first estimating the tolerances which are acceptable for the bullets, and then figuring out how long a set of dies will give that range of tolerances, and how many bullets are made with each set, for what price. The lowest cost per bullet indicates the best value, all other things being equal.

In the high speed punch press, a set of dies might easily cost $3000. They might slowly wear to an unacceptable tolerance after two million bullets were made, at a cost per bullet of three thousand dollars divided by two million bullets. This is a cost of 0.15 cents (not fifteen cents, but fifteen hundredths of a cent) per bullet. In this kind of operation, properly made tool steel dies might only last 50,000 bullets, at a cost of about $300 for the dies. That is 0.60 cents (sixty hundreds of a cent) per bullet.

Obviously, the value is four times greater for using the carbide dies in this application. One might reasonably expect to make two million bullets on a punch press system: at 40 strokes a minute, and a bullet per stroke, that is only about 104.167 days or about 3.5 months—assuming the punch press is run eight hours a day, which isn't unreasonable.

But even the largest and most successful custom bullet maker seldom turns to punch presses. The average custom bullet operation (if one could ever say these outstanding operations are anything close to "average") turns out about 50,000 bullets a year. After all, the market is limited and the price is fairly high (worth it, but not cheap). You probably wouldn't make one million bullets in a lifetime of hand swaging. If you could make two bullets a minute, and worked at it every weekend for four hours, you'd only be making 24,960 bullets a year.

When run at less than ten strokes a minute with proper lubrication, the high-carbide content die steels used by Corbin hold acceptable tolerances for at least 500,000 bullets, and some have made over 1,500,000 bullets in commercial operations started years ago. Assuming the dies would make 500,000 bullets, this means your $300 investment in dies would last for over 20 years if you made two bullets a minute, working every weekend for four hours, every week of those years.

If you are just now turning 20 years old, you'd be 40 before you needed to buy another set at that rate. If you expected to live to be 100 years old, you would have a lifetime of bullet making on just three sets of dies, for a total cost of $900. Now, most people don't make anywhere near 24,960 bullets a year unless they are in business to make bullets. The odds are great you'd never make 500,000 bullets in a lifetime. But just suppose you did.

Your cost per bullet for determining die value would be $300 divided by 500,000 bullets, or .06 cents (six hundredths of a cent) per bullet. In your lifetime, if you made 1.5 million bullets, you'd use up three sets of dies, so your total cost per bullet would be $900 divided by 1.5 million bullets, or .06 cents. This is for using tool steel dies.

If you purchased $3000 carbide dies, you would not get one bit more accuracy or any better die, other than the fact that long-term abrasion resistance would be less, so you could get by with one set of dies for your lifetime. We assumed you might live 100 years, and make 1.5 million bullets. Your cost per bullet with a carbide die set would be .20 cents per bullet ($3000 divided by 1.5 million bullets). The steel dies are three and a third times better value for this application! That is 333% more value for your money with the steel dies.

The reason I've gone so long into this is not any animosity toward "carbide", but because of the widely-held perception that just stamping the word "carbide" on a die automatically blesses the product with supernatural powers and makes it somehow more accurate.

A die is only as accurate as you can make the hole. It is a lot easier to make a good die from a material that can be worked in its annealed state, then hardened and given its final adjustment in size with diamond lapping in the hard state. The easier a job is to do, the less it has to cost. So, you get more value: the same accuracy for far less money.

Obviously, it is much easier to promote the myth, than to explain the facts. Advertising is sold by the column inch or fractional page, or by the word...and it costs a lot more to educate than to dazzle the reader. Fortunately, a book has plenty of space for education and you've chosen that path rather than just allowing yourself to be dazzled.

Following the "carbide worship" path, the term "ECM" or "EDM" sometimes is waved about as a sort of accuracy magic wand. The terms refer to "electrochemical machining" or "elecrical-discharge machining". ECM is a form of "reverse plating" where metal is removed from the surface of the work by a strong flow of electricity through a conductive electrolyte solution. EDM is a form of "spark erosion" where an arc burns away tiny pits in the surface and eventually removes it in a controlled manner, often under an insulating solution that carries away the eroded metal.

Electrochemical machining is a last resort, not a step up. It is used when there is no other practical way to machine a part, because it is very costly, slow and difficult to make the hole precisely the right diameter and shape without going to much higher expense than with traditional machining techniques. ECM has its uses, one of which is to machine carbide materials that simply cannot be cut any other way. There is nothing inherently more accurate about ECM. It costs fortunes in equipment just to make it the same accuracy as lathe boring, reaming, and diamond lapping. Using ECM makes sense when you can't cut the material in a more traditional way. People who sell ECM machines are the first to tell you this.

There is nothing inherently "more accurate" in using electrical machining as opposed to diamond lapping. Thin, fragile sheets of metal or brittle, hard carbide materials are best machined by ECM, but materials which can be machined with a faster traditional method should be. One who simply swallows the advertising hype is set up to spend extra money without getting the extra value.

If I thought that there was better value for my clients in selling them $3000 dies, I'd certainly have no reason NOT to do it! I'd rather get ten times as much for a set of dies, if I could justify it to myself and to my customers. But for the past 40 years I've been proving over and over that it isn't good value for this application. What, exactly, is the benefit, other than making more money for me? I'll just have to rely on the good judgement of ten more handloaders, instead, to make the same amount!

The Myth of Equating BC with Accuracy

Another myth is that aerodynamic shape is synonymous with accuracy. Years ago, I made some bullets that were just cylinders without any ogive at all, and fired them from a benchrest rifle in .224 caliber into a group that measured about 0.2 inches center to center. Then I fired another group made with 6-caliber ogive spitzer bullets made exactly the same way, with the same weight and diameter and the same materials. These made almost exactly the same size group. The gun was at its limit and the bullet shape had no effect on accuracy, except that the cylinders landed a little lower on the target (more drag, so they dropped slightly more).

In our work for various government agencies, Corbin made dies that we called the "Ultra Low Drag" or "ULD" design, many years before the popularity of the so-called "VLD" design of the late 1990's. The two designs are quite similar. In fact, nearly all low drag designs that are practical utilize a long ogive and some kind of boattail. Ours used a nine-degree rebated boattail, and a 14-caliber radius curve that was offset by 0.014 inches from the tangent (a secant ogive, in other words). There is nothing magical about the numbers. There are dozens of variations which would work approximately as well, better in some guns, worse in others.

There is a problem with promoting these buzzword designs: people tend to believe that they solve all problems of accuracy, when in reality they are very special designs made for certain kinds of loads, rifling twist rates, and purposes. They are not always more accurate nor are they even useful in some guns. Here are some of the problems with the very low and ultra low drag designs (which means "high BC", the ballistic coefficient):

To offer less air resistance, the bullet needs to be more streamlined, which in turn makes it longer for the same weight, or lighter for the same length as a conventional design. To keep the amount of shank in approximate balance with the extra long nose (which would fill up with all the available lead in a normal or light weight design and leave nothing for the shank), these bullets are usually made in the heavier weights for the caliber.

This means that the long, heavy bullet has the center of balance shifted toward the rear, so it wants to turn over more easily than the conventional bullet, and thus requires a higher twist rate to stay nose first. If you have a barrel with the appropriate faster twist, you may get a flatter shooting bullet with equivalent accuracy to a normal design. Since the custom swaged bullets are usually made with more care than mass produced bullets, you may even get superior accuracy plus a flatter trajectory. But if you don't have a faster twist rate, you may find accuracy actually is worse than that of a shorter bullet having lower BC.

The longer ogive and boattail (or rebated boattail) combine to make the same weight of bullet longer than in a conventional shape, which means that the bullet may not chamber or feed in some guns, and may actually be too long for the throat in the barrel. This might require setting the base of the bullet far down into the cartridge, intruding into the powder space, and possibly requiring the case neck to be partly encircling the start of the ogive. This means the bullet may not be held securely on a center line with the cartridge, but instead might be able to tip and start into the rifling at a slight angle, which does no good for accuracy.

Bullet jackets need to be longer for the same weight, since the long thin nose doesn't hold as much volume (and thus weight) as a more rounded shape. And if you wish to make a light weight bullet, you'll need to use low density core material such as Corbin bullet balls, because if you fill the long ogive with lead, you'll need to at least balance the nose with a reasonable shank length. Having a long nose and balancing it with the shank means the minimum weight is higher than with a more rounded nose. In other words, you trade a somewhat flatter shooting bullet design for versatility in range of weight. A more traditional 6-S ogive or a round nosed shape will give you both heavier and lighter weight possibilities.

On the other hand, extremely efficient airframes do give you a flatter shooting bullet, because they drop less in the same amount of flight time. While less trajectory isn't necessarily the same as more accuracy, it contributes to your ability to judge distance and hold the sights in the right place. It helps you be a better shooter, rather than actually improving the accuracy of the bullet, but the effect is the same.

My point is that if you use accuracy and flat shooting as synonyms, you'll be just far enough off the mark so that you'll fall for some of the advertising hype about bullet shape. You may be like the fellow who heard that three of the top benchrest shooters won that year using bullets that happened to have a 7-S ogive (a nose shape formed by a curve that has a radius of seven calibers) instead of the more common 6-S, so he passed up good buys on both 6-S and 8-S ogive die sets to wait for a custom made 7-S set. In truth, any of those sets would have been fine, and the 8-S would be slightly flatter shooting yet.

I'd like to let you in on another secret: there is no inherent difference in accuracy between spire points, truncated conical points, round noses, spitzers, and secant ogives, if you make all of them from equal quality materials with the same level of care. A round nose or what we would call a 3/4-E (elliptical ogive with a length of 0.75 times the caliber) handgun bullet is inherently no less accurate than the regular 9 or 10 degree truncated conical bullet (truncated means cut off, and the TC is a spire shape with the end cut off, usually at about 40% of the caliber). Whichever you like best and feeds best in your gun is the one to use.

A common request is for dies to make a bullet with some arbitrary BC number, usually higher than anything else on the market from mass producers. But this is a little like spending all your money on a great set of magnesium wheels for your car, so you have nothing left for the engine or body work. Lots of teenagers did that when I was of that age. Today I hear the thumping of huge, overpowered speakers from expensive stereos coming from cars that could use a paint job and a tune-up, usually with the same genre of fuzzy-minded youthful driver who spent his burger-flipping paycheck for "cool mags" back in the 'fifties.

Putting all your attention on the ballistic coefficient and ignoring most of the other factors is very little different. The real goal is usually to hit the target at long range with greater reliability. Confusing the real goal with some narrow part of the total package that will get you there is a problem created by the myth that somehow, an arbitrary BC number bigger than anything available currently means the bullet will be more accurate.

Sorry, but the BC is only a relative measure of inverse air resistance compared to some standard bullet, such as the one-inch artillery projectile that has been considered a 1.0 on the BC scale for decades. The BC means nothing by itself. You must also know the standard against which it is compared, and advertising sometimes plays on this fact to overstate the comparison or ratio by subtle use of a different standard projectile.

For example, I could easily publish BC numbers of 2.50 or 3.59 or anything else I wanted, whereas most BC numbers are less than 1.0. How? By noting in the fine print, which no one reads, that the standard projectile used for comparison is a five grain wad of newspaper chewed to a soggy consistency and fired from a pursed pair of lips (yes, a spitball). More subtle yet, I could simply assume that everyone "knew" I was using a conventional 6-S 168 grain spitzer flat base bullet as my "standard", and then publish comparison BC numbers relating the bullets I was attempting to market to this standard.

Not drawing any particular attention to the standard just reinforces the myth that BC has some independent value as a figure of merit. It is in fact a ratio, so it requires two items for comparison and has no meaning otherwise. Stating the BC alone is like saying the odds of the Atlanta Braves winning the next game against the Giants is "3". But three compared to what? You might assume 3 to 1. Maybe the Giants fan meant 3 to

6, or 2 to 1 in favor of the Giants! Normally we would assume the other bullet in the implied BC figure is the old military standard one-inch projectile, but remember the old saying, “Assume makes an Ass of U and Me”.

Seeking a high BC is not a foolish quest, but it is foolish to think some number higher than that you read about a factory bullet will solve all your problems and improve the accuracy of your new bullet. How are you going to measure it? If you use the dual chronograph method, your measurements can be off by a very wide tolerance unless you fire a large number of rounds. Sometimes the variance is greater than the amount of supposed gain. The best way to achieve good accuracy is to judge it by the holes in the target. That is, use anything that improves the group and don’t put on blinders in the quest for one specific part of the accuracy formula.

High BC is desirable, but the higher spin rate it may require of the longer bullet can exaggerate normal eccentricities in the bullet, and wipe out any accuracy gains from a flatter trajectory. Each factor in the design of a bullet is part of an equation that tends to be self limiting: making any one factor too large automatically makes the others too small. You get the optimal performance by achieving the right balance of factors for your particular application, not by pushing one of them to the limit and ignoring the rest.

The Myth of Critical Diameter

There can be a significant difference in accuracy between bullets of different diameter, but there is no cut and dried rule about it except that undersized bullets (compared to the rifling groove-to-groove depth of your particular gun, not to some arbitrary industry standard) generally don’t shoot as well as bullets with a diameter at or slightly larger than the groove-to-groove depth.

Oversized bullets tend to have minor problems in some guns with case swelling and chambering. The pressure difference is insignificant for a 0.308 inch bullet compared to a 0.309 inch bullet until you reach those loading intensities where the gun is about to come apart anyway. If it will feed and fit the chamber with the larger bullet seated in the case, it will probably shoot better than with a smaller bullet (if everything else is equal and the load is generally accurate and safe).

For my money, if I were to decide on a given diameter for my swage dies, I would always choose either right on the money for diameter compared to my gun’s rifling groove-to-groove depth, or slightly larger (between half and one thousandth, depending on whether it is an Auto-loader or not—some pistols have a problem with slightly larger bullets which bulge the case and cause feeding failures).

On the other hand, if I had a bullet that shot well in a given gun, I couldn't care less if the bullet was undersized, lopsided and backward! The goal is to hit where you aim, and if the bullet does that, forget about what it ought to be and just be happy that it works so well. Some armchair ballisticians tend to wind themselves up so tightly in their theories that they miss the fun and the point of it all: shooting. If it works, it must be right by definition.

Many factory barrels of the same caliber are far different from each other in diameter. The differences in bore diameter at various points even in the same barrel can be far more than the wildest tolerances in any bullet. Since the whole idea of controlling bullet diameter and tolerance is to make it fit into the bore, or the rifling grooves, there's a problem here!

Why worry about an overly precise bullet diameter if the bore isn't at least that precise? We've had clients send us sample bullets, pushed through a factory barrel, that came out as much as .41 caliber from a .40 caliber pistol! In one instance, the client sent the gun back twice and got two different oversized barrels, both different by as much as 0.005 inches from each other. I won't mention the gun-maker, but it is a respected name and the problem isn't unique.

This doesn't mean that it isn't important to have good control over bullet diameter. It merely means that you should not take the "published specifications" for granted. Measure your gun if you really want to specify the bullet correctly to fit it. If you don't know how to measure it, you can fire a low velocity slug through it and capture the slug in water, and send us the slug to measure. By low velocity, I mean just enough pressure to get it out of the barrel reliably.

Measuring a barrel is an art. Firing the bullet through it only gives you an idea of the diameter at the point where the bullet came out. Suppose your barrel has "waves" in the bore, where it varies 0.002 inches larger than the average, but the muzzle is actually tight at 0.001 smaller than the standard specifications. The bullet might expand when it passed through the big areas, but it would be drawn down again when it hit the tight spots. Which dimension is really the size of your bore? Who knows—it all depends on your meaning. Average? Mean? Tightest point? Loosest point? Standard deviation?

You want a bullet to fit so it won't be distorted and so powder gas won't escape around it and cut the jacket or lead like a torch. It's worse to have gas jetting around the bullet in the loose places than it is to have the bullet slightly elongated by the tight ones (since the amount of distortion is so tiny, yet the damage by gas cutting can be so harmful to both bore and accuracy). That's why I lean toward large bullets so long as they don't cause any other problems.

The fellow who says he must have a 0.2240-inch bullet for his .224 rifles could be right, if every one of them has a barrel with a .2240 maximum groove- to-groove diameter. But unless he actually knows that for a fact, he could be just as well off or perhaps better with a bullet from .2242 to .2245 diameter.

The Myth of the Pressure Ring

You've probably heard this one: a good accurate handmade bullet must have a pressure ring slightly larger than the rest of the shank, whereas a factory bullet doesn't have one and that is why factory bullets are less accurate. Lots of shooters believe this one.

Actually, the pressure ring on the back end of a swaged bullet is there for two reasons. The difference in diameter between the core seating die, which is used to make the bullet expand to nearly final diameter in a cylinder form by pressing the lead core into the undersized jacket, and the point forming die, which forms the ogive on the bullet, must be very small, but still the point forming die should be slightly larger than the core seating die (in diameter of hole).

If the core seating die is the same size or larger, the bullet will tend to stick in the point forming die. People who don't know much about swaging will assume the point forming die is bad, when it is likely that the core seater is producing a bullet too large to easily slip into the hole of the point former. The difference is very small. A typical .224 bullet would be made using a core seating die of about 0.2238 inch diameter, or at least the bullet would come out of the core seater at that size (the hole might be slightly different because of material springback).

A desirable range of diameters for a .224 bullet would be from 0.2240 to 0.2245 inches in the parallel shank section. Right at the base, the bullet might measure from 0.2242 to 0.2248. This "pressure ring" is the lack of springback across the solid disk of metal that makes the bullet base, compared to the springy tubular sides of the jacket. Having a large difference between core seater and point former die cavities will make the pressure ring larger, and if the difference gets too large, then the bullet will start to come out with a "wasp-waist" shape, like the old Herter "Super-Sonic Wasp-Waist" bullets of long ago.

(A note about those Herter's bullets: these were most likely reject bullets made because of a severe mismatch in a set of commercial swage dies, but Herter's was innovative enough to turn someone else's rejects into their "Model Perfect" offering of the season. Strange advantages were touted for this bullet: it was said that the air went in a sort of circle around that hourglass shape and somehow whipped around behind the bullet, whacked it in the rear and drove it faster! If this were true, Herter's discovered a perpetual motion machine with a new twist. Imagine what would happen if you accidently gave one of those bullets a thump with your finger while it rested on the table: the air would start accelerating it faster and faster until it was zipping around the room at supersonic speed, blowing holes in all observed physics!)

The pressure ring is not a design feature: it is a physical fact of life that gets in the way of having a nice parallel shank on the bullet and can expand the case neck as the bullet base passes through, leaving the bullet slightly loose. In a short-necked round like the .300 Savage, the pressure ring is a real problem, since the case holds part of the ring and part of the shank, and the bullet flops around as a result.

Most of the time, the pressure ring doesn't hurt anything but if there were a way to get rid of it without hurting accuracy in some other way, it should be done. The best way to minimize it is to match the core seater and point former dies very closely, more closely than you can do with a regular micrometer. You can also make the bullets slightly oversized and tapered, so the dies really eject easily, and then push the bullet through a ring die that irons the sides perfectly straight: now you've got a factory bullet! That's the way it's done. But that also tends toward a loose fit between jacket and core: the core pushes in and stays there, while the jacket springs back a tiny bit and loosens its grip on the core.

If you bond the core (using Corbin Core Bond flux and melting the lead core into the jacket for a permanent adhesion), you can draw down the shank of the bullet without any springback effect. But all this is not necessary for target shooting and barely necessary for anything else so long as the ring is only slightly 0.001 inch or less) larger than the rest of the shank. If you have any problem with the bullet in a short necked case, then this is worth some consideration.

The main thing is, don't be suckered into thinking that you must have this mysterious feature in order to have a top-quality benchrest bullet. It's just how they come out, no design required or intended, and rather than admit it, many bullet makers in the past have turned it into a "feature". This is rather like the software bug that the technical support person claims is actually a feature: it's supposed to work that way, didn't you know? (Good thing software companies don't design cars. Cars might have become 100 times cheaper and get 200 miles to the gallon if they followed the improvements made in computers, but I'm not sure I'd want to drive one that crashed four times a day!)

The Myth of Magic Jacket Alloys

Here's another myth that needs to be shot down: copper fouls your bore, and brass is too hard on it, so you have to use a mysterious metal called "gilding metal" that only the factories have. In the first place, gilding metal is 95% copper and 5% zinc, whereas the brass most people refer to is 70% copper and 30% zinc. Copper is normally 99.95% copper and a trace of silver or other elements, sometimes phosphorus, sometimes arsenic. You can have any of them for the going price, any time you like. Corbin stocks various kinds of bullet materials and can get others if you order the minimum run. Our jacket drawing equipment can use any of them (we may have to "tweak" it for a particular material, though).

The factories normally use either gilding metal or commercial bronze for bullet jacket material. Commercial bronze is really not bronze at all. It is another kind of brass, made with 10% zinc and 90% copper. It is cheaper than gilding metal, slightly tougher and can be made harder. Any of these metals can be used to make good jackets. None of them necessarily has to foul the bore any more than the others.

Pure copper, properly annealed, makes a fine jacket material but it is a little more "sticky" in the punch press dies and harder to draw to deep cups, so it is seldom used in high speed mass production. A little zinc makes the material easier to draw, but more brittle when it strikes the target. When it comes to a choice between helping the mass producer produce the product, or making the product work better for you, guess which way it goes! (To be fair, the price you pay is based on how fast the jacket can be produced and the price of the metal used, and the mass market is by definition interested in the best price.)

Why do people think copper fouls more than gilding metal, then? I wondered about that for a long time, since we are involved with shooting lots of bullets made with copper and have not noticed any unusual fouling problems. (We get into all kinds of calibers, from .12 to 25mm. We've shot .50's made from everything you can imagine, and fouling isn't any worse with copper.) I think a big part of it is the finish of the material used to make the bullets, and the treatment it gets during the process.

Copper tubing is a traditional material for making bullets. It tends to have a slightly soft, powdery surface after it is annealed. Annealing with gas heat, or in an oxygen atmosphere, will oxidize the surface and cause a reddish or blackish oxide to form. These tend to be flaky and loose. When the copper is drawn down and shaped into a jacket, it will harden slightly but the surface may not be burnished enough to get rid of the porous layer. I think this layer is what comes off in the bores.

Nearly all metals will leave something of themselves in the bore, but we are talking about fouling bad enough so that it is a problem, an exceptional amount of fouling. And with properly drawn and polished bullets, I have not seen any significant problem. With the highly finished copper strip that we use for making drawn bullet jackets, there is no problem worth consideration.

Some of the rumor probably comes from the fact that people who do this sort of experimental work with bullets are more curious and inspect their guns more carefully than people who just buy factory bullets, and they notice even a small amount of fouling sooner. Some of it comes from the loose, porous finish that experimenters may get on their torch-annealed copper tubing jackets. So, use annealed copper instead of annealing it with a torch, or polish the jackets so that the outer surface is removed down to the hard underlying metal. Don't worry about it unless you actually experience a problem, which you probably won't.

The Myth of Mysterious Rites of Swaging

I've heard all these tales about how you have to let the bullets "rest" overnight before you shoot them, or how you have to swage cores and then put them in a jar and give them a day to "normalize" (whatever that means) before putting them into the jackets. Hardened lead alloys often change hardness over a period of time after having been subjected to stress, such as swaging, but if you are interested in accuracy you probably use pure lead wire (which has no such time-related hardness change).

Most of this is purely in the mind of the person who believes it, and came about either because someone else said it, or because the person happened to shoot a great group one day after doing something of the kind and from that day forth will always give the ritual credit. I wonder if a hunter who dropped his rifle and had it go off and by sheer luck shot a deer with that stray bullet would henceforth go into the woods and toss his loaded rifle on a rock?

I suppose we all know people who got lucky one time with totally inappropriate equipment or techniques, and without any further testing just assumed that the thing they did incorrectly was responsible for the good fortune of that day. Likewise, bad results are sometimes blamed on coincidental precursors. A statistic says that 80% of all people killed in car wrecks ate carrots during the previous twelve months. So, does this mean that eating carrots causes you to get killed in a car crash? If you don't eat carrots, do you thus avoid such a fate? If you think so, maybe it is time for a refresher course in syllogisms.

The Myth of Weight Tolerance Versus Accuracy

Once Friday I made a pile of bullets and wanted to shoot a good group so much that I spent all afternoon weighing and sorting them into two piles. The first pile had almost no weight variation that I could measure: they were right on. The other pile had the other bullets, which could vary as much as three grains plus or minus from my desired weight. After supper, I went back out to the bench and I carefully loaded cartridges for my heavy barrel .222 Remington on a nice Sako action, weighing every charge, and seating those bullets with the greatest of care. I was ready for Saturday's match.

Saturday was a great success, and my group was as small as I could have hoped. I was now positive that absolute bullet weight control was the secret of small groups. Upon my triumphant return home, the first thing I noticed was the pile of bullets on my loading bench. It looked suspiciously small. Weighing a few, then a few more, it finally dawned upon me that I had loaded the rejects and shot them, instead of the selected ones. Come to think of it, there were a lot of loaded rounds! So I guess a six grain range of weight variation didn't make all that much difference in group size, after all.

If a bullet is unbalanced, so that one side is heavier than the other, it will tend to spiral in flight and will land at different points around its axis of flight. That much is well proven and has been known for years. If the difference in weight between two bullets is caused by a bullet jacket that is thicker on one side (eccentric jacket walls) or if it is caused by an air pocket or void within the core of one bullet which is off-center, then the weight variation is a way of telling us about eccentric construction.

Note that we don't know which of the two bullets is built incorrectly. With air pockets, the lighter bullet is probably the bad one, but with eccentric jacket walls, we don't really know if the heavy bullet has a thicker wall on one side, or if the lighter one has a thinner wall on one side. If the lighter bullet has a thinner wall but it is concentric, then provided we had five more like it, we could shoot just as good a group as we could with a concentric, thicker-wall jacket. If we had bullets with air pockets that were perfectly centered, such as you get with a hollow base or hollow point that is correctly swaged, then there is also no problem with eccentric weight or balance.

Mixing bullets that have eccentric weight variations into a group that has none will increase the group size. Mixing thin walled concentric jackets with thicker ones can change the group size only because the friction of the jackets as they pass through the bore may be different, so the powder burns a little differently, and the velocity may vary. This can cause the bullets to drop more or less depending on their velocity. The variation due only to difference in weight, meaning the gravitational drop, is so slight at 100 yards on a few grains (such as 2% or so of the bullet's weight) that you can disregard it. You may as well talk about the effects of an airplane flying over and its gravitational pull shifting the bullet impact as the weight variation in a 2% or less situation.

If you make your own bullets, and you have jackets that not only weigh the same but have walls that are the same on all sides, and you seat the lead cores to the same pressure so there is no loose core and no air pockets, then you will be able to ignore weight variations of less than 1% of total weight for any kind of shooting, and below 2% for anything but top level benchrest competition. Any weight variation in this range would be simply more or less core, concentric to the bullet center line, and would have no serious or noticeable effect on group size.

If you have the same weight variation and it can be shown that the cause is eccentric walls or anything else that causes the weight to be shifted in an eccentric manner, then you will probably notice an increase in group size. So, weight variation is not an absolute measure of quality, but it is an indicator of a possible problem.

Eccentric bullets are easy to make by putting a known weight of nylon string down one side of the jacket before swaging in the core—you can control the weight and position of the variation this way. We find the groups of bullets made with concentric weight variation (more or less core weight) are within the average size for the control bullets, whereas the eccentrics tend to fall outside in proportion to the amount of eccentricity.

My point is that weight is not some absolute number that tells you "good" or "bad" about a bullet. After all, a 2 grain plus or minus variation on a 50 grain .224 is plus or minus 4% of the total weight and may have some noticeable effect, whereas the same variation on a 500 grain .458 bullet is only 0.4% and is below the limit of accuracy of most electronic meters and chronographs, and is unlikely to have any affect that can be measured.

Get out the instruction manual for any high precision digital scale, and you will probably find a "specifications" section that tells you the accuracy of the scale is from 1% to 5% of full scale reading, plus or minus the final digit. That is, if you are using a scale that goes to 500 grains, and the scale has an accuracy rating of 1% of full scale reading, that means the scale itself cannot tell the difference, reliably, between 495 and 505 grains! Not only that, but if the scale reads out to 0.01 grains, the last digit can be anything from 0 to 2 and still be within the range of accuracy guaranteed.

Years ago, I established and ran a precision calibration laboratory as part of an electronics company that I had founded. We needed to certify accuracy of commercial and law enforcement radio transmitters to a certain accuracy, and sign our names to the tests on forms that would stand up in court in case of any problems with radio interference or licensing issues. Digital equipment was just starting to become affordable outside of the military, and we used the latest products from Hewlett-Packard and Tektronics, which were the best available. I was somewhat taken aback to learn that much cheaper equipment was advertised as having far greater precision, until I read the fine print and found that readout accuracy was being touted, not instrument precision.

Most people wouldn't know the difference, and would be fooled by this bit of deceptive advertising (which the major brands avoided). The digital readout is "accurate" to whatever last digit is offered, but connecting a readout with 0.0001 mile final digits to your car odometer cable certainly does not give you distance measuring to that fine level! All the tolerances and inaccuracies in turning the cable, sliding the tires, play in the gears, and so much more, would make that kind of readout accuracy a joke as far as precision of measurement. But it is still a good way for a company to sell cheap instruments to people who do not read the fine print! Even medium-priced digital micrometers sometimes tout read-out accuracy without mentioning actual instrument precision and repeatability.

As a rule of thumb, strive for a maximum of 1% plus or minus weight variation in your best target bullets, and don't worry if you make hunting or defense bullets with a 2% variation. To get this figure, divide the difference between the heaviest bullet and the lightest bullet by the average bullet weight, and multiply by 100. The average bullet weight is the total of all weights divided by the number of bullets that you weighed. You can hold the tolerance to about 1/2% if you take extra care with consistent timing on the core swaging operation, and sort all your bullet jackets into similar weights before seating the cores. It only matters to the people who buy your bullets, because the one fairly accurate tool most handloaders own is a powder scale. No matter that it reads to about 1% of full scale, plus or minus. If your only tool is a hammer, every problem looks like a nail. If the only thing a person can measure with high accuracy is weight, then weight becomes the answer to every problem. Only, it isn't. At worst, it can be an indicator of other problems.

The Myth of the Infallible Micrometer

One last example is the myth of the infallible micrometer. I think that at least once a month we hear from someone with the world's most accurate micrometer. That remarkable tool certainly gets around. Since the advent of digital electronic readouts of reasonable price, and the availability of micrometers and calipers with stated accuracy of either 0.0005 or 0.0001 inches (or sometimes 50 millionths, or whatever the ad writers feel like writing that week) there have been more than a few people who call to note that they expect to order a bullet that measures some ridiculously precise figure and wonder if we'll guarantee it.

In the first place, Corbin makes the most precise bullet swages you can buy because we have put literally decades into building the only full-time, full-line bullet swaging equipment and die-works in the world, and you can't run one without the best measuring instruments. Each of our diamond lapping machines has a gauge mounted on it that cost several thousands of dollars, and is tested and set with a setting fixture that is periodically sent in for NBS calibration. The setting fixture alone costs more than most people would pay for their second car. The diamond probes that fit into the precision bore gauges cost several hundred dollars, and each one only covers a narrow range such as .204 to .210 inches, so we have thousands more in all these little diamond probe sets.

I am not reciting all this to impress anyone with what we spend on measuring tools, so much as to make this point: if there were anything better that was appropriate to this application, we'd buy it. That's our business. We have to know the limits and uses of precision measuring tools to survive. Those salesmen who call on Corbin certainly are more than anxious to sell us the latest and best technology, and they keep us appraised of it. Precision measurement isn't something we only read about in an old copy of Machine Tool magazine at the dentist's office.

I also don't mean to imply that we know it all and no one could possibly measure anything better. I'm sure that at NASA or Sandia Labs or Cal-Tech there are tools of greater precision than we need or can afford. But what I do mean to point out is that someone with a digital micrometer that costs a hundred bucks or so isn't even close to the state of the art in measurement precision, and if this high priced equipment we use is only guaranteed to give plus or minus 50 millionths of an inch precision, you can darn well bet that the micrometer isn't going to actually give you anything like an absolute precision of plus or minus a half thousandth inch, which is 500 millionths.

So, how can the ads in the machine tool catalogs say that the readout is accurate to 0.00001 inches or whatever they claim? Easy: they are talking about the readout. The digital readout is the thing that displays the numbers. If it says a given number, you can bet it means exactly that number, to the last digit it can display plus or minus one digit (since any digital tool has no finer division than 0 or 1 on its last number displayed, you never know for sure if the last number is half way between 0 and 1).

But the trick—the secret, if you will—is in that wording. The *readout accuracy* has nothing to do with the *instrument accuracy.* You can connect a digital readout to anything, and the numbers will click off just fine, but they mean nothing more than the mechanical limit permitted by the actual instrument itself.

Digital readout on a moderately priced instrument is a way to fool gullible buyers into thinking they bought the world's most accurate tool for a few dollars, while the "uninformed" laboratories continue to spend thousands to get the same kind of accuracy. It's the stuff headlines in supermarket checkout magazines are built from: "Man Survives Fall From Space Shuttle: Doctors Baffled". It's human nature to want to think that all the experts are wrong, because it gives the average fellow's ego a little boost. Sometimes the experts are wrong, of course, in some particular circumstance where their theory turned out to be off the mark. But, really, if it were possible to get dependable accuracy in the tenths of a thousandth inch with cheap tools, why would anyone in business waste money on anything else?

I will never convince the person who is so proud of his new digital mike that he can't repeatedly and accurately tell what the diameter of a bullet is to five places, and probably not to four. The limit of accuracy of a lead-screw micrometer, which nearly all of them are unless you buy laser or magnetic track instruments (for thousands of dollars) is the physical accuracy of the mechanical screw thread itself, not the digital readout. This cannot honestly be guaranteed to be better than 0.0005 inches in the very finest of instruments, (such as the Starrett "Last Word" bench mike) and more likely is only accurate to 0.001 inches. Of course they read to zillionths of an inch (well, at least 0.0001 inches) but being able to display a tiny number does not mean the tool really sees it repeatedly or even sees it at all.

For all practical purposes, a micrometer you can hold in your hand will give you the nearest thousandth plus or minus about half a thousandth. So if you specify a bullet of 0.308 inches plus or minus 0.0005 inches, you have some chance of telling it is between 0.3085 and 0.3075 inches. If you buy a gauge block with guaranteed traceable dimension of 0.3080 inches plus or minus 0.0001 inches, you can set your mike as a comparator to see if your bullet is .3081 to .3079 inches.

But you can't tell if you have a .30805 or a .30795 inch bullet. A screw thread measuring system just won't repeat any closer than that. All it can do is give you a readout where the numbers themselves are guaranteed to be whatever the ad says, not that they represent what the measured part actually is. That is how many precision tool brands are sold to the public today. The difference between readout and instrument precision is just complex enough so that some people don't care to understand it. It's much easier to believe you bought the precision of a $5,000 lab tool for $150.

What matters is that the bullets land in the same hole, or as close to it as possible, and there is no way yet devised to determine if they will do that before shooting them! Bullets that are undersized to the bore by even half a thousandth may show signs of lower accuracy, whereas bullets that are a thousandth oversized from this ideal usually shoot as well as the "right" size bullet.

But we don't really know in advance what is "right" because it depends on your particular barrel. We do know that in general, if you want maximum accuracy, you should strive for a tolerance range of minus zero, plus one thousandths of an inch from the groove-to-groove depth. You may not find this is "right" for every gun or load, but it is a good starting point.

4. Tubing Jackets

Before you can make a jacketed bullet, you need the jacket. The jacket wall thickness, length, and size determines the dimensions and sometimes even the number and type of other dies you will be using. The issue of what jacket you plan to use comes first, assuming you are using a jacket of course. Not all swaged bullets need a jacket. We will discuss paper-patched, lead, and other types later.

You can buy some sizes and lengths of ready-made jackets (the cups or empty skins for the bullets). Corbin offers the high precision Versatile Benchrest VB™ jackets in popular rifle calibers, and nearly all standard calibers of handgun jackets. Bullet jackets are from .001 to .005 inches smaller than the caliber, so they can be expanded upward when you insert and seat the lead core.

Because of the limited size of the market and the high cost of making and stocking good quality jackets, you can't always buy the calibers, lengths, and thicknesses you want to use. There are good alternatives to buying them. You can make your own, or you can buy something that is available and draw it down to make a smaller diameter, greater or less length (by pinch trimming), and thinner or thicker wall (by design of the punch to die clearance).

Commercially made bullet jackets normally contain from 5% to 10% zinc, with the balance of the alloy being copper. The 5% zinc alloy is called "gilding metal", and the 10% zinc alloy is called "commercial bronze", even though it isn't a bronze at all (bronzes are tin-copper alloys). The advantage of the zinc is that it makes the jackets easier to draw into deep tubes, starting with flat strip, without breaking through at the end or wrinkling. But for shooting purposes, pure copper tends to hold together better on impact and has about the same level of fouling if the surface finish is equally good.

Corbin makes two different systems to form your own bullet jackets, one system using tubing, and one using flat strip. Tubing dies cost less and fit more kinds of presses, but strip jackets have the accuracy edge and can be made with greater control over the wall tapers and thickness. Corbin offers deep-drawing grade copper strip in 5-pound bundles of cut sections (typically 2-foot pieces), and in 50-pound pancake coils with a 16-inch center, which fit on our automatic uncoiler for automatic feeding.

We also offer supplies of copper tubing in 1/4-inch, 5/16- inch, 3/8-inch, and 1/2-inch diameter from stock, and nearly any diameter on special order. All calibers from .224 to .512 can be made with the stock sizes. Jacketed shotgun slugs can be made with 3/4-inch tubing, and 1-inch

Gatling or 4-bore (.998) bullets can be made with 1-inch tubing. We do not stock these larger sizes but by the time the dies are ready, we would have a special order ready for you.

For big game hunting, the tubing jacket may have the edge since it is easier to build thicker walled, tougher jackets with tubing (after all, the deep drawing operation is done for you in tubing and all you have to do is round over one end and adjust the diameter in a draw die). Jacket drawing from strip can be done easily in a hand press only for the shorter jacket lengths, because punching out a disk and turning it into a cup requires a lot of power early in the stroke. Hand presses generate almost all their power at the end of the stroke. Hydraulic presses are used for rifle jacket lengths, in order to get full power at the start of the stroke.

Copper Tubing Jacket Maker Sets (CTJM-1-S, and -H)

You can make jackets from copper tubing (or almost any other metal, but copper, aluminum, brass, and mild steel are the most practical things to use, and of these, copper works best for most shooting needs). To do this, you could use copper water tubing (yes, the same kind used to hook up wash basins), boiler tubing, or refrigeration tubing. Corbin has precision drawing grade tubing available also, if you want "good stuff" for testing.

The cost of new tubing generally means that you won't save money over buying jackets if the jacket you want is already available on the market. But most large caliber jackets for rifles, or heavy walled jackets of any sort, are simply not available unless you make them, so the cost of the jacket is secondary to whether or not you want a better bullet! If you can get a reasonably good quality surplus tubing from contractors or plumbers, and the wall thickness variation is not too great, construction sites and contractors might be a low-cost source.

Regardless of the size or type, you would cut the tubing to length, deburr one end, put the piece over a precision punch and round the end over in the proper diameter end-rounding die (looks like a blunt point forming die), anneal the tube, draw it to smaller diameter, and then flatten the end with a special punch in your normal core seat die. All the tools you need to form the cut tubing pieces are included in the CTJM-1 tubing jacket maker, with the exception of the tubing saw to cut the tubing to length, and the proper core seating die to flatten the end of the tubing (or to form the boattail base). The core seating die (or boattail base former die) is part of the bullet swage set, so it is normally assumed that you have this die already.

If you only want to make the jackets, and do not have the bullet swage die, tell us so that we can recommend the proper die to finish the jacket and add this to your package. Generally, if you want to make a tubing jacket it is because you also want to make the bullet. It would be redundant to charge you for two of the same dies, one to complete the base and the same one again to seat the lead core. But sometimes a person only wishes to make and sell jackets, not finished bullets. If this is the case, we need to know it. You can't finish the jacket without one of the dies used in the normal bullet swaging set, and that die is not normally included in the CTJM-1 set.

The tubing jacket maker set will include whatever additional components are needed in order to seat the core into the jacket. For example, if you order the tubing jacket maker for .458 caliber, we will provide a proper size core seating punch to fit the jacket for a given weight of flat base bullet. However, if you plan to make a rebated boattail bullet, you might need to purchase one additional punch, an adjustable length core seating punch. This is a shouldered punch, which presses against the end of a given length of jacket and keeps it from extruding forward while the lead is being seated. Sometimes a RBT design will cause the copper tubing to extrude forward, which not only elongates the jacket but stretches and thins it at the base, where it may separate within the die. Using the adjustable length core seating punch holds the jacket in place and prevents this from happening.

Tubing Jacket Advantages Over Drawn Jackets

The advantages are (1) the tooling is lower cost, (2) the number of operations is relatively small and easy to learn, (3) tubing is fairly low cost in modest quantities compared to buying large rolls of strip material, and (4) the process makes excellent bullets for big game shooting.

In a Corbin hydraulic-powered press such as the CHP-1 Hydro-press using the -H family of high pressure dies, you can completely close the base so no hole appears. In the -S family of hand press dies, which fit the Corbin S-Press CSP-1, or when using an -H die in the Mega-Mite CSP-2 hand press, you usually cannot generate enough pressure to completely close the base, so a tiny hole remains, but it is far smaller than most military open base bullets and causes no problem.

Tubing jackets are not just pieces of tube shaped into a bullet: they are almost identical to a normal closed-base jacket. Generally, they have thicker walls with no taper toward the front. You can make almost any reasonable length and wall thickness, if you use the correct press and dies. In each diameter, we stock one wall thickness, which varies with the diameter from .028 to .035-inch.

Tubing jackets are most often used with hunting bullet designs, and nearly all commercial bullet makers today use Corbin Core Bond to create a bullet that will not shed its core, and can be shot "inside out" without losing much of its total weight. Core Bond is inexpensive, fast, and works much better in actual big game hunting than a partitioned design. The entire core is secured to the jacket, rather than just protecting half of the core. In my eclectic bullet collection, I have a bonded tubing jacket bullet that William McBride (founder of Star Custom Bullets) brought back from South Africa. It had been shot at a charging Cape Buffalo's head, penetrating the thick horn and skull (probably more than six inches of solid horn and bone).

It killed the animal with this difficult brain shot, and the 0.065-inch thick brass jacket was turned inside out from the impact but still retained nearly 100% of the bonded lead core. He also brought me a full metal jacket military bullet that was formed into a U-shape from being shot into a Cape Buffalo. The bullet came back out the same side. Either it or another one like it struck one of the South African professional hunters in the leg (and in typical fashion, the jolly fellow insisted on stopping at a bar before going to the hospital!).

I have dozens of other examples of amazing and possibly lifesaving performances from bonded core bullets using our Core Bond process, compared with other designs which failed. There is no doubt in my mind that, given the choice, every bullet I fired at a dangerous game animal would be a bonded core design.

Disadvantages of tubing jackets:

1. The walls are straight, rather than tapered, so that without special operations the jacket will not be the "controlled expansion" type.

2. Tubing jackets larger than .257 caliber generally are not practical to make below .030 wall thickness (sometimes you can get .025 wall tubing, but it is harder to find and doesn't always form, in every caliber or shape, without buckling).

3. It is not practical to build precision benchrest grade bullets using readily available tubing. This is not to say tubing jackets are "inaccurate", but only that a deep drawn jacket can be made with closer tolerances given the materials available on the market today. Tubing jacket bullets can, and have, set match records. But they probably will never set high

level competitive benchrest records. On the other hand, they certainly do bring home a lot of big game every year where the thinner and more brittle drawn jackets fail and let it get away!

4. Tubing jacket makers do not lend themselves to automatic production as easily as strip jacket makers. The initial step in making a tubing jacket is to cut a piece of tubing to a specific length. From this point on, it is handled as an individual component. Strip can be fed into a stacked or progressive die system that allows some of the operations to be done to the jacket in a continuous feed procedure, as the strip itself provides some of the conveyance of the forming jacket. On the other hand, there are less steps involved in making tubing jackets than in forming strip into a jacket.

Copper Tubing Jacket Maker sets:

The CTJM-1-S (Copper Tubing Jacket Maker, type -S) uses 1-inch diameter dies, and fits the S-Press (CSP-1) or the CSP-1H Hydro-Mite. This set can make jackets up to 1.3 inches long, although you must move the punch holder back and forth to load longer pieces and form them, or use the optional FPH-QC-S quick change punch holder. The wall thickness is limited to 0.035 inches (the standard type L copper tubing normally has 0.028 to .035 inch thick walls). Only "pure" (not alloyed or brass) copper tubing is recommended.

Jackets can be made in .22 to .458 caliber in this die family. In theory, you could also make smaller calibers from tubing, but it is cheaper and easier to make them from fired .22 cases. At this time, tubing is available from over 200 primary sources in the USA alone, but almost all the available sizes are 1/2 inch, 3/8 inch, 5/16 inch and 1/4 inch O.D. without paying for custom drawn production runs. These can be used to make all calibers in the range mentioned

The CTJM-1-H (Copper Tubing Jacket Maker, type -H) uses 1.5 inch diameter dies, and fits the CSP-2 Mega-Mite press and the CHP-1 Corbin Hydro-Press. There is almost no limit to the kind, thickness, and length of material you can form in these dies. Mild steel, copper, brass, aluminum—all are candidates for a set of tooling to make good jackets. However, you cannot interchange them with abandon. A set of dies developed for the characteristics of one metal, one wall thickness and diameter of tubing will not necessarily work with different material or dimensions.

You can order tubing made from nearly any material, but unless it is commonly available from the mills, and stocked by the distributors, you may pay a hefty premium for the use of such materials. Corbin stocks copper tubing in the proper grades, tolerances, anneals, and diameters to make nearly any caliber within our standard range. Unless you really have a strong desire to dive into deeper waters, and do not mind that it will cost extra for both the material and possibly for the development of correct dimensioned tooling that is nonstandard, it is best to stay with proven materials and dimensions.

Changing jacket lengths:

You can change the length of a tubing jacket, if you also purchase an additional punch per length. The end rounding punch has a turned-down section that is just shorter than the desired length by half the diameter of the tubing, so that enough metal protrudes to be rolled over into a base within the first die. Normally you can use the same end flattening punch for a modest change in length, if it is longer than the punch tip. The whole idea of these punches is that enough unsupported tubing projects past their end to roll over into an angle or curve (in the end rounding die) and then flatten by pressing firmly in the core seating die (without a core).

If your jacket projects a little more past the end than the sample sent with the punch, it will probably work anyway, until it gets long enough so that a lot of jacket is unsupported and collapses inward on itself when you try to round the open end. But if the jacket is even a little too short, the punch will come up against the end of the die and there won't be any jacket there to be rounded. Thus, you have wider base openings, incomplete closures, and might even damage the die or punch trying to get the base to close up.

The right length to cut the piece of tubing is marked on the side of the end-rounding punch. You want the cut tube to rest on the punch shoulder, be supported by the reduced diameter tip up to about half a caliber that projects beyond the punch end. You are going to fold half a caliber per side to close up the base. The length of the cut tubing is critical to within about 0.01 inches for a given punch.

An alternative to buying specific length end-rounding punches is to purchase one adjustable length punch. The adjustable length punches can be set so that the shoulder section moves, like the barrel of a micrometer, and allows more or less of the tip to project beyond it. The pressure is tremendous, stress on the parts is high, and the punch has to be made very strong if it is to last. An adjustable punch will cost more than a solid one-piece punch.

The cost advantage is twofold. First, if you want three or more lengths of tubing, the adjustable punch will usually pay for itself over buying individual punches. Second, if you don't know for sure what length you want, but only have a rough idea based on approximate weight and amount of exposed lead or open tip, then the adjustable punch avoids mistakes and lets you use whatever length eventually proves to be best for your ideas and weights of bullet.

Changing Tubing Dimensions:

A CTJM-1 tubing jacket maker set is designed for a specific diameter and wall thickness of tubing. The length is easy to adjust by using different end rounding punches (within reason). The actual tubing diameter controls the size of the dies, and the wall thickness of that diameter of tubing controls the diameter of the punches. Therefore, changing tubing diameter means getting a different tubing jacket maker set, and changing the wall thickness means changing the punches with possible exception of the punch that draws down the jacket to actual caliber requirement (sometimes this punch will work with thinner walls than the original jacket design).

Note also that if you change the diameter of tubing, or the wall thickness, you will probably need different components from the separate bullet swage set. The core swage die accepts a specific size of lead wire and expands it so it fits properly into a given jacket. If you change the jacket internal diameter, the same core may no longer fit inside. This would mean getting a different core swage die. If the wire that you used before is now too large to fit the new core swage die, then you will also need to obtain smaller wire diameter.

Also, the core seating punch probably will not fit a different diameter of jacket I.D. since it must be a pressure-sealing fit to the jacket. Changing wall thickness almost always requires a new core seating punch for the core seat die. You can see that going from a .030 to a .050 jacket wall thickness could require different lead wire, different core swaging die, and different core seating punch. Going the other direction, you may be able to get by with just a larger diameter core seating punch, because the smaller core probably will still fit into the jacket well enough.

If, on the other hand, you were to change jacket materials from a .050 to a .030 wall thickness, there is no doubt you would need new smaller diameter lead wire, core swage die, and core seating punch, in addition to the end rounding punch, jacket drawing punch, and end flattening punch. If you have multiple lengths or adjustable length punches for the .050 tubing, you may wish to replace them all to have the same length capabilities for the new .030 tubing.

In order to build the new components, we will need the entire set here. This is especially true if you obtain your own tubing, since it may react differently than ours to the same pressures and dimensions of tooling. A development fee usually applies because of the amount of time it takes to build and test different punch diameters and to develop the information we need with tubing different from that we have thoroughly examined for years. Normally this is two hours at current shop rate.

The two most common problems clients have using tubing jacket makers is failure to use the same material that was used to design the tools, and failure to follow directions about length and annealing steps. The problems often show up further down the processing line, instead of immediately (at least to the inexperienced jacket maker). Bullets may stick in the point forming die, and the bullet maker is ready to condemn the swage die when in reality the entire problem is a skipped annealing step when the jacket was being formed. Jackets may wrinkle, deform, crack at the base, or stick fast to the end flattening punch, and the problem is simply that the operator believes his tubing, obtained locally, is equivalent to the tubing used to develop the die set when it is far different in some respect.

Even if the dimensions are the same, the hardness or grain structure of the metal may be different enough to cause problems during precision redrawing and base forming. When we build a jacket maker set, it is best if we start with the material you plan to use. If you change materials, we can add punches (so you build a wider range of working supplies) or modify your existing punches (probably not as cost effective, since it takes close to the same labor cost to change them as it does to make new ones).

Selecting the right tubing:

The standard sizes of tubing that are available, and which we stock for resale, are 1/2 inch O.D., 3/8 inch O.D., 5/16 inch O.D., and 1/4 inch O.D. We can also make custom diameters. They are more expensive than the standard sizes but we can draw them for you. The wall thicknesses are normally .028 or .035 depending on the diameter and standard tubing industry practice. We can obtain .050 and .065 or close to these diameters in the 3/8 and 1/2 inch sizes, on special order. We can also custom order anything you want that a copper tubing mill will make, but it may be subject to minimum quantity and must be prepaid. You are probably well advised to buy it for yourself and make your own best deal, then send us sample material to build the tools, once you step outside of the sizes and thicknesses that are popular enough for us to stock.

I'll be glad to act as a buyer agent for you, but judging from past experience, a person who hasn't been shopping for custom tubing tends to rapidly change from vertical to horizontal orientation upon learning the price... and it is less stressful for me to be the one hearing about it from you, than conversely. All that having been said, people do buy custom tubing now and then, and although it is normally higher than what we stock, if it does the job better than anything else, and you are satisfied with the performance (or can sell the bullets for a reasonable profit) then obviously the tubing price isn't too much.

In each caliber, the closest larger diameter of tubing is selected as the starting point. The 1/2 inch tubing is used to make all calibers from .512 down to just above .375 (for instance, the .400 caliber). Both rifle and handgun calibers can be made, although you need end rounding punches for each length. The first step, rounding the tubing end, is the same for all of the calibers that a given diameter of tubing can make. It uses the same end rounding die.

For example, if you wanted to make both a .458 rifle jacket and a .429 pistol jacket, you could start with exactly the same .458 CTJM-1 die set, because both of them use 1/2 inch diameter tubing. You would need two different end rounding punches, assuming the .429 was a short pistol jacket and the .458 was a longer rifle jacket. Otherwise, if the length is the same, and you are using the same diameter and wall thickness of tubing, then the same end rounding die and punch can be used for both.

If you plan to get your own tubing somewhere else, we must have at least six feet of it on hand before we can start your order. We will cut it into pieces and test the tooling. The length and diameter, whether the tubing sticks or releases from the punches, the concentricity and evenness all depend on the temper, grain, alloy, tolerances, wall thickness, and diameter of your tubing.

Plumbing is not especially precise in these factors. If you get a large quantity at one time, it will probably be consistent enough to make good bullets, but if you change suppliers there is no guarantee that the same nominal sizes you get will be anywhere near identical. The jacket maker punches may need some adjustment, or different punches need to be made, in case you change vendors or your vendor changes specifications.

Corbin's tubing is higher cost than some of the tubing you will find in the hardware stores, but not by a great deal. We are very strict with our specifications and order large lots of high quality tubing just for bullet making. We recommend that, unless you have a good source of tubing in mind, you use our standard tubing to get started. We can help you obtain larger quantities when your needs outgrow a few dozen feet at a time, but until then, the odds are good that you won't find much better pricing.

My recommendation is that you establish prices for your custom bullets that allow you to make a profit even with the higher cost material, purchased initially in small quantity. Then, by the time you can afford the larger mill orders, you'll have already guaranteed a higher margin and your success will be just that much greater.

The range of calibers for each size of tubing

Custom sizes frequently used:
7/8: .787 down to .750 such as 20mm and similar slugs.
3/4: .75 down to .626, such as 12-gauge jacketed bullets.
5/8: .625 down to .510, such as .600 Nitro, .577 Snyder.
7/16: .438 down to .380, such as .40 caliber or .44 Magnum

Standard (stocked) sizes:
1/2: .510 and .458 down to .380 diameter.
3/8: .380 down to .318. Best in .375, .358.
5/16: .318 down to .264 caliber. Best for .308.
1/4: .257 down to .224 (but free .22 cases are available)

To cut copper tubing cleanly and accurately, at a good production rate, Corbin builds a power tubing cutter saw (SAW-1). We also make a version for continuous lengths (no limit to the cut length on either side of the blade) called the SAW-2. A standard, roll-type tubing cutter usually rolls the end so much it won't fit over a punch.

You can also use either a lathe, or a metal cutting blade in a saw. Some of the more successful methods include a fine tooth metal cutting blade in a chop saw, table saw, miter box saw, jig saw, or band saw. A home-built stop, consisting of nothing more elaborate than a block of wood clamped to the saw table, will give you reasonably accurate lengths. The number of teeth per inch should be from 32 to 40 on a hacksaw blade. The rule of thumb is "three teeth in the material at all times". Copper is a little "sticky" so you may wish to use a blade with a special tooth set or with a reverse rake on the teeth.

There are some low cost modified circular chop saws available that are supposed to be made for tubing, but I have tried them and they leave much to be desired from the standpoint of precision, clean cut, or safety. If I thought they were any good, I would simply buy and resell them rather than build our own.

To get a good clean cut without vibration and burning, we use a high speed steel blade that has been cyrogenically treated and dry film lube coated. The blades have a rake that lets them cut copper smoothly, and no set to the teeth so you get a minimum amount of waste with each cut. To reduce the risk of kickback and for other safety concerns, we use a 3-inch diameter blade and secure it to a ball bearing shaft supported at both ends, driven by a toothed rubber drive belt, in the manner of a tool post grinder.

The precision spindle assembly reduces wobble and drift to nearly zero. On the continuous length model, we use two such spindles so the tubing can clear the drive assembly and be infinitely long. On the standard bullet-makers' model, you can cut up to about 3 inch long pieces, more than sufficient for any reasonable bullet that doesn't require a mobile platform gun!

We also have tubing in 2 foot lengths, easy to mail or ship anywhere in the world. You can save some labor cost by chopping these up yourself. Tubing normally comes in either 20 foot pieces in big boxes of 200 to 500 pounds each, or in coils (annealed tubing). We use hard drawn or 3/4-hard, as it is called, because it is easy to handle in a lathe for cutting.

How to make tubing jackets:

First, you cut a supply of tubing to the length specified on the end rounding punch. If it says "1-1/4" on the side of the punch, that is the length to cut the tubing. It will make shorter jackets because the end will be rolled over. But it may also become longer in the process of drawing down to size, so you can't really tell exactly how long the jacket will be until you have made a few with a given material.

Step 1, End Rounding:

Make sure the cut tubes will slip over the end rounding punch. They may fit snugly, but if they can't be forced on by hand, it is probably due to a burr or rolled edge from the cutting operation. This will need to be removed using a countersink or a chamfering tool. Jackets cut with the SAW-1 normally are burr-free unless the blade has become worn out. (Blade life can be greatly extended by making sure a light oil or tool coolant is used on the felt pad that rubs the sides of the blade, inside the guard, and is frequently refreshed).

To round the end of the tubing, first install the die marked "J" (for jacket making die) in the ram of your press. This die has an ejection punch, similar to a point forming die. It fact, it is a modified version of a point forming die. The internal punch needs to be "trapped" by the stop pin in the S-Press. To easily do this, remove the internal punch from the die and grasp it by the tip of the ejection pin. Hold the punch so that you can see about how far down the hole or slot in the punch head has to be, within the ram, in order to put the stop pin into it. (Older -M type dies have a slotted punch that uses the short stop pin, current dies use a hole through the punch and a long stop pin.)

I like to hold the pin between my thumb and forefinger on the outside of the press, and slide it so that the hole in the head lines up with the stop pin with my finger tips just level with the top of the ram. Then without changing my grip, I move the pin into the ram, lower it until my fingertip touches the ram top, and insert the stop pin. With very little jiggling up and down or turning, I can always get the stop pin to pass through the hole this way.

If the internal punch (or, if you prefer, ejection pin punch) is secured, you can pull it and it won't come out of the press ram. Now, align the hole in the threaded end of the die with the punch tip, slide the die down, and screw it into the ram. The punch is now centered by the hole in the die, and is secure within the ram by means of the stop pin. Insert the external end rounding punch into the punch holder in the top of the press.

If you are using the -H dies and larger presses, then a retraction pin goes through the hole in the punch, and the knockout bar goes under the punch head, through the slot in the ram. All swage dies (not draw dies) work this way. Some do not require the retraction pin, but the end rounding die does.

Lubricate the inside of the jacket with a swab, using Corbin Swage Lube. Wipe a little of the same lube on the outside. You can use your fingertips for this. The amount isn't critical, as long as you have some present. Some people lubricate the outside of the top punch (the external punch). This really isn't as good. When you push the tube over the punch, the snug fit probably will shove all the lube up and fail to get inside the tube at all. Then the tube may try to stick on the punch. A swab saturated with swage lube is a quick and easy way to get plenty of lube inside the tube, where it will do some good.

Adjust the floating punch holder so that the punch is rather high in the press, and allows the ram to go all the way up without any contact inside the die. With the ram all the way up, lower the punch holder until you can't turn it by hand because the jacket is against the end of the die cavity. Lower the ram slightly, and give the punch holder a slight turn, perhaps a quarter to an eighth of a rotation, toward the die. Then raise the ram. Repeat this adjustment process until you feel some resistance. Lower the die and inspect the jacket. You have gone far enough when the end of the jacket is rolled over so it makes a hole slightly smaller than the diameter of the ejection punch. If there is enough length to the jacket, it will be possible to just start to form a little “pipe” on the end of the jacket, where the jacket tries to go up the ejection pin hole. That is nearly perfect adjustment.

Lower the ram, and you should be able to turn the jacket by hand and slide it off the punch. If it sticks on the punch and cannot be removed with only mild force, by hand, then it means the tubing wall is too thick for the punch diameter or you did not lubricate the tube properly. The latter is easy to fix, the former means you need a different punch or different jacket material.

Step 2, Annealing:

You must anneal the tubing jacket *after* you have formed the rounded end and *before* drawing it down to correct diameter. If you fail to heat the jacket red hot and let it cool (annealing it), then you will have problems with cracking, sticking on punches, uneven or difficult forming. A regular propane torch is all it takes. Just sit a few jackets on a couple of fire bricks, arranged in an “L” shape so the flame is reflected back, and heat them by playing the flame directly on the jackets, one by one.

Corbin offers a ceramic block “kit” for heat treating and annealing, consisting of two low thermal density ceramic blocks and a template for drilling a pattern of 32 holes, to support the tubing jackets for annealing and for bonding cores. The soft ceramic material is easy to drill with a pocket knife or a wood bit (not a new one unless you plan to resharpen it). One block can be used as a reflector to direct heat to the opposite side of the jackets. All it takes is a few seconds to heat them and let them cool for a few minutes before further handling.

A great many of the problems that some bullet makers have with tubing jackets and bullets comes from skipping the annealing stage. For whatever reason—maybe because it takes extra work—they assume the step is unnecessary. Wrong! Skip it and you will have problems with tubing that sticks in the dies or on the punches, bullets coming out the wrong diameter, or bullets that come out the wrong length! Maybe you will get away without annealing in some rare case, but by and large, it is a required step that affects the rest of the operation severely if skipped.

We also offer electronic-control, electric heating furnaces with digital readout. The HTO-2 Heat Treatment Oven runs on 120 volts or, optionally, 240 volts, and can safely generate 2000 degrees F. and hold the temperature within a few degrees. All you need to anneal the tubing is about 1400 degrees F. for a few seconds. Just a visible red glow is enough. No need to keep it hot past that.

You must anneal *before* attempting to draw down the jacket material. The only exception to this is with rimfire jacket cases, because of the head unfolding. In this case only, you must anneal *after* drawing, *never before drawing*. Annealing a rimfire jacket before drawing it can cause the drawing punches to break, if the soft thin jacket tries to bunch up around the punch. But copper tubing is tough and thick, and needs to be annealed before you do any more to it so it won't become too brittle. I thought I should mention this exception, so you don't get confused later when we reverse this procedure in making free jackets from fired .22 cases.

Softened copper tubing expands better and generally is less likely to fragment on impact. It also picks up a scale that comes off in the bore, unless you tumble or vibrate the bullets in a polishing media to remove it. This scale may be what causes some kinds of custom bullets to "foul" worse than a gilding metal jacket.

To eliminate this soft surface scaling or powdery finish on the tubing jacket, we make the BPK-1 Bullet Polisher Kit. It is a kit consisting of a vibrator motor prewired with thermal cutout, line cord and switch, a mounting bracket and anti-vibration hardware, instructions and a package of polishing media. Mounting this motor to the bottom of a coffee can or bucket is the usual procedure, with the container suspended from a shelf bracket or a door spring hooked to some kind of hanger. Vibratory polishers tend to move the media around and carry the bullets in it, instead of rolling the bullets against each other.

You do not need to polish the jackets yet. Wait until they are finished. When you do polish them, it is best to use walnut shell without any additional abrasive. Abrasives used to polish bullets will embed themselves in the surface of the jacket, and be carried to the bore, where they tend to "lap" the bore and thus cause unnecessary wear on the rifling.

Lapping is not always desirable! Once the bore surface has been polished, further lapping is just wearing it out. I mention this because some people have suggested that abrasives embedded in bullets could be used as "fire lapping" treatment.

Great idea, but wait until I start selling replacement barrels before you try it! It's a little like saying "If a little wear is good, a lot of wear is better!" Better for the guy waiting to sell you another barrel, that is.

Lapping is just controlled wearing away of the high points. Tooling chatter makes high points and low points, and lapping wears away the high points so they come closer to matching the low points. But rifling is the ultimate high point in your bore, and continued lapping is just wearing that away until it matches the groove depth and you have a somewhat larger bore shotgun. Geeez...you'd think this was obvious but believe me, not everyone gets it.

Where was I? Oh, yeah, I was getting to the point of copper tubing bullets and fouling. It bears repeating, since I probably mentioned it in other places: copper tubing doesn't foul your bore any worse than factory bullets, unless the material was left in a poor surface condition. Now, I know, you have probably used tubing jacketed bullets before, and maybe you got some that had not been burnished or polished correctly (or at all). These bullets probably did leave some excess copper wash. So the end result is that you may have equated copper jackets with fouling.

But it doesn't have to be that way. Just polish them with walnut shell or other non-embedding media (corncobs will work, much more slowly than walnut). This removes the loose, flaky surface finish, and gets you down to the work-hardened surface. It glides along on top of the rifling just fine, and leaves no more of itself behind than any decently finished gilding metal jacket.

Step 3. Drawing to Size:

You now have a tubing-diameter "jacket" with one end rounded over but not flattened. The next step is to draw this original diameter jacket down to a size that fits into the core seating die. For this, a punch is used which screws into the press ram, instead of into the floating punch holder. The punch holder is removed from the press, and instead the JRD-1 jacket draw die is installed. In a hand press, this die is set relatively high, engaging at least two or more threads fully, but set to use the maximum leverage at the end of the stroke just as the jacket clears the constriction of the die. In a power press, this isn't so important, because there is full power all through the stroke.

In the S-Press, it is generally desirable to change the stroke into the long mode (move the pin that fastens the ram to the toggle arms so it moves in the widest arc). Be certain to remove the Stop Pin, in the front of the press, or else you will not be able to use the full stroke and may possibly shear off the stop pin if you try hard enough! The stop pin is only used for bullet swaging, in the short stroke. If you do not use the long stroke, you may not have enough ram travel to push the jacket through the draw die, or even to load another jacket onto the punch.

With jacket drawing, you may or may not have to put any more lube inside the jacket. Play it by ear unless the instructions that come with the set say otherwise. If the jackets stick on the punch, lube them inside with a swab. But otherwise, skip it. It is a good idea to wipe a little lube on the outside of the jacket, since this part of the material will be in heavy contact with the die. Slip the jacket over the end of the punch, with the ram all the way down. Raise the ram and push the jacket through the die. If it doesn't pop out the top, use the next one to push it out. But generally, it is best to get out jacket all the way "free" even it if is still sitting in the top of the die.

Drawing punches are somewhat long and of small diameter, so try not to ever side-load them by cocking the jacket sideways or running the jacket into the die face instead of into the hole. These things would be a result of hurrying too fast and not paying attention to the alignment. Drawing is straightforward: in the bottom, and out the top. The jacket should be easy to remove from the punch after drawing.

If the jacket is reduced too much for the punch, it will pinch the punch and may pull the punch apart on the down stroke. This would be a matter of possibly selecting the wrong punch when you have several that look similar, or using a jacket with walls that are too thick... assuming of course that the die and punch and jacket combination worked when it was tested and shipped. Change any of the three, and it might not work.

The jacket drawing step is the first point where you can add more calibers to an existing die set. There are two ways to do this.

First, you can change the draw die, and get a different end flattening punch as well, and then use the reduced jacket in the new caliber core seating die. This method is the most likely to always work with all calibers.

The second way is to go ahead and finish the jacket at the larger caliber, for which the set was built, and then draw down the finished jacket. This method still requires a draw die (with different dimensions) but does not require a new end flattening punch. And usually it works. But sometimes the base tries to unfold when a tubing jacket is drawn down too far, because the punch diameter supports only a small part of the jacket base while pushing against the resistance of the reducing die.

(Someone in the back row yells out "Well, make the punch bigger!" about now, forgetting that the punch has to fit easily inside the jacket after it has been reduced, and thus if the difference in reduction is great, the punch will be relatively small...or else, relatively stuck! Never mind: he works for the government.)

Within the normal range for a given diameter of tubing, you can simply add a JRD-1 jacket reducing die for the tubing, and a matching End Flattening ("E") die for your existing core seater die, and turn a CTJM-1 set into a different caliber, either smaller or larger than the original design. In some cases, you can finish the jacket and then draw it to a smaller size (not larger) with a JRD-1. When deciding which way to go, it is wise to figure on the first method. Sometimes we can get the second way to work reliably, but not always.

Step 4. Finish the Base:

Now you have a round-ended jacket, annealed, and drawn to the correct diameter to fit within a core seating die (or the BT-1 boattail forming die). The final step is to finish the base, either making it flat, or shaping it into a rebated boattail.

The punch marked "E" is similar in appearance to the "J" punch (jacket maker or end rounding punch). It has a reduced diameter section from the tip back to a shoulder. However, it has a smaller diameter in both sections than the "J" punch. The end flattening punch presses against the base of the copper tube jacket, from the inside, and forces it against the internal core seat punch within the core seating die, flattening the base between the two punches. Or, in the case of a rebated boattail base, the end flattening punch is actually a boattail forming punch. It has an angle on the tip, matching the inside dimensions of the boattail shape. The rounded base is formed both with a flat and a boattail angle, in the BT-1 die. The rebated boattail is formed later, after the core has been seated into the jacket.

Normally, only one "E" punch is required for a wide range of jacket lengths. The shoulder on this punch usually performs only the function of centering the punch within the die, and does not push on the end of the jacket. We are not shoving the jacket material by the bottom edge, because we now have the rounded end to push against. The exception is the shouldered punch, which is often made in adjustable style, and is used to stop the jacket from growing longer as a boattail base is formed. Some materials and calibers tend to extrude the tubing jacket forward as you form the boattail base. It can be severe enough to stretch the base angle to the breaking point, so that the base pops off the jacket. The shouldered punch prevents the jacket from moving or extruding forward and solves the problem.

Remove the jacket reducing die and punch, and install the floating punch holder. If you are using the S-Press, shift the ram pin into the short stroke position again, and put the stop pin back in the press. If you forget the stop pin, the internal punch for the core seating die will drop down into the ram and you may have to pull the ram out and turn it over to drop the punch out. Speaking of removing the ram, remember that when you pull out the ram-to-toggle pin without the stop pin in the front of the press, nothing holds the ram but luck and friction. It is a good idea to insert the stop pin before removing the ram pin. That way, the ram can't drop out and land on your foot.

With the normal core seating die, or the BT-1 boattail preforming die, in the press ram, the press back in short stroke position (hand press), and the "E" end flattening punch in the floating punch holder, lubricate the inside of the jacket and wipe a little lube on the outside as well, and put the jacket over the punch. Raise the ram, and then bring the punch holder down until contact is made between the jacket and the die. Adjust the punch holder so that the base just closes or forms the boattail shape with a flat base. This operation should take place at the end of the stroke, using the best leverage, in a hand press. But stop adjusting closer and closer, once the base forms. If the base isn't totally closed, do not try to make it close further in this operation. It will not do so, and the attempt may break the die or bend the punch. If further closure is desired, it must be done by making the tubing slightly longer prior to the first step, and then creating more of a "pipe" on the end of the tubing jacket while rounding the end.

Sometimes, in the boattail operation, the jacket may stretch or slip back and open up the base hole beyond what it was before flattening. In that case, an adjustable end flattening (or actually, boattail forming) punch may solve the problem. However, the hole in the base is much smaller than with military full jacket bullets, which are often fired in hot-running machine guns. If the lead doesn't "melt out" of these bullets, it surely will not in a civilian target or hunting gun.

Also, if you calculate the amount of force on the exposed core area, versus the amount of force on the rest of the rolled-over jacket, you will find it runs better than 100 to 1 in favor of pushing the jacket rather than the core. The issue is whether the core can be "shot out" of a tubing jacket bullet. Of course, it can, if the force on the core is greater than the force accelerating the jacket. To make sure this cannot happen, tubing jacket bullets should either be bonded, or should use an ogive that wraps the jacket material around the nose so that looking at the bullet straight on, the jacket covers at least 1/2 of the total cross-sectional area.

To put this potential problem in perspective, we've been making tubing jacket bullet sets for about 30 years, and our clients have made millions of tubing jacket bullets in that time. So far, we've had about...let's see, ummm...zero instances reported of a core being shot out of the tubing jacket. Looks like a fairly safe bet to say it isn't likely to happen. But still, it could, if you made a non-bonded bullet with a wide open, nearly cylindrical nose shape and not much of a roll-over at the base. Fortunately, there isn't much interest in that shape, in the calibers and styles that people typically want to use with tubing jackets.

There is no step 5. You just finished the jacket. Now, regardless of whether it is a flat base or a boattail, you'll want to seat the lead core into it just as if it were a commercial flat base jacket. That is, swage the core, then seat the core in either the CS-1 core seater die (flat base), or the BT-1 boattail preform die. The reason for seating the core is to expand the jacket from internal lead pressure, and form a tight fit between the jacket and core. If you want to bond the core, it would be done now, prior to seating the core.

But before you do anything else, clean the jacket of any internal lube. Swage lube inside the jacket will either unbalance the bullet, cause the core to slip when the bullet is fired, or burn into a film that prevents core bonding. Very hot water with a little detergent in it will remove the Corbin Swage Lube. Organic solvents like alcohol, benzene, acetone, and similar non-oily (not kerosene) solvents can be used. Slosh the jackets around in the hot water or solvent, and then let them dry. Lube on the outside is OK, but lube inside is not.

The lead cores will also need to be cleaned before insertion into the jacket, whether or not they are to be bonded. To bond the core, drop the core into the jacket, add one or two drops of Corbin Core Bond, and then quickly heat the jacket until the lead melts. Let the core cool, and then wash in hot water with a teaspoon of baking soda per quart. Spread the bonded cores/jackets out to dry before you seat the cores. I'll discuss core bonding in more detail later.

5. Drawn Strip Jackets

A second form of jacket making uses flat strip instead of tubing. This is the method used by the mass producer of bullets. Strip material generally costs less per bullet than tubing, and lets you make exactly the wall thickness, wall taper, and length of jacket you desire. In a hand press, the jacket must be kept relatively short, generally under 3/4 inch. But in Corbin's CHP-1 Hydro-Press, you can make 20mm jackets, .50 BMG jackets, or jacketed 12-gauge shotgun slugs if you wish (as well as all the smaller calibers, and jacket walls thicknesses up to virtually solid material).

I'm especially pleased with the work that we have done in bringing the costly high-speed production system down to an affordable, lower-volume operation. Until our years of work brought about the JMK- series of tools to make flat strip into quality bullet jackets, you would have been faced with rebuilding old transfer presses that cost at least twenty thousand dollars each, building progressive dies with a shuttle feed for another five to ten thousand dollars, and then buying all the feeder and handling equipment to make it work, plus hiring a die-maker to keep it operating and fix it when it failed. There was no affordable, turnkey package that you could just purchase. You had to design and build it yourself, or hire someone to do it.

But now, with a considerably smaller investment, you can make every bit as good a jacket, usually better. More importantly, you can make these jackets in the specific way that will perform best, not just some way that lets them feed fast through an automatic machine. And, you can use ductile, pure copper if you wish, which is normally too sticky for the high speed punch presses: it tends to break out at the base as you slam it through a progressive die. This is the main reason why a five or ten percent zinc content is used in factory jackets. Adding zinc makes the material stronger so it can resist the end-tearing force of drawing, and makes it a little harder and slicker so it won't stick quite as much on the punch or in the die.

By using the relatively low impact of a slower-moving hydraulic ram, Corbin's system eliminates the problem of breaking out the bases with ductile copper material. You no longer have to use copper tubing to get the large mushroomed bullets that don't crack apart on impact.

Changing calibers or operations is quick and simple in comparison to a punch press. Twenty minutes would be a long time to set up the Hydro-press for jacket making. Five minutes would be slow for changing calibers. Fifteen hours might possibly give you enough time to get a punch press retooled for another caliber, including the tedious testing and adjustment period.

As with most things in life, there is a balance to be made. The punch press system costs as much as a new car and takes days to tool up, so you must make hundreds of thousands of the same part once you have it working. Otherwise, the set up time eats up all the benefit and there is no gain. Your cost per jacket would be astronomical. But most shooters and custom bullet makers don't need to make more than twenty thousand to perhaps as many as a hundred thousand jackets a year. That would be a day or two in punch press production time.

If you need millions of jackets, the cost and time involved with full automatic presses make good sense. If you need a more moderate quantity, it can't be justified. The Hydro-press can easily justify its own cost with the kind of quantities a custom bullet maker requires. Bear in mind that the goal of making custom bullets is, in fact, the custom feature. If the bullet you want is available from a mass producer and the price is reasonable, buy it. But if you want to fine tune some particular combination of features to make the best possible bullet for a certain purpose, then you need the kind of control over components that a jacket drawing system can give you.

Copper Strip

Copper strip can be purchased from Corbin, or from over 200 copper mill outlets in the United States and Canada. Many of the large copper mills have outlets around the world. Names such as Olin and Revere share space in our "World Directory of Custom Bullet Makers" with the makers of precision brass, gilding metal, German Silver, bronze, and aluminum tubing and strip. You can find their addresses and write for a list of outlets close to you, or direct shipment terms and prices.

Generally, for moderate size lots, our prices will be reasonable. But I would encourage you to shop around. Sometimes our prices are far better, during high copper market prices, because we stockpile when the market is low. Copper isn't a bad investment when you have reason to take delivery of the actual material. You just have to know the historical price swings and buy when it is cheaper, or buy futures options and sell them when it goes higher. Sometimes, if you find the market for copper is low, you can buy strip at a better price elsewhere. But generally, the minimum mill purchase will be too much for a lower-volume bullet maker to justify. We sell in five pound bundles or fifty pound coils, for example. Most mills are interested in 500 pound coils, and usually a truck or railcar load minimum gets you into the wholesale pricing ranges.

In most cases, if a bullet jacket is selling for eight cents, you can make it from strip for about five cents. But the custom bullet you can make from this jacket typically gets another two or three cents worth of lead added, and then sells for a dollar and a half! Typically you would make from 50 to 100 bullets an hour, depending on the complexity of the bullet. But let's say you could only manage to complete twenty bullets an hour. Your hourly cost is what you could pay to replace your own labor. Just for illustration, let us assume you could hire someone to push the buttons for six dollars an hour. Prices tend to move in relationship with wages over the years, so the example will hold true even if the numbers do not.

The one hour labor costs you six dollars, and the material cost for twenty bullets is eight cents each, or one dollar and sixty cents. So the hour's production cost you seven dollars and sixty cents, and the average price a serious shooter will pay for custom bullets is a dollar fifty each. That means thirty dollars for your hour's work. Subtract the seven sixty cost, and your profit is actually $22.40. The return on your investment is 294.74 percent!

And you wonder why people become custom bullet makers? Are you getting anything close to 200 percent on your money now, sitting in a savings account or in mutual funds, insurance, or any other typical investment? You are the best investment you can ever make: bet on yourself and be a winner! You know the horse, the rider, and the trainer, in a manner of speaking, since your mind owns them all.

You can use gilding metal (5 percent zinc) or commercial bronze (10 percent zinc) like the factories do, but you don't have to (and they do). These zinc alloys are a little harder, but they are also harder to obtain in small lots because they are binary alloys which can be made in a virtually unlimited number of alloy mixes, grain structures, and tempers. Copper is just one element, and it comes as annealed (dead soft), three-quarter hard, half-hard, and full hard drawn. It comes in a standard and a deep-drawing (non-earing) grade.

The non-earing grade isn't completely free from the little lobes or ears that grow on the edge in a deep drawn tube (like a jacket), but the amount of this waste is minimal compared to standard strip used for flashing, welding transformer windings, and other non-drawing operations. An uneven edge is caused by tiny differences in grain or hardness which show up as greatly stretched differences in a deep drawn part. The more uniform the grain, the less earing will occur.

The edges need to be finished, so that there is very little burr or waviness in the edge of the strip. If the edges are curled, as they might be when cut with shears or tin snips, the strip thickness appears to be much greater so it won't feed through the slot in the disk cutting die. If the edge is rough or wavy, it will be difficult to pull the strip through the guide slot. A die set is made for a certain width and thickness of strip, as well as a certain material. If we have plenty of your material, we can make special dies for it. Otherwise, we offer the dies made for our own material, and cannot recommend or guarantee operation with anything else. Fortunately, our material is a standard around the world, so you can get it from hundreds of other suppliers.

When we design your dies, we will also calculate the correct thickness and width of copper to use for the jacket. You can also do this with a software program called "DC-CUPS", available from Corbin. This program can record specific jacket designs, including details on every step of drawing, and print out a production process giving all the parameters. You can calculate strip width and thickness for any jacket, and even design the jacket given a certain bullet weight, style, caliber and shape. The program works with both strip and tubing.

CU-5 (Copper Strip, 5-lb bundle):

Corbin offers copper strip in two packages. First, you can purchase a five-pound bundle of strip, in pieces cut to 18 or 24 inch lengths. We provide our standard .030-thick deep drawing grade pure copper, in a 1 inch width. This is a very practical and versatile size, which can be used for Base-Guard disks, gas checks, half jackets, and all calibers of handgun jackets, and the smaller rifle jackets. We also can provide other widths and thicknesses as needed from our normal stock.

CU-50 (Copper Strip, 50-lb coil).

The most economical weight is the 50 pound size, which we stock in several widths and thicknesses. These are flat, pancake coils with a large "eye" or center hole, which fit on the Corbin Strip Uncoiler machine (CSU-1) for automatic feed into the press.

I should point out that the CSU-1 can be used with either the automatic feed die set, or the manual feed set. If you purchase large coils, you'll either need the CSU-1 or something like it to uncoil the strip without kinking it, or you will need to chop it into easily handled pieces. The whole idea of the continuous coil is to let you run the blanking and cupping stage in the "automatic" mode, which really means you keep an eye on it but it runs by itself until you have made the desired count of jacket cups. A counter on the Hydro-press lets you know how many pieces you have made.

Jacket Maker Kits (JMK-1-S, -1-H, -2-H)

Corbin makes all the tooling you need for any kind of jacket imaginable, from a .14 caliber to a 20mm cannon. The process can be done in a regular jacket-maker die set, or an automatic strip feed system that blanks and cups the strip at better than 600 per hour, no hand feeding required for the first stage. Both systems require handfeeding of the cups into the redrawing and pinch trimming (to exact length) stages. The demand worldwide for these sets has been overwhelming. As a consequence, we often have delivery times that can be over a year. This is not always the case, of course, but it has been in the past and may be again at times (whenever panic sets in because of some harsh new ammunition or firearms law). Find out whether we have anything available in stock, or whether our backlog of orders is extremely long, before you plan a business around the strip jacket making equipment, or schedule a trip to see it or take it back with you.

JMK-1-S (Jacket Making Kit for S-Press):

Corbin hand presses make jackets from .030 inch (or less) thick strip. That covers most handgun jackets, and some smaller caliber rifle jackets like the shorter .22, 5mm, .17, and .14 calibers. It leaves out the larger rifle lengths of bullet jackets with thicker walls and larger diameters, which typically run from .75 to 1.3 inches in calibers below the .50 BMG. For these, you need the Hydro-press.

A hand press just doesn't have the starting pressure at the bottom of the stroke to punch and coin a blank of copper, then draw it into a deep cup longer than about 7/10 inch. Sorry: that's just physics. If people were made with 20 foot long arms and legs, then we could build hand presses with bigger strokes. But once you've made a .45 caliber jacket about 0.7 inches long, you can redraw it and make it smaller and longer. So long as a fairly thin jacket is acceptable, you can make long jackets in calibers from about .308 downward in diameter by redrawing.

The first stage is a blanking die. You pull the strip of copper through a slot, and work the press handle up and down to punch out little disks. The second stage is a cupping die, which turns the disk into a short, thick cup. The third stage redraws the cup to make it longer and thinner, and the final stage trims the cup, while giving it the final diameter. Detailed instructions are put with each set.

The standard kit makes a .45 pistol jacket, from which you can draw other jackets by adding additional JRD-1-S jacket reducing die sets. Because it is necessary to blank and cup the jacket at a larger diameter and shorter length than the final trim, we will, in most cases, have to pass through the step of making the cup close to .45 caliber at some early stage, even if you want a 9mm or .32 jacket. Rather than have a lot of different prices or charge what would cover the maximum number of draws for the set, we sell the set to make .45 caliber jackets, and then simply let you add one or more JRD-1-S draw dies and ET-2-S trim dies to produce various diameters and lengths.

A .452 jacket can be reduced to .40 caliber or anything in between with one draw. To get down to .38 or 9mm caliber would require a second draw die (you can only reduce so much in a single draw). From .40 down to .354 or anything in between is one additional draw. To get from 9mm down to .30 or anything in between in another draw. And from .30 down to .224 or anything in between is another draw.

However, we can switch to a .224 caliber JMK-1-S die using a 5/8-inch wide strip, which makes a better .224 jacket with fewer steps and less cost for tooling. If you want to make .224 or smaller calibers, it is a good idea to start with this scaled-down strip width.

If we try to push too big a jacket through too small a hole, the bottom just pops out. On the other hand, if you wanted to make .44 Magnum (.429) and .41 Magnum (.410) jackets, we would make the basic JMK-1-S in .452 and two additional draw dies, and you would go directly from .45 to .44, and .45 to .41. The draw dies have a "nest" or guide section, which is designed to align the jacket while it is at a certain initial diameter, and guide it evenly into the reducing section. If you were to make some .429 jackets and then try to reduce them to .41 in the .45 to .41 reducing die, the .429 jacket would not be properly guided and aligned, and you might be some lopsided jackets at .41 diameter.

Each draw die is marked with a starting and ending diameter, and it means what it says. Likewise, if you decide to reduce a jacket with a different wall thickness, this could be a problem. For instance, if our JMK-1-S made a .452 jacket with a .015 inch thick wall, and a jacket reducing die was made to take these down to .400 diameter, the clearance between the punch and the die would be such that the thin wall jacket fit easily.

But if you found some .452 jackets with a wall thickness of .020 inches, and tried to push them through, they might become stretched out excessively or even generate so much pressure that the die or punch could be damaged. Jacket making tools are precision devices. As long as they are used with the materials intended, they deliver excellent results.

JMK-1-H (Jacket Maker Kit, Manual Strip Feed):

Hydraulic power presses, such as our Hydro-press, have full power from the bottom of the press stroke to the top. The JMK-1-H is designed for use on the CHP-1 Hydraulic press. The CHP-1 is designed with electronic sensors that can accurately determine the stroke length and the pressure, and can interface with the CSU-1 Corbin Strip Uncoiler. You can set up both pressure and position stops, which will prevent the ram from bending the various punches and crushing the pressure pad springs used to hold flat strip so it will not fold as it is drawn into a cup shape. The CSP-2H does not have all the controls of the CSP-1 nor does it have automatic pressure transducers, but it does have position sensors, which allow it to be used safely with this manually-fed die set.

In the JMK-1-H kit, there are usually four stages, but the exact number depends on the length, thickness, caliber, and taper of the jacket wall. We can build almost anything for you, working backward from the jacket you want to get the proper strip width and thickness. The first stage is a blanking die. It cuts a disk from the strip of copper. You simply pull the strip through a slot in the die, as the ram goes up and down. Disks, like coins, are punched out.

The second stage is a cupping die, which has a spring-loaded pressure pad around a punch. The disk is put into the die face, in a recess made to hold it. The pressure pad is run up against the disk, and it holds the disk by its edge while a punch travels up and draws the disk into the die, pulling it from under the pressure pad. This keeps it from folding or bending.

A third stage redraws the short, thick cup into a longer, thinner jacket. This stage could be the final one, for short jackets. Or it might be repeated one or more times for longer and thinner ones. Until we know precisely what dimensions your jacket is to have, we cannot say how many steps it will take to make it.

The last stage is a trim. The trim die is normally the ET-2-H, which is adjustable over a reasonable range of lengths. This means you can make just about any reasonable range of lengths from one set of tooling. We still would like to know the range of lengths or the main length that you want, so we can see if you will need additional trim dies to cover it.

Each jacket maker kit is designed around one specific caliber, wall taper, and a specific material. The dies control diameter at each step, and the punches control the wall thickness and wall geometry such as taper or length of straight section. If you change these parameters, it means a change in the associated tooling. We would need a supply of the initial cups in order to change the rest of the set and to develop the correct dimensions for the punches and dies. Most of this work is experimental, in the sense that we need to actually draw your cups to see how best to configure the punches for any given stage. It is partly art and partly math.

So, you can see that jacket drawing equipment is not easy to design and may be difficult to modify, or quite easy, depending on what kind of jacket dimensions it is originally made to produce, and what kind of modification you intend. Sometimes you can draw down an existing jacket to smaller calibers, longer lengths, and thinner walls just by adding a stage or two to the operation.

This may result in two or more practical jackets from the same die set. But don't count on it in every case! If you initially budget one complete die set for each length, each caliber, and each wall taper or thickness, you may be pleasantly surprised to save money by using fewer tools to achieve a few of the different effects. But if you count on using one die set for a wide range of jackets, it might not be possible, and then your budget would be shot, your plans ruined and your dog might scorn you, too.

We'll let you know any time we see a good way to save money by using any of our tools for multiple purposes, and ask if you want to change your order to accomplish that. As I said earlier, your success is what builds our future, too, and I'd rather take the long view and save you money now so you'll be a bigger success tomorrow and buy more equipment from us when you need to.

JMK-2-H (Jacket Maker Kit, Automatic Strip Feed)

The Hydro-press has special plugs and screw holes made so that you can install this rather amazing system. It has a lubrication roller system to put lube on the strip, a roller-cam hitch-feeder, and an interesting kind of blanking and cupping die all combined into one unit. The jacket material is automatically fed in, lubricated, blanked into a coin, drawn into a thick, short cup, and carried out into your container, ready for redrawing to a longer, smaller diameter jacket.

The entire assembly replaces the head (and in some designs, the ram) of the Hydro-press. You remove the rear cover of the press, unfasten two nuts that hold the press head and rods onto the base plate, unscrew the ram from the cylinder, and pull the head and guide rods off the press along with the ram (again, in some versions). Then you install a new head (and ram, if required), and put the hitch-feed mechanism on it according to directions that come with the system.

The CSU-1 Corbin Strip Uncoiler is used with this system to provide a steady source of material without undue drag on the feed. The uncoiler is controlled by the amount of sag in the strip, which loops from the 50 pound coil to the press head over a seven foot distance. A separate sensor stand has upper and lower limit switches that detect when the strip is pulled snug. The upper limit switch then trips, turns on the uncoiler for a brief, quiet partial turn, feeding out a few more inches of strip. This lets the strip sag until it trips the lower limit switch, and stops the uncoiler. It's fun to watch this run, because it is almost silent and seems to anticipate the needs of the press.

Without this device, you would have to devise some other way to keep the hitch feed from lifting or pulling more than a pound or two of resistance. Otherwise, you would not have reliable feeding, and the die or punch assembly might be damaged unless you cleared the partially cut disks before another stroke mashed the parts together. The press can also controlled by the strip feed, with a sensor that detects the metal's presence and shuts off the press when the strip begins to run out. The optional sensor package can also detect non-movement of the strip and stop the press if a jam occurs.

The JMK-2-H consists of three separate parts that you can use to mix and match with other calibers in some cases. The automatic press head assembly can be used with any caliber or size of blanking and cupping die set. It is the hitch feed, strip lubricator, die holder, and all the other general machinery that makes the system work, except for caliber-specific dies themselves. The blanking and cupping die might also be used for several calibers, and can be changed separately from the head assembly. It is made for a certain width and thickness of material, which will be drawn down to make a certain caliber, taper, wall thickness, and length range of jacket.

Each jacket has one blank diameter and width that maximizes the use of material. But often, there are other calibers you could make with it. A short, heavy walled jacket might be possible in a large caliber, such as .45 ACP, using the same strip that makes a longer, thinner, but smaller diameter caliber such as the .308 rifle. I can't publish a table here that shows what is possible, because all the various parameters make it too complex.

When we make a jacket maker set, it is designed for one specific jacket only. Then, after that is working fine, we try to figure out if there might be some other useful calibers in certain lengths and wall thicknesses that could be gotten with the same blanking and cupping die, by using different redrawing and trimming dies. You can purchase the DC-CUPS software program (for any MS-DOS or Windows compatible computer with a hard drive) to calculate all this and much more, including costs of jackets, and recording and printing the operation steps for making any jacket.

The redrawing and pinch trimming dies are the same in the JMK-1-H and the JMK-2-H. In fact, you can add the automatic feeding die head assembly and the blanking and cupping die that fits it, to an existing JMK-1-H set, to create a new JMK-2-H set. That's the same as saying you can upgrade the manual jacket maker just by adding the head and first stage die assembly (which is a significant part of the total price for the auto-feed jacket-maker kit).

You can also buy just the redrawing dies or final trim die, if your particular jacket set would be practical to convert into another caliber (we have to figure that out on a case by case basis). Generally speaking, you would want to plan for one complete JMK-2-H set for your style of jacket, and then just the dies (both the first stage and the redraw and trim dies) for any other jackets. If we get lucky, maybe some of the jackets can be made using the same original strip width and thickness, which means you don't need another first-stage die.

I hope that isn't too badly explained. Just think of the pages I'd need to write to explain how the factory 12 station jacket maker press works! This one only has from three to six steps, typically four steps, depending on the length and thickness and caliber of jacket.

The e-book "WD-1-E" or "World Directory of Custom Bullet Makers" also lists wholesale suppliers of copper and lead, custom bullet makers from around the world, and has a wealth of information about the commercial aspects of custom bullet making.

When we build a jacket making kit, we send you full instructions and pictures of the set up and operation. You are also welcome to visit before we pack the equipment for shipment (which takes most of a day). If you can come to the die works when we have just finished building your jacket making outfit, and while it is still set up on either your new Hydro-Press or on a test press, then we can show you in person how to set it up and run it. You are always welcome to visit.

6. Base-Guard Bullets

You can swage bullets without jackets, using just the lead, or you can swage jacketed bullets, but there is a kind of hybrid design that reduces the cost and increases production speed while extending the usable velocity range beyond that of a lead bullet. In fact, this special design, called the "Base-Guard", can let you shoot pure, soft lead bullets at up to 1,400 feet per second without fouling the bore, without using any lubricant whatever, and even cleans fouling from your bore as you shoot!

Years ago, the Harvey Prot-X-Bore bullet stirred up some mild interest because it made similar promises. The bullet was a plain lead pistol slug with a zinc washer swaged to the base. The lead would extrude through the hole in the washer, and form a rivet head by flowing into a larger diameter, shallow dome-shaped cavity in the face of the base punch.

We made many of these die sets for clients, but I was never convinced the design worked as well as some people claimed. The National Rifle Association tested it at least twice and both articles concluded that there was no difference between using the zinc washer and shooting a plain lead bullet. Both fouled their bores. But people kept buying the zinc washers and dies, so someone must have had good luck.

Shooters don't generally keep doing something that doesn't work, yet I was not having much luck with it. So, with the help of several relatively famous shooting friends, people who set world records and were serious about their bullets, I conducted a long series of experiments to find out whether the zinc base bullets really worked or not.

I found out, after thousands of rounds, that zinc itself has little to do with the fouling or not fouling. Aluminum, sheet steel, brass, copper—all of these materials would work, or not work, equally well. It all depended on two factors. When both were right, the washer bases worked wonderfully, making it possible to eliminate the jacket and build bullets that kept the barrels clean, at very low cost and at high speed. When either one was absent, the idea was a miserable failure with fouling that just about plugged the bore!

Here are the two factors. First, the washer or disk has to be precisely the diameter of the bullet. Even a ten thousandth of an inch undersized is too much. At the pressure developed by even the lower powered handguns, lead will flow back under the disk unless the disk fills the barrel to the very bottom of the rifling grooves.

When I measured the zinc washers (which are stamped out of sheet zinc in a high speed punch press), I found variations of up to 0.002 inches! That is twenty times greater than the minimum required to work! But once in a while, I found a short run of zinc washers that actually measured a little oversized, or perhaps right on. Those worked, provided the other factor was present.

The second necessary design factor is that the washer must have both a sufficient thickness and strength to resist bending under the drag force on its edge as it speeds along the bore, and at the same time it must have a sharp, burnishing-tool kind of edge *facing forward* to seal and scrape fouling out.

If the edge is rounded, or if the material is thin enough to bend backward under the stress of firing, the lead will flow under it, and be smeared along the bore, filling the rifling with fouling. But when the diameter is perfect and the edge is sharp, and facing forward, a thick enough disk will work wonderfully, making an astounding bullet that is cheap, fast, easy to build, and that works without the need for any lubrication, at least up to the speed where the material is bent back from drag and inertia and effectively quits presenting its scraper tool edge to the fouling.

The metal did not matter. We used barn siding, tin cans, shim stock brass, and copper jacket material as well as zinc. In fact, copper seemed to work better. The main thing was the difficulty in holding such tight diameter tolerances on a low-cost part. The high precision disks were just too costly to make, but they worked fine. They worked better than a half jacket on handgun bullets and on .45-70 rifle bullets.

So, the problem was how to make them almost perfect zero tolerance diameter and also how to form the sharp edge without a lot of expense. We realized that if the disk were cut slightly oversized and made cone shaped, the diameter would effectively be reduced so it would easily drop into the swage die. But when pressure flattened the conical disk again, it would grow back to original size! The die wall would stop the growth, and any extra material would be forced to extrude forward, into the soft lead bullet, just below the edge. The other side would be backed up by a hard steel punch, blocking any extrusion in that direction.

We had the answer! Just make the disks conical and slightly over caliber before the cone shape is applied. Then, the cone will drop into the die, grow to full diameter plus a burnishing tool edge, and there will be absolutely zero tolerance between the diameter of the bullet (the lead part) and the diameter of the base disk! It could be no other way: both parts receive their final diameter from the swaging action, within the same die, at the same moment.

A second benefit is that the disks work in a wider range of calibers. A disk made for the 9mm pistol would also work in a .357 Magnum, and a disk made for a .45 ACP would grow enough to fit a .458 or a .45-70 (which has a groove to groove diameter about 0.006 inches larger than the pistol). The .41 caliber disks worked fine in .40 caliber barrels. And they all worked amazingly well in nearly every gun, provided the bore was in good shape and the bullet diameter was either exactly groove to groove or slightly larger.

One of the special advantages of using no lubricant is that there is no puff of lubricant smoke, which means that the Practical Pistol shooters don't have to try for double-taps while looking at an obscured sight picture on the second shot. When you are firing two shots that come so fast they sound like one, lubricant smoke can be a problem.

The big advantages of the Base-Guard are that you can make the bullet in one, or at most, two, strokes of the press, and the cost is almost the same as a cast bullet without the disadvantages of lubricant, extra handling, hard lead alloys, and rejects. I have made four hundred bullets in just under an hour, including cutting the lead wire, swaging the bullets and making the Base-Guards!

Base-Guards are superior to gas checks and half jackets in three ways. First, they cost less, usually about half the price of gas checks and a fourth the price of half jackets. Second, they turn with the rifling on their central axle instead of being pinched against the bullet, so if the bullet slips in the rifling, the Base-Guard keeps tracking and seals the gas. Third, they scrape fouling out of the bore, instead of ironing over it again and again.

Gas checks and half jackets rub more lead on the bore and then pass over it with the smooth side of the copper. Base-Guards are like a tool bit, presenting their sharp edge to the fouling and machining it off like a lathe bit. Try turning a lathe bit sideways to the work: that's how a gas check looks to the fouling plastered along your bore!

If you use preformed Base-Guards, which we offer in bags of 1000 at a very low cost (barely more than the cost of material to make them), you can turn out up to 500 bullets an hour. Or, you can use .030 to .040 inch thick copper strip and punch out the Base-Guards yourself, using a BGK-1-R, BGK-1-S, or BGK-1-H Base-Guard kit. The BGK-1-R works in your reloading press (assuming it is similar to the RCBS Rockchucker).

BGK-1-R (Base-Guard Kit, type -R)

This tool is a threaded die with a slot cut more than half way across one end. The section below the slot is closely fitted to a punch. The punch screws into the press ram. You would use it by stroking the ram up and down only enough to move the punch past the slot and back down to let a piece of copper strip pass through.

As you stroke the ram up and down this short distance, you would advance the copper strip through the slot, always making sure that you bring the last hole past the edge of the punch before the punch comes up and cuts out another Base-Guard disk. The disks begin to come out the top.

BGK-1-S (Base-Guard Kit, type -S)

The die screws into the press head from the bottom, up. This is just the opposite of most kinds of dies that fit the press head. The threads point UP, not down. The slotted end of the die faces the ram. The punch is never removed from the ram during operation, so there is no possibility of it striking the edge of the die and breaking the portion below the slot.

The press ram is stroked up and down just enough to push the punch through the strip and cleanly cut out a disk, then the ram is lowered to clear the punch from the hole in the strip, and the strip is pulled forward. Repeat this process until you are buried alive in as many Base Guard disks as you can ever shoot. Corbin sells the .030 X 1-inch wide copper strip in five pound bundles and 50 pound coils.

BGK-1-H (Base-Guard Kit, Type -H)

This die set works in any Corbin press designed for -H dies, such as the Hydro-Press or Mega-Mite. It is substantially the same design as the -S and -R sets, with dimensions and threads scaled up to fit the larger presses. The operation is the same: pull strip through the slot while the press is made to stroke up and down in short strokes, punching out disks which eventually emerge from the top.

If you wish, we can build a feed chute for the die, so that cut pieces are fed by gravity down the sloped channel and into a waiting container. This is not a stock part, but it can be built with your die.

Converting Dies to BG base:

You can add the Base-Guard option to any of your existing sets of dies, just by ordering the appropriate base punch. The Base-Guard punch does no harm if you use it for lead or conventional jacketed bullets: the only difference is that your bullet will have a little round bump projecting from the very center of the base, which only serves to identify your bullet and has no other effect.

Here is what you would need to order, if you want to add the Base-Guard capability to any set of dies:

For any LSWC-1 set (Lead, Semi-Wadcutter single die), you would want (1) PUNCH-M (or -S, or -H depending on the die), Internal, BG, and specify the diameter. The BG base only works with a flat base. It is ineffective or worse with boattails, hollow bases, or paper patch (undersized) bullets. We have, however, made tooling to produce rebated boattail (RBT) lead bullets, with the BG disk formed at the rebate, using a much larger than standard hole in the disk. This would be a special order item.

For any FJFB-3 set (Full-jacketed, Flat Base three-die set), you would want (1) PUNCH-M (or -R, -S, or -H), Internal Core Seat (CS), BG, plus (1) PUNCH-M (or -R, -S, or -H), External Point Form (PF), BG. Whenever you apply the Base-Guard in the core seater and then shape a smooth ogive in the point former, you must use a matching base punch for both dies, or the little rivet head will be smashed flat and made less effective at retaining the Base-Guard.

7. Draw Dies

Drawing dies have a hole all the way through, and they fit into the press head. You push a jacket or a bullet through them, in one side and out the other, to make the part smaller in diameter. Since the die screws into the press head, there is really no difference in the 7/8-14 threaded die body for type -R or type -S sets. The only difference is the punch, because a reloading press (-R) uses a T-slot ram and Corbin presses use threaded rams (5/8-24 TPI for the S-Press).

The -H dies utilize tougher materials that stand up under greater force and speed. Part of the reason they cost more is because of the additional time it takes to form and heat treat this material. You can adapt a -M or -R draw die to a Hydro-press, but it is not as economical as it may seem because of the possibility of breakage and less efficient use of the available stroke for alignment and guidance of the components.

The JRD-1-S, -R, or -H is designed for drawing jackets smaller withut changing the wall thickness, and for operations which do not significantly affect the run-out. For reducing jacket walls and maintaining high precision wall concentricity, the JRD-2-S or -H is recommended. This version has a special punch with precision guide sleeve, which mates with a nesting cavity in the bottom of the draw die. The design pre-aligns the punch with the axis of the die, so that the jacket is centered and the punch contacts jacket exactly in the middle of the base.

When a certain jacket drawing operation needs the benefit of the JRD-2 design, we quote that instead of the lower cost JRD-1. But there are some operations which can be done just as well with the lower cost die, and we use that instead when appropriate. It isn't a selection between two levels of quality so much as between two different kinds of requirements in the drawing operation.

Die life with any draw die or swage die is to some extent subjective: it depends on what you consider "worn out". A high precision benchrest bullet maker might consider a die worn out when the wall concentricity increases by 0.0001 inches, or the diameter of the jacket increases by 0.0002 inches. This might happen after 25,000 to 50,000 jackets have been drawn, or it might not happen until 100,000 or more have been drawn, depending on ambient conditions and use of lubricant. Dust, heat, and abrasive airborne materials in some locations can cut die life in half.

On the other hand, a person making premium hunting bullets might find that even 0.0005 inch wall run-out or 0.001 inch jacket diameter change has no effect on the practical accuracy of the bullet. In fact, if the jacket fits into the core seating die easily enough, there is hardly any effect on final parameters no matter what the actual jacket size, since the bullet diameter is only slightly affected by big changes in jacket diameter prior to core seating. The jackets are always smaller than the bullet, before swaging.

When an operation is expected to be especially high volume, certain higher wear resistance materials can be used for the punch and die. This will cost more because the materials are harder to machine and heat treat than the die and punch steels we normally use. It may or may not be a good value, and we'll suggest the use of special materials if we think it would be a good trade between cost and tool life, for a high volume commercial operator. Everyone else will probably get a lifetime of use from the standard version, if the jackets are kept clean and properly lubricated.

Type -R dies are only available in the standard design, because it is not practical to use a reloading press for high precision or high production work. A reloading press would be incredibly hard to use for production work (think hydraulics!) and to attempt to use one for high precision jacket drawing of the benchrest class would be an exercise in futility.

It seems curious that people are willing to spend several thousands of dollars on "benchrest" swaging dies, and then use them in a reloading press, which has no bearings, no hardened ram, no hard chrome ground finish to help keep the ram from wearing out of alignment, and an alignment which, though adequate for reloading, is hardly in the class of an actual swaging press. (To be fair, some people do spend hundreds more dollars having a conventional cast iron frame press re-bored for better alignment and put a different ram into it. But wouldn't it be cheaper and better to start with a press that had high precision and long life designed in, instead of tacked on?)

JRD-1 and JRD-2 Jacket Reducing Dies

You can produce special jackets by drawing down an existing larger caliber to produce a smaller diameter, longer jacket. This method is often used to make some of the less popular calibers, or to make heavy-walled .224 jackets by drawing down a .243 jacket. It is also used with a Corbin JMK-1-S jacket maker set to reduce the .45 caliber jacket which this kit initially produces, to other sizes.

A .45 caliber jacket can (usually) be made into a .44, a .41, or a 40 in one stroke. A .44 can be made into a .41 or .40 caliber. A .40 (10mm) can be made into a 9mm or a .357 caliber. A .30 can be made into a .284, .270, .264, or .257 jacket. Each reduction makes the jacket longer, smaller in diameter, and tends to make the jacket wall somewhat thicker up to the limit of the base material itself, since it pulls base material into the wall area. Wall thickness can be controlled by the punch to die clearance, however.

Drawing is the opposite of swaging. People sometimes ask about "swaging down" a bullet to make a smaller one. That is wrong. Making something get smaller is called "drawing", and it is done by pressing the jacket or bullet through an annular die (a "ring die", we call it). The part goes in one side and pops out the other, where it springs back slightly larger than the hole size.

We need to have sample material to draw down if you want the parts to come out precisely, since different materials and lots will spring back a little different amount. Swaging always expands a smaller component to become larger. If you try to push a larger bullet into a closed swaging die with a hole even slightly smaller than the bullet, you'll make it stick in the die. The material wants to spring back toward original size, so if it was originally larger than the hole, it will keep trying to grip the die walls.

On the other hand, if you do it right and use a component smaller than the hole you are about to shove it into, it will go in easily, expand under pressure until it hits the die walls, and as soon as you relax the pressure, the component will spring back slightly toward its original smaller diameter, releasing its grip on the die walls.

In a drawing die, you can apply a lot of pressure to the full diameter of the bullet, or to the inside diameter of the jacket, and push it right on through, even though it is trying to grip the die walls. In a swage die, especially a point forming die which relies on a tiny ejection pin, this isn't possible.

Benchrest shooters often ask about concentricity of a drawn jacket. Since all jackets are drawn at some point, this isn't a unique issue with redrawing. Concentricity is measured in thousandths of inches of run-out, the difference in the jacket wall thickness as you measure around the jacket at any given distance from the end. A typical tubing jacket might have a run-out of 0.001 to 0.002 inches, which is fine for hunting applications but about 10 times greater than you would desire for benchrest shooting.

With higher quality tubing, the run-out of the jacket is improved over ordinary plumbing, which can have a run-out greater than .003 inches. Still, ordinary plumbing has been used for decades to make good hunting bullets. The original Barnes bullets built by Fred Barnes used nothing more than plumbing copper tube for jackets, and Barnes was quite successful. I remember that Fred used to pull tubing through a home-built die by chaining a bar of steel to a tree, said bar of steel having a funnel-shaped hole in it, and then forcing the crushed down end of a piece of copper tubing through it, clamping the end of the copper tube to another chain tied to his car bumper, and pulling a 20 foot section of tubing through that "die" with his car! It was after World War II and things were tough! Successful people were resourceful. But the point is, it worked.

How much better we have it today! —Precision equipment is available to use high grade tubing that you can get in a few days with a phone call to Corbin! Fred would have traded two cars for the convenience, not to mention the additional accuracy (of course, he's long departed this world, but I get the feeling that his spirit peeks down and chuckles with glee at how far his original tubing bullets have come, now and again).

The run-out of a jacket drawn from flat strip starts with the cupping operation, and is caused by a number of factors. The first is the quality of the strip that you use. If it is thinner on one side, it will draw a jacket with more run-out than if it is closely matched in thickness across the width. Also, if the grain structure of the material is consistent, and properly aligned and sized, it will draw more evenly than, say, roofing copper or decorative copper sheets cut into strips.

One a cup has been formed, it is drawn smaller in diameter, which puts the material volume into length. The thickness of the cup walls usually is reduced in the drawing, so that the base material remains about what it started in the strip, and the jacket walls can either taper or simply be drawn to a more or less straight wall of less thickness than the original material.

Drawing a cup to smaller diameter means that the punch which must fit inside and push the cup through the die has to fit inside after the cup has been reduced. Therefore, the punch will be smaller than the inside of the cup before it is reduced, and may not be perfectly centered. This is a major source of jacket wall eccentricity or run-out.

To help solve the problem, Corbin jacket reducing dies feature a "nest", which is the term for a section of the die that accepts the original jacket diameter for a sufficient length to insure that the jacket is perfectly aligned with the smaller hole that will reduce it. The nest aligns the jacket before it starts into the actual draw. This greatly reduces the amount of run-out in the jacket walls. The JRD-2 system goes further with a sliding sleeve around the punch, which in turn aligns the punch with an extended nest in the die mouth prior to the jacket entering the drawing constriction.

In a simple drawing die, the punch still is able to wander slightly inside the cup even if the cup is aligned perfectly with the die, and it may force the material to draw slightly heavier on one side as a result. The effect is minimal with a nested die, but to further reduce run-out, the punch can be a special guided or sleeved design as in our JRD-2 system.

A steel button is placed around the punch. This button is a very close fit to the punch, so the punch just slides through it. On the top side of the button, a thin shoulder is machined so that it slips inside the jacket and fits very closely. You press the jacket over the top of the button, so the raised shoulder fits inside.

Now the jacket mouth is aligned on the button, and the button is aligned on the punch. The punch will contact the center of the jacket or cup, and cannot wander off to the side. In another version of the tool, a spring around the punch supports the shouldered button. The thin part of the button is not long enough to fit inside the smaller diameter of the die. It remains within the nest area during the draw.

Recently, the stripper system has been simplified and improved, and the alignment system has been improved with a special nested guide system, so that the JRD-2-S and JRD-2-H dies now include these as standard features.

The jackets are stripped off the punch when the punch pushes them past the top surface of the draw die, and a slotted steel plate is moved so it will slide under the jacket mouth. Lowering the ram brings the jacket mouth against this steel plate, so the jacket is forced off the punch automatically. An electric solenoid can be added to the Hydro-Press to operate an automatic jacket stripper. It plugs into the accessory power plug on top of the press and is activated at the top of the stroke.

BRD-1-R, -S, -H (Bullet Reducing Dies)

You can draw down existing bullets, but only within very small limits: if you try to reduce an existing bullet more than about .006 inches, the amount of lead you are moving becomes significant enough to materially spoil the accuracy and looks of the bullet, and the stresses in the jacket material will begin to cause serious "banana-shape" distortion.

This means making a 9mm (.355 inches) bullet from a .38 (.357 inches) slug is easy and practical, while making a .41 caliber from a .44 caliber (.429 inches) gives miserable results. A practical limit is making a .318 inch diameter 8mm bullet from the modern standard 8mm of .323 inch diameter.

There is a huge difference between drawing a jacket, and drawing down a bullet. A jacket is just the empty cup. You put it over a punch, and shove it through the die by pressing on the inside of the base, so it is drawn over the sides of the punch. You can reduce a jacket by up to 30% less than the original diameter in most instances.

Don't confuse the .006 inch reduction limit for bullets with the vastly larger potential reduction for bullet jackets. Also, like most things in life, this rule isn't written in stone. Some few bullets with nice soft jackets and room for the lead to go into a hollow cavity or base can be reduced more than .006 inches. But you are asking for trouble if you want to do that as a general rule. What might work sometimes on a particular experiment, may fail almost all the other times with other materials.

This gets some people into trouble: just because something happens to work one time, they think it will work in every instance. Not just in bullet swaging, this is a common mistake. A fellow takes a big elk with a .243 target bullet, and from that day forth he is convinced that a 6mm is big enough for game the size of an elk. He might have used a target bullet. So he thinks that there isn't any problem using bullets constructed for target shooting, with their thin jackets and non-bonded cores, on noble game.

Sure, you might do it once. If you are a great shot and a superb hunter, you might do it all the time, but I couldn't. The odds are overwhelmingly in favor of most people just wounding the animal and having it get away.

In swaging, if something works that maybe shouldn't have, then that's a reason to carefully experiment and find out why. It's bad judgement to assume it will always work in every instance, especially if others who have spent years in the field are dubious. You may have found something new, but try it on several calibers, styles, and materials before you count on it always working.

Drawing down bullets is certainly one area where you can find all kinds of exceptions that work, but only because the material, hardness, and style are just right in a particular instance. Corbin will make tools for you to your specifications, against our own advise and experience, provided you take responsibility if they don't work. If we design and recommend the tools, then of course we guarantee they will work.

Draw dies for the Hydro-press (type -H dies) are more sophisticated and can produce results that may not be possible in a hand press. The long stroke and great power of the Hydro-press give us room to build special guide sections and ejecting punches that won't work on a hand press. In drawing, full power is generally required at the start of the stroke, not just at the end (as with most swaging operations).

Since nearly all the hand operated presses have about half an inch of extremely high pressure travel toward the end of the stroke, and progressively lower pressure as you retract the ram, it follows that drawing operations which may require high pressure over a longer travel than about 7/10 inch may not be practical in a hand press.

Can you draw down a solid copper bullet or a full jacket military bullet? Probably. If you want to order a bullet reducing die, you really need to send us five or six samples of the same bullet that you plan to draw down. Then we can test the idea, and use your bullets to adjust the die so that it produces the correct diameter, given the amount of springback in your particular bullets.

For some reason, there seems to be a general reluctance to send sample bullets. Maybe it is the desire to get the dies faster, not waiting for a chance to go get the bullets and ship them. Maybe it is a feeling that this is a waste of time and not necessary. Or maybe it is just to save the cost of shipping them.

But for whatever reason, it isn't that unusual for someone to balk at the idea of sending samples to draw down. When that happens, we have no way to tell if your particular bullet will come out the same size as the ones we must then use to test and adjust the die. Also, we don't know if you are not telling us about a special base shape that might be distorted if we just make a normal flat base punch. In fact, we just have to go on blind faith that your bullets are actually close to what we can make or get easily here for testing.

When you don't send samples, the only thing we can do is guarantee that the die is in fact a nice draw die that makes the size you said with the bullets we choose to use. We can't guarantee that the die will make the same size with your bullets. If it doesn't, then it is your problem. You can order another die and send samples this time, but the first die is still yours and can't be traded back in (because the next person who sends in sample bullets will want a die make properly to fit them, not your die).

If you know this, accept it beforehand, and will be happy with the results even if there is a difference of up to .001 or so inches between what the die makes with our test samples and whatever bullet you choose to push through it, then we are happy to skip the samples.

If you tell us that you want a draw die to reduce a Sierra .338 bullet down to .333, and instead of sending us the sample bullets, you send us the Sierra stock number, then you'll also have to send enough extra payment so that one of our die-makers can drive into town and shop for a box of those particular bullets, which is a minimum of about an hour plus the cost of the box of bullets. We will be glad to send the rest of the bullets along with your die, and of course the drawn samples used to make and test it. But that extra hour of the die-maker's wages might seem steep, and I agree. Die makers are paid for making dies, not shopping for bullets, usually. I don't have a position here for "bullet shopper", so I have to use the people available.

It is probably much cheaper for you to send us the sample bullets than for us to try and locate them. Still, whatever you want is fine, so long as the cost of doing it is acceptable. That is the bottom line for anything that is moral, legal and safe.

Bullet drawing dies are used by screwing the die into the top of the press, and putting the punch into the press ram. The die should be set high in the press, when starting. Two or three threads of engagement are enough. Put the bullet on top of the punch and guide it into the die mouth. If the bullet does not draw down or pass through the tight part of the die, lower the die until it does so at the end of the press stroke (for hand presses).

In a power press, you can set the stroke length and position for your convenience, since you have enough power anywhere in the ram travel. For a hand press, the job becomes much easier when you use the very end of the stroke to get the hard work finished.

In most cases, the bullet will need to pass through the tightest point in the die on one pass. It may not necessarily emerge from the top of the die, but it should be loose inside, not stuck halfway through the draw, before you insert another one. One bullet can "lift" another one up, but if you try to actually use one bullet to finish drawing another, it is likely that the nose will be damaged on the second bullet. Corbin Swage Lube is always a good idea, applied just by touching the lube and then rolling the bullet between your finger and thumb as you insert it.

With special base shapes, you may need a special matching punch. For instance, a rebated or conventional boattail bullet may suffer some base damage and expansion if you push it through a draw die with a flat punch. A punch with a "socket" to accept the base of the bullet will still need to be smaller than the original bullet, since it must pass through the die. This means the angle has to be very close to the original bullet, or else the edge of the punch might press into the tail of the bullet and mar it.

In some sample bullets, we find that pushing the bullet through nose first doesn't work as well as making a special punch to fit the nose, and pushing it through the die base first. This isn't something we can know before trying your bullet. It's not predictable. But it is consistent once discovered. If we discover this is true for your sample bullets, we'll make the punch so it fits the bullet nose, and push the bullets through base first.

To expedite production, especially on the Hydro-Press, we can make a sleeved punch with a spring loaded collar. The spring goes around the punch, and the collar sits on top of the spring, helping to hold and guide the bullet into the die. In fact, the collar might be made so it fits into a recess in the die, pre-aligning the punch so its fragile edges will not be damaged by hitting the die face. This sort of work is available as custom jobs, usually quoted and not found in the price list, because we don't know in advance in every case just how much time and effort will be required to design and build a given solution. Typically, though, the additional cost of a custom punch is all it takes, which at this writing is about 3 times the cost of a standard punch. The difference in speed of use is often quite remarkable with certain kinds of bullets.

We can put a metal chute on top of the die, as well, to roll the bullets down into a bucket or other container, so you do not have to handle each one as it comes out of the die. All these things are overkill for the hobbyist, who is only doing a hundred bullets or less at one sitting, but they quickly make the difference to a custom bullet maker who is salvaging 50,000 pulled 50 BMG bullets and needs to process them as quickly and easily as possible. The cost of doing these things is not significant compared to the time they save in commercial applications, but the price of a good die without the speed features may already be right on the edge of what a hobbyist could justify.

I understand. That is why we don't build everything possible into every product, but offer many of them as options for people who find them valuable, while keeping the basic tool prices as low as we can with high quality work and material. It is no problem to add features to a good tool. I've never regretted buying anything that was too good for what I was doing. All it did was cost a little more than I might have spent otherwise. But often I found later that there were other, new things it could do, and I was glad I spent a little more for it.

My wife bought me a very high resolution digital camera for a birthday present, and I seldom use more than its lower middle range of resolution, and not many of its special features. But every so often, I am glad it can deliver a high quality, big format photo, or do some trick that I have to break out the manual to accomplish, even if a much lower priced camera would do 90% of my work. Just having the option of doing more is comforting. I can add options to it that work right, whereas adding them to my lower priced cameras would be frustrating, since the basic tool itself would be too limited to really take advantage of things like sharp telephoto lenses, macro flash attachments and microscope adapters.

The same is true with swaging tools. If they are built better than you probably need today, then tomorrow when you decide to try something more demanding, they will deliver. But it is frustrating to add features to tools that are working right at their limit, as with a poorly built die set or a reloading press used for swaging. (Have I mentioned that swaging presses do a much better job? Really? I must be getting forgetful in my old age, and starting to repeat things!)

RFJM-22 -R, -S, -H (Rimfire Jacket Maker, 224 caliber)

One of the most popular tools we've ever made is the Rimfire Jacket Maker set, which turns fired .22 cases into excellent jackets to make .22 centerfire bullets. You've probably read about this before. RCBS, Speer, Hornady and many other firms got their start by doing just this. You can do it today, and with the price of bullets, it is more popular than ever.

Fired .22 short cases make great 40 grain Hornet jackets. Fired .22 long or long rifle cases make the standard .705 inch long 52 to 60 grain open tip or small lead tip bullets for all flavors of centerfire .22 cartridges, from the .222 to the .225. Some shooters don't realize that all modern .22 caliber centerfires, including the 5.56mm, actually use the same diameter barrel (a nominal .224 bullet size fits them all).

The .22 high velocity loads such as the "Stinger" use a case slightly longer than the standard long rifle, which will produce a little heavier bullet. You can make 65 to 70 grain .224 bullets using these for jackets.

The process is simple. You wash the fired cases to remove grit. I like to boil them in a mixture of water and some detergent, plus a little vinegar to help restore the shine. Then, I pour off the water, and spread the cases out on an old cookie sheet. I fire up the kitchen oven and heat the jackets quickly to drive off the water.

Shortly, I have a tray full of clean, dry cases. I take them out, and put the jacket maker die in my press. The die itself is the same for both reloading presses and for our S-Press. The -R differs from the -S version only in the punch.

In the reloading press, the punch has a T-slot head or button, like a shell-holder. In the -S version, to fit our S-press, the punch has a kind of die body attached that screws directly into the ram. The die screws into the press head in all versions.

Use a little Corbin Swage Lube on your fingertips and give the punch a quick wipe of lube, then pick up a case and put it over the punch tip. Adjust the die so it is very high in the press threads. Raise the ram carefully. The rim of the case should just barely start to go into the die as you reach the end of the ram stroke.

Lower the die until this point of adjustment is reached, and then lower it just another quarter turn or less. Lower the ram, as necessary to adjust the die, and then raise the ram. Little by little, you should be finding the point where the rim is ironed out cleanly, leaving no ridge behind. Then continue to carefully adjust the die downward, until you can just push the jacket through the tightest part of the die and out the top with one smooth but powerful and rapid stroke.

Do not operate the press with the die so low that it takes all your effort to push the cases through! This is not necessary and will only strain your bench mountings and your patience. A firm one hand push will do the job, in a single pass.

These little jackets represent a lifetime of free components, so it is worth spending a little time to learn the fine points. Once you have drawn the jackets, you may have to anneal them. One fine point is that the annealing temperature can be critical. If you make a wide open tip or a large lead pointed bullet, you may not have to anneal at all. But if you try to make a small open tip bullet, or even a small lead tip, you may find that the end of the bullet folds over with a little flap of metal instead of drawing to a smooth curve.

This is a sure sign that the jacket material is not annealed sufficiently. Actually, annealed may be the wrong word because that implies a dead soft condition. You can just soften the brass to a lesser degree, more of a stress relief heat treatment. If you overheat the cases, they will turn discolored and may become rough on the surface. You can always heat them a little more, but you cannot undo the damage from overheating. Some people use a tuna can floating in a molten lead pot to hold the cases for annealing. I like to use the self-cleaning oven, or a propane torch with one of those fishtail flame spreaders and just heat the cases until they are barely red in a dimly lighted room. It only takes a few seconds to get them that hot. You can do a small group of twenty or so at one time.

You can try skipping this, but make one bullet all the way to completion before you seat all the lead cores in those jackets: you may find out that you need to heat a little more. If that happens, your seated cores make it harder to do (but not impossible).

If you find that the jackets have circular rings in the shank area, like badly-made cannelures, this is a sure sign that you have overheated the cases to the point where they are rough and dead soft. Then they will not have enough strength to resist folding like an accordion against the pressure needed to shape the ogive or nose. This kind of folding usually happens in the point forming operation, as does the flap of metal that folds at the ogive when the jacket is too hard.

Sounds tough, eh? Too soft, and the shank gets rings in it. Too hard, and the nose folds over. But there is quite a wide range between those extremes where the bullet forms very nicely, with barely any suggestion of the little fold lines you would see on all commercial spitzer bullets (less so on round noses) if they were not polished out in a tumbler before being boxed. The ogive curve on the spitzer shaped bullets brings the metal close at the tip and thickens it, and it tends to develop lines that look like scratches but are actually folds. This is normal, but not commercially attractive. So, commercial bullets are polished to remove or burnish over this minor cosmetic flaw, and you don't see it. (If you inspect the bullets very closely, you may in fact see some remaining signs.)

The Corbin RFJM-22 dies have gone through a number of versions over the years. At one time, we built a tube and disk ejector that slipped over the ram, to strip the jackets off the punch on the down stroke. Now, we make the punch long enough so you can find that point of adjustment to push the jacket all the way through the die at the end of the stroke, and we make the top of the die with a square, sharp junction between the edge of the hole and the die insert.

When the jacket mouth passes through the die, the jacket springs back slightly toward original diameter. The jacket mouth becomes larger than the hole, so that when you pull the punch back, the top of the die pushes the jacket off the punch. Of course, it cannot do this if you do not push the jacket all the way through the die.

The rimfire case starts with a diameter of about 0.225 or .0226 inches, which is too large because the jacket must be smaller than the finished bullet. To unfold the rim and draw it evenly into a smooth cylinder, as part of the jacket wall, we must reduce the jacket to about 0.219-0.220 inches. This happens to work out very well for a .224 jacket diameter. The punch diameter to fit inside a .22 rimfire case and accomplish this draw needs to be about 0.199-0.200 diameter. By the magic of subtraction, we can see that this leaves a difference of about 0.020 inches, which means that each wall of the jacket must be about 0.010 inches thick.

Commercial bullet jackets for .224 caliber are usually made from strip that starts out 0.026 to 0.030 inches thick, with walls that taper forward to perhaps as little as 0.012-0.015 inches at the mouth. But the greater part of the jacket wall is more likely to be from 0.020 to 0.026 inches thick. This means that your free .22 rimfire jacket is about half as thick, in general, as the commercial bullet jacket. It is also made of a higher zinc content brass, having nearly 30% zinc as compared to the 5% to 10% zinc in the commercial bullet jacket. This means it is slightly harder but more brittle, as well as thinner.

These factors result in an excellent varmint shooting bullet, with little or no ricochet odds (when the thin, brittle jacket hits the ground, it usually explodes or pops open into a four pointed "star" all the way to the base, even at modest speeds). But the speeds must be kept relatively modest, or else the thin jacket will come apart in flight. I usually recommend that you maintain a velocity of 3200 fps or less. Some people shoot them faster and get away with it. It probably depends on the depth and sharpness of the rifling in a given barrel, and whether it cuts into the thin jacket or irons the grooves without weakening the jacket even further.

Making rimfire case jackets is one of those operations where I can honestly say that our smallest hydraulic power press does the best job (the big ones do OK, but they really are overkill). The CSP-1H Hydro-Mite press can push those jackets out all day long and never get tired. For decades, one of our clients has made a nice retirement income building 224 bullets with free rimfire cases, using a manual press. I've tried to get him to go to a power press, but he's happy with three manual presses. I mention this because it shows that you can make a business doing everything the opposite of what I recommend and it still works for some people! I generally do not recommend a standard design of .224 bullet for a business, because there are plenty of mass produced .224 bullets that sell for a low price. But if your materials are free, and the price you get just pays your labor, then it must work.

Probably by now the ancient fears about fouling, barrel wear, and accuracy have long been settled, and forgotten. I should mention them in case there is still someone, somewhere, who has the idea that fired .22 cases cause any problems in these areas. Yes, once, all these things were issues. The reason: mercuric priming.

Fulminate of mercury was one of the earliest of rimfire priming compounds. It is easy to make and gives reliable ignition. But the mercury reacted with brass cases, and made them brittle. Therefore, it wasn't long before center-fire cases, which could be reloaded easily, were the cause of a demand for non-mercuric primers. Otherwise, the cases would be too brittle for reloading, and reloading is one of the major benefits for center-fire cases.

But rimfire cases are almost impossible to reload. You'd have to somehow get the dent out where the firing pin hit the rim, or else that would be one spot where you'd get unreliable or no ignition the second time around. And you would have to figure out how to make a priming compound slurry and spin it into the rim again, evenly deposited in just the right amount. It could be done, but the expense and trouble just doesn't seem worth the result, not to mention the danger of blowing one's fingers off or worse, while mixing up priming compounds.

So, rimfire cases are not reloaded by most shooters (in fact, I've only met one who even tried it). That meant mercuric priming gave no particular problem to shooters of rimfire cases. Who cares if they get brittle after being fired? They are thrown away or left on the ground, anyway. Except some few brave souls began to pick them up, and turn them into jackets for .224 center-fire bullets! Now you can see where the fouling, accuracy, and even barrel wear issues came about, right? Until the late 1960's, there were still mercuric primed .22 rimfire cases being made.

Since then, issues with health (from the mercuric vapors mixed in the powder gas, fired in indoor ranges, where lots of kids learn to shoot with rimfire rifles) have largely gotten rid of any mercuric priming. Tin-based priming compounds replaced the mercury compounds. For decades, the problem has been buried, but not forgotten. People still remember and talk about the old days when fired .22 cases made into bullets used to flake off in the barrel, or come apart in midair for no particular reason. Just because it has not happened for thirty or forty years is no reason to let go of a good rumor!

That takes care of the fouling and accuracy issues. A fired .22 cases made into a bullet is actually less likely to cause fouling than a commercial jacket. It has more zinc, which makes it harder, slicker, and tougher, and less likely to come off in the bore. Accuracy is well known by now. Some brave souls even won benchrest matches with fired .22 case bullets. If you select high grade brass and sort them into lots, fired from the same gun, such as those you might pick up at your indoor target range after someone you know, or yourself, has finished a match, then you can get just as good a quality including jacket run-out as the best commercial jackets. Ely Club ammo used to be the best for quality rimfire case jackets.

But flyers do happen when you pick up cases off the ground, and some were fired in different guns, some were dented more or less than others or even cut through by the firing pin, and some are different brands. The stress history of the metal will change it slightly, even if you anneal it. The firing pin dent, which is ironed out and virtually invisible in the final bullet, might be an issue with extreme accuracy, and certainly will be if it varies from one case to the next. Cases cut through by the firing pin probably will not shoot to the same point of impact as those not cut through.

For all these reasons, I would not recommend going to the Nationals with winning in mind if you use .224 bullets made with fired .22 cases. But I would expect a good shooter with a winning rifle to do very well, in any case, and probably to win most of the local matches. Rimfire case bullets are much better than they might appear to the casual reader. In fact, they can be surprisingly good, better than many factory bullets. It depends on the care taken in making them, and the quality of the dies used to form the bullets.

A clever and analytical reader might at this point say, “This is all very fine, but I think you skipped over the issue of barrel wear: the jackets may not be brittle any more, but you said they were harder and tougher than commercial jackets.”

Right you are. The additional zinc content makes the jacket harder by a modest amount. It is still far softer than the barrel, far softer than a steel jacketed military bullet. But it also is half the thickness, so it pushes inward much more easily than a commercial jacket. When the rifling (of about 0.004 inch height) pushes against the rimfire jacket, is meets the resistance of a mere 0.010 inch thick wall, instead of the typical 0.026 to 0.030 wall of a commercial jacket. Subtract the rifling land height from a commercial jacket wall, and you still have 0.022 to 0.026 inches of metal under the rifling groove in the jacket, supporting it and pushing it against the barrel. Subtract the 0.004 inch land from the 0.010 rimfire case jacket, and you have a mere 0.006 inches of support. The difference in metal toughness is not nearly enough to make up for this, and the rimfire jacket flexes under the rifling to a much greater degree with a resulting lower friction and wear rate.

Not only that, but the coefficient of friction of the high zinc content alloy is lower than with the typical gilding metal or commercial bronze jacket (5% or 10% zinc/copper alloys are used for most bullets, with the "commercial bronze" being a total misnomer that is in standard usage anyway: there is no gold in gilding metal, no tin in commercial bronze because it is not bronze but just another brass ratio). That is, the metal surface is "slicker" and causes less heat and wear as a result.

Bottom line: rimfire case jackets are easier on your barrel, just as accurate, and probably foul less, than commercial jackets. Their main drawback is that they are thin and therefore cannot be driven so fast. Likewise, their thinness makes them unsuitable for big game. But most of us are not that good a shot or a stalker to allow us to use a .224 for big game and still call ourselves good sportsmen. (Some are, and I applaud them, but the first time they lose a deer or an elk that a medium or large bore rifle would have taken cleanly, they should have the good grace to quit using a small bore rifle.)

Their advantage over commercial jackets is cost: they are free. If you want to make a good varmint bullet that blows up like it was going 4,000 fps when it hits at a mere 3,000 fps, then that is another advantage —not to mention how much fun it is to out-shoot your buddies, who paid good money for their bullets and refuse to believe that anything you can make from free materials could possibly work as well or better!

8. Making Lead Cores

Lead is the most commonly used core material for bullets. What is a core? We call the material that fills up the jacket a core, but even if you don't use a jacket, the piece of lead that will form the swaged bullet is also called a core. Swaging requires that you prepare the core so that it will fit inside the swage die. You can't shove a huge billet of lead into the die, of course, but you can melt the lead and cast it in a multi-cavity "core mould" to form the right diameter and length of ready-to-swage cores, or you can simply purchase lead wire. With Corbin power presses and optional extruder die, you can make your own lead wire.

Lead Wire (LW-10)

Lead wire in 10 pound spools, LW-10, is available from Corbin in sizes from .100 to .430 inch diameter. Lead wire is by far the most convenient and time saving way to produce bullets. It eliminates all of the risk from hot lead. All you do is chop the lead wire into the correct lengths using a tool called a "core cutter". Since Corbin lead wire is 99.995% pure, you can use it as a sample for hardness testing (Bhn 5.0). It is provided in single rolls, or in case lots of four rolls for a discounted price (provided the four are the same diameter).

Lead wire comes in .100, .125, .170, .185, .218, .247, .275, .312, .340, .365, .390, and .430 diameter. It is provided in pure form only, not as alloys. Alloyed lead can be cast, but it is more difficult to extrude. In most cases, there is no advantage to hard lead for swaging. Soft lead is more dense, expands better without breaking apart, and bonds very well to the jacket.

Four cavity core mould (CM-4a)

If you prefer to cast lead cores, the CM-4a four-cavity core mould can be adjusted for any practical weight of core by setting the displacement of four pistons in their matching, honed cylinders. It is rather like a straight-line automobile engine: the sprue cutter is a long handle similar to the engine head; the four pistons slide up and down inside of matching cylinders to eject the cores as soon as you rotate the sprue cutter to one side; the cylinders are machined in a special iron alloy block with a long mounting handle, in the manner of a car's engine block.

The pistons rest upon a "rest plate" which in turn is supported by two threaded rods, but loosely, so it can move up and down. There are two pair of nuts on each of the rods, which form a stop that adjusts the position of the rest plate in the down position. This sets the piston displacement, which in turn sets the weight of lead core you will make in each cylinder.

The CM-4a core mould mounts to your bench with two screws so the pistons and cylinders hang over the edge. I like to mount it on a short piece of two by four wood, and clamp this wooden block in a bench vise so the mould is held parallel to the floor. In fact, by mounting the mould with a common door hinge instead of directly to the bench top, the motion of opening the sprue cutter can also be used to tip the mould over so the cores fall out into a box.

You do not need to cut the cores which are cast with a core mould, because core moulds are designed so that you can adjust the length of the core as it is cast. Core moulds let you take advantage of existing supplies of scrap lead, provided it isn't too hard for the kind of swage dies you have. Any hardness of lead can be swaged, but you need type -H dies for alloys over about Bhn 10-12 hardness to avoid die breakage. Generally there is no advantage to hard lead for swaging, because swaging gives you so many other ways to eliminate bore leading.

The CM-4a core mould comes in standard diameters of .185, .218, .247, .275, .312, .340, .365, .390, .430, and .489 inches. Smaller diameters are not practical to cast (use lead wire or an extruder die). Larger diameters can be made to custom order. The weight is adjustable.

Precision Core Cutter (PCS-1):

Corbin core cutters mount to your bench, so that the lead wire is fed straight down, into the top of the cutter. A stop screw is adjusted to stop the wire at the desired projection below the shear line of the cutter. This is what gives you the desired core weight (plus a little for final adjustment in the core swage die or LSWC-1 die—usually 2 to 5 grains more than desired weight is enough to assure a good final weight control).

Core cutters quickly shear the lead as you feed it down into the device and move the handle back and forth with the other hand. Usually it is easiest to cut about eighteen inches of wire, or whatever amount will stand up straight in the air without sagging over to one side. Then insert this length into the cutter and let gravity feed it down as fast as you can chop off pieces. A gentle support with one hand is usually all it takes to give good feeding. You can also mount rolls of lead on a simple pipe stand, so they feed down into the core cutter and lengths can be pulled off quickly.

The PCS-1 core cutter is designed to use PCS-1D die inserts, which look very much like drill bushings. These half-inch diameter hardened steel dies come in pairs. One mounts in the top bar of the cutter, and the other mounts directly under it in the moving arm. The standard sizes are .125, .185, .218, .247, .312, .340, and .365 (size of wire that easily slips through the hole, not the hole size).

Each cutter comes with one set of dies for a given caliber of your choice, and you can add other standard sizes at low cost, or order custom made sizes at a reasonable price. If no size is specified, we will send whatever size we feel is appropriate based on our best guess of what you plan to do with it, usually based on the caliber of your other orders.

Magnum core cutter (PCS-2):

For cutting lead wire diameters larger than .365 inches, the PCS-2 Magnum Core Cutter is recommended. It is nearly three times the size of the PCS-1, and uses specially made individual hardened die inserts, PCS-2D, for each range of wire sizes up to 0.5 inches. This larger cutter can also handle sizes down to .185 inches but the minimum length of core is half an inch, because this is the thickness of the steel frame holding the dies.

Thus, for lighter weight cores in the .224 or smaller caliber, and for light cores in 9mm and .38 caliber, the PCS-2 cannot be used. If the core can be at least 0.5 inches long, it works very nicely and is highly recommended because of its great strength and leverage. But if you need cores that might be shorter than 0.5 inches, the PCS-1 is the correct choice provided that the core diameter can be .365 inches or less. Stock sizes of dies are .365, .390, and .430. If you do not specify the diameter of die, we will send either .390 or .430, because these are the most popular for the large cutters. Dies can be custom made in any diameter.

Lead Extruder Die (LED-1-H):

The CHP-1 Hydro-Press can be used to extrude lead wire in virtually any diameter. Only pure, soft lead can be extruded with this die set. The die is actually part of a kit that includes two billet moulds (for casting soft lead into cylinders that fit inside the extruder die) and a mould base, the die, three sizes of die inserts for different wire sizes, the extruder punch and a lock nut.

The die screws into the top of the press, replacing the floating punch holder. The punch screws into the press ram. It is designed to be easily removed and replaced, to facilitate loading the lead billets up into the die.

First, mount the mould base on a sturdy bench. Then push one of the billet tubes over the base, and pour hot lead into the tube. Wait until the mould cools slightly, then pick it up with a padded glove or other heat-resistant material, and give it a rapid shake to slide the lead out. As the lead cools it will shrink away from the billet tube and come out easily.

You can set the lead-filled tube aside if the lead won't slide out yet, and fill the second tube. By the time you remove the second tube, the first one will probably be cool enough for the lead to come out. Place the empty tube back on the base and continue filling and rotating tubes until you have made enough.

After the lead has cooled enough to handle safely, you can then spread a thin film of Corbin Swage Lube on the surface of the cylinder, and push the lead cylinder up into the bottom of the extruder die. Replace the slide-out punch, and align it with the die (the lead will probably rest on the punch end). With the proper diameter of die insert in the top of the die body, and the retainer bushing screwed firmly down against the die insert, start the ram moving upward.

The punch should smoothly enter the die mouth and start to compress the lead. The pressure should be turned up until the lead starts to extrude from the top of the die. Usually this takes 1,800 to 2,000 psi on the gauge. Do not place any part of your body over the top of the die. Lead may be expelled with great force if any air is trapped in the die. When the lead wire starts to move, it will heat the die insert, and this will in turn cause the lead to move even faster. In a second or so, the lead will spurt out rapidly and will come out very hot. Do not touch it without using a glove. The entire billet should extrude in a few seconds.

When the lead is extruded, lower the ram. Loosen the retainer in the top of the die, and remove it. You should be able to pull the die insert out of the die body by grasping the lead wire and pulling up. Push the lead back through the die just far enough to allow you to clip off the enlarged flange of lead remaining. Then reload the die and extrude another length of wire. Do not try to join the wires together by loading before the last billet is cleared from the die. It will make a bad joint that comes apart later.

You can specify any three diameters to come with your extruder, from our standard sizes. Or you can order a custom diameter of LED-1D extruder die. Additional billet mould tubes can also be ordered for higher production. If you want to extrude hard alloys, we can build a custom extruder with a smaller bore, which generates higher pressure with the same ram thrust. Some alloys, however, are just too hard to extrude reliably. We will need a test sample before we know if your alloy will extrude.

Core accuracy (weight control):

There is no difference in the accuracy of bullets made with cast or wire cores, if you process the cores with either a core swage die or the LSWC-1 style of die (both have bleed holes to adjust the core weight precisely). In theory, lead wire would be slightly more precise because it has been extruded at high pressure and probably does not contain any air bubbles or voids, but the core swaging operation takes care of that in any case.

If you do not use a core swage or LSWC-1 die to adjust the core weight, then your core variation should be less than 2% of the total bullet weight with careful casting or cutting technique. Bear in mind that percentage of total bullet weight is what matters, not absolute weight difference. Five grains makes no practical difference in a 500 grain bullet, but it is very significant in a 50 grain bullet. Swaged cores typically are held to less than 1% of total bullet weight, and perfectionists achieve less than 0.5% tolerances. This could be any amount of grains, of course.

With nearly any set of swage dies, the first die should be a CSW-1 core swage. This die extrudes a small amount of lead through bleed holes in the die, leaving a fixed volume which you can set with the punch holder (the distance between punch ends controls the volume, and thus the weight, of the core). The core swage only works if you go to the end of the stroke each time, so that a fixed distance is established between the top and bottom punch. This in turn established a fixed volume within the die. Any additional volume of lead is extruded through the bleed holes. Holding the pressure for a constant amount of time at the end of the stroke also helps make more accurate weights. Double swaging adds a tiny bit more precision to the weight control process, but is usually overkill except for perfectionists (you know who you are!).

In a power press, the top of the stroke can be set by an electronic sensor, which shuts off the fluid power flow when it sees the ram guide plate. This is a convenient way to adjust the press for the shortest stroke (ram travel) that will do the job, making the job go faster than if you used the entire stroke. But there is a slight variance in the final stopping point, due to differences in the trip point of the sensor, ambient temperature changes that affect both the electronics and the hydraulics, inertia in the hydraulic system, and other physical causes.

To eliminate these sources of weight error, you can either use the entire stroke and stop the cylinder against the end of its housing (a positive, unchanging position) and use the pressure reversing mode to control the press stroke, or you can get the Positive Stop Punch Holder, FPH-2-H. This punch holder is made of hardened steel, drilled all the way through the center. The punch drops in from the top, and rests on a thick ledge at the bottom of the hole. A long, hardened steel threaded rod is then screwed into the top of the holder. The position of this rod controls how far the external punch can travel back up in the holder.

The punch holder is then adjusted so that the face of the swage die actually contacts it, and stops the ram movement in the upward direction. The punch holder is designed to withstand all the force that the press can generate. By stopping the ram this way, there is nearly perfect consistency in the volume left in the die at the end of the stroke, and thus nearly perfect core weight. So why don't we supply this holder instead of the regular one? It is much slower to load the punch, and for most purposes, you do not need this degree of weight control. But, if you do need it, the optional FPH-2-H will deliver.

Core size (diameter):

Because there are differences in jacket walls depending on how you make or where you acquire the jacket, it isn't possible to absolutely specify a proper diameter for each caliber. The rule of thumb is that the lead wire or cast lead core should drop easily into the jacket, to the bottom. If it contacts the jacket wall before that point, then air can be trapped behind the core. If you seat the core you can compress the air to 30,000 psi, and it may be trapped in the base, but I've seen cores pop out of the jackets with considerable force after the seated cores and jackets have been left on the bench for a few minutes, especially if the sun happens to fall on them through a nearby window! The right size of lead wire or cast core is that which fits easily by hand into the core swage die (CSW-1) or the LSWC-1 (for lead bullets) and yet isn't too long and thin to fit completely into the die prior to swaging. The right size of core swage is whatever makes a core that drops into your jacket all the way. So you can see that the core size, for jacketed bullets, fits the core swage, and the output of the core swage fits the jacket.

In general, if you use the jackets most often available for these calibers, here is a table of core sizes, core swages, and calibers that would work, assuming normal or thinner than normal jackets (extra thick jackets require smaller cores):

CALIBER	WIRE SIZE	SWAGED CORE SIZE
.142	.100	.105
.172	.125	.130
.198	.125	.167
.204	.170	.173
.224	.185	.191
.243	.185	.191-201
.251- 257	.185	.191-220
.265- 277	.218	.220-224
.284	.218	.230-235
.308-338	.247	.249-257
.355-375	.312	.318-257
.400-412	.340	.350-370
.429-458	.365	.370-380
.475-505	.390	.400-420
.511-998	.430	.435-550

Please bear in mind that actual lead core diameters depend on the jacket wall thickness, so that you might need the next standard smaller size of wire if the jacket wall is thicker. Likewise, if you plan to make lead bullets without a jacket, then use the lead wire size that is at least .005 inches smaller than the caliber. For instance, a .452 or a .458 lead bullet would use .430 wire, but a .429 lead bullet would need to use the .390 size instead.

Lead wire larger than .430 is too difficult to coil, so it is either supplied in straight lengths or you would use a core mould. In fact, when the required core is larger than .430 the cost factor per bullet favors casting your own cores. When the core is below .218 inch diameter the cost factor favors lead wire instead of casting. The convenience and time saving of lead wire is a strong consideration regardless of diameter and cost per bullet.

If you want to make a paper-patched .45-70 bullet, and your bullet diameter with the patch applied is to be .458 inches, using 0.0025 inch thick paper, this would require a bullet of .448 inch diameter before patching.

Why? Paper patching material is generally wrapped around the bullet twice, so the edges just come together on the second wrap. Looking at a cross section of the bullet, then, you would have the bullet diameter, plus four thicknesses of paper. Generally you would want the total diameter to fit into the bottom of your rifle grooves. A .45-70 bore generally has a groove-to-groove depth of .458 inches and a .450 inch bore hole, for .004

inches of rifling per side. Subtract four times the paper thickness from the barrel's groove-to-groove diameter, and this gives you the correct bullet diameter to make.

In this example, .458 less 4 times .0025 gives us .458 -.010 or .448 inches for the bullet. You can use .390 lead wire, since this is the largest practical coiled diameter available. But if you were to have an extruder made, or a core mould, it would be even better to use .440 to .445 inch diameter cores. Any diameter that fits into the die nicely and is not too long, at the weight you desire, to be enclosed completely in the die before any pressure is applied, will work.

The upper limit of core diameter is whatever fits easily into either the jacket, or the die (for lead bullets). The lower limit is whatever just fits completely in the die without sticking out the die mouth, and allows at least one caliber of length for inserting the external punch before any pressure is created. If you use too long and thin a core, it will contact the external punch before the punch can be aligned at least a full caliber depth in the die. This can cause the punch to be tipped or bent when you apply pressure to compress the core. Any core diameter between these two extremes works, but the closer the core is to finished diameter, the less folding and wrinkling takes place and the less work it is to compress it smoothly and evenly.

Core lubrication

When a core is swaged, it is first lubricated with Corbin Swage Lube, simply by applying a drop to your fingertips and rolling the core back and forth once or twice as you pick it up. No detailed ritual is required. A thin film of lube transferred to the lead surface is sufficient. If you want to lubricate a large quantity, put half a teaspoon of Corbin Swage Lube inside a clean tumbler and load it with as many cores as your tumbler will spin without overloading it. Then turn it on and let them tumble for half an hour, or until all the cores are evenly lubricated.

The film of lube greatly reduces swaging pressure, helps insure long die life and eliminates lead fouling of the die and punches. Once you have swaged the cores, the lubrication must come off before you put them into jackets. Corbin Swage Lube will wash off by boiling the cores in a pot of hot water with a little strong detergent added. In fact, just the hot water works reasonably well. I like to use boiling water, because the heat quickly drys the cores once you pour them out onto an old towel to dry. You don't want them to sit around very long with moisture, because they will tend to oxidize, and this prevents a good core to jacket fit.

Swaging lubricant is not the same as bullet lubricant. Swaging lube acts as a high pressure film between the die and the bullet, reducing friction and lowering the pressure needed to form the part. It is not designed for use under high temperature, and it is designed to be easily removed in solvents or water. It is clean, and is normally quite safe to handle (in rare cases someone may be allergic to the castor oil or lanolin components). Corbin Swage Lube is made from medical grade compounds designed for cosmetics.

Swage Lube forms a hard lacquer film when heated to annealing temperatures for copper jackets, however. This film prevents Corbin Core Bond from working, so be sure to wash off the lube from any bullet jacket and core which are intended to be bonded using the Corbin Core Bond process.

Core bonding is a process of melting the lead, within a jacket, in the presence of the liquid Core Bond. The Core Bond lowers the surface tension of the melted lead so that it can easily penetrate into the copper jacket, forming an actual alloy that is shallow but stronger than solder or glue by a considerable margin. The advantage of the diffusion junction between the lead and jacket is that there is a gradient of tensile strength created, instead of a sharp junction between the 1000 psi lead and the 18,000 to 22,000 psi jacket material.

A sharp junction, such as exists under a layer of solder or glue, acts as a point of concentration for sudden stress. When the bullet strikes, a tremendous amount of stress is created within the bullet in a very short amount of time. The force is channelled to areas where there is a big difference in tensile strength, and tends to separate them. When the tensile strength of the materials flows through a gradient, becoming different over a distance rather than suddenly, the force of impact can flow with it, and cause less concentration at that point.

The bottom line is that a bonded core bullet can usually be shot inside out and still retain nearly all of the core, whereas glued and soldered or plain unbonded bullets often separate at the junction of the core and jacket. Microphotographs taken of bonded jackets, under a scanning electron microscope, show atoms of lead within a one to two micron depth beyond the inner surface of the jacket wall. You don't get that with any kind of glue or other surface adherent bonding. That is the technical reason behind the fact that 90% of the world's custom bullet makers who build hunting bullets use our bonded core process. It is fast, low cost, and it works better than the alternatives.

9. Swaging with a Reloading Press

Some Corbin dies are designated type -R. This stands for "Reloading Press", and means that the die set was designed to fit into a regular single-station, slotted ram reloader with standard 7/8-14 threads. Any of our tools that have the -R suffix are meant for use in a reloading press. The dies screw into the press head, like a reloading press die. The external punch snaps into the slotted ram like a shell holder.

Why would you want to use dies modified for use in a reloading press, when swaging presses are so much faster and more versatile? The reason is economic: if you already have a reloading press, and don't wish to make benchrest quality bullets but will settle for a reasonably good bullet (about equal to or slightly superior to standard factory bullets), then you might want to use the -R dies.

Disadvantages of using a reloading press

1) The pressure required for swaging larger calibers places a severe burden on the unhardened screw-stock rams used in most reloading presses, which can cause undue wear and distortion of the ram. Most reloading presses are not equipped with any bearings, so the pivot pins, ram, and other moving parts are placed under high frictional forces when harder alloys or larger calibers are swaged. Therefore, Corbin reloading press dies are built only for use with pure soft lead cores. If you use alloy lead, the pressure will be considerably higher, and could break the die or damage the press.

2) A reloading press has no built-in floating alignment, and in fact is generally quite sloppy compared to the alignment of an actual swaging press. This is fine for reloading because there is no real need for high precision alignment: the shell holder and fit of the cartridge case both are so sloppy that there is no gain in making the press highly aligned between head and ram. But in swaging, better bullets result from precise alignment of the press head and ram. The forces are considerably higher, so that a little off-center torque can make a difference in punch life and bullet quality. The lack of high alignment precision means that certain styles, such as the rebated boattail, are not available for the reloading press.

3) A reloading press has no built-in way to eject the bullet from the swage die. You need to use a small plastic mallet and tap the plunger provided with the swage die, to knock out the bullet (and catch it with

your other hand). Actual swaging presses have automatic built-in ejection when used with dies designed to fit the ram, and are considerably faster to operate.

4) A reloading press has less than half the leverage of any Corbin swaging press, since it must use about four inches of ram travel. Swaging only requires about two inches, for most of the calibers and styles that can be made by hand. Therefore, by simple physics we can double the force with the same amount of handle travel. This makes swaging with a real swaging press far easier (less than half the effort required).

5) A reloading press does not generally have any bearings, so they tend to wear and become quite loose under heavy loads. Corbin swaging presses such as the S-Press or the Mega-Mite travel on needle bearings with the rams guided in long oil-impregnated bushings. This extends the life and lowers the friction, which in turn reduces your effort for a given amount of thrust output.

Most loading presses have sufficiently heavy frames but rather weak, soft screw-stock rams and pins which are sometimes reduced to half their visible diameter inside the hole, as safety links, to prevent damage to the rest of the press. Corbin swaging presses use full-diameter, hardened alloy steel links which turn inside high-pressure bearings. The swaging press can be physically smaller and yet still be considerably stronger, especially those which built from alloy steels. The S-Press, for instance, uses 130,000 PSI steel, whereas the most popular large reloading presses advertise "35,000 PSI tensile strength" for their cast iron frames.

All this being said, a reloading press that you already own is far cheaper than purchasing a new swaging press! So Corbin makes some kinds of dies for swaging bullets in a 7/8-14 threaded head, RCBS-style T-slotted ram reloading press (single station). The kinds of bullets you can swage are limited by the press accuracy and strength, stroke and power, but within those limited, the dies will do a nice job. If you only need to make a limited quantity of bullets, in one or two calibers, then reloading type swage dies (type -R) may be your best value.

Available tooling for reloading presses

One type of -R die comes in any standard caliber from .224 to .540 inch diameter for soft lead, semi-wadcutter style bullets (that is, bullets which have their noses made entirely from lead, and which have a small step or shoulder between the nose and the shank). These dies are called the "Pro-Swage" dies. They are only made in the design of a core seater, not point form, lead tip, core swage, or lead semi-wadcutter. Weight control (extrusion of surplus lead) is done by means of an optional weight-adjusting punch (bleed-hole punch).

You can get flat base, cup base, dished base, or hollow base styles, or the Corbin "Base-Guard" base. The internal nose-forming punch is available in Keith, 3/4-E (a typical pistol round nose shape), 1-E (a typical Winchester or Sharps rifle nose shape), target wadcutter, button-nose wadcutter, hollow point (which is then followed by another punch to get both the HP cavity shape and the nose curve shape), auto-loader (a sort of bell-shaped round nose that feeds nicely in most autoloaders), and conical.

We also build -R dies in two, three, or four die sets to make jacketed rifle or handgun style bullets. The two die set normally consists of a CS-1-R core seating die, and a matching PF-1-R point former. The three die set adds a CSW-1-R core swage die for more precise lead core weights. The four die set adds a LT-1-R lead tip forming die for a professionally finished lead tip. These are available in the following calibers, in the 6-S ogive shape: .224, .243.

For larger jacketed rifle calibers, you need to step up to one of Corbin's swaging presses and the dies to fit it. If you use type -S dies, there is no difference in die cost (well, actually, the -S dies cost less than -R type for the same function). The big difference is the swaging press, and it makes so much difference in speed and ease of use that you will surely thank me later for not even attempting to start you with a reloading press. Every tool and process has its practical limits.

I know that other people have made designs that I would not recommend, and some may even be trying it as you read this. I suppose the thing to do is scan through the old gun magazines and look at all the outfits who used to make swaging dies. You'll see Corbin tools, of course, but you'll also see a number of other brands offering those designs which are absent in our line. Try to find those other firms today. They are not in business now, you say? Really! And they made the designs that Corbin does not recommend?

Perhaps there is something to be learned from that. There will always be a few new comers touting the same reinvented square wheel, who will shine in the spotlight of publicity and win a few converts, then suddenly disappear when enough of their work comes back to bite them. It is always sad to see someone fail in business—which is why I am happy after talking to my clients (with their 98% plus success rate in the custom bullet business).

There is always a tiny but fairly steady trickle of challenging phone calls and letters from people who have glowing stories about the use of design ideas that we long ago ruled out as a reliable good value to our clients. Honestly, after decades of patiently explaining why they are not good ideas in spite of the fact that Cousin Joey had great luck with one or some temporarily famous shooter or mechanic is getting rave reviews from some niche of the shooting fraternity at the moment, I really don't care to spend any time debating it.

There will always be dark corners where long term value and scientific fact is excluded by blind exuberance. A goodly number of these ideas revolve around using a reloading press in some way that is technically possible, but not a good long term value. The lure of getting by cheaper is strong enough to overpower good reasoning, sometimes.

I am not doubting that some of the ideas work, at least from time to time, in specific situations, when run by very careful operators. But the reason we do not offer them, and would prefer not to be "talked into" making special exceptions, is that there is a better way. Better might mean more cost effective, giving you the same or better value, as with using solid carbide versus a high carbide die steel in non-automated presses.

Better might mean less likely to stick, jam, or break if a person gets forgetful or careless about lubrication, alignment or pressure, as with our standard ejection pin sizes. Or, better could mean equal in final result but standardized for replacement parts, service, and knowledge accumulated to help you with various situations. Sometimes, better means it actually works every time, consistently, and has enough history behind the design to warranty the product, even if there seems to be a cheaper alternative or one with fewer steps. Still, we do a lot of custom work, and take each request on its own merits. No harm is done by asking!

Reloading presses suitable for swaging

For the fired .22 long rifle cases drawn to make .224 or .243 bullets, you can use almost anything that will accept the dies and the punches. The little RCBS Junior press was one we used to demonstrate swaging at gun shows, in the old days. It doesn't take a big press to swage smaller caliber bullets. You can use Rockchuckers or Pacific Multi-Powers or C-H Champions, of course. They are sturdy, standard design presses. Any press with a single station head and ram, which accepts standard RCBS-type button shell holders, and has a 7/8-14 threaded top, with a physical layout similar to the Rockchucker, should be fine.

The ones you can't use are those which have special mechanical shell holder devices instead of a slotted ram, or those which have a handle that swings over the top of the press, like the Bonanza Co-Ax press (the handle parks itself right over the die, where you need to tap on the swaging die's knockout rod to push the bullet out of the die). I prefer not to use turret or progressive presses because of inherent alignment and strength problems. Swaging puts a lot of strain on that pivot! Aluminum and light duty reloading presses may be usable for smaller caliber swaging, but are not ideal for it.

The popular Dillon progressive reloading presses are not made for bullet swaging, and could be damaged if you try. Most progressive or multi-station presses are best used for their intended purpose, not swaging. This is in no way a criticism of the press. Most presses that sell in good volume over a long time period are good, solid presses, or else people would soon find out and quit buying them. The lightweight Lee presses are very sturdy and entirely suitable for their intended jobs. But swaging places unusual forces on the top of the ram, and on the pivot pins, links, and toggle. Designs that work just fine for reloading may not last or provide enough alignment and rigidity for swaging.

I wish it could be otherwise, because it would simplify my work considerably if I didn't have to design and build swaging presses, and could just concentrate on making the tools and dies. We are of the same mind when it comes to making the equipment as affordable as possible: I could interest even more shooters if bullets could be swaged with a wine cork press or a garlic press! Unfortunately, neither of these presses is suitable for reloading or swaging, and many reloading presses are not suitable for swaging (although with minor changes any of them could press garlic).

Types of dies suitable for a reloading press

Corbin makes virtually every sort of bullet and jacket reducing die in the range of .224 to .458 in the -R type (such as the BRD-1-R to turn a .357 into a 9mm, or the JRD-1-R to draw a .452 jacket into a longer, heavier jacket for a .40-65 bullet). These are discussed under the "Draw Dies" chapter. We also make type -R draw dies to turn fired .22 rimfire cases into .224 or .243 caliber jackets, and to turn fired shotgun primers into .25 pistol jackets or partitions for use in .30 caliber jackets.

Gas checks can be punched and drawn from flat copper strip (.030-thickness, 1-inch wide strip is available from Corbin). The tool to accomplish this is called the Gas Check Maker, or GCM-1-R. It consists of two dies, a blanking die that punches out a round circle of copper, called the disc or coin, and a cupping die that turns this disk in to a short-sided cup and finishes the gas check. I can make this die set for a reloading press, but it works better (less effort, more precision) in our S-Press.

Although gas checks are useful for cast bullets, the Base Guard is even better for swaged bullets. It does everything that the gas check is supposed to do in protecting the bullet base, and in addition, helps to keep your barrel clean by actually scraping fouling out of the bore with each shot. The Base Guard is made from the same material as a gas check, but takes only one stroke in a single die.

In a reloading press, you can use the BGK-1-R Base Guard Kit. This is a single die and punch, with a slot in the side of the die through which you pass the inch-wide strip of copper while you stroke the press up and down in a short stroke. The punch never actually leaves the die, but simply drops below the slot so you can move the copper strip. Then you raise the punch and poke out a new disk, with a hole through the exact enter. This small hole allows lead to be extruded through during the swaging process, to form a rivet head, holding the gas check in place but allowing it to turn with the rifling (unlike a gas check, which is clamped to the bullet so that if the bullet "skids", so does the gas check).

Bullet jackets can be trimmed to exact (and adjustable) length using the ET-2-R die set. This is an "Expand/Trim" type of die, which pushes the existing jacket up into a 7/8-14 threaded die that has an adjustable stop screw in the top. The jacket contacts the end of the stop screw, and is held from moving any further, while the punch (in the press ram) continues upward. The punch is made with a small guide tip that fits inside the jacket mouth, and a long tapered cone.

When the jacket comes to a stop and the punch continues upward, the cone is forced into the jacket mouth and expands the jacket until the punch finally reaches the die mouth. The jacket is pinched between the mouth of the die and the punch, and is deeply scored, almost cut through but not quite. The flared portion comes off easily by tumbling, twisting or pulling.

The reason you should not try to cut through is that the thin web of jacket between the sharp die edge and the tapered punch is all that keeps the punch edge from being peened over. If you run the punch right into the die edge, it rolls the edge and then you have to resharpen it by taking a light grind on the die face. Since you can set the length anywhere you wish, nearly any length of jacket can be made shorter.

Actual bullet swage dies include the PRO-1-R Pro-Swage design, and the -R type swage dies that make up the two, three, and four die sets for spitzer rifle bullets of the ogival type (no shoulder).

The Pro-Swage Die

The Pro-Swage is normally used for paper-patched bullets in rifle calibers, so we supply it with a cup base and a 1-E round nose ogive punch for rifle calibers unless you specify something different. A popular use of the PRO-1-R is for centerfire pistol and blackpowder rifle Base-Guard bullets. Generally, a pistol swage set would be supplied with a Keith SWC nose style and a BG base style unless you specify something else. The Base-Guard base punch can be used without a Base-Guard disk. It simply creates a small rivet head in the exact center of the bullet base, which hurts nothing (and serves to identify your bullet among others recovered later).

A die designed to make lead bullets may also be used with gas checks. Base-Guards are much more effective at keeping the bore clean, however. Once you've used Base-Guards, it's doubtful you'd ever go back to gas checks. If you wanted to use the same die for gas checks, half jackets, or three-quarter jackets, you can do it without any change in tooling. If you don't want the little bump on the bullet base that results from using the BG punch, just order a flat, cup, or dish base punch and use it instead.

The PRO-1-R die itself is threaded 7/8-14, so that it fits the reloading press top. The upper half of the die is screwed onto this hardened 7/8-14 body in a semipermanent way (held with a thread locking compound). The top of the die is threaded for an adjustable bushing that can be removed to replace the internal punch, which is held captive within the die body by this bushing. A knockout rod in the top of the die pushes the internal punch down (using a plastic mallet or length of wood as a hammer) to drive out the swaged bullet. The internal punch is usually the nose (we can make it the base if you prefer, but you have to keep track of it for future punch orders and make sure to specify "internal" punch).

Other -R type bullet swage dies

The -R type core swage die (CSW-1-R) is actually made the same as a core seating die, without bleed holes in the die itself. The diameter is smaller than the same caliber of core seating die, of course, so that a lead core can be swaged to fit inside the jacket, which in turn fits inside the core seating die (CS-1-R). Lead weight is adjusted by using an external punch with a hole through the center, so that lead can be extruded through it. The lead goes into the ram slot, just like a spent primer, except that it may remain attached to the core like a thin lead wire antenna. This is easily snipped off with a pen knife or nail clippers.

The reason that a -R type core swage does not have bleed holes in the die itself, as the -S and -H dies do, is because of the geometry of the typical reloading press. Unlike a swaging press, which has a ram stroke that stops considerably short of the press head, leaving room for the die, a reloading press ram is made to stop just below the press top. In order to use the end of the stroke (both for maximum power and also as the positive stopping point necessary to establish constant weight from one core to the next), the -R die cannot be adjusted so that the die extends below the press head. The die is positioned in the middle of the press threads, in fact, so putting bleed holes in the side of the die would spurt lead directly into the threads!

Decades ago, I made core swage dies with angled ports and reduced lower diameter to clear the threads and extrude lead at about 45-degrees to the bore, but the dies were not successful in the long run. Using hard lead has never been recommended with -R dies, but it positively blew these angled port dies to bits (although nothing flew around, since the pressure was instantly relieved when the die fell apart). The -R core swage die works reasonably well, but it does require an extra step of snipping off the single wire extrusion. Core swages used in our swaging presses automatically shear off the extrusions on the down stroke.

The -R core seating die (CS-1-R) is nearly the same design as the core swage, except the bore is larger and the external punch either makes a lead nose and fits the die bore, or makes an open tip and fits inside a certain wall thickness of jacket. All of the -R dies are 5/8-24 thread and have a 5/8-inch body, which screws into a black 7/8-14 thread adapter. This adapter is bored nearly through the other end, but the hole stops short of going all the way. A quarter-inch diameter hole does go through, and takes the ejector rod which is tapped firmly to eject the component. The internal punch is captive within the adapter, and can be changed by unscrewing the die from the holder.

The -R point forming die (PF-1-R) uses a music wire coil spring to keep the ejection pin pushed to the top position within the adapter body. Ejection pins are typically .081 inch diameter for these dies, which are made in .224 and .243 caliber in 6-S ogive shape.

The -R lead tip forming die (LT-1-R) is nearly identical to the CS-1-R core seating die, except that the bullet goes into it facing upward, tip toward the die. The internal punch has a cavity shaped like the bullet tip, and reshapes the lead to make a sharper end than can be made with the .081-inch diameter ejection pin in the point forming die.

Those four dies can be combined to make two-die sets (CS-1-R and PF-1-R) as with our standard .224 and .243 bullet making kits, a three-die set by adding the CSW-1-R core swage, or a four-die set by adding the LT-1-R to make nice sharp lead tips. The CSW-1-R and CS-1-R can be used as a pair, also, to make semi-wadcutter bullets. However, the PRO-1-R die can do the same thing by using a weight-adjusting punch (with a hole through it) to set the exact core weight and then changing to a nose punch to create the actual nose shape.

General instruction for swaging in a reloading press

Some folk have complained that there was no simple, 1-2-3 instruction for swaging bullets, and they didn't want to read a lot of details about how to do it right. For those who might feel this way, here are the simple 1-2-3 instructions for making a lead rifle or pistol SWC type bullet of any nose or base shape using the PRO-1-R or CS-1-R die:

1. Cut or cast cores to desired weight, and lubricate them with Corbin Swage Lube. A little lube on your fingertips will be all you need.
2. Put the die in the press head and the bottom punch in the press ram, and then put a lubricated lead core in the die.
3. Adjust the die so you form a finished bullet at the end of the stroke, with the press ram all the way up just as the bullet forms completely. Make as many bullets as you need once you have the die adjusted.

And for jacketed bullets made in a core seater and point forming die (ogival shape, no shoulder), the most basic operation skips the core swage die and uses a cast or cut core directly in the jacket:

1. Cast or cut the core to the desired weight (bullet weight minus the jacket weight) and put the clean, unlubricated core into the jacket. Lubricate the jacket lightly with Corbin Swage Lube, and put it into the core seating die.
2. Use a core seating punch that snugly seals the jacket and press gently to expand the lead inside the jacket, until the jacket expands and contacts the die walls evenly. The jacket and core must stay up in the die when you lower the press ram. Eject the seated core and jacket by tapping on the knockout rod placed in the top of the die.
3. Remove the core seating die after you have seated a quantity of cores in the jackets, and replace it with the point forming die (which has a spring-loaded internal punch you can feel by pushing the knockout rod by hand).
4. With the point forming die high in the press threads, place the open jacket and core mouth upward, open end facing the die, into the die cavity. Use the largest diameter punch in the set, which just fits into the die, to push on the closed base of the jacket. Raise the ram all the way or until you encounter resistance.

5. If you do not encounter any resistance with the ram at the top of its stroke, turn the die to lower it until you cannot turn it any further by hand. If you do feel some resistance, lower the ram and inspect the bullet to see if the ogive has formed. If not, or if you felt no resistance, lower the ram slightly and give the die another 1/4 turn lower. Raise the ram, then lower it and knock out the bullet.

6. Examine the bullet, and if the tip is not yet closed down to the size of the ejection pin (.081 inches in most dies), continue to lower the die in small increments and re-form the tip until it reaches this point. If you go too far, the bullet will acquire a little pipe on the tip from extruding the jacket up the ejection pin hole. Just short of this, it makes a nice bullet tip and you have finished!

Detailed swaging instructions for a reloading press

For those of you who would like to know both why and how to do it right, here are the details and the reasons behind them:

Remove any shell holder from your reloading press, and clean out the slotted ram with a swab to remove any accumulated primer residue and shavings. These can prevent alignment of the swaging punch and die. Snap the reloading press punch into the ram (like a shell holder). Don't try to use a shell holder in addition!

Screw the die into the top of the press just a few turns. Don't try to set up as you would a reloading press die (against the end of the ram). Just barely get it started. We want to use the top of the stroke for a positive stopping point, and adjust the die up and down to get the right pressure and nose shape, so we have to start with the die too high, and slowly bring it down while making our initial adjustment.

Cut the lead wire, or cast scrap lead cores to the right weight. If you are using a core swage die, add about five grains to the desired final weight. For jacketed bullets, put the jacket in the scale pan, cut a piece of lead wire and adjust the length so that the total weight (jacket and core) are a few grains more than you desire for the finished bullet. Without a core swage die, the total of bullet jacket and core is the finished weight.

Open a bottle of Corbin Swage Lube. Put a tiny bit of lube on your finger tip, and when you pick up the lead core, give the core a turn between your thumb and finger tip. That's all the lubricant you need. (If you are using a core swage die, that is.)

(Please note that PRO-SWAGE dies are basically core seaters, made in final diameter with nose and base punches. They are a single-die system, not including a core swage, point former, or lead tip die. Those other dies are part of the ogive-style rifle die sets, not the simple semi-wadcutter style of the PRO-SWAGE. It adjusts the lead core weight by using a separate weight adjusting punch with a bleed hole in it.)

Put the core into the mouth of the core swage die, then carefully raise the ram of the press until you can remove your finger and let the punch hold the core. Gently raise the ram all the way. If the punch is stopped before you get to the end of the press stroke, raise the die slightly. If you are not using a core swage die, then put a clean, unlubricated core into the jacket, lube the OD of the jacket, and put it into the core seat die. Follow exactly the same adjustment procedure.

With the ram of the press as high as it can go, lower the die (screw it down, toward the ram) until you can't turn it by hand any further. You've just pushed the lead core up against the end of the internal and external punches. It is important to understand why you are doing this initial adjustment: it is to use the end of the press stroke, where you have maximum power, and to provide a consistent point of reference so all your cores will be made exactly the same. If you stop short of the press top, then the distance between the top and bottom punches is arbitrary and will change from stroke to stroke. This leaves different amounts of volume within the die on each stroke, so naturally you don't get the same bullet weight in a core swage, or amount of closure in a point form die.

Lower the handle of the press very slightly, and turn the die about half a turn closer to the ram, then raise the ram again. When you feel a slight resistance on the handle, lower the ram all the way and inspect the core (or seated core, or finished bullet, depending on the die you are using). To eject the bullet, put the knockout rod into the top of the die and tap it firmly with a plastic mallet.

When the lead forms completely (square ends, sharp edges, full diameter of the die with parallel sides), you have found the correct adjustment. If, during this process, you feel that the pressure is too great (too much force on the handle—you should not feel more than about what it takes to seat a bullet or expand the mouth of a cartridge case), stop and inspect the lead. Perhaps it is much harder than you thought. Only pure, soft lead is really suitable for reloading press swage dies. If lead spurts around the punch, you are using too small a punch diameter for the operation.

Lock down the locking rings on the die, and proceed to swage all the cores you wish. Use care to insure that the punch tip goes into the die and doesn't strike the edge. (Make sure it doesn't pinch your finger, either:

that hurts!) When swaging lead cores in a reloading press, it is important that each stroke is exactly the same distance, so you leave the same volume or spacing between the top and bottom punches inside the die. The extra lead will be extruded through a hole in the bottom punch.

With a core swage die, or a "bleed-off" punch used in a PRO-1-R die, you will note that there is a little "antenna" or bleed-off of lead on the end of each lead cylinder. Snip these off with a pocked knife or nail clippers. If you don't get this bleed-off, your cores may vary in weight. A core swage can only remove extra lead—it can't add more. That means your cores must be cut, or cast, heavy enough so that all the variation is smaller than the amount of extra lead you left to swage off.

Clean the lubricant from the cores, if you intend to put them into jackets next. For lead bullets, you don't need to clean them yet. To remove the lubricant, you can slosh the bullets around in a can of organic solvent such as acetone, or Corbin's Cleaning Solvent. Or you can wash them in hot water with a little detergent added. Either way, roll them on adsorbent cloth or paper towel to dry them.

To make a Keith semi-wadcutter (a variety of truncated conical bullet), you would select the CS-1-R or the PRO-1-R die and a nose punch of the desired shape. If you want a hollow base, cup base, flat base, or a Base-Guard base, select the punch having the face that is machined to transfer that shape to the bullet. The punch trapped inside the die body is the internal punch. The punch that snaps into the ram slot is the external punch. Both can be changed, to change the base or nose shape.

Place the cleaned cores into jackets. Just set them in the jackets. You want to avoid getting any lubricant inside, since it will just keep the core from pressing firmly against the jacket wall. Then, put a drop of lube on your fingertip, and pick up the jacket (with core inside). Put the jacket into the die, so that the lead faces the nose forming punch.

The lead core must drop into the jacket easily without stopping against the die wall (needs to fit to the bottom). If you try to mash the lead into the jacket when it doesn't fit correctly, you'll trap air below it, and it could pop the core out again later! Not all diameters of cores for a given caliber will fit into all the jackets that could be available for that caliber: jackets can have different wall thicknesses, and require different core sizes.

Swage as described previously for making the cores. One difference: if you are using a jacket and an external punch that forms a semi-wadcutter or a lead tip bullet, the length (and thus the weight) of the lead core must be such that the lead will be at least as long as the jacket after the core is fully seated. If you try to use too light a core for the jacket length, and a punch that requires lead to fill its cavity, the punch will push against the edge of the jacket and wrinkle the jacket. You could damage the punch.

Please note also that you only need as much pressure as it takes to expand the jacket to fully touch the die ID. Using more pressure than it takes to expand the jacket just stresses the die and could lead to breakage. Just use the minimum effort required to get the jacketed bullet to fill out properly and become the proper diameter. This should require very little effort in smaller calibers, with increasing effort as you get above .308 and into the large pistol or paper-patched rifle calibers. Proceed carefully so you do not break the die from excess pressure.

Lead cores expand and become shorter as you seat them: you need sufficient length of lead so that there will be material to fill the cavity in the external punch tip. If you are using a hollow point punch, use it first to extrude lead forward, and then shape the lead with the second punch. If the hollow point is uneven, try flattening the lead core first with a flat punch, then use the hollow point punch, and finally use the Keith or other semi-wadcutter punch.

If you are making a BG (Base-Guard) style of base, you might wish to pre-form the bullet without the copper disk first, then put the disk into the die with the peak of the cone-shaped disk facing the lead. Push the bullet back into the die against the BG disk, so that the lead flows through the hole in the disk and forms a rivet head in the small depression in the center of the base punch. You can try forming the BG disk onto the bullet in one stroke, and it will probably work if the end of your lead core is flat enough. Typical cut cores have an angle, which may make it harder to get a good, straight alignment of the BG disk. Pre-shaping them solves that problem nicely.

You may be done at this point, if you are making semi-wadcutter style bullets (which includes paper-patched rifle bullets or any other type having the SWC shoulder). If so, congratulations! Wipe the lube off the bullets and you are ready to load them. If not, it means you have one or two more steps to perform to make a smooth ogive bullet or to form one with a small lead tip.

To form a smooth ogive, lead tip bullet, you need to make a seated core with exposed lead beyond the jacket. If you want a smooth ogive, open tip bullet, then you need to use a punch that fits inside the jacket, rather than just inside the die. The core is made shorter than the jacket. We call this the "open tip" style. A "hollow point" is something else: you make a HP bullet by pushing a punch with a conical projection into the lead core, so that a hole is pressed in the lead. The core can be down inside the jacket at the time (making an open tip hollow point) or it can extend beyond the jacket (making a lead tip hollow point). Press the core down so it fills up the jacket, then stop pressing. Remove the core seating die, and replace it with the point form die (PF-1-R).

With the point form die in place, and a full-diameter base punch in the press ram (which just slides into the point form die by hand with very little tolerance), put a small amount of lubricant on your fingertip and roll the seated core and jacket between your thumb and forefinger. Put the seated core and jacket into the point forming die, so that the lead faces up (toward the die). Gently push the punch in behind the bullet and adjust the die position so that you feel only a light resistance when swaging at the end of the stroke. Eject and examine the bullet.

If there is a pipe or extension on the end of the bullet, it means that you have the die just a bit too low. Turn it counterclockwise very slightly. If the bullet won't eject or has a large, rough and unfinished looking tip, it means you have not pushed it far enough into the die. There is a position where you will get maximum tip closure before the lead flows up the ejection pin hole. You can find it by trial and error. (Hint: save a good bullet to use as a setting gauge next time. Put the bullet in the die, raise the punch and ram, and screw the die down until it stops.)

To make a smooth flat tip on your bullet, just turn it over, push it backward into the die, and gently bump it on the nose with the base punch. It doesn't take much pressure. You can make any size of flat point this way. If you are making a handgun bullet, you have finished. Wipe off the lube, and load it. If you are making a lead tip rifle bullet, you may need to go to one more die: the lead tip forming die.

To finish a lead tip rifle bullet, remove the point forming die and install the lead tip forming die. You'll notice that the lead tip is deformed and mushroomed by the force of ejection. The secret of making a good lead tip bullet is to leave plenty of lead: your core needs to be longer than the jacket and you need to make sure you don't close the jacket down so small that it leaves no room for a strong stem of lead joining the tip with the main body of the core. The wall thickness of the jacket, at the tip of the bullet, can use up a considerable distance across the total tip distance. The jacket walls need to be far apart at the tip, so that a strong stem of lead comes up between them and holds the tip in place.

Push the bullet up into the lead tip forming die and let the internal punch reshape and shear off any extra lead extruded from the tip. If you press very hard, a ring will be impressed in the ogive section. Find that delicate point where you just shave off the extra lead and leave no mark on the jacket. It works very nicely.

Paper-Patched Lead Bullets

If you want to make a paper-patched bullet, just install the PRO-1-R Pro-swage, cut or cast some lead cores of the right weight, and swage them using the gentle, increasing pressure method until you get the right shape. Typically, if you had 0.0025 inch thick paper, you'd want the bullet to fill the grooves at .458 inch diameter with two complete wraps. That means you'd take .458 and subtract four times .0025 (two wraps, but doubled because it is on both sides of the bullet) and make the bullet .448- inches in diameter (before patching).

The only difference between a paper-patched bullet swage die, and one for making a bullet that will be dip-lubed or grooved and lubricated, is the diameter of the swage. Most paper-patched bullets also use a cup base shape, so you can tuck the twisted end of the paper patch into it, but that is entirely up to you. The formula for determining die size (D) for any caliber of paper-patched bullet when you know the barrel's diameter across the grooves (G) and the thickness of the paper (T) is:

$D = G - 4T$

If you know the bore size (B) and depth of rifling (R), and paper thickness (T) that you have available, then you can calculate bullet size (and die diameter D) this way:

$D = B + 2R - 4T$

You can purchase one swage die and a bullet grooving tool (similar to a cannelure tool but with wider grooves for lead bullets) for lubricated full size bullets, and get a bullet reducing die for making paper patched bullets out of these, but the cost is just about the same as getting a second die. Also, you can try something interesting with two dies of different diameter that are made for paper patching and for shooting directly as swaged: you can wrap the smaller bullet with teflon pipe tape and swage it upward in size in the second die! This gives you the proper size bullet with a teflon jacket swaged into place.

Of course, if you shoot in a match you'll need to check the rules first. You can try this with paper, too, by using a slightly thinner paper than the smaller die was originally designed to use, so the paper-patched bullet will fit easily into the second die and pressure will shorten and expand the bullet, rather than scraping the paper off as you try to insert it.

You actually have the ability to make several kinds of bullets with two diameters of the same shape bullet, rather than just the two styles. Swaging lends itself to experimentation and combinations that create new ideas, so long as you remember that anything going into a swage die should be smaller than the die bore. Never swage down, just like you never draw up. Always swage larger, with the odd exception of the dual diameter sizer die which combines drawing and swaging in one tool (and has its limits, as you can read in the section that discusses this exception to the first rule of swaging).

Full-jacket Open Base (military style) Bullets

Put the bullet jacket in the point forming die, with the open end facing the die mouth. Push a piece of lead core into the jacket with a punch that fits inside the jacket mouth. The seated core should be just below the jacket mouth, perhaps one eighth or less of an inch. Don't try to make too sharp a point, because the jacket will just break through if you do. Eject the bullet. You'll have formed the ogive on the normal base end of the jacket. (Having a flat ended jacket makes no difference: the pressure will expand and reshape the end just as if the copper were a balloon skin.) But to finish this bullet, you must do something else: you must roll the open end of the jacket over the core.

If you leave the base open, when the bullet is fired the muzzle gas pressure will peel the jacket away from the core and the bullet will be very inaccurate. It might even cut ragged asterisks in the target instead of round holes, from having the jacket expanded so much that it splits at the base.

To get the muzzle gas to help you keep the jacket folded tightly on the bullet, reverse the bullet and put the open end into the point forming die. Gently push on the bullet nose with your punch. The curved die wall will move the edges of the open jacket slightly inward. Eject the bullet again, turn it over once more, and push it back into the die. Now, you have an angle applied to the open base. The pressure of pushing the bullet back into the die nose first, one final time while using a flat punch will flatten this angle, folding the jacket over the core.

Gas pressure on the base of the bullet will help hold it shut, not tear it apart. For this to work, the empty projecting jacket needs to be just the right length. Too long, and you get a buckle or wrinkled line around the base. Too short, and the lead spurts out and smears over the base. Just right, and you get perfect military style bases. This means you either have to adjust the jacket length or adjust the bullet weight slightly to get the right ratio of core to jacket. The jacket length can be adjusted with an ET-1-R jacket trim die.

Let me summarize this quickly: 1) seat the core in the jacket using the point forming die, to form a full metal tip and open base, 2) turn the bullet over and push it backward into the point forming die with a flat base punch to gently roll the open end into a slight boattail shape, 3) turn the bullet over again and push it nose first into the point form die with a flat punch to securely flatten the jacket edge over the core. If you want to do this more precisely, we can provide a "FMJ Base-Turning" punch that has a concave face, in order to help make a better fold prior to using the final flat punch. This inserts a step between 2 and 3, where you apply this sharp fold point with the FMJ punch.

If you want to make somewhat sharper tips, or if the jacket is thin or brittle so that the lead tends to break through the tip when seated, you may need to get a custom point forming die that has a pressure-sealing, length synchronized ejector punch. This is a larger than normal ejection punch which is fitted carefully into a honed ejection pin hole, and adjusted precisely to seal the end of the die cavity.

It is made to withstand the forming pressure, instead of just pushing the bullet out of the die. Normal point forming dies use a wire ejection pin which is retracted out of the main cavity of the die during bullet forming. It is brought against the tip of the bullet during ejection, on the down stroke, and pushes the bullet out.

That's all it has to do, so it is simple to build in comparison to a pressure-sealing ejector. That is why all point form dies are not built with the more costly kind of ejector: there is no purpose for it in an open tip bullet, or a lead tip that will be created in a following lead tip die. No point making people pay for capability they don't require.

It's an option. But this is only suitable for dies used in the precise Corbin swage presses, not in reloading press dies. The press dimensions need to be part of the equation in the more advanced designs, and they are neither fixed or close enough tolerance if the press isn't made by the die-maker. Third party presses are whatever tolerance and design the third party wishes to use, and can change at any time without asking permission of any bullet swage die maker!

Changing the Nose and Base Shape

With semi-wadcutter and wadcutter styles, the nose shape is controlled by the punch you select. With smooth ogive bullets (those without a step between the shank and the nose), the ogive is controlled by the particular point forming die that finishes the bullet.

To change nose shapes with a bullet that uses a point forming die, you need a different shape of point forming die. That is the PF-1-R. If the bullet is finished in an PRO-1-R or a CS-1-R die, then all you need is a different nose punch. It is important to understand this, because it makes a big difference in planning and ordering. Point forming dies cost about six times more than a punch, so if you can use a bullet with a little shoulder and a lead nose instead of having a smooth curve without a shoulder between ogive and shank, you'll save money on tooling. If you need the smooth ogive shape, then the matched pair (core seater and point former) is the only way to do it.

Spare punches can be purchased in standard shapes of flat base, dish base, cup base, hollow base, or Base-Guard base. Nose punches can be purchased in conical, Keith (semi-wadcutter, truncated conical), 3/4-E pistol round nose, target wadcutter, button nose wadcutter, hollow point (a universal HP punch that works in conjunction with any other punch), open tip, or 1-E rifle round nose. Other custom shapes can be specified (with dimensioned sketch or sample) at extra cost for the additional shop time and tooling.

Open tip core seating punches must be made the correct diameter to fit into whatever jacket you plan to use. If you order a set for use with a rimfire jacket, and then try to use a commercial jacket, you'll find the core seating punch is too large and will dig into the commercial jacket wall. If you order a core seating punch to fit any specific jacket, either specify one of ours to fit, or send us three or four samples so we can match the average size to the punch. This is very important. If you try to use the wrong punch diameter, lead can spurt out around the punch, the pressure won't develop to expand the jacket, and you can get undersized or tapered bullets as a result.

Boattail and Partitioned Designs

Those are best done in swaging presses, not in a reloading press. But you can simulate a boattail by pushing a bullet backward into a point forming die, thus applying a slope or angle to the base. Then form the nose in the same die by reversing the bullet. Because it takes less force to shape the open end of the jacket than to change the base shape (on most jacket, the base is thicker), the same pressure will create a nose without materially removing the base angle. This doesn't work for all bullet styles and calibers, but you can try it.

To make a good partition style bullet, use another jacket small enough to fit inside, and short enough to fill just a little more than half the larger jacket's length. Or, in the .224 and .243 calibers, use fired primers as heavy walls between two short pieces of lead core! A .243 jacket makes a good partition in a .30 caliber jacket, and a short .30 jacket fits inside a .358 or .38 jacket. You can seat a core in the smaller jacket first, with lead exposed, then put the lead end down, into the larger jacket, and seat the assembly like a core to expand it in the larger jacket. Top that with a short piece of lead core, and finish as usual.

Fired .22 Case Jackets

Making bullet jackets for .224 and .243 caliber bullets from the spent cases of fired .22 ammunition is, even after all these years, a very popular way to make free bullets that perform as well, sometimes better, than the ones you buy. Corbin builds the RFJM-22R Rimfire Jacket-maker to gently unfold and redraw the rimfire case, making it into a jacket that looks for all the world as if it were intended to be that way. Bullets made with a rimfire case for a jacket have much more explosive expansion than those made with conventional jackets. Friction is lower in the bore, so your rifled barrels last longer. Fouling is less, partly because of the higher zinc content of cartridge brass and partly because the thin jackets need to be loaded to lower velocity to avoid coming apart in the air.

The performance of fired .22 cases used for jacketed bullets is outstanding. The price is right (free). About 1976, Wolfe Publishing's *"Handloader"* magazine published an article wherein Rick Jamison (currently with *"Shooting Times"* magazine) made some rimfire jacket bullets and shot them from a benchrest rifle. The groups obtained were in the 0.200 inch category, and the same gun and loads used with Sierra match bullets got slightly larger groups, and slightly smaller groups with certain of the custom swaged benchrest bullets using commercial jackets.

The point is, rimfire jacket bullets are at least as accurate as the ones you buy, produce less fouling, are easier on your gun's bore, and cost you nothing. Their only drawback is the need to load them to lower velocity because they are very thin and explosive. At 3200 feet per second, a rimfire jacketed .224 or .243 bullet performs more violently than a conventional bullet driven to over 4,000 feet per second! Your varmint hunting expeditions are safer with them, because there is almost never a ricochet: once these bullets touch the ground, they disintegrate. (See the chapter on jacket drawing for instructions on the use of the RFJM-22 and RFJM-6M dies.)

Briefly, rimfire jackets are made by lubricating and pushing cleaned .22 Long Rifle, Long, or Short cases through the proper die, using a punch which fits inside the jacket. The point of adjustment is somewhat critical: too high in the press and you can't finish pushing the jacket through, so the next one may jam into it, and too low in the press requires way too much effort, even to the point where you could pry the press off your bench. (Rick Jamison actually broke his reloading bench, so if you did not understand the importance of correct die adjustment, you are in good company!) When you find that exact position where the force required is leveraged by the press and quite manageable by the operator, and the jacket goes all the way past the tightest point in the die, you can process hundreds of jackets per hour as fast as you can push them through.

After drawing, they need to be annealed or softened, so that the tips won't fold over when you form the ogive. If you use enough lead to support the ogive fully and do not bring it to a small point, you can skip this. But if the bullet you want to make gets a triangular flap of metal folded over at the nose, then you need to anneal the rest of the jackets. This can be done by heating them briefly with a propane torch, just long enough to bring them to a slight red glow in a dimly lighted room. No quenching, no lengthy heating is required. A few seconds will do it.

Corbin offers a heat treatment block kit, consisting of two high temperature ceramic blocks and a drill template that you can tape over one of them. Use a regular wood "spade" bit to drill a series of holes matching the template, and you have an efficient way to heat treat jackets or bond cores. One block holds the jackets and reflects the heat evenly around them, and the other block is propped up behind the first one to act as a backstop and further reflect heat from the back side. I highly recommend this procedure, because it is cheap and easy, and very fast.

Open Tip, Lead Tip, and Hollow Point

For open tipped bullets, you need to use a punch that slips inside the jacket (and a core length short enough to allow this). For lead tipped bullets, you need to use a punch that fills the die bore, not the jacket I.D., or else seat the lead core very close to the end of the jacket. When the ogive is formed on the bullet, the lead will move forward and extrude from the open end if there is enough lead.

A lead tipped bullet expands more quickly than an open tipped bullet, since the jacket is left with a larger opening. The jacket opening controls the expansion far more effectively than the amount of lead exposed. A hollow point, on the other hand, may expand faster or not, depending on what it hits and whether the initial contact plugs up the cavity and turns the bullet into an effective solid nose.

To make a hollow point bullet, you would seat the core using a punch that had a conical projection on the tip. This forces a hole into the lead, perfectly centered. This punch can fit either the die bore (for making lead tip hollow points) or it can fit the jacket I.D. (for making open tip hollow points). You can see why it is important that you use the terms "open tip" and "hollow point" correctly, since they require different equipment.

You can have an O.T.H.P. or a L.T.H.P. but you cannot, by definition, have a L.T.O.P. or an O.P.L.T. (same thing stated another way). This is because O.P. means open point, lead core shorter than the jacket. L.T. means lead tip, lead core longer than the jacket. It can't be both at the same time. But it can be shorter than the jacket with a hole poked into it, just as it can be longer than the jacket with a hole poked into it. The hole is the H.P. It's not that hard to learn and it can save you mis-shipped items and delays while the terms are restated correctly the second time around! The problem is that many other bullet makers tend to mix up the terms. They do not need to be clear about it, since they are not selling you any tooling to make your own bullets. If Speer calls an open tip bullet a hollow point, it hardly makes any difference to you or to them. We have to be more precise.

10. Bullet Swaging Presses

Corbin builds several models of bullet swaging presses. The presses each have a range of capabilities, and dies of a size that match those capabilities. Some of our older literature refers to the Silver Press (CSP-3), or the Mity Mite press. These are discontinued, horizontal ram cast-frame models, which accepted a small diameter of die called the type -M. The -M dies used 5/8-24 threads, same as our -S dies, but had a body of 3/4-inch instead of 1-inch. The -M dies can be made on special order to fit older Corbin presses.

More recent literature and published articles and advertising, especially during from about 1995 to 2002, referred to the Series II press. This had the catalog number of CSP-1, and was replaced by our current S-Press, which looks similar. The Series II was built entirely of steel, and except for the first version, had needle bearings in the links. It used a stop pin and ejection system similar to the Silver Press, which in turn required a slotted punch head on the ejection punches. The stop pin was supported with a hardened bushing pressed into the front of the frame, but did not extend through the ram. The ram was slotted only on one side.

Today, Corbin builds two hand-powered presses, the S-Press (CSP-1) and the Mega-Mite (CSP-2). The S-Press uses type -S dies, which have the 1-inch main body with a 5/8-24 threaded shank, providing a wide shoulder to adsorb axial force against the top of the ram (instead of passing the stress through the threads). The S-Press also uses a ram slotted through both sides, and a long stop pin that passes completely through the ram.

The punch heads for -S type ejection punches have a hole through them, rather than a slot. They are also larger in diameter than earlier -S or -M internal punch heads. Older -M and -S dies can still be used in the S-Press, however, by using a short stop pin with it. Current production internal punches have a punch head too large to fit into the older presses, however. This is easily fixed by sending in your older press for an upgrade, which will bring it up to current standards for less than half the price of a new press.

The Mega-Mite uses type -H dies, same as our larger power presses. The -H dies have threads of 1-12 (1 inch diameter, 12 turns per inch) on their shank, and have a 1.50-inch diameter main body. It is suggested when you want to make bullets larger, longer, or from harder material than can be reasonably swaged in the S-Press, or when you want to move toward a power press but would like to start with less investment (the dies interchange with the larger power presses).

Corbin builds two models of power presses, which operate from either 115 volt 60 Hz single phase power (standard household supply in the USA), or from 205-240 volt 50 or 60 Hz single phase power (optional, for export to other countries). The power presses are the Hydro-Mite (CSP-1H), which uses -S dies and the Hydro-Press, a self-contained cabinet model with automatic timing, stroke control, and interfaces for automatic feed of copper strip for jacket making operations.

Advantages of a swaging press

1. *Self-ejection on the back stroke.* Dies which fit into the ram, and have their internal punch automatically operated by a hardened stop pin, so that as you draw the handle (and ram) back, the stop pin contacts the end of the punch and stops it, while the die continues back with the ram. This pushes the bullet out of the die mouth, cutting several seconds from the time required to make a bullet. Those seconds add quickly!

2. *Self-alignment of external punch and die.* The external punch is held in an adjustable floating punch holder, in the press head. The punch is secured by a hex bushing, threaded with hand pressure into the holder's mouth so it pushes on the underside of the punch head, and holds it in the punch holder. A certain small amount of "float" takes place, so that the punch can align perfectly with the die walls. This results in less punch and die wear, and perfectly square bases (not tipped).

3. *Less than half the effort, over 300% more strength.* Most reloading presses use a four inch ram travel and are cast from 35,000 PSI grey iron or aluminum alloys. Corbin hand presses use half the ram travel with the same amount of handle travel, doubling the available ram thrust. The industrial chromed alloy steel ram and special components of Corbin presses result in at least 130,000 psi tensile strength. Corbin power presses are "off the charts" on both power and strength compared with any reloading press. Yet, all Corbin presses ARE also usable as high precision, benchrest quality reloading presses! They can even be purchased with optional arbor press anvil inserts, for use with non-threaded benchrest type reloading dies. All come with adapters for standard 7/8-14 RCBS type reloading press dies and button-type shell holders, at no extra cost.

4. *Built for the job.* Corbin swaging presses are built from the ground up for the stresses involved in high pressure swaging, and will maintain accuracy while outlasting retail-trade reloading presses. Being equipped with bearings in all moving joints, hardened alloy steel rams and other high strength features lacking in reloading presses, the Corbin press is a lifetime investment.

In addition to the press itself, the Corbin -S dies give you further reason to use this advanced swaging system. Since Corbin pioneered the semi-custom manufacturing method for swaging, where standard presses and die dimensions within broad families allow us to make large "blank parts" runs, and then finish the cavities and punches as your orders are entered, instead of "reinventing" each particular set of tooling from scratch with every new design of bullet, it has become practical to manufacture custom calibers, shapes and designs of bullet swages without paying huge prices.

This is practical with all Corbin presses, because we can control the tolerances and dimensions of the entire swaging system and are not at the mercy of dozens of different press manufacturers, each with their own ideas of tolerances and dimensions for ram slots, press heads, ram travel, ram diameters and leverage systems. Certain standard lengths of dies and punches handle all the various calibers from .123 to .998 diameter in all practical lengths of bullets.

Thus, we can manufacture huge "runs" of die blanks in the appropriate lengths, matched to the standard punch blank lengths, and achieve great cost savings over making all these one at a time. When your order for a special benchrest .243 with a 14-caliber secant ogive and an 8 degree boattail comes in, we know right away that all we have to do is reach into the bin of 2 inch long die blanks and pull out three of these, knurled and threaded, center-drilled and ready for the die cavities.

We know for certain that we can use internal punch blanks manufactured while the machines were set up for a week's total production of nothing but these blanks. They'll fit perfectly, once we diamond lap, heat treat and hand fit them to their die cavities. In other words, you save hundreds, perhaps thousands of dollars in some cases, and get the same quality of die, compared to fiddling with someone else's press and coming up with a unique set of dies just to fit it, or compared to making low volume, single-unit custom parts from scratch on every order (as most of the bullet swage die firms have done in the past).

One final reason to get a Corbin Press instead of trying to buy custom reloading press dies is that the price of the press and a complete set of dies to fit it, is usually less than half the cost of any comparable quality alternative. Those who make "benchrest" swage dies generally charge from $1500 to $3500 for a set of just the dies. They probably fit your reloading press, since few die-makers today build actual bullet swaging presses. But look at how much money you'd save by getting a press designed for precision bullet making, instead of buying the efforts of a die-maker who is attempting to design around the limitations of a reloading press!

S-Press, CSP-1

This is the most popular press today, because it not only accepts the original type -M dies, but also uses 1 inch diameter type -S die (same threaded shank size, 5/8-24 tpi) in the ram. The S-Press is a vertical design, with the floating punch holder in the press head, which uses the same 7/8-14 thread as conventional reloading dies. An adapter converts the ram to hold regular button shell holders, and arbor press anvil inserts are available for the punch holder and the ram, for use with benchrest reloading dies.

The S-Press looks like a Roman numeral II from the front. The main components are machined from steel, not cast iron, so it is smaller and lighter than iron presses, which have less tensile strength and half the power. The ram linkage can be quickly set for 4-inch or 2-inch stroke (reloading, or swaging). A set of four needle bearings in the links provides smooth operation. Bearings also surround the ram.

Bullets from .123 to .458 caliber, with a length limit of 1.3 inches, are well within the range of most small arms calibers, and are also within the capability of the S-Press. The advantage of the S-Press over conventional reloading presses is the greater strength (up to 130,000 PSI versus 35,000 PSI), higher leverage due to the full 180 degree arc of the handle travel and dual stroke length, more sophisticated engineering (all moving contact points use bearings, including the ram, which is surrounded by two inch-long bearings mounted in a precision honed cylinder), and capability to do reloading. The CSP-1 press comes with a FPH-1-S floating punch holder and a reloading adapter (to hold standard RCBS shell holders in the ram, extend the ram height, and provide a port for spent primers to drop into the primer catcher tray, also provided).

A stop pin, mounted in the front of the press, pulls out so you can use a long reloading stroke, and pushes back in so you can use it to stop the downward movement of swaging punches and cause automatic bullet ejection on the down stroke. The long stroke is set by removing a retainer pin (which looks a little like a hand grenade pin) from the link, pushing the steel pin out of the ram and toggle, and moving the ram to a second set of holes in the toggle, then pushing the pin back in and replacing the retainer pin. This is easily done by hand: just wiggle the toggle and ram a bit as you push out or push in the pivot pin to help get it lined up in the ram bearing.

The CSP-1 press would be the right choice if you plan to make bullets from .123 to .458 diameter, in lengths of 1.3 or less inches, with a core material that is no harder than Bhn 12 (and this should become less as the point becomes sharper and the diameter becomes larger, so that a spitzer .458 would probably need to be no harder than Bhn 6 to Bhn 8) in the type -S dies.

With harder alloys, the guiding factor is your tolerance for being careful, and the odds of breaking the die doing experiments. If you might use a little wheelweight alloy from time to time, might get in a hurry sometimes and throw the handle pretty quickly when swaging, or want to play around with some techniques that no one may have tried yet, then the type -H dies and the larger CSP-2 press is a much better choice.

If you want a caliber over .458, or a length of bullet over 1.3 inches, or a hardness of material over Bhn 12 (such as a steady diet of wheel weight alloys or linotype) then you want type -H dies and the larger presses that use them. All the wishful thinking and rationalizations in the world won't make you any happier later, when you break the die, no matter how much work it was to get the person on the phone to agree with you, eventually, that maybe, yes, you might be able to get away with the less expensive equipment for jobs it wasn't designed to do.

You might also bag an elephant with a .22 long rifle, but I'm not going to stand in that elephant's path while you try it. Sometimes a person will spend a hour on the phone trying to wheedle an admission that something might work, so they can save a few dollars and buy an inappropriate tool based on this "advice", and then later on, when it finally breaks from continued abuse, they can whine about it and try to get another one free (which will also break eventually).

Please! Give me a break, not the die. The -S dies do a great job for the materials and dimensions for which they were designed, and that is what they are warantied to do. Anything else that works is just pushing the envelope, and you might get away with it, but if it breaks, you still own both parts. The larger -H dies and presses are made because there are situations where they are required for reliable operation, not just to make unnecessary larger sales. I'll be the first one to tell you that you don't need something larger, if the smaller one will be perfectly fine. Usually, getting a larger than necessary hand press isn't a good idea because you work harder than necessary operating it. A power press is a delight to use even if you don't really need it for the job, on the other hand.

Mounting the CSP-1 Press

The S-Press mounts directly to your loading bench, or you can purchase the optional CSP-B Bench Stand. This sturdy steel stand puts the press about a foot higher than your bench top, so you can look directly into the area where the external punch enters the die, and so you gain some extra leverage on the handle. The Bench Stand has a shelf to hold spare parts and dies and a thick steel reinforcing plate that mounts under the top section. The press is held slightly forward, over the bench edge, to keep the handle from striking the front of your bench.

Using the Bench Stand gives you room both under the stand and on the shelf, so you wind up having more storage room than before, instead of decreasing your bench space. But the main reason I like it is that most reloading benches are the right height for reloading, where you want to look down into the case during operations, and with swaging it is better to look straight at the die during the swaging stroke, so you can watch the punch and die come together.

Corbin also offers the CSP-S Floor Stand, which is a heavy steel assembly using a vertical post like a drill press to support an inch-thick mounting plate so you can view the operation from a standing or shop stool seated position. The same floor stand fits both the CSP-1 and CSP-2 presses. We drill and tap two sets of bolt hole patterns, just in case you want to use the other press.

The Floor Stand needs no mounting: it has a deck on which you stand, and your own weight is sufficient to stabilize the operation. This makes it ideal for rented spaces where you cannot put holes in the floor or build in a sturdy bench. It also makes the press somewhat portable, since you can slide the bench stand around to get it out of the way when you are not using the press. The floor stand is heavy enough so it has to be shipped by truck. If you order it with the other items, it usually doesn't cost any more to ship them all in the same carton.

Changing the Stroke Length

The CSP-1 press has two stroke "modes" or settings. The short stroke is two inches of ram travel, and the long stroke is four inches. For bullet swaging, where the die screws into the press ram, you want to use the short stroke and the stop pin should be in place in the front of the press. But for jacket or bullet drawing, and for reloading operations where the die goes into the press head (top), you want to remove the stop pin and use the long stroke. The ram position at the end of the stroke is designed to match the reloading adapter height and the use of shell holders or drawing punch base lengths, so that you can get the proper position of the die at the end of the press stroke.

When changing the stroke length, I like to position the ram so that I can insert the stop pin before I remove the pin that holds the ram to the toggle. Nothing keeps the ram in the press, once you have removed the ram to toggle pin, other than the stop pin, so you want to keep on hand on it to prevent it from sliding out of the press and falling on the floor (or your foot!) or else make sure the stop pin holds it in place until the ram to toggle pin is back in place. Don't forget to remove the stop pin in the long stroke mode, though. Otherwise you will wonder why you can only move the handle through part of its travel!

The CSP-1 has a special feature not present on most reloading presses, and that is the offset toggle arms that straddle the ram, allowing for a full 180-degree rotation of the toggle. This can add another 20 to 25% effective leverage to the press, even in the same stroke mode as a conventional reloading press. Many popular reloading presses have a 135-degree handle arc, which limits the amount of leverage (a ratio of distance times the degrees of travel for the handle, divided by the distance moved by the ram).

By increasing the "input" travel for the same amount of "output" travel, ram tonnage is increased for any specific integral of travel, since the press leverage is designed around a log-function power curve. For instance, for a 1 inch arc movement of the handle at a given point in ram travel, you might get a 1,000 times multiplier of force, whereas the next 1 inch movement of handle would get a 10,000 times multiplier of force, approaching near infinite force as the ram movement approaches zero for the same 1-inch arc travel at the end of the stroke. But I don't want to put anyone to sleep just yet, so let's skip the math.

Mega-Mite Press, CSP-2 Model

The Mega-Mite is a huge version of the CSP-1 S-Press, weighing over 75 pounds and having a triple stroke of 2, 3 and 6 inches. The press also uses needle bearing links—much larger ones than the CSP-1 model—and a huge hardened steel ram guided at the top by a bearing-aligned steel plate which runs up and down on two massive hardened and ground guide rods.

The Mega-Mite uses type -H dies, and can be used with the reloading adapter kit. The press head is removable, as it is in the S-Press, but uses a 1.5 inch 12 tpi threaded plate for the FPH-1-H punch holder. The ram accepts 1 inch 12 tpi threaded dies or punches, rather than the 5/8-24 tpi of the S-Press (-S) dies. The standard type -H die is made with a 1.5 inch outside diameter. Custom -HC dies can be ordered with 2 inch, 2.5 inch, or even 3 inch diameters where appropriate for the pressure.

The same dies which fit the powerful Corbin Hydro-Press also fit into the Mega-Mite press. This does not mean every die set of type -H will work in the Mega-Mite, because there are some calibers and materials that require much greater pressure to form. For example, the Mega-Mite press has no problem accepting any lead hardness, but you cannot exert enough force to swage finned 12-gauge shotgun slugs (although this can easily be done in the Corbin Hydro-Press using the same dies).

Also, the stroke length and power cycle affect some designs of bullets: you can swage a soft lead .600 Nitro bullet in the Mega-Mite, but you can not make the same caliber with a spitzer nose, or with a hard lead core, even though the press and dies can make long spitzer noses in smaller calibers, and even though the dies can handle harder lead without breaking. The pressure in a hand press is primarily generated at the end of the stroke, so if you have bullets that form the nose in the last half inch of travel, then you probably have plenty of force during the last half inch to do it.

If you made a .500 A.E. pistol bullet, the blunt nose and short length means you can use the end of the stroke, and thus apply force during the maximum power portion of the ram travel. That design of .50 caliber bullet can be swaged in the Mega-Mite press, provided you don't also try to use hard lead or a very thick jacket (over .035 inches for the walls, in copper). You might have trouble making an Ultra Low Drag nosed .50 BMG bullet because that calls for a long, heavy slug with a nose that is longer than half an inch, and will require considerable force early in the stroke. You might do it by adjusting the top punch up and down so you get a couple of swings at it, first forming it half way and then adjusting the punch down and forming it the rest of the way. But that is too much work for me. I'd rather get the Hydraulic press.

With the most blunt nosed, soft lead bullets, a .720 caliber short bullet (under 1.5 inches) can probably be swaged, as can smaller ones. Lead wire extruders designed for the hydraulic presses will not work in the Mega-Mite. Practical lead extrusion takes full power from the start of the stroke, not just at the end. No matter how large you make the press, if it uses practical leverage a normal human being can operate, it probably will have about the same amount of final tonnage and power cycle. This means about half an inch of the final travel will give you 90 percent of the power. Making everything larger does not give you more leverage. All it gives you is a stronger tool, not a more powerful tool. Some people have a problem understanding the difference, and a few of them even make and sell presses with rather wishful thinking expressed in their specifications.

Press Design Considerations

Bear in mind that power output is just a simple physics equation: at any point in the stroke cycle, the instantaneous power available (or leverage to apply the power) is the force you can apply to the end of the handle multiplied by the ratio of how far the handle will travel (in an arc) to move the ram a given distance. This is an ideal differential calculus problem, but it can also be thought of logically without higher math. Lets say that you want to move the ram up another 1/10 of an inch (.1 inches). How far does the end of the handle travel to get that amount of ram movement?

With a press linked through a swinging toggle, you have a compound lever system that constantly changes the ratio of movement. As the handle approaches the middle of its stroke, you might move the end of the handle in a 1 inch arc to get 0.1 inches of ram travel. That is a ratio of 10 to 1. If you pushed fifty pounds on the handle, you would generate five hundred pounds of thrust on the ram. But as the ram gets to the end of its travel, the handle might swing another four inches while the ram only moved up 0.1 inches. At that point, you have a 40 to 1 ratio, so pressing the same 50 pounds on the end of the handle gives the ram a thrust of 2,000 pounds. If you need 2,000 pounds of thrust in order to start forming a long ogive, you may not have it early enough in the stroke cycle and there isn't a lot that can be done about it in a practical hand press. If you make the handle longer, eventually you reach a point where you can't reach the handle!

With the Mega-Mite (and S-Press), we've maximized the arc length in two ways. First, we make the longest practical handle that can still be conveniently reached at both ends of the stroke. Second, and more important, we designed the toggle so it fits around the ram at the end of the stroke. This allows a full 180-degree arc, so you can input more handle movement with the same length of handle. Most reloading presses can only swing an arc of about 135 degrees.

Thus, with a three-foot long handle, you can input force through a distance of 9.425 feet (length of the arc of half a circle with a radius of three feet) on a Corbin press, but only 7.069 feet if you put the same length handle on most reloading presses.

The reloading press has a total ram travel of about four inches, as it must to handle rifle cartridge reloading. Four inches is 1/3 of a foot. The overall leverage ratio is 7.069 divided by 0.333 or 21.2. This doesn't mean you have a 21.2 mechanical gain through the entire stroke, of course, because the specific ratio depends on where you are in the stroke. But it gives you a nice comparison figure for overall performance. This assumes the use of a 3-foot handle, to make the comparison fair. Actually, most reloading presses have much shorter handles and so their leverage is even less.

In the Corbin press, the ram travels 3 inches in the CSP-2 press. That is 1/4 of a foot. The overall leverage ratio or mechanical advantage for the press is 9.425 divided by .250, or 37.7. That is 16.5 more than the reloading press, or expressed as a percentage of improvement, the Corbin press has 178% of the leverage of a reloading press, assuming the reloading press were to be equipped with the same handle. In reality, it probably has close to twice the power since reloading presses have typically shorter handles.

Building the press twice as large would not change this ratio, and would not change the power at all. It would only make the press larger and stronger. If the handle was moved in a bigger arc but the ram went a longer distance, by the same ratio, then no power is gained. We're using power to mean mechanical advantage, which isn't strictly true but amounts to the same thing for our comparison. Besides, if the press were made twice as large, you'd need to climb on a ladder and grab the handle, and then jump off to swing it through its full arc!

Making everything except the handle larger or longer would actually decrease the leverage. The Mega-Mite design is at the limit of practical power for a hand press, unless you want to add a crank and gears instead of a handle, so that the cumulative distance you move the crank gives you more input stroke for the same ram movement. An arbor press is a step toward a crank and gears (using a single drive rack and pinion gear). But the better answer is hydraulics. Adding gears and making you spin them for each stroke is too much like making ice cream with a hand-cranked freezer! If you have done that, you know how long it takes to get good results. Of course, electric motors do the job today. But adding an electric motor to a mechanical gear press has its own problems, which I discuss in detail in the chapters on mechanical press design in the book "Power Swaging". I won't repeat it all here.

Roller Side-Bar Handle, CSP-2SH

The Mega-Mite press can be provided with either the long swaging handle or a shorter handle with a side-bar grip. For reloading and swaging operations that do not require maximum leverage, the short handle is convenient and easy to use. It reduces the amount of movement you must make with your arm on every stroke, at the expense of a lower mechanical advantage. Those who use the short handle are enthusiastic advocates. But some operations, such as long bullet draws or tubing jacket end-forming operations, or very large calibers, require all the leverage you can get in a hand press. For these jobs, the long handle (CSP-2LH) is required. Specify whether you want the short or long handle with the press. The other is always available as an option. Handles are easy to change. Most people who have the short handle also purchase the long one.

Floor Stand, CSP-S

The Mega-Mite press is available with the same CSP-S Floor Stand as the S-Press. There is a separate set of bolt hole patterns in the top mounting plate of this stand, so you can use the same stand for either press (but not both at the same time). The CSP-2 Mega-Mite press, without stand, can be shipped by United Parcel or by Air Freight. It is not mailable by standard U.S. Postal Service. It can also be delivered by truck, and if accompanied by the stand then truck or Air Freight are the only practical delivery methods.Using the Knock-Out Bars

The Mega-Mite comes with a set of knockout bars instead of using a steel pin passing through the ram to stop the movement of the internal punch and cause ejection from the die on the down stroke. The bars are hardened and ground steel. They are different heights, but the same length and width.

The bars slip through a slot in the press ram, below a large steel spring surrounding the ram. The spring presses down on the top of this bar, and the internal punch rests on the bar. The correct bar to use is the one that, together with the length of the internal punch, brings the internal punch to the mouth of the die at the end of the down stroke. Internal punches come in different lengths. Longer punches are used for lighter or shorter bullets. Middle range lengths of bullets take a middle length of punch, and the heavier bullets, which are generally longer, take the shortest punch. The knockout bar which makes up the difference in punch length is the one to use with any given punch.

You can easily tell if you are using the right combination of knockout bar and punch: the face of the punch should come even to the end of the die on ejection (fully lowered ram position). If not, just change the knockout bar until it does. The ram needs to be raised so you can get the bar under the spring.

Using the Retraction Pin and Spring

Most type -H punches have a quarter inch diameter hole through the head, so that you can put a steel pin through the hole. The big spring around the ram goes on top of this quarter-inch diameter pin. The purpose of the pin is to let the big spring push down against the pin, which in turn pulls the internal punch down, keeping it out of the die cavity until you lower the ram to eject the bullet.

Not every -H punch uses this "retraction pin" or has a hole for it. Those operations which use the bullet or core to push the internal punch down do not normally require spring retraction. But point forming dies, boattail forming dies, and certain other dies require that the internal punch be pulled down by something other than the insertion of the bullet components. In the case of a point forming die, the ejection pin (which is the internal punch) cannot be inside the open end of the jacket while it is being formed into a point (or else the pin would be trapped inside the jacket tip). The spring pulls down on the retraction pin, which in turn pulls down the internal punch, and thus keeps the wire pin portion of the punch out of the main die cavity until you need it for ejection.

Reloading Adapter Kit, RLA-1-H

The CSP-2 Mega-Mite press is a very capable reloading press when used with the appropriate adapter bushing and ram extender/shell holder adapter. It can accept .50 BMG reloading dies directly in the head (if they are 1.5 X 12 thread). The RLA-1-H Reloading Adapter kit converts the press for use with regular RCBS shell holders and 7/8-14 tpi reloading dies. It also follows that you could use Corbin type -R dies for swaging in this press, or in the S-Press. With an adapter kit, you can use some kinds of -S type dies in the larger -H type presses, but usually it is not a good idea because the presses can so easily generate enough force to pop the smaller dies. If you do this very often, you'd find a second press of proper size for the dies to be a better deal!

50 BMG Reloading and Priming (PT-50-H)

The Mega-Mite is ideal for .50 BMG reloaders and bullet makers. Corbin also makes a special shell holder, the SH-50-H, which is threaded to fit into the top of the reloading adapter's ram extension. The shell holder is hardened, and glass bead peened, so that it will last and provide excellent grip on the big 50 case rim. One of the shell holders also comes with the PT-50-H priming tool, which is designed so you can use it in the ram of the Mega-Mite, for precise adjustment of the seating depth, and also leave it in place without adjustment for depriming!

To use the PT-50-H, first move the ram-to-toggle pin into the long stroke (reloading) position. Then place your depriming/sizing die in the press head. Place the knockout punch for the PT-50-H in the press ram, resting on a knockout bar. Adjust the hardened hex-socket screw in the upper part of the tool so that the primer punch protrudes the desired amount (you can fine-tune it later). Screw the priming tool body, with the shell holder in place, into the ram.

Place a case in the shell holder, and run it up into the depriming/sizing die. Adjust the die to do its job of knocking out the primer and resizing the case according to standard procedure. The spent primer will fall through the shell holder, into the priming tool base, and out an angled port hole. A plastic cup or shallow dish, like a margarine tub, with a hole through the bottom to slip it over the ram, will catch the spent primers if you wish. Otherwise you can catch them as they come out of the priming tool.

Lower the ram part way, to free the case from the die, and slip it out. Hold the primer pocket against a power primer brush or clean it by hand, then with the ram slightly raised, put a new primer in the center of the shell holder. If the ram is raised slightly, it will drop into the hole. Slip the shell case back into the shell holder, and lower the ram. Then remove and inspect the primer, and adjust the setting of the hex screw so that the primer is set as desired. Once you have set the primer tool, it will maintain accurate primer depth.

Arbor Press Adapter Kit, APA-2-H

The Mega-Mite press can also use the optional APA-2-H Arbor Press Adapter kit. This consists of two inserts, one for the floating punch holder in the press head, and one for the ram. Their faces are ground flat and polished, so that inserting them gives you the equivalent of a very powerful arbor press with the ability to adjust the feel or the power depending on where in the stroke the work takes place. For more "feel", adjust the floating punch holder lower. For more power, adjust it higher. Dies that were designed without threads, for use in an arbor press (benchrest style dies) can be precisely operated by utilizing the APA-2-H kit. Unlike an arbor press, which has only one fixed power/feel ratio for the whole stroke, you can select the degree of feel and the ease of use by adjusting the punch holder to the desired end-of-stroke position.

Quick Change Punch Holder, FPH-QC-H

If you make bullet jackets from copper tubing, and the jackets are quite long, you may find that getting them in and out of the die requires adjustment of the punch holder on each stroke. This is slow and inconvenient. A better answer is the FPH-QC-H Quick Change floating punch holder. Using it is much faster and easier than constantly adjusting the punch holder up and down. Since the quick change punch holder is not necessary with short and medium length components, has more parts and takes a little longer to set up, we do not supply it with the press. But if you run into a situation where removing the top punch quickly would make operation faster, it is a good option.

Stripper Kits, SK-1-H or SK-2-H

You may have noticed a pair of holes with bearings in the top plate of the press. These are used with the optional jacket stripper kits. The first kind, SK-1-H, is a pair of long threaded rods with a series of heavy spring clip pins through them at various points, and a heavy steel bar at the top joining them. The SK-1-H is used in certain jacket drawing operations, to provide a way to push down on a punch in the top of a drawing die and eject a component, or to hold a stripper plate below the draw die, through which a long drawing punch passes.

The SK-2-H is similar but does not push down on an ejector. It suspends the steel bar with a key-hole cut-out across the top of the draw die so that the larger, round hole is directly over the die top. The jacket, having been drawn to size on the punch, protrudes from the top of the die. The jacket mouth is above the level of the stripper plate, which slides back and forth on two steel pins which fit into the two holes in the press head.

You simply tap the end of the plate to move it over so the narrow slot now comes under the mouth of the jacket, then lower the ram. The slot is precisely sized to the caliber or diameter of jacket, so it strips the jacket off as the ram and punch go down. In the Hydro-Press, an optional automatic electric operator can move the stripper bar as the press cycles.

Generally, the SK-1-H stripper kit will come with one plate or bushing to fit a certain punch, and additional plates or bushings can be ordered for other punches. Unless you need it, there isn't any point in ordering one. It is a special purpose tool, which will be suggested if the tooling that we develop for you calls for it. But I thought you might be curious about those holes! They are "just in case", not something that everyone will use. Nothing is missing, just because the holes are there when you get your new press!

The JRD-2-H jacket maker dies come with the necessary stripper plate to fit the particular size of drawn jacket. A set of pins to support the plate are placed in the two holes in the top of the press. The plate does not need to be secured, and in fact it is safer it if just rests over the die as designed. That way, if there is any misalignment, the plate is simply lifted up with the jacket and is not bent, nor does it place any stress on the punch if you use the wrong stripper plate.

Hydro-Mite Press, Model CSP-1H

The Corbin CSP-1H Hydro-Mite is the smallest hydraulic powered press Corbin builds. It is the same general size and frame as the S-Press, but is equipped with a 3/4 HP 120 volt AC remote controlled power system. The smooth, quiet operation makes the normally long jobs of jacket drawing, bullet reducing, or case sizing go quickly with almost no physical effort. The press isn't as well suited for bullet swaging as the other hydraulic or hand presses, however. I recommend it very highly for making jackets and other redrawing operations, but not so highly for bullet swaging.

Although the press can generate more force than hand presses, the main advantages are the lack of effort required (so that even disabled persons can perform long runs of production without becoming tired) and full power from the start to finish of the stroke. It is a linear power stroke rather than the log power stroke of a hand press, meaning that you can do drawing operations, lead extrusion, and other jobs which use the same power at the start as they do at the end.

The press has the same caliber and length limitations as the hand operated CSP-1 because the same dies (-S) are used. But jobs that normally require adjusting the punch holder back and forth to get enough force at the end of the hand-operated stroke can be done in one pass without moving the adjustments. For this reason, the CSP-1H Hydro-Mite can produce more jackets per hour (and the operator does not tire nearly as soon).

The Hydro-Mite is ideally suited to production runs of small parts, such as drawing .22 cases into jackets. Because you can generate sufficient power to easily pop a type -M die of nearly any caliber, it is not recommended that you use anything except type -S dies in the Hydro-Mite press. This is not to say you would break -M dies or you couldn't break -S dies. Any die can be broken with enough applied pressure, and pressure can be focused on a narrow point in any die by using hard materials which do not spread out and distribute the force until high levels of localized pressure are reached.

This is why you can swage .375 rifle bullets from lead and copper jackets all day long and then break the die on a single attempt to form a solid copper .375 in the same die with the same applied pressure: the localized pressure at the contact point of that solid copper rod can exceed a hundred thousand pounds per square inch, whereas the same ram thrust spread out over the softer material contact area would result in perhaps 40,000 PSI localized pressure. But drilling a 1/8-inch diameter hole through the end of the solid copper rod, about halfway down the axis, allows the material some space to take up as it squeezes down in diameter, and thus reduces the pressure to a practical level.

Hydro-Press, Model CHP-1

The CHP-1 Hydro-press is used by more custom bullet firms than any other press. It forms the basis for successful bullet making businesses around the world, from Australia to South Africa, Nova Scotia to Paraguay. This press can be ordered with either 120 volt, 60 Hz power (1.5 HP), or with your choice of domestic 60 Hz 220 volt or export 50 Hz 240 volt power (1.5 HP). It weighs about 350 pounds, and is self contained within a sturdy steel cabinet having a colorful Lexan-overlay work surface, with color-coded indicator lights and controls.

The e-book "Power Swaging" describes in details how to set up and run the press with various tools. I won't repeat all that here. The catalog number of the book is "TB-4", because it was once published as the volume of Technical Bulletins, No. 4, decades ago. Now it is published on CD-ROM as an e-book and is called "TB-4e". Of course it is constantly updated as we develop new features for the Hydro-Press and other power presses. The book is part of our library of swaging, or is available separately. I will use this book to describe the features and design, rather than repeat the operating details (which would be hard to remember without actually having the press to try them).

The CHP-1 has an adjustable stroke of from zero to six inches, making it capable of loading the largest cartridges and forming bullets with calibers as large as one inch diameter. There is no limit to the jacket wall thickness, other than practical considerations of performance. You can swage virtually solid jacket material with merely a tiny hole through the center, or in some cases even copper rod with an axial hole part way through the ogive end, if we are aware of your intentions and design the dies to handle the pressure.

The normal die size is 1.5 inches in diameter, but custom dies can be made as large as three inches. Custom dies of 2-1/2 inch diameter are sometimes built to handle slightly higher than normal pressures. Such dies are quoted individually depending on features needed.

The ram is threaded for 1 inch by 12 threads per inch (tpi), and moves inside precision fitted guide bearings. The press head is aligned and guided by a heavy steel plate, which itself runs up and down on two high-tech frictionless bearings, on hardened and ground steel guide rods.

Instead of just providing raw power, the CHP-1 applies intelligent use of force to your bullet making operation. You can set the appropriate starting point, for proper ejection of the bullet, by moving a non-contact electronic position sensor. Then you can set a second point where the ram will come up and stop, retracting the internal punch a short distance to allow easy insertion of the next part. This is set by a second proximity transducer, mounted on a steel standard beside the press head.

The top of the stroke is set by yet another proximity transducer. You can define the precise amount of ram travel and end points of travel, which in turn defines the amount of space you have to load components, eject them, and form the bullet, jacket, or other component. Reloading with the Hydro-press is a pleasure because of this precise stroke control feature.

The press also features pressure transducers which monitor the applied pressure and can be set to stop the travel of the ram at a predetermined pressure, hold that pressure for a given amount of time (adjustable precisely in milliseconds, seconds, minutes, or even hours), then either wait for your manual command to retract, or follow a programmed stroke cycle that can include automatic ejection, and return to a loading position.

With a key-locked automatic/manual mode switch, the press can be set for fully automatic stroke cycling. This allows you to meet safety standards by controlling who will be allowed to run the press in automatic mode. It also lets us design electronic interfaces with the JMK-2 jacket maker kit, so it can work with the CSU-1 Corbin Strip Uncoiler. You can set up a fully-automatic strip feed that handles 50 to 100 pound coils of jacket material, and can lubricate, feed, punch disks and draw them into cups, chop up the scrap material remaining for easy handling and resale to a metals dealer, and run the cups into a waiting container!

All of this may not be of great interest to the person just starting in the bullet business, but it can be a valuable bonus feature later when the business expands. Instead of buying new machinery, you can continue to use the versatile CHP-1 with optional add-on systems.

The CHP-1 is best used for making bullets from .224 to .720 caliber (12 gauge), although it can make bullets up to 1 inch diameter with custom dies and punches, and some restrictions on the jacket materials and core hardness. It can extrude a 14-ounce cylinder of lead in seconds, turning it into yards of bullet wire from .430 to as small as .040 inch diameter (below about .125 inch; we use multiple die holes and extrude several streams on the same stroke).

Jacket length is of little concern: the CHP-1 can make bullets for the .50 BMG or a .600 Nitro, or draw long jackets for 6.5mm bullets with equal ease. Even jacketed 12-gauge slugs are simple to build. The CHP-1 is covered thoroughly in the book "Power Swaging". This book is highly recommended before attempting to operate the press.

Safety is a primary concern with any powerful machinery. The safety record of the CHP-1 is remarkable. No injuries have been reported since the first machine was shipped decades ago. The normal operation calls for one hand to press an "Energize" button, and the other to press on a large "UP" or "DOWN" button. A bright red light comes on when you put the press in automatic mode, with the key lock switch. Even then, you must follow a correct sequence of pressing the "ENERGIZE" button, holding it down, then pressing and releasing the "UP" button, and finally releasing the "ENERGIZE" button, before the auto sequence will be recognized.

Ram speed can be controlled from zero to about 2 inches per second. This is fast enough to make over 400 lead bullets per hour, and yet slow enough so that occupational health and safety officials are not concerned excessively about the need for elaborate guards on the machine. The press comes with two bright orange metal guards that clip onto the moving ram guide. Their main function is to intercept any lead extrusions which pop out of the CSW-1-H core swage or LSWC-1-H lead semi-wadcutter dies, so that their energy will be expended and they cannot strike you.

The CHP-1 is designed so that the cabinet is part of the cooling system for the motor and hydraulics, and also holds the hydraulic fluid in a closed, baffle-stabilized tank that is the lower portion of the cabinet. Air is moved through the cabinet from two 100 CFM electric fans on the left side, and drawn over the oil reservoir section, from a fixed-width gap that causes the air to expand slightly and thus adsorb heat from the tank.

The front panel of the cabinet comes off to expose the motor, control and logic panel, drive cylinder, and hydraulic plumbing. A hydraulic oil filter of the canister, screw-on type, is mounted inside and will need to be changed only once every five or so years of normal use. The closed system with vertical cylinder mounting puts very little wear on the cylinder seals and permits little or no contamination of the oil. Thus, maintenance is reduced to virtually nothing: just keep the guide rods and ram reasonably clean of grit and use a light oil to prevent rust in damp environments, and don't keep the machine in an unheated space where condensation can form inside. Operate at normal room temperatures of from 60 to 85 degrees F. for best results. That's it!

The CHP-1 press uses type -H dies. The cost of adapting -M or -S dies to this huge machine would be prohibitive, and it would be far too easy to crack them from excess pressure. Reloading press dies, on the other hand, are easily fitted by using the RLA-1-H Reloading Adapter kit. This kit consists of a 7/8-14 tpi to 1.5"-12 tpi bushing (for the press head), and the combination of a ram extender and shell holder adapter (T-slot with primer port, similar to the RCBS ram).

Optional accessories for the CHP-1 include the LED-1 Lead Extruder set, to make lead wire from scrap lead (soft lead only), anvils to screw into the punch holder and ram so you can use the press as a high powered, precision arbor press, and both the JMK-1 and JMK-2 jacket maker kits for turning strip into drawn jacket, just like the factory—only better!

The Hydro-press can also be used to punch and form medals and coins from gold, silver, brass, nickel-silver, and aluminum, and to stamp and shape such items as gun sights, trigger guards, and other steel parts. It has been used to manufacture components from fishing tackle to power transmission line connectors.

You can, of course, build as powerful a machine by connecting an appropriate size cylinder to a hydraulic pump and motor. But it would not be designed with the various dies at hand nor with the years of experience getting the dimensions, control circuitry, and appropriate cycle timing. And if it cost less, the odds are extremely good that the components used are not the same quality: we buy hundreds of pumps and cylinders from top makers like Vickers (The TJ-Aeroquip division is right around the block from our plant) and generally it is more economical to buy a lot than just one, a savings we pass along in pricing the machine.

The CHP-1 press is built to do everything from making your lead wire, to forming the jackets, to swaging the bullets, and even to reloading the cartridges, with the effort it takes to press a button. It is not a high-speed production machine, like a progressive loader, but is a high precision, high power production machine for profitable, exotic bullet styles that are not offered in high volume by anyone (because their market is smaller and more exclusive).

Our purpose in developing the custom bullet market over the past decades has been to carve out a niche with appropriate tools, in the appropriate price range, so that individuals who wanted to have an interesting, profitable business at home could do so without the need for high risk investments in high speed production and the huge markets that are needed to support them. The custom bullet market is ideally sized for the machines we build, because we built the machines with the business concept of custom bullet sales and markets in mind. Then, we built the markets by showing clients how to promote, advertise, and sell high performance, at a fair profit, instead of run-of-the-press mass production that must compete only by offering a lower price and thus virtually assuring a low profit.

The CHP-1 Press is the main tool used by hundreds of full-time commercial bullet makers today. It is not a mass-production, high volume, low profit machine. It is a custom production, high profit machine. It stamps out profits for its owners, with every bullet you carefully assemble, because it can make bullets many shooters are willing to pay over a dollar, sometimes over two dollars, each to obtain. Almost every advertisement you see today for custom bullets is from one of our successful clients. Some are quite famous now. It makes me feel very good about the swaging field.

For more information about the business aspects of custom swaging, we offer the “Marketing Information Package” or MIP. It provides information regarding return on investment, capitalization of labor, market size and so forth, plus a comparison of the casting and swaging businesses, and spreadsheets and projections for starting a typical one-person business at home. A Corbin book on disk you may wish to read is called “Turning Ideas Into Income” (Cat.No. DC-TIII). The nuts and bolts of the bullet business are covered, in detail, from the organization, marketing, and logistical standpoints, with a lot of information on the thought processes, goals and strategy you can use both in this field and in many other business ventures, turning ideas into income, and then turning income into wealth.

Questions about the CHP-1

How much maintenance does it require?

Virtually none. The system uses a vertical mounted cylinder with no side drag on the seals, and the hydraulic circuit is a closed system with recirculation filter. People such as Swift Bullet Company who purchased these presses in their start-up stages, many years ago, have used them to make millions of bullets with only cosmetic wear to the finish, sometimes an early switch or position detector failure, minor items such as the indicator or work lamp bulbs. By and large, if a person stays out of the cabinet and does not play with the design, take the precision hydraulic components apart and get dirt into the system, the presses will run decades with no more than indicator lamp replacement.

What has failed?

Very few presses ever have a problem, but of those few which have (over more than 20 years) the main items which were replaced have been the solenoid valve (direction control valve for the cylinder), the two-stage hydraulic pump (rarely), and the single-phase 60 Hz 1.5-HP motor. From damage or misuse, the main item of failure would be the position transducers (normally from someone adjusting them to stick so far out that the moving ram strikes one). But in most cases, the failure was either right away and covered by warranty, or it was after 10 years or more of hard use, well within the normal range of mechanical things.

Do you need spare parts, then?

I would not buy spare parts unless you are located in a land where it is difficult to get air shipments, or the project is so critical or profitable that being down a few days would cost more than the value of the parts and air shipment. The failure ratio is so low that most people will never need to replace anything for decades. If you really use the machine hard, such as two shifts a day and six days a week, then maybe getting a second machine would be sensible. We do have a spare parts kit, which includes indicator lamps, relays, and the solenoid valve, plus a spare position sensor and dwell timer. But every year the reliability of the components seems to improve, with new solid state electronics replacing more of the early components. Even the first machines were very reliable. The ones we make now are remarkably solid, and I don't say that just to sell them. If I thought you needed parts to keep them going, I'd say so. It doesn't hurt General Motors and Ford that there is a big aftermarket for parts. But I just can't honestly say there is much to go wrong, based on what really happens to the ones we've sold all these years.

Do you need special hydraulic fluid, and how often do you change it?

You need to use the right fluid, but it isn't that special. It is the same as Chevron AW-40, a standard non-synthetic anti-foaming hydraulic fluid. Do not dump brake fluid or other nonspecific types of hydraulic oils into the machine! If you can't find an equivalent to the Chevron fluid, from Mobile or BP or whoever else is handy, then contact us and we can ship you a gallon or two. But having said that, the only time I've found it necessary to change the fluid was in cases where the machine sat in a cold unheated building and was subject to sweating and condensation when the heat was cycled on and off during the work week.

Or, if a person decided to tear into the guts of the machine and take the thing apart, and lost fluid in the process, that would be another case where you need to add fluid. Or, in one final instance, where the machine was dropped or tipped over during shipping, contrary to the instructions on the box that say clearly "DO NOT TIP PAST 15 DEGREES" and have a 15-degree angle printed on the box to illustrate how much that is. There is a filler and breather cap combination, just at the front of the machine, inside the front panel, on top of the hydraulic tank. The entire lower portion of the machine is a hydraulic tank. It holds about six gallons of fluid, although we may make design changes so follow the information that comes with the machine if it differs from this.

You would seldom if ever need to change the fluid. If you did, there is a plug at the rear, near the bottom, that lets the fluid drain out. But unless it is contaminated from something dumb that someone decided to do to it, or unless it was subject to a lot of condensation that might have put water in the tank, odds are you could run it forever on the same fluid. Most people do.

Do you need special power wiring?

No, but you need a line that can run a 1.5-HP motor without undue voltage drop. Some household circuits share with a refrigerator, toaster, or air conditioner, and those lines will probably be overloaded when the machine reaches peak load, at the end of the stroke. Or the breaker might blow when you first turn the machine on, if a high-current appliance is also running at the same time on the same circuit. A normal 20-ampere fused circuit is fine. You may even be able to run it from a 15-amp line, assuming that the circuit breaker can handle momentary surges at the very end of the press stroke and when the press is first is switched on. Generally there is no need to run a special line. But in some mobile homes and older houses where the wiring might be a little substandard, yes, you probably will need a dedicated line.

Is the machine noisy?

It sounds somewhat like a vacuum cleaner. If you live in an apartment or your shop is next to the bedroom, I probably would suggest not running it while people were trying to sleep. If you find it annoying to operate because of the noise, you can isolate the cabinet behind a wooden enclosure that has good air vents and soften it somewhat. Most people don't think it is unpleasant to operate, but there is hardly anything as variable as people, so I'm sure someone will. As a guide, you could turn on an average vacuum sweeper and figure that is about as loud as it gets. The machine gets slightly louder at the end of the stroke, and quieter as it runs on the high volume side of the two stage pump, moving the ram up and down. It has an idle mode where you switch off the pump but have the cooling fans moving 100 cubic feet of air through its cabinet for a mild fan sound. If your neighbors can't hear you sweep the floor, they probably can't hear the press run.

Is the press dangerous to operate?

Anything that applies a lot of force between two objects can be dangerous if you put your fingers in the way, but I have seen far more accidents of the pinched finger variety take place with a hand press. People just automatically seem to respect the fact that a big hydraulic press could do major modification to their fingers, and that helps keep them alert. I would not be operating it around small children, or while finishing the second six-pack of beer, or in any other circumstance where I couldn't keep my mind on the business at hand.

But so far, in decades of people using the machines, no one has reported an accident, not so much as a pinched finger. Based on history of use, I'd say it was pretty safe. Based on human nature, I'd say the person who has not blown themselves up handloading is smart enough to avoid sticking their hand under the ram and leaving it there while holding the "Energize" button down with an elbow and pushing the "UP" button with the other hand.

Some people have modified the safety features, and gotten away with it. I don't recommend it. The press has an "Energize" button on the left top, and an "UP" and "DOWN" pair of buttons on the right of the top panel. You have to push two buttons to make the press ram move up, and since this should take both hands, it would seem hard to lean that far to the back of the press and force your head into the space between the top plate and the ram. Or to get one leg up and stick your foot into the area of danger. But if one taped the "Energize" button down or put a brick on it, I suppose one could figure out a way to get hurt.

Does the pressure in the system pose any danger?

The hydraulic pressure generated is not like the pressure in an air system, or in a gun. In both of the latter cases, pressure is caused by compressed gas, which wants to expand. If a crack should appear in a gun barrel, or in an air line, the gas wants to rush through it and continue to blow until all the pressure is relieved. Tremendous power is stored in the compress gas itself. It can rapidly widen the crack and tear hunks of metal out of the surrounding container, throwing them at high velocity.

But a hydraulic system uses a relatively incompressible fluid. All the power is transmitted from the pump, through the medium of the fluid, to the walls of the pipes and cylinder. If a crack occurs, the fluid leaks or sprays out, and the pressure instantly drops. Hydraulic fluid spraying out of a pinhole under high pressure could penetrate the skin, and it could spray out as a mist that a spark could ignite (although the fluid isn't nearly as flammable as kerosene or other fuel oils).

But usually, if you have a leak, it is more of a seep and you notice from a drip inside the cabinet. And this is quite rare now, since we are using flexible lines instead of steel lines (shipping would sometimes vibrate the steel lines and cause them to loosen under the flare fittings, causing a seep of oil). There is no danger whatever of an explosion from the pressure, in the same sense as compressed air or powder gas in a gun can cause damage.

If the die should break from excess internal pressure, the pressure is relieved the instant the die cracks. The die does not "explode" except that in rare circumstances it might shatter and the physical stress in the die metal might cause some of the pieces to fly out. But in hundreds of broken dies (some on purpose for testing, some I wish I could say "I meant to do that!"), by far the most common breakage is a loud pop and no immediate visible sign of where it came from!

When a good die is broken (that is, a die that did not have a flaw in the metal, an extremely rare thing on a par with a politician who doesn't want to raise taxes and demands a smaller staff) the pressure simply distributes itself evenly around the die until it finds the weakest points, then forms a stress crack along the axis and instantly relieves the pressure by allowing the die to expand a few thousandths of an inch, like a collet opening.

Sometimes the die isn't broken apart entirely, but is joined at one end and a visible crack like a pencil line can be seen nearly the full body of the die. Usually the die actually breaks into two fairly even halves (if it is a core seat or point form type die) almost as if it were cut by a saw, and comes apart when you unscrew it from the ram.

If the die has bleed holes, like a core swage or semi-wadcutter die, the holes form stress risers because the core was trying to extrude too rapidly through them. We use 120-degree hole spacing, so the die tends to crack into three parts, with the cracks more or less radiating straight from the holes to either end of the die. These kind of breakages indicate a good die that was overstressed.

But while it is possible, in theory, for the die to shatter and throw parts of itself with dangerous velocity, I have never seen it happen. I have seen a punch strike the die face out of alignment with the hole, bend itself, and shatter, and the stored energy in the spring-like bend tossed part of the punch with enough force to be painful, but not lethal. Lead wire extruders are another thing entirely. They compress a billet of lead and extrude it through a small hole.

But if any air or lubricant is forced toward the extruder hole, it can propel the lead in front of it with good velocity, and probably could drive a piece of lead through someone's skull. With extruder dies, I always recommend putting a cardboard tube or some other shield over the top (they project straight up from the top of the press) to prevent anyone from reaching over the top while it is operating. When the lead starts to flow out, it moves fast and is hot, so I let it sag over and then guide it with a leather-gloved hand into a box. But I never, ever, look into the top of the die or put my hand directly over the extruder while it is spurting out wire. I have witnessed a rare dangerous "big bang" of a piece of lead being shot into the ceiling, so I know it can happen.

Conversion of manual presses to hydraulic

Neither the CSP-1 S-Press nor the CSP-2 Mega-Mite press can be "converted" easily to hydraulic operation. Hydraulic presses use different rams and other components designed for the stresses applied. It would cost more to purchase the same quality and safety of components on a single-unit order and try to build up a solitary prototype than it would to take advantage of the experience, tooling setups, and volume production of a Corbin press, for which parts are readily available.

I mention this because we are sometimes asked if we could supply hydraulic parts for someone to modify a press, or if we would provide diagrams and specifications to help someone build their own press. Naturally, we'd rather sell ours, but beyond that, the dies are made to fit and operate in a specific design of ram, stroke, and clearances. It is unlikely that they would eject properly unless a press identical to ours in most parameters and dimensions were to be used. By the time we provide all the right parts on special order as individual components, we might as well fit them to a frame and sell the completed unit: it costs about the same either way.

Did you ever try to build a car by purchasing all the parts? We figured that in the days when a Volkswagon bug cost $5,000, the parts to build one would cost you $20,000. Then you add your labor. Parts put into inventory for future use are far more costly than parts that are scheduled to be assembled along with a matching set of other parts and sold as a completed unit.

People who have no manufacturing business knowledge probably will never understand why, but those of you who are familiar with the human hours of labor involved in keeping track of inventory, physically protecting and storing it, paying the business property taxes on it, and providing expensive indoor storage space by the cubic foot, will know what I mean.

A part that might take an hour to make might cost only $10 in material, but anyone who thinks the machinery, tool bits, machinist wages, benefits, insurance and taxes allocated to making that part are insignificant would be out of business in short order. In fact, the material cost is the least expensive component.

Labor related expenses (wages, insurance, benefits, taxes) are the highest expense in making anything that you do not make yourself in your garage, where you can afford to do it for "nothing". If you can make a lot of these parts at one time, then you can save both on the material cost (a minor savings) and on the labor (a big savings) because there is only one setup of the machinery, and you only have to find or buy the tooling once for the entire run. Setting up to make one part can take more time than making it.

Then, if you can plan well enough so that you make runs of all the parts that produce a certain number of finished products, without any odd bits left over, then assemble and test them one after another, the people who are doing it get good at it quickly. They develop little ways to save time and motion, which would not happen if they were only building one or two products and then going on to something else. Anyone who has ever worked in an assembly and testing situation knows that you just get better at the job if you do several at a time, so that you can do just as good a job in much shorter time than someone who has not done it for a while. (On the other hand, if that is all you do day after day, it can become so boring that errors creep in from lack of interest...there is an optimal number to a production run where a person is able to learn faster moves without hurting the quality of work, then enjoy applying his new skills for a while, before it starts to get old.)

Setting a few parts aside for individual sale doesn't cost anything more at that point. But it does cause a ripple effect on future costs, because now there are mismatched numbers of parts on hand which may or may not be sold before the design is changed, which may or may not remain in inventory through one or more property tax cycles and accumulate expenses in states or counties where property tax is levied, and which in every case will require valuable space in the building, labor to keep track of the inventory count and location, protection against rust and dust and handling, and of course represents all of that accumulated cost as a dead weight, earning nothing on the capital tied up, until it is sold.

That is why it must sell for more than the total of such parts in the finished product. Otherwise, the business will slowly lose money on such parts until it must either increase prices on the finished products to cover the parts inventory carrying expense, or in extreme cases, go out of business.

I expound upon this because at one time, before I became a manufacturer, I used to rail against the high price of parts as opposed to their likely percentage of the finished product value. Checking the price, for instance, of a new print head for five-year-old dot-matrix printer, I found that buying just this print head cost half the price of the printer (when new), and I was a bit put out by this. Now I know that the printer company was probably doing me a big favor just by having spare print heads in stock for a product that was designed for about a three year product cycle.

They probably are just about breaking even, having tied up their capital and labor in stocking the old print head for five years, when most of the users of the printer have purchased newer, faster units and there is little demand for parts. It doesn't make me any more cheerful about paying half the price of the printer for the part, but at least I know the reason isn't sheer greed, now that I am in almost the same situation with parts as the printer maker (except my products have a much longer life cycle).

Sometimes a person will ask "Can't you just sell me the parts and let me hook up my own hydraulic system?" And the answer is yes, we can, but I don't plan to because it never stops there. I've done it, and regretted it every time. It never fails that the same person who just wanted to "hook up" his power steering pump to our parts, finds that there is quite a bit more to it just like I had been saying all along. And then they want more parts made, special adapters, and yet more advice, and all this time they are getting frustrated because they assumed it would be so simple to "hook it up". But there are no "hooks". You have to design and build them. We already did. In fact, we probably made every mistake in the book at least twice before we got it right.

Every new product takes hundreds of hours of prototyping, throwing away things that didn't quite work right, rebuilding again and solving problems that no one even considered. Getting reliable suppliers for components is just part of it. Sometimes it is years before we're ready to actually announce a product, from the time we start on the project.

But the person who just wants to "hook it up" to save money, doesn't know all that. He just assumes it must be easy because it looks easy to someone who has never done it. And by the time he has accumulated enough experience to know it isn't easy, he's mad at the world and thinks someone hoodwinked him by reluctantly providing him what he asked for. I can spend hours on the phone (free) trying to teach him about hydraulic design and mechanical stress and whatever else he needs to know, but if he doesn't have the machining skills and equipment at hand, it does no good.

Usually, by the time the project is finished, the person has bought a lot of parts that probably didn't get used, and wound up trying to get me to buy them back after he has dinged them up and made them unsalable. By helping him "save money" instead of just buying one of our presses that we know works right and is guaranteed, I've actually helped him waste a lot of his time and money, and a lot of my time on top of it, building something that probably doesn't work right and certainly isn't guaranteed. Instead of a happy customer making bullets, he may be angry and making no bullets. So I say, forget it. You would probably feel exactly as I do, after having been through that a few times!

At this point, the thoughtful wheedler may ask, "How about sending me plans to build a copy of your equipment, then?" It never hurts to ask. And the answer is....

No, we don't provide blueprints on how to make our equipment. Ask Coca-Cola if they'd like to give you detailed instructions on how to brew their drink yourself! Or Ford if they'd care to put an engineer on the phone and tell you exactly how to build their latest engine? Or Krispy-Kreme Doughnuts if they'd send you a copy of their famous doughnut recipe? Or even McDonald's if they'd like to give you some tips on how to organize a fast food business? The response may give new meaning to the old Simon and Garfunkel song “Sounds of Silence”. Or maybe it would just be peals of laughter and a loud click.

But we’ll figure out how to make any bullet you wish to build, if there is any way it can be done on our equipment, and give you not only the plans but even the right to market designs that we developed, without any royalty, recognition or other payment for the idea. We’ll even help you market your bullets, by providing free information about publicity contacts and methods that have taken us decades to develop.

We sell solutions: free information and help with bullet design is part of our service. Some of the valuable information is only free to our clients, meaning if you purchased equipment from us. A fellow who just bought a casting machine isn’t going to get thousands of dollars worth of free marketing data unless he also purchased a press and swaging dies from us! We may be generous with help, but I hope we have not become senile.

But if that fellow called and wanted to know how to make a better lead bullet than he could cast, and needed to know if there was a market for it and how to reach it, I’d be glad to point him in the right direction. I would spend some time explaining how higher profit custom bullets can be successfully marketed at lower volume but higher net than cast, how to reach that market, and what equipment he would need.

After he purchased equipment and was ready to start marketing the custom bullets, I would be glad to provide an extensive and exclusive mailing list of publicity contacts, filling in the blanks with specific details. Very frequently, our clients who first went elsewhere to try and start their swaging operation tell us that even if our equipment cost more, they’d be glad to buy it because of the support and service extras, some of which can mean the difference between a bullet business struggling for years or being profitable in a reasonably short time.

11. Lead, Base-Guard, Gas-Checked and Paper Patched Bullets

Bullets which have a shoulder between the nose section and the shank can be made in a straight cylinder kind of die, by using a punch that has the nose shape machined into a cavity. The edge of the punch cannot be knife-edge thin, because it would soon break off from the stress of being pressed under tons of force against the die wall and then moved to eject the bullet. In fact, the edge would break off at a ragged point about .020 inches thick.

This is why we build the punches with a nominal edge thickness of about .020 inches: it is the minimum practical thickness of edge that will withstand being pressed outward by swaging pressure and then moved.

A common misconception is that one should somehow be able to make a bullet in the straight cylinder and punch cavity type of die (which we would call the LSWC-1 style) with no shoulder—in other words, a typical rifle bullet or a full jacket style of handgun bullet. How? Well, they suggest making the punch edge razor thin. Simple. No edge, no shoulder.

Too bad it doesn't work. We could save untold thousands of dollars invested in machines and tools to build diamond-lapped point forming dies, with the shape of the bullet carefully reamed and lapped into the cavity itself instead of into a moving punch with an edge.

A straight hole, through the die cylinder, fitted with a close-fitting punch that has the nose shape machined in reverse (a cavity), can form lead, gas check, Base-Guard, or paper-patched bullets with virtually any shape of nose. You can make wadcutters, semi-wadcutters, big hollow cavities like the old Webley Man-Stopper, sawtooth bullets, and even pointed rifle type bullets—provided the nose is all lead and the jacket stops where the punch begins, with a shoulder the width of the punch edge.

We call any bullet of this general type a "semi-wadcutter" or "wadcutter" depending on how much of a nose it has, if any. That doesn't mean you can't make a very nice .45 caliber round-nosed paper patch rifle bullet with the LSWC-1 die. It just means the nose will be joined to the shank with a small shoulder, which you will probably just barely cover with the edge of the paper patch.

To get rid of the shoulder, you would swage the bullet in a point forming die, which is a semi-blind hole shaped like the bullet, having a small ejection pin at the tip to push the bullet out. But this kind of die is not sealed on both ends: the small ejection pin needs to be out of cavity to avoid putting pressure on it during swaging, because it is, after all, very long and thin. Since the die is not sealed, you cannot develop the same high, uniform pressure that is produced in a cylinder type of die.

So, to be able to extrude surplus lead, adjust the weight, and form a more nearly perfect diameter and roundness of shank, you would first swage the lead slug in a CSW-1 core swage die. This would give you the high precision weight control and diameter you want in quality swaged bullets, and at the same time would put a nice flat on both ends, instead of a rough cast or cut wire end. Then, the smooth flat end will shape itself more cleanly into a smooth round end in the next die.

No shoulder means two dies: a core swage, and a point form. A shoulder means you can use one die: the lead semi-wadcutter. Yes, even for paper-patched, round nosed rifle bullets: it is exactly the same kind of die, even if you make the nose cavity longer and don't normally think of the bullet style as being a semi-wadcutter. We can't call this die a "Lead, gas-check, Base-Guard, and paper-patch bullet swage that can make wadcutters, semi-wadcutters, and rifle type noses too". That won't fit in the 8 character space our computer order system provides! So we'll just call them all "LSWC-1" dies.

In the -R (reloading press) dies, we have the Pro-Swage. It is similar to what we would otherwise call a "Core Seater" die or "CS-1" style, being a cylinder fitted with punches to form the nose and base of the bullet on one stroke. Putting bleed holes in the side of the die makes it a "LSWC-1", if it does in fact have nose and base punches so it can finish up the bullet in one stroke. (If it made the core for a bullet, and was fitted with flat punches, it would be a "Core Swage" or "CSW-1" style of die.)

The Pro-Swage can't have bleed holes in the side of the die, because it fits into a reloading press. The reloading press is designed for reloading, so the ram comes almost to the top. That is where all the power is developed in the stroke, so that is where the die must be set to form the bullet. If the die is in the top of the press, there is no place for lead extrusions to be spurted out of the die sides. The bullet is being formed inside the part of the die that is surrounded by threads of the press head. In the PRO-1-R die, you adjust the weight by casting or cutting the lead as accurately as you can before swaging. Or you can order an optional weight-adjusting punch, which has a flat end and a hole through it, so you can bleed lead from one end of the slug to adjust the weight precisely by volume.

In any of the Corbin presses, you would put the LSWC-1 die into the ram, along with its internal punch. With the type -S dies, in the S-Press, there is a round stop pin projecting from the press. It has a knurled head. Normally you just leave this pin in place with all the dies except for the point forming die, which uses this pin to trap the ejection pin punch so it is retracted from the die cavity when the bullet forms. All the other dies have punches large enough so that they will be pushed back by the component when you raise the ram.

The stop pin pushes on the tail end of the internal punch when you pull the handle back down (retract the ram). This stops the punch from moving back down with the die and ram. They continue down, the stop pin holds the internal punch and keeps it from moving, and so the bullet is pushed out of the die on the down stroke. This provides automatic ejection.

In the Mega-Mite and Hydro-Press, a steel bar goes completely through a slot in the ram and serves the same purpose as the stop pin. The bar for the press is made in different heights, so that the total length of the punch you use and the height of the bar, combined, are always the same distance. With a longer punch, you use a shorter knockout bar, and vice versa.

Punches are made longer or shorter to accommodate longer or shorter bullets. A .50 caliber bullet is quite a bit longer than a .224 bullet or a .38 pistol bullet. A .308 rifle bullet is somewhere in the middle. There would be no point and a lot of wasted metal in making a .22 or .38 die the same length as a .50 BMG die, so that is why we have three standard lengths of dies, which have matching length punches, which have corresponding length knockout bars.

Installing the external punch

The external punch always goes into ram in a reloading press, just like a shell holder. But in Corbin presses, the external punch fits into a threaded body called the "Floating Punch Holder" or "FPH-1". The S-Press comes with a 7/8-14 tpi punch holder, catalog number FPH-1-S. A larger 1.5"-12 tpi FPH-1 is used in the Mega-Mite and Hydro-Press. It is called the FPH-1-H.

A special high accuracy punch holder made of hardened steel with a hole all the way through it, so you can drop the punch in from the top, then screw in an adjusting stop bolt, is made for the Hydro-Press. It is designed to contact the die face and stall the press, providing almost zero tolerance weight control. This special punch holder is not provided with the press, but is available as an option. It is called the "FPH-2-H" Positive Stop Punch Holder.

To make the insertion and removal of long components easier, without moving the punch holder up and down, a T-slot punch holder is available. This punch holder is called the FPH-QC-S or FPH-QC-H, depending on its size and threads. As you probably have learned by now, the -S means S-Press and the -H fits the various large presses such as the CSP-2, Hydro Junior, and Hydro-Press. The quick change punch holder is also useful for jobs where you want to apply two punches in sequence, such as a hollow point and a toothed punch.

In the reloading press you would move the die up and down to adjust for weight and changes in style. In any Corbin press you would move the punch holder up and down. The external punch is held in the punch holder by a retainer bushing. In the early type -M and current -S dies, the external punch is identical and interchangeable, whereas the internal punch is longer with the type -S die.

Type -M and -S dies can have the retainer bushing (also called a “hex bushing” since it is hexagonal at the exposed end) fitted to the punch permanently, if the punch tip is larger than about .375 inches. Smaller punches use the retainer bushing that comes with the punch holder, which comes with the press. In earlier external punch designs, here is also a steel ring or collar, which slips over the punch before you screw in the retainer. This collar allows the punch to move slightly under pressure for perfect die alignment (hence the name “Floating” in the punch holder designation). Current external -S punches do not require the ring.

No collar is used in the FPH-1-H. The retainer can be hexagon or round. Generally if it is made round it will have knurling or a pin wrench hole to snug it down. Hand tightening is usually sufficient except for long production runs.

Moving the punch (or punch holder) down, closer to the die, is just like using more powder in your handloads. You want to approach any changes with care, use small changes and test the results, watch for risky pressure signs, and back off if it appears you are raising pressure too far. It’s not likely you’ll hurt anything but the die or punch with careless operation, but damaging either one of those will hurt your budget.

Setting the stroke mode

In the S-Press, with the die and internal punch in place in the ram, make sure the stop pin (the little knurled head with the short pin, fitted to a hole in the top of the press) is in place. This pin stops the internal punch from going back with the ram on the ejection stroke, which is what pushes the bullet out of the die. If you don’t have the stop pin in place, you can’t eject anything from the die.

Corbin hand presses have at least two stroke lengths, a short stroke for swaging, and a long stroke for reloading and drawing. The Mega-Mite has three, so you have an intermediate option balancing power and stroke length. Make sure the ram is in the short stroke mode. In the reloading mode, the ram travel is too long and the position of the dies will be incorrect for ejection, and too high in the upward position for good adjustment of the punch holder. If you do use the press for reloading, you must remove the stop pin, or else the stroke will be blocked by the pin.

To change the stroke, locate the single pin the fastens the end of the ram to the toggle bar. There are two sets of holes in the toggle arms. One set is closer to the end of the toggle arms, and the other set is closer to the bar itself. The set closer to the bar (body of the toggle assembly) is for swaging. It gives the ram a shorter stroke and twice the power. The set of holes closer to the unsupported end of the toggle arms is for reloading. With the ram pinned to these holes, the travel is doubled.

If you put the pin in the long stroke set of holes, the stop pin in the S-Press will limit the ram travel so that you cannot move the handle all the way up or down without damaging the stop pin. Always remove the stop pin, if you plan to use the long or reloading stroke. But push the stop pin back when you switch to the swaging stroke. Some beginning swagers forget about the two strokes, and try to use the press in the wrong mode. Conversely, they may fail to put the press in the long stroke mode for drawing jackets or reloading operations, which require more stroke with less power.

Generally, when the die fits the top or head of the press, you will want to use the long stroke. When the die fits the ram, you want to use the short stroke with the stop pin in place. But there may be exceptions, so read the instructions that come with each die to make sure. Regardless, never try to use a “cheater” bar on the handle! There is nothing you can do safely with this press that needs a cheater bar or handle extension: all the components are designed and matched to the amount of torque and leverage you get with the normal handle in place.

Setup and adjustment

Cast or cut a piece of lead to approximately the right weight, plus a few grains (unless you are using the PRO-SWAGE, in which case you want the right weight now). Put a small amount of Corbin Swage Lube on your fingertips, and give the lead a turn between your fingers to spread some lube film on it. Then put the lead in the die, and gently move the ram up so the punch enters it, pressing on the lead core.

I like to adjust the punch holder so that, with the ram all the way up, there is no contact with the bullet. Then I screw the holder down until I can’t move it by hand, lower the ram slightly and give the punch holder about a quarter turn further down. Raise the ram and swage. Inspect the bullet. If it isn’t formed out completely, keep lowering the ram in 1/4 turn increments until it forms, but don't apply more than a comfortable amount of pressure on the handle. If the pressure goes way up, you have the punch holder too close to the ram and have lost the point of high leverage that makes the operation easy. A five year old could do it if you adjust the position just right. A gorilla couldn't do it if you go half an inch too low.

In every operation, with each kind of swage die, you will want to follow this basic procedure unless there is a specific instruction supplied to the contrary. Moving the external punch closer to the ram always reduces the space between the internal and external punches at the end of the press stroke, and thus generates more pressure on the core. Approach this just as you do when increasing the powder charges in a handload: work from a known safe level in small increments toward higher pressures, checking the results as you go. As soon as you see any signs of excess pressure, back off!

The signs you may see would be an increased effort without an increase in the diameter of the bullet shank, or excess lead extruding around the punch. When the diameter of the bullet or core reaches that of the die cavity, you have done all that is necessary or wise, and should stop applying any more pressure. Further force only stresses and eventually breaks the die or bends the punch.

It is a good idea to test the actual diameter of any die by making a pure, soft lead slug in that die and then measuring the diameter of the slug as a standard to compare with jacketed bullets formed in that die, and with the size of following dies to be used. In the case of the LSWC-1 or PRO-SWAGE die, this isn't necessary because you generally make lead bullets as the final product. But in a core seat or point forming die, boattail dies or lead tip forming dies, the difference between the component diameter formed in the previous die and the bore size of the next die is critical.

You should always have a slightly larger hole into which to push the component on the next operation. If the component is already at or larger than the size of a lead slug formed in the die, you'll probably get hard ejection and stuck bullets. In the LSWC-1 or PRO-SWAGE die, however, the bullet is finished when it comes out of the die, and there are no more operations to perform on it.

Making hollow points

Hollow point noses in the lead SWC bullet can be made in two ways. First, you can use a separate HP type external punch to poke a hole in the nose, which of course displaces lead and changes the nose shape. You can either use the HP punch first, on the flat end of the lead slug, forming a broad flat-end wadcutter with a large cavity, and then change punches and wrap the nose around with the regular nose punch, or you can use the regular nose punch first and then push a HP punch only part way into it. Pushing a bullet all the way to the bottom of the die would totally change the nose shape into a flat-end hollow point wadcutter.

The way you get consistent, partial-insertion shapes is to back off the punch holder, moving the external punch higher, and then use that setting with the end of the stroke. Do not try to get good results by guessing how far to raise the press ram on every bullet. I can't do that either. You need to have a fixed reference point for the end of the stroke, because that positions the internal punch face precisely the same, so you have the same volume between it and the external punch face on every stroke.

The second way to make a HP cavity is to get a custom punch with the HP probe and nose cavity combined in one punch. This kind of punch can have an adjustable HP depth if the probe is straight (rather than tapered), so you can adjust its position by changing a screw depth in the punch head. The end of the punch can be tapered, but if you adjust this part back into the punch body, lead will flow up around the taper and make a nipple on the end of the bullet.

The advantage of a custom HP nose punch is that it can have adjustable depth and still form the entire nose in one stroke, without changing punches. The two drawbacks are increased cost for this more complex punch, and the limited size of the hollow point diameter. It cannot be made very large because if so, the probe that forms it would take up nearly all the room in the punch cavity. This would cause two problems: 1) the lead would probably stick in that narrow gap between the punch cavity wall and the probe, and 2) lubricant would build up in the tight space and prevent complete forming of the nose. Better to use a separate HP punch and two strokes per bullet when you need a very large HP cavity.

Gas checks and half jackets

For gas checks and half jackets, the lead slug that you use for the core must fit inside the jacket or gas check before it is swaged to final size. The jacket should always be slightly smaller than the final bullet diameter, so it will fit easily and expand upward, creating a snug fit on the lead when you release the pressure. If the jackets are, for instance, 0.3575 inch diameter and your die has a bore of 0.3570 inch diameter, all you get is difficulty forming and loose cores or gas checks that pull off from base drag on their way to the target.

On the other hand, if you use half-jackets or gas checks that measure at least 0.001 inches smaller than the desired bullet diameter (and bore of the die), they will be expanded nicely and then spring back slightly when you release the swaging pressure, gripping the lead tightly, coming out of the die easily, and preventing the lead from turning inside the jacket.

You can use jackets that are as much as .005 inches smaller than the bullet without any problem. Some jackets can be even smaller, depending on their strength, temper and wall thickness. Corbin jackets are correctly sized for the caliber, but some jackets from other sources are not because mass production techniques for making bullets do not always follow the same procedures that you would. I once purchased a large quantity of bullet jackets that turned out to be too large to fit into the correct caliber swage dies. The jackets were used by a company that made the bullets oversized and then drew them down in a final operation (which can leave the jacket a bit loose on the core because of the difference in springback).

I had to find a buyer who wanted them all, and then make him a jacket reducing die to bring these jackets down a couple of thousandths before using them. But I learned that there are major bullet makers who do not make bullets using the high precision techniques proven by early benchrest bullet makers, namely the "up-swage" principle expounded by Biehler and Astles in the 1960's. This is the principle upon which all modern bullet swaging is based, and it requires a jacket smaller than the final bullet diameter.

Base Guards™

Base-Guards are conical disks with a hole in the middle, like a very wide washer. The hole is usually about 1/8 inch in diameter. The Base-Guard is normally made of copper, about .030 inches thick. Because they are conical, they will expand when compressed and become the exact size of your swage die. Any surplus metal will be extruded forward to form a burnishing tool edge, because one side is backed by the steel punch and the other side only faces soft lead. This scraper edge will engage the rifling and push fouling out ahead of it, making it unnecessary to use any bullet lubricant, up to reasonable velocities of 1,200 to 1,400 feet per second.

The best way to make a Base-Guard bullet is to first swage the lead slug into the bullet shape using either a flat base punch or the special BG punch, which has a shallow depression in the exact center. Then eject the bullet, drop a Base-Guard disk into the die with the cone tip facing out, toward the bullet, and swage the bullet again.

This double-swaging process does two things for you. First, it assures that the base is already square and flat before the Base-Guard disk is attached, and thus prevents the Base-Guard from having to bend and shape itself to a rough or uneven lead core prior to attachment. Second, it helps to adjust the weight and get the nose formed perfectly before worrying about the correct pressure needed to extrude the lead stem through the hole in the Base-Guard and form a good rivet head in the punch depression.

If you use cast cores, they are probably already flat on the end and you can swage all in one step with just about as good results as double-swaging. If you cut lead wire, there is always a shear angle to the cut, which tends to tip the Base-Guard disk and can result in a few bullets being made with the disk at an angle or pushed up along one side of the bullet. However, try it both ways and decide for yourself the best combination. This should not be taken as a criticism of cut cores, though. Lead wire is far easier and faster to use than cast cores, and it is generally much more consistent in density than scrap lead, so the minor issue of a shear angle on the end does little to detract from the benefits. If you seat the core into a jacket, this is of no consequence except with hollow point punches. My solution is to press them flat with a flat-end core seating punch and then perform any other operations.

To order or add the BG capability to any LSWC-1 die, just order the internal punch with the specification "BG". We'll know exactly what you mean. You can add the Base-Guard capability to any set of dies, by the way, although for the RBT or "Rebated Boattail" base, the disk has to be embedded in the bullet and the boattail formed as a separate piece, which requires some custom punch and die work. But for any flat base die set, just order the internal core seating punch as a type "BG", and if you use a point forming die, also order an external punch for it in the type "BG", because the little lead rivet head would be smashed paper-thin and probably would not hold well if you used a regular flat punch on it when forming the step-less nose in a point forming die.

Paper-patched bullets

For paper-patched rifle or handgun bullets, nothing special is required except that you may wish to use a cup-base (CB) internal punch, instead of the usual flat base punch. There are actually three standard base cavity shapes that Corbin produces (as well as any custom dimension you wish, of course). These are: 1) Dish Base (DB), 2) Cup Base (CB), and 3) Hollow Base (HB).

The Dish Base is a shallow curve that extends from one side of the bullet to the other, with no flat "margin" on either side. It is used to slightly force the edges of the bullet against the rifling so that moderate loads of slower burning powder will quickly expand the bullet into the bore and prevent early gas leakage. It is used when the pressure is fairly high (hot loads) and cup or hollow bases might become flared excessively from the muzzle gas pressure.

The Cup Base is a deeper curve with margins on the sides, designed to hold moderate muzzle pressures in blackpowder rifles and in modern target handguns firing typical target loads. The curve is less than one caliber in depth (typically 0.02 inches). It is very useful in paper-patched bullets as a place to tuck the extra paper gathered at the bullet base, and can help fit a standard diameter bullet to various bores during firing.

The Hollow Base (HB) is the deepest curve, with margins that are designed to hold muzzle pressure so the base won't expand excessively when the bullet pops out of the barrel. The design is to shift weight forward and lighten the bullet for its length. Air gun pellets, shotgun slugs, and muzzle loader bullets that are made to slide down the bore and then expand into the rifling on firing generally work best with this design. It is not usually employed for paper-patched bullets, but there is no particular reason why you should not do it if you want to. Just order the internal LSWC-1 punch with "HB" designation. (Usually, the top or external punch is the nose, and the base is inside the die or internal.)

Of course, the big difference between a paper-patched bullet and a lead bullet is the diameter of the die. With a paper patched bullet, you would want the die to be smaller than the groove-to-groove depth of the bore by four times the thickness of the paper. To illustrate, suppose you wanted to make a .45-70 paper patched bullet. If the bullet were to be a Base Guard, gas-checked, or have lube groove or knurling rolled into it with a Corbin HCT-3 grooving tool or HCT-2 knurling tool, then you would want the die to be .458 diameter.

But for paper-patched bullets, that would leave no room for the paper. The most generally used fit is to have the paper take up the space left by the rifling grooves, so that the bullet sits on top of the rifling or fits the actual bore of the barrel, perhaps even loosely if you use black powder. A commonly available cotton bond paper is 0.0025 inches thick (and pulling or stretching it will make more than 0.0005 inches difference in its thickness, so it isn't terribly important to have "precise" paper).

The paper patch is usually cut to be the length of the shank (parallel sided portion) of your bullet, plus enough extra paper to form a wrap around the base and tuck into the cup base cavity. This might be roughly an inch, in a 1-E ogive 450 grain .45-70 bullet. So you would first cut some of your 0.0025 thick cotton bond paper into inch-wide strips. Then you would take one of the strips and wrap it around the bullet so that it made two complete turns, bringing the outer edge exactly matching the position of the inner edge so the paper didn't have a lump from any extra overlap.

You'd mark that point on the strip with a pencil, and then slice the patch with an angle of anywhere from 30 to 45 degrees across both ends, so that you start with a narrow tip, wrap the paper around the bullet, and when you get to the last of the paper, the edges just butt together with one layer between them. Some people wet the paper and wrap it, and some dip it in a lubricant such as Corbin Dip Lube, which helps hold it on the bullet and reduces friction when it goes down the bore.

The important thing for our purpose is determining the swage die diameter to make the right sized bullet. With a typical .45-70 barrel, such as a Shiloh Sharps or other quality replica, the rifling plus bore measures .4580 across. Four thicknesses of paper (two complete wraps around the bullet) is 0.0025 times 4 = 0.010 inches. Subtract that from 0.458 and you get 0.448 inches, which is exactly the standard size of swage die most people use.

You can use a 0.451 or a 0.452 swage die, which happens to be the right size for a jacketed or BG style pistol bullet for most .45 caliber handguns. To do that, you would want a different paper thickness. Working in that direction, subtract the bullet diameter from the desired rifling plus bore diameter, and divide by four. This would be 0.458 - 0.452 = 0.006, divided by 4 = 0.0015 inches. So you would want to use a very thin onion skin or perhaps the high grade linen or abaca fiber paper found in the computer industry for polishing hard drive surfaces. If you did this, you would be able to use one set of dies for both handgun and rifle calibers. Should I be telling you this? Now you only need one, instead of two!

Hard lead alloys

In the Hydro-Press you can swage moderately hard lead in a LSWC-1-H die that is designed for the job. Be careful to use the orange press-fit guards around the die, however. The pressure that it takes to extrude the lead is very high, thousands of pounds, and can build up before the lead extrusions finally move through the bleed holes. When they do let go, they can fly out at fairly high velocity. They are generally light and not very aerodynamic, so they lose velocity quickly and are easily stopped. Stopping them with your body could be painful when using hard lead, because of the higher pressure, and the guards work much better.

Never put your face down close to the die when you are swaging! If you should happen to exceed the breaking point of the die by applying too much pressure, generally there is a loud pop and the die either falls in two (or three) fairly even pieces, or it cracks without any apparent change, and is held together at the threads.

Sometimes, though, there is enough lubricant or air under pressure in the die to blow a piece of lead or broken die at high velocity in any direction. If it hits you in the eye, it could blind you. This kind of thing has never happened in the years of my experience, but it is possible, so wear eye protection and keep your face back from the die while swaging.

With hard lead, the pressure required to make the metal flow can be considerably greater than the pressure that makes pure lead flow. Some dies may not be suitable for use with hard lead, if they were designed using normal soft lead. You need to let us know in advance, if you plan to use hard lead. We can make the bleed holes larger in those dies which use bleed holes, and we may be able to do other things to either reduce the required pressure, or to build the die even stronger than usual. Some of the techniques used to make a die stronger are fairly expensive, because they may entail special metals that machine with more difficulty, use up tooling faster, and need special time consuming heat treatment processes. Rather than force everyone to pay more for their dies, when they don't need this additional pressure, we offer custom dies to those who do.

How hard is too hard for a standard die? That depends on the caliber and the bullet shape to a large extent. If the die cavity is very long and narrow, as with sharply pointed spitzer bullets, the pressure required to force hard material into the nose will go up quickly. The same material might form a round nosed bullet in the same caliber with relative ease. Soft lead is 5 on the Bhn scale. Each integer increase is a square function of hardness, so going from Bhn 5 to Bhn 10 is not twice as hard, but more like four times as hard. My experience has been that the pressure is related to the increase in hardness with most materials, including gold, silver, lead, aluminum, brass, copper and other commonly swaged materials. (Yes, we have made both gold and silver bullet swaging equipment for clients! The purpose of such bullets is not generally to be shot, but for decorative purposes...though there is a small market for silver werewolf ammo that could actually be fired, believe it or not!)

If a die has a breaking strength of 150,000 psi, and pure lead flows in a given shape completely at about 20,000 psi, then you can see that raising the pressure four times probably will work but going up eight times would blow up the die. Therefore, if you increased the hardness to Bhn 20, the die would probably crack before the metal formed into proper shape. There is no hard and fast rule about hardness. The die wall thickness helps increase strength, of course, but eventually the tensile strength of the die material is reached, and then the thickness hardly matters. Any die can be broken with enough pressure. The pressure required to form even moderately hard lead can be too much for the smaller -R dies, so they are warrantied only for use with soft lead.

The larger -S dies generally work with up to Bhn 8 to Bhn 10 hardness, but even this depends on the shape and the operator. If you jerk the handle quickly, you can blow up nearly any die from the combined shock and pressure. A positive, smooth application of pressure only builds pressure from the straight math involved in the force divided by the cross-sectional area to which it is applied. But a rapid jerk of the press handle adds both inertial resistance to flow and kinetic energy from the velocity times the mass of the moving parts. The sum or end result of this, plus the static pressure, is what we call "shock". It is similar to what happens when you pull the trigger with a load of fast burning powder and a heavy bullet. The pressure soars to a high peak and then drops off to a lower level as the bullet starts to move. This sudden pressure peak can far exceed the breaking point of the die, and is also one of the few reasons why anyone would break a hardened link pin.

Some operations (including point forming and core swaging) which work best if you have a constant smooth stroke, not a jerky motion with a lot of stops and starts. Making the stroke very slow can increase the friction, because moving lead generates a small amount of localized surface heat and lowers the pressure required to move the lead. As lead becomes warmer, it flows more easily. This is obvious from the logical conclusion that if you warm the lead up to its melting point, it takes no more pressure than its own weight to make it flow! But something below the point where the heat would destroy the temper of the die (below 250 degrees F.) is certainly desirable. Therefore, if you move the handle in an assured, smooth stroke with the timing of saying "one-thousand and one" from start to finish, you'll probably have the right idea. That puts the mild internal heating from friction to work for you, while avoiding the inertia/momentum conflict of too high a stroke speed.

Don't take this as meaning you have to be a master of timing to swaging anything. Most operations work over a very wide range of stroke speeds. But as the hardness of the material goes up, the speed plays of bigger part. And very fast or jerky motion is never a great idea, if only because it jars your equipment and loosens the settings, and doesn't give you any time to notice a punch that isn't aligned with the die before you smash them together in an energetic manner.

Fit of the external punch

You should be able to put the external punch into the die by hand, so long as the punch is clean and lightly oiled. It may take a little gentle turning and pushing with some cavity-shaped punches, since the cavity area will expand slightly after usage and fit itself snugly in the die. But if you cannot push the punch into the die by hand even with a moderate amount of force, don't put it in the press and push it in! Send back the die and punch and we'll adjust the diameter by lapping and honing. Don't take sandpaper or a file to it, or turn it down in a lathe. Some punches are designed to be very snug fits, in order to protect their thin edges from expanding and cracking under pressure. The die wall supports a thin wall, but only if there is very little clearance, perhaps almost too hard to put in by hand. But not quite.

The internal punch can become too snugly fitted to easily remove by hand, because the three lead extrusion holes may still have a bit of lead in them from the last job. These little plugs of lead are bearing firmly against the side of the punch, and can make it hard to move by hand. The fact that it is already in the punch means you can safely assume it is the right diameter. If you try to put a different internal punch in the die and it won't go by hand, that is a different matter. Clean it very well, oil it, and gently turn it back and forth while applying a modest amount of pressure by hand. If it still won't go in, probably it is the wrong diameter: don't force it with the press.

The fit of a nose punch (with a cavity) is critical in a LSWC-1 die. If you try to use a punch that was not specifically built to work with that die, there is a good chance that the fit of the punch will be just enough undersized so that the punch will expand slightly and crack. This is only true with punches that have a cavity and therefore thin walls. The pressure of swaging the bullet works against the inside of the cavity, pushing the thin walls against the die. The die supports the punch if it is a close, handmade fit. Otherwise, it may not. A hairline crack may occur as a result. Using the wrong size punch would not really be a warranty issue, since it is a user option. Punches for LSWC-1 dies are usually marked with the caliber and a "W" code that stands for "semiWadcutter" (we already used the "S" code for a core Swage die).

Internal or external?

As a technical matter, it doesn't really make any difference if the external punch is the nose, or the base. But since people normally change the nose more frequently than the base, and the external punch is faster to change, we generally supply the nose as the external punch, and the base as the internal punch. Since we've done it this way for decades, our inventory and job planning is set up to continue it. You can have it the other way around, but from that point on you must specify any future additional nose or base punches for that set as being external or internal. Left without specific instructions to the contrary, you'll get external nose punches and internal base punches.

In the Pro-Swage for the reloading press, we reverse this because reloading presses are so poorly aligned that it is important to protect the edges of the punch that has the deep cavity (nose punch). Making it internal gives it the protection of the die walls. The external punch may get damaged if you smash it into the die face, but it is more sturdy and will take more abuse than the nose punch.

Jackets that cover the bleed holes

A note about jackets that cover the bleed holes in the die: if you want to use a 3/4-length or full jacket, you are welcome to try it in the -H dies. Chances are it will work unless the jacket is too thick or hard. Lead will simply blow a hole right through the jacket wall and you'll have three tiny, shiny dots of lead showing through that lock the core into the jacket. If you try it with the -M or -S dies, you are taking a risk of die breakage or at best hard ejection as the jacket bulges into the bleed holes but does not let the lead pop through. In large calibers such as .40 to .45, the die walls are thin enough that you will probably break the die if you keep this up very long, and die breakage from overpressure is not a warranty problem. (If you do break a die, send back the punches and we can make just the die body, thus saving you a fair amount of the total die cost.)

Jackets drawn from thin material, with walls of 0.018-inches or less at the point of the bleed holes, probably can be used in a LSWC type of die. The pressure will usually pop three tiny discs from the jacket wall and push them through the bleed holes along with the lead. But if you try this with a thicker jacket wall, it probably won't work until the pressure has done bad things to the die. Note that jackets can be tapered from as little 0.010 at the mouth to as much as 0.050 at the base. The only thing that matters is the thickness where the bleed holes are located. You can have as thin a jacket mouth as you wish, and it has no effect on the thickness further down, since the taper can be whatever the jacket was designed to have. (Actually, the jacket cannot be any thinner, further down...so there is at least some relationship between the mouth and the rest of the jacket wall).

Pistol jacket length and terminology

Most half-jackets are from 0.25 to 0.35 inches high. Most 3/4-jackets are from 0.437 to 0.560 inches high, and most of the pistol caliber full jackets are about 0.70 inches high. A point of confusion seems to be between half-jacket and half inch jacket. A half-jacket is just the common name given to the shortest length of jacket for a caliber, which normally goes about halfway up the shank of a normal weight for that caliber. A half inch jacket length could well cover the entire shank, and thus would be called a three-quarter jacket (because the shank is normally about 3/4 of the total bullet length). Hey, if firearms terminology was easy, everyone would be using it!

You can use Base-Guards to replace both gas checks and half-jackets. They work better and are cheaper, easy to apply and don't require that your lead core is much smaller than the final bullet since you don't have to put the core inside the jacket. Base-Guards replace 3/4-jackets and full jackets as long as the velocity remains somewhere below 1,400 feet per second and the gun has a fairly good bore, and the bullet fits the bore closely. If you need to use either 3/4-jackets or full jackets, then the LSWC-1 type of die is not the best one for your bullet. Instead use a two-die set consisting of the CSW-1 and CS-1, or a three-die set that adds the PF-1 to these. Swaging the lead core first, in a core swage die (CSW-1) and then seating it in a die with no bleed holes, which is the core seating die (CS-1), means that the core can be precisely adjusted prior to insertion in the jacket. Then the bleed holes are in no way affected by jacket length. I will cover this in more detail in the chapter on jacketed semi-wadcutter bullets.

12. Jacketed Semi-Wadcutters

If you need to make a jacketed bullet, and the jacket must cover most of the bullet's shank, then the LSWC-1 style of die won't work because it has bleed holes to adjust the bullet weight right in the side of the die. The long jacket would block them. Instead, graduate to the next level of equipment, where you swage a lead core in one die, at a diameter that will fit into the jacket for your caliber, and then seat the core into the jacket in another die that makes the bullet full diameter.

These two dies are called the "Core Swage" and the "Core Seat" dies. The Core Swage (CSW-1) must be large enough to accept the lead core wire or cast core by hand, and not so large that it produces a finished core too big to fit all the way to the bottom of the jacket you wish to use. Different jackets may have different wall thicknesses and internal tapers, so changing the jacket might require a different size of core swage die.

On the other hand, core swage dies don't have to be any specific size so long as you can get the core into the jacket easily and the core isn't so thin that the weight of bullet you make requires the core to be so long it sticks out of the core seating die. This means you can save some money by getting one core swage die for a smaller caliber and using the same die for larger calibers that are close enough in weight to permit such use.

A .40 caliber jacket, for instance, normally uses a .340 inch diameter lead core. While we would usually provide a core swage of about .370 to .380 diameter for a .44 or a .45 caliber bullet, you could use the .340 core swage on all but the heavier bullet weights. A .38 Special and .357 Magnum both use .357 inch bullets, and a 9mm, .380 ACP, .38 Super, and several other 9mm calibers use .355 inch bullets. All of these can use a .312 diameter cast or cut wire core, which swages to .315 in the core swage die. This diameter fits most of the .38/9mm jackets available.

The same core swage die would work for .358 rifle and even .375 rifle (assuming the same jacket wall thickness), except that we normally make the head of the internal punch longer for pistol length cores and may have built the swage die itself somewhat shorter than you need for heavy rifle bullets. If the swage die is long enough, we can just provide a different internal punch, so that the punch head is shorter and lets the punch slide back further into the ram. This gives you more usable space to make the heavier rifle cores.

When we build a core swage and core seater as a matched set to produce jacketed semi-wadcutter style bullets, we call this combination a "JSWC-2-" set (with -M, -S, or -H added to indicate which kind of press and die diameter). The JSWC-2 set is 2/3 of the next level: add a point forming die (PF-1) and you will have built a FJFB-3- die set that makes full jacket, open tip bullets. But there is a slight caveat regarding the diameter of the core seating die, which needs to be understood clearly.

An external punch (usually with the nose shaped cavity) made to fit the typical core seating die probably will be slightly smaller than the proper nose punch to fit the same caliber of LSWC-1 die, unless the core seating die was specifically made for producing the finished bullet rather than preparing it for completion in a point forming die. This difference in diameter is usually small, designed to allow the seated core and jacket to fit into the point forming die. But when an external nose punch is used to complete the bullet in the same core seating die, that punch should fit properly in the die. A typical core seat die for a .357 caliber might produce a .3568 bullet diameter, whereas a typical lead semi-wadcutter die for .357 caliber would actually produce a .3570 bullet.

The difference is normally insignificant as far as the effect on accuracy, but it does mean that the punch built to allow your 3-die set to make 3/4-jacketed or lead pistol bullets without using the point forming die will be undersized for use in a lead semi-wadcutter die that you might purchase later.

If the core swage and core seating die were built specifically for making .3570 bullets of the jacketed or lead semi-wadcutter style, then of course the nose punch would probably be identical to one for a .3570 lead semi-wadcutter die. So it isn't strictly correct to say that all core seat dies are slightly undersized for the caliber, since a few of them could be made to produce the finished bullet instead of preparing it for the point forming die. But most CS-1 dies are a couple of ten thousandths of an inch smaller than their matching PF-1 dies, and most point forming dies make the final bullet diameter desired.

You can see that if you purchase a point forming die later, to expand the JSWC-2 set and make it a FJFB-3 set, and the core seater currently makes bullet of, say, .3570 diameter, it is likely you will need to get a point forming die that has a .3571 to .3572 diameter cavity in order to maintain the principle of always swaging "up" in diameter. This is further complicated by the fact that different jacket materials have various amounts of "springback", so that the actual bullet diameter and the die that produces it will probably be different. So, to make things simple for you, as a bullet maker, if you send a few sample seated cores and jackets from your existing core seating die along with your order for the point forming die, we can use them to determine the actual die cavity size rather than guessing what it ought to be.

Building sets from simple dies

We'll discuss point forming dies in another chapter, but just be aware that once you get past the LSWC-1 type of die, all the dies build to make the next set in capability. The various combinations are just putting together the same few basic types of dies in different ways, to make certain kinds of bullets, the way Taco Bell puts the same few basic ingredients together in different ways to offer you all sorts of menu options. The LSWC-1 die doesn't build toward any other sets because it is a combination itself of the core swage and core seat into one single die.

The LSWC-1 is really a core swage die fitted with the nose and base punches you want, and made in the final bullet diameter. A CSW-1 is the same thing made in a diameter that produces a core, rather than a finished diameter bullet, and is fitted with flat ended punches. The CS-1 is likewise a straight cylinder die, made in final bullet diameter or just slightly under (perhaps .0002 to .001 inches smaller), but it has no bleed holes for lead weight adjustment.

Because the CS-1 die doesn't have bleed holes, you can build up considerable pressure inside it, enough to form all sorts of elaborate hollow cavities, deep hollow base skirts, and fancy nose shapes. Ridges, teeth, hexagon shaped hollow points, and much more, can be formed because there is no pressure escape route through bleed holes.

The LSWC-1 does not let you make certain shapes completely, because thin or long sections of lead may take more pressure to form than the pressure needed to spurt lead through the bleed holes. Once you begin extruding lead, the pressure inside the die can't go much higher. All you do by trying is to make lead come out faster, leaving partly finished noses or partly filled-out skirts on deep cavities. For this reason, we sometimes suggest a two-die JSWC-2 set even though you might be making an all-lead bullet which in theory could be formed in the LSWC-1.

Making bullets in sets that use the CSW-1 core swage die

Cut or cast a piece of lead to approximately the right weight, plus a few grains. Put an empty jacket in the scale pan, and set the scale weights for the final bullet weight you want plus about three to five grains extra. Snip off a length of lead about equal to the jacket length or longer if you plan to make a semi-wadcutter. You can do this by trial and error the first time (measure a bullet length of the weight you want, as a starting point). Once you get the weight right, you can save one core as a gauge and use it to set the tools next time.

Lubricate the cores lightly with Corbin Swage Lube. You can roll them on a lube pad, handle them with a little lube on your fingers, or roll them in a tumbler with some lube added. Whatever suits you is fine. The lube is to keep the dies in good shape and reduce the amount of force and wear. It is removed before you put the cores into jackets or shoot the bullets. Swaging lube is not the same as bullet lube: it isn't for reducing fouling in the bore, but only for reducing pressure and friction in the dies.

Put the CSW-1 die and its internal punch in the press ram, and put the external punch in the press head (in the FPH-1 floating punch holder). A retainer hex-bushing holds the punch in the long, threaded punch holder. (The FPH-1 punch holder looks like a reloading die and is sometimes confused with a die by beginning bullet makers.)

Put the lubricated core into the die, and run the ram up so that the external punch slips into the die mouth. Make sure that the core is completely inside the die before any pressure is needed, and that the core is small enough to drop easily into the die. Also make sure the external punch is the correct one: it must fit easily into the die by hand, but be a close enough fit so that if it were not for the bleed holes you could pull a vacuum inside the die with the punch. Swage one core, weigh it, and adjust the punch holder position so that you get the desired core weight. The core weight plus the jacket weight should be exactly what you want for the final bullet weight. You should be bleeding off from three to five grains minimum. A little more does not hurt anything. Do not try to extrude it too fast, though. A gentle firm push that takes a full second or two is about right. Rapid extrusion can build pressure and generate excessive "shock", which is just another term for transient high pressure surges. Enough of that can crack a die that would normally handle the load applied at a slower rate.

For the maximum benchrest precision in core weight, double swage the cores. Swage them all once, and then put them back into the die without changing the setting and swage them all again. If you are using a hand press, try holding the pressure at the top of the stroke for just a second or two. If you are using a Hydro-press, set the dwell time for a second or so, and make sure that the pressure is high enough to extrude immediately, with no apparent delay. For the ultimate in precision, use the FPH-2-H Positive Stop Punch Holder. It eliminates any drift in ram position, and enforces an absolute stopping point by actually stalling the ram, using the pressure-reverse feature of the Hydro-press to automate the procedure.

Make as many cores as you need, then remove the CSW-1 core swage die and install the CS-1 core seating die and punches. For 3/4-jacket handgun bullets, you want to use an external punch that fits into the die closely, with a cavity in the end of the punch shaped like the bullet nose you desire to form. The normal handgun set comes with either a 3/4-E round nose or a Keith SWC nose punch. You can specify other shapes, standard or custom.

Seating the core

Seating the lead core into the jacket is a bit of an art: you need to learn how much pressure expands the jacket to the size of the die, and how much more would be hard on the tooling. Normally, once the jacket expands to the diameter of the die, you are done. Higher force only stresses the die, and does not give you a better bullet.

I like to seat the core gently and see if the core and jacket stay in the die, or if they come back out on the punch. If they stay in the die, odds are good I have expanded the jacket enough to make it press against the die walls, and that is about all you need to do. If you get lead bleeding past the punch with light pressure, it just means that your core seating punch is too small. You cannot develop enough pressure to expand the jacket to correct diameter with an undersized core seating or nose forming punch.

You can make a lighter bullet in a longer jacket by using either a plastic "bullet ball" to take up some of the space in the bottom of the jacket, or filling the bottom part of the jacket with compressed cornstarch. Cornstarch can easily be compressed into the bottom of a small cardboard pill box, using the lid of a telescoping box to hold the powder and the bottom as a piston to compress it.

This firm layer of cornstarch will take up about a quarter of the original height. You can then use the jackets like cookie cutters, pushing them down into the firm layer to insert a specific amount of material into the jacket. One, two or three "cookies" can be pushed into the jacket, as needed to take up room without adding much weight. Then the lead can be seated on top. Your bullet will have the length of a heavier projectile.

You can also make a heavier bullet in the same jacket, just by making a longer nose, less of a hollow base (switch to cup or dish base to make the bullet heavier in the same length), or by letting some of the lead core extend past the jacket at full diameter. This is not necessarily the best design, because lead touching the bore will cause fouling at some velocity, eventually. You can even telescope two jackets end to end over a single core, squeeze them in the core seating die with a wadcutter nose punch, and make a fully jacketed bullet that is longer than any available single jacket

With any Semi-Wadcutter design of bullet (which also covers wadcutters), it is very important that there be at least a tiny amount of lead extending past the end of the jacket. The reason is that there is no way for the jacket edge to jump over the punch edge. If you expect the punch to last, it has to be made with a minimum of .020 inches of thickness at the edge. Otherwise, the force of moving the punch after applying tons of swaging pressure to the bullet would simply expand the thin edge against the inside of the die, and rip it off. You would have about .020 inches of edge thickness, but it would be rough and broken. Better to machine it neatly where it would normally break anyway.

This edge means you cannot make the jacket curve away from full bore diameter in the LSWC-1 or CS-1 die (both of which use the punch cavity to form the entire bullet nose). Hence, both kinds of straight wall dies, using a punch cavity to form the nose, are restricted by physics to making lead nosed bullets with a shoulder. Below the shoulder, it doesn't matter if you have a jacket or not because either lead or a jacket will expand nicely against the die walls.

If you try to make a bullet that has too light a core for the jacket length, the nose punch will compress the lead until the punch edge contacts the jacket edge, then proceed to crush the jacket. Making the lead core heavier solves this problem. If you want to make the same weight of bullet, you can use a hollow base, cup base, hollow point or a light filler in the jacket. Any of these methods will displace some lead, cut down the weight (or keep it the same, depending on how you look at it) and move the core forward so it has room to fill the entire cavity in the nose forming punch.

If your bullets have an angle or uneven spot on the nose, it probably means that the core isn't long enough to fill the entire nose cavity in the punch, or the lead is too hard to flow at the pressure you can safely apply with that die, or there is trapped lubricant between the punch cavity and the end of the bullet. Normally you won't have this problem with the JSWC-2 die set, because swaging the core in the first die makes the end square and smooth, so it flows evenly into the nose punch in the next operation.

But, if you should have these symptoms, use pure lead just to see if your supposedly soft lead is really not so soft after all. Hard lead is much more difficult to flow than pure lead. Alloys that seem soft to you might actually be fairly hard compared to pure lead. A rule of thumb is that each 2 point increase in Brinell hardness number (Bhn) will just about double the pressure required to fill out the bullet completely. Soft lead is Bhn 5 and Linotype is about Bhn 22. Most wheelweight metal ranges about Bhn 10-15. Going from Bhn 5 to Bhn 7 may double the pressure needed to make the edges form completely. This is fine if your dies will handle the pressure. The type -M dies can only handle pressure designed for Bhn 5 to Bhn 6 hardness of lead, especially in the .40 to .45 caliber sizes. Type -S dies may handle up to Bhn 10-12 alloys, and type -H generally handles any lead you can put into them (but that does not mean the dies will never break, no matter what you do: they can be broken from applying too much pressure or applying it too fast, just like any other die).

Changing nose and base shapes

You can use more than one nose punch on the same bullet, to achieve special effects such as various diameters and depths of hollow points. Thousands of shapes that are not exactly the same as either of the punches can be created by remembering one thing: after you have once applied the force needed to expand the jacket fully, you don't have to apply that level again. This means you can push the next punch into the die as lightly or as short of full contact as you wish, and only partially make the bullet nose reform to the new shape.

The most versatile way to make a hollow point, for instance, is to use two punches. First, form a giant hollow cavity by seating the core only with the HP punch, which has a conical projection on its tip. You have just made something like the famous old Webley "Man-Stopper", excellent short range defense bullet for revolvers, which might not feed in some autoloaders.

Now, pick out a second punch, be it round nose, or Keith, or any other shape of cavity (wadcutters are not as effective). Push this punch only partly into the die, lower the ram, and examine the bullet. Adjust the punch holder so that the punch consistently forms the desired shape at the very end of the ram travel, so you don't have to guess how far to raise the ram (just go all the way up, with the punch holder set high enough to prevent full pressure and complete reforming).

Play with the punch holder position, using the end of the stroke each time, and see how many interesting different bullets you can make with only two punches! Change back to the hollow point punch and see how reversing the order of use makes a completely different shape bullet, even if both punches are used to the same relative depth of insertion. In fact, if you have a cup base or hollow base punch (internal), try using a flat or wadcutter punch to push the base into the die, forming the nose against the internal punch, then reversing the bullet direction for a second pass with the punch holder set higher.

This is a source of fun in bullet making: you get instant results, some good and some bad, but all of them interesting. You don't have to spend any more money on tools to make these bullets, but just use your imagination and the adjustment of the punch holder and order of different punches in the operation.

One of my favorites is the large HP punch, followed by a Saber punch (as in the Saber-tooth Tiger). This punch has a number of saw-teeth cut into the steel of a concave curved surface. You get a sort of buzz-saw bullet that zips through targets. It is a crowd-pleaser, assuming the crowd is not made up of attacking wolves or feral pigs. Put a few of those on your table at a gun show and see how fast they are picked up by handloaders!

Six teeth is the optimum number for this kind of punch, because eight makes the teeth too thin and they won't stand up very long to the high end pressure. You can nick the edge of the jacket (on purpose) with these teeth, to help it start expanding, but don't try to actually cut down into the jacket material very far. This will soon overstress the sharp edges and break them. As long as most of the Saber-teeth are formed from the lead extending beyond the jacket, this concept works very well.

We've also had good luck making the curve almost a half ball, cutting six teeth into it, and pushing it down against a jacket that has lead seated even with or below the mouth! The jacket buckles inward slightly, and the thin sharp teeth slide under the jacket, crimping it like a blank cartridge case mouth. This lets it fold further inward, so that the jacket take on the half-ball shape of the punch end.

This is the only instance I have seen where it actually is possible to make a full-jacket bullet in a straight-walled die. The crimped-in grooves strengthen the jacket to impact along the edge, so that feeding difficulties disappear, yet cause stress lines that help the bullet peel back from a direct nose impact. All together, the design is a great defense bullet (especially when the core is not solid lead, but swaged number nine lead shot).

Minimum and maximum weight limits

Core seating and core swage dies have a maximum and minimum weight limit, related to the length of the core and jacket. The heaviest possible weight is reached when the core and jacket are so long they do not let you put the external punch at least a full caliber length into the die. You need at least one caliber length along the external punch to be supported and guided by the die cavity before any pressure is encountered. Otherwise, the punch may be driven off to one side so that it is damaged by striking the die mouth, or pressure in a nose forming cavity or rebated boattail cavity may build up to the bursting point of the thin punch walls, since they are supposed to be supported by the solid steel die walls when pressure is applied.

The lightest core and jacket that you can make, and hence the lightest bullet, is determined by the minimum volume left in the die, between the internal and external punch faces, when the ram is all the way forward toward the die. The length of the head on the internal punch determines the minimum and maximum weight for a given die. By using two or sometimes three different punches, with the same overall length but with a different punch head length, you can swage the widest possible range of weights. Here is how that occurs:

In a reloading press die, the threaded die holder body is machined to accept a die in one end, and a quarter inch diameter knockout rod in the other end. The internal punch has a head, half inch diameter, which keeps the punch from falling out of the die.

In any of Corbin's swaging presses, the threaded die holder is replaced by the ram itself. All the dies screw directly into the ram, so they do not need an adapter. The ram is machined so there is room for a 3/8 inch diameter head on the internal punch to slide back and forth for the length of the die. The part of the punch which fits into the die must be the same length as the die or you could not eject the bullet fully. The overall length of type -M or type -S internal punches must be the same, or the stop pin would not push the punch forward to the right point for ejection.

But the head of the punch can be different lengths. It is a larger portion of the punch that keeps the punch from dropping out of the die. The back edge of the punch head contacts a shoulder in the ram, regardless of the kind of press. This shoulder and the head length together determine exactly how far back the internal punch will slide before it is stopped. The shoulder inside the ram takes all the force applied when you swage the bullet, so there is a minimum necessary thickness or length to the head. However, by varying the head length, the amount of protrusion into the die is also varied.

To swage a heavy core, you would want an internal punch with a short head length, so the punch would slide back as far as possible inside the die, offering as much volume to fill as possible. But if you used this punch to swage a light core, the external punch might travel past the bleed hole location, blocking the bleed holes. Then you might crack the die by trying to extrude lead through those holes, because no matter how hard you push, no lead can come out.

If you want to make a light core, very gently try to swage it and watch to see if the external punch goes into the die so far that its face would cover the bleed holes. You can easily determine this by holding the punch beside the die, in the same position as it would be when swaging. Align the face of the punch just below the bleed holes, so they would be open if the punch were inside. Use a marker pen or grease pencil to put a line on the shank of the punch, where it would just line up with the die mouth.

Now, when you try to swage the first light core, notice whether or not the mark you made disappears into the die mouth. If it does, you cannot swage that short of a core with the internal punch currently installed. You need an internal punch with a longer head, so the punch is held further into the die, closer to the die mouth. Then, the light core would be contacted before the external punch could cover the bleed holes.

You will also find this true of other dies besides the core swage. A shorter head is used with heavy weights, and a longer head is used with lighter weights. Normally the range is great enough so that the division is roughly between "pistol" lengths and "rifle" lengths. Weight alone does not tell the story: you need to know the caliber and the weight to determine whether it is a light or heavy core.

Generally, two punches will allow you to make any practical weight. Sometimes it takes three to cover special purpose light cores such as triple or double core or partition-style bullets using split cores. When you order, let us know the heaviest and lightest bullet or core you want to make, and we can determine how many core swage or core seat internal punches it will require.

With the -H dies, you can use the bottom electronic position sensor (one of three adjustable sensors mounted along the press head on a standard) to set the point of ejection. A single steel ejection bar slides through a slot in the ram and rides up and down with the ram. On the lower part of the down stroke, this bar comes to rest on the mounting plate for the press head, and stops moving down. The ram continues down. The die and internal punch go with the ram, but the internal punch head comes up against the top of this ejection bar and thus must stop moving. The die and ram continue down, which pushes the bullet out of the die mouth.

Longer bullets and cores use a shorter head on the internal punch. Shorter bullets and cores use a longer head. The adjustable ejection position, as well as adjustable stroke length of the Corbin Hydro-Press and Hydro Junior, allow you to use one height of ejection bar. The manual-powered Corbin Mega-Mite only ejects at a fixed position at the bottom of its stroke. Thus, different heights of ejection bars are provided with the press. The height of the ejection bar plus the punch length (from tip to head, full measurement of the punch) must be the same for whatever combination you use.

That is, a short punch uses the tallest ejection bar. A medium length punch uses the middle height bar. The longest punches use the shortest height of ejection bar. If you set them alongside each other, they would all measure the same total, combined length when properly paired. If you should use the wrong height ejection bar with a punch, in the CSP-2 Mega-Mite (manual) press, you would not get good ejection of the bullets, or the punch would project beyond the end of the die on the down stroke instead of just coming even with the face of the die.

13. Full-Jacket, Flat Base Bullets

In the previous chapter, we described a 2-die set called the JSWC-2 using a CSW-1 Core Swage and a CS-1 Core Seater. This set could make jacketed or lead bullets, but the bullets could not have the jacket curved inward away from the shank because a step was required between the nose and the shank. The edge of the jacket would strike the edge of the nose punch, and be crushed, if you tried to make too light a bullet or force the jacket into the nose punch. By adding one more die, we can eliminate the shoulder.

If you take the JSWC-2 set, and add a PF-1 "Point Former", you have just built what we call the "FJFB-3" set. We call this a "Full Jacket Flat Base" set because that is the main or basic bullet design that it makes. Using various techniques, this set builds both rifle and pistol bullets. It can make open base military-type full jacket, or closed base open tip full jacket bullets. In the closed base full jacket style, it can produce both open tip and soft point bullets, with some limitations on the sharpness of the soft point (which are overcome by adding a fourth die).

Everything that applied to the JSWC-2 set still applies here, except that we can build the ogive or nose on the jacket, if we wish. The PF-1 point forming die has a cavity shaped just like the bullet we want to make, instead of forming the nose in a punch cavity. This eliminates the edge of the punch, and thus eliminates the need for a shoulder on the bullet.

In bullet swaging, we refer to "open tip" and "hollow point" as two completely separate features. The open tip (OT) is made by pushing a lead core into a jacket, so that the core is shorter than the jacket by enough to allow the point to form and leave the core short of the bullet tip. The core just stops and the jacket continues, leaving an open space inside the tip. You can fill this with a plastic "Bullet Ball" or leave it open. This is the open tip. It is made with an open tip core seating punch, supplied as a standard item with rifle caliber 3-die sets. This punch fits the inside diameter of a particular jacket, at a certain distance from the mouth, and seals the pressure at that point to let you seat the core.

The hollow point (HP) is made by pushing a conical-shaped projection machined on the core seating punch down into the lead core. You can do this regardless of the length of core compared to the jacket. If the HP punch fits down inside the jacket, then you can make an open tip bullet that is also a hollow point. We call that OT-HP in our terminology, which means Open Tip Hollow Point.

If the HP punch is made large enough to fit the die bore, instead of going into the jacket, then it requires a lead core longer than the jacket after seating. The lead projects beyond the jacket, so it will form a soft point with a hollow point cavity. The hollow point punch supplied by default is the soft point variety, and is most often used with pistol calibers. If we don't know whether you intend the set to be rifle or pistol, we normally provide an open tip core seating punch. If we are sure it is for a pistol and you don't specify anything to the contrary, we would probably provide a HP punch that is a soft point type, which fits the die bore.

It is not uncommon for people to use the term "hollow point" in referring to what we call "open tip" bullets. That is fine unless you are ordering equipment. Be sure you understand the difference and order what you really want to make. You can make an open tip hollow point, an open tip, a lead tip, or a lead tip hollow point. It would not be possible to make an open tip lead tip: those two terms contradict each other. Either the lead is longer than the jacket (soft point or lead tip) or it is shorter (open tip). It cannot be both.

Technically speaking, you can seat the lead so it comes to exactly the same length as the jacket after the ogive is formed. But this is just a little bit too fine an argument to create a new name, because in order to accomplish this, the core will be seated below the jacket in the open tip style prior to forming the ogive. The lead always moves forward to some extent, and this is just a matter of setting the open tip style so that the lead moves right the jacket edge when you process it through the PF-1 die. Call that a "flush tip" if you like. Nosler calls that design a "Protected Point" since the lead is more or less protected by the jacket.

Jacket and core seating punch fit

Now that we are putting the lead and the external punch down into the jacket during core seating, a new consideration arises: fitting the punch to the internal diameter of the jacket at the point where the lead will be seated. Most jackets are tapered inside, getting thicker toward the base. Copper tubing jackets are usually not tapered. You can probably use the same core seating punch with almost any weight of core, when you build your own copper tubing jackets. But drawn jackets require that the punch diameter fit closely to the jacket I.D. at the point where the lead will eventually come to rest.

With a tapered jacket, you will need different diameter core seating punches if you plan to make both light and heavy bullets in the same jacket. Some latitude is possible. The limits are reached when a punch lets too much lead spurt out around it (reducing pressure below that required to expand the jacket), or sticks tightly in the jacket, possibly plowing up jacket material. Usually there is enough range so that two or three core seating punches will make every practical range of weights with any jacket.

If you change jackets, going from a thin one to a thicker one, you will also need to change core seating punches (to a smaller diameter, in this case). If we build a set of dies and test it with 150 grain open tip bullets, and you decide to make 125 grain open tip bullets, the odds are good you will want a smaller diameter core seating punch for that. Likewise, if we build the set for 100 grain bullets and you try making 140 grain bullets, you may find the punch is too small at that point in the jacket.

Again, the Bullet Balls can come to the rescue by moving the lead forward, so that a large diameter punch still fits at the same point in the jacket even with a shorter lead core. Corn starch does the same job. Any light material that is stable under swaging pressure can be used to take up volume without adding much weight. Bullet Balls are good because they are very accurate in weight and size, so you can depend on them to give you consistent bullets.

However, in practice you have enough weight range so that a small amount of the bullet weight can be shifted (plus or minus 10 percent) around the core seating punch's perfect point of contact. If the punch is just a little small, or just a little large, it either lets an insignificant leakage of lead around it or it makes a very tiny amount of jacket displacement, and will probably release from the jacket if there is some lubricant on the punch and you expand the jacket so it firmly contacts the die walls.

A very tapered wall with sharp angle will allow less adjustment of weight without changing punch sizes. A shallow taper will allow a great deal more. You can only tell by trying it. If the lead leaks around the punch and the jacket won't expand to the same size as a lead slug does, in the same die, then probably you need either a shorter core, a thicker jacket, or a larger diameter core seating punch.

If the punch sticks into the jacket, or the jacket comes out shorter and not expanded enough in diameter, it probably means that the punch is too large. This can stop the punch too early, so that there isn't enough pressure developed in the core to expand the jacket properly. You then get tapered, undersized bullets in the point forming operation, which is the same thing that happens if the punch is too small.

A punch that is too small, or too large, will prevent you from developing enough pressure to expand the lead core during core seating, and this in turn makes the jacket and core undersized for the point forming die.

When you form the ogive on the bullet in the next die (point former), the base expands to contact the die wall, but the undersized shank probably will not expand evenly.

Instead, it may expand near the contact point on the ogive, and be curved inward like a Coke bottle in the shank area. The amount of curve is very small, usually just the difference between the original seated core and jacket diameter and the final bullet diameter at its largest point. But it can cause the bullet to be a loose fit in the case neck after you load it. This may not be a problem in a single shot, but in a repeating rifle or magazine fed handgun it may cause trouble in feeding. In a revolver it may cause the bullet to slip forward during recoil and lock up the cylinder.

The answer is to experiment with the particular jacket and core length combination you are using, and if you are having any of these problems with expansion, make sure that you are using a punch that fits correctly. To correct the problem, use a different core length, a different jacket, put some filler behind the core (such as a bullet ball or corn starch), or get a new punch that fits your combination correctly. There is no wrong or right punch by itself: each punch is only right or wrong for the particular length of core and jacket wall thickness.

Corbin offers the VB (Versatile Benchrest™) jacket design, which has a thin, parallel-wall (constant ID) mouth section, joined to a thicker, slightly tapered shank and heavy base. This design lets you use the same diameter core seating punch over a wider range of weights (from the mouth to the junction between the thin and thicker sections of the wall). If you trim the jacket shorter or seat the core below the parallel-wall mouth section, then you will need a smaller diameter punch to fit and seal the small inside diameter in the bottom portion of the jacket.

Making a lead bullet without a shoulder

Point forming dies can also be used with just a core swage to make lead bullets which do not have the semi-wadcutter shoulder. Paper-patched bullets or lead pistol bullets can be made either in the LSWC-1 type of die (in all but reloading presses) or in a combination of CSW-1 and PF-1 dies.

In theory you could put holes in the side of a point forming die and make the core and the ogive all in one operation, but in actual practice the lead tends to flow up the ejection pin hole about as fast as it extrudes through the weight-adjustment holes. We can build a custom point forming die with bleed holes and an adjustable ejection pin designed to seal off the end of the die. This custom die trades an increased cost of tooling for a faster production rate by eliminating one step and finishing the lead bullet in one stroke.

The ejection pin in a point forming die pushes the bullet out by its tip. This means that a bullet with a blunt or flat tip probably will look good, with perhaps a small circle where the ejection pin pushes on the lead tip. But a sharp spitzer tip bullet isn't practical with the PF-1 die as a final step, because the ejection pin crushes the tiny point. In the next chapter we discuss the LT-1 lead tip die and how it is used to solve this problem.

Custom point forming dies with adjustable length ejection punches can be ordered instead of the lead tip forming die. The ejection punch has an adjustable length and a larger than usual diameter, with the curve of the die wall machined into a cavity in the tip of the punch. The punch is adjustable in length so that tiny variations in different press rams can be "tuned out", allowing the die wall curve to smoothly match the curve in the punch tip. The advantage of using this custom point forming die is higher production speed, since you do not need to follow it with the lead tip forming die in order to get a perfect lead tip. The disadvantages are somewhat higher cost, and less versatility (the end of the bullet must take its form from the shape of the ejection punch, and cannot be varied unless this special punch is replaced by a different one).

A standard point forming die costs less to make, and allows somewhat more flexibility in how the tip will be formed (smaller or larger, as you adjust the punch holder to push the bullet material further or less far into the die). However, it does require the LT-1 lead tip die, as a final operation, if you wish to make perfectly formed lead tip bullets. This adds one more operation, which may be significant enough in regard to production time to justify the cost of a custom point forming die. There is no right or wrong way: it depends on the individual circumstance and design of the bullet, as well as the variations in design that you wish to make.

Full metal jacket bullets

Full metal jacket (military style) bullets can also be made by turning the jacket backward, so the base faces the cavity of the PF-1 die, and actually seating the lead core into the jacket in the PF-1 instead of in the CS-1 core seater. The pressure changes the flat jacket end into a pointed shape, conforming to the die outline. But the base is still wide open (the lead core should come just about 1/8 inch below the jacket mouth).

To make a proper base, eject the bullet, turn it over and push it back into the point forming die. But use a special "base-turning" punch that has a shallow concave face. This punch doesn't do anything a flat punch wouldn't do at this point, but it will in the next step and it saves you from changing punches yet again. You want to just barely push the open end of the jacket into the ogive portion of the PF-1 die, so it acquires just the start of a curve. Then, eject the bullet and turn it over one more time. Press more firmly this time, using the “base-turning” punch. Because the jacket edge has already been curved inward, it will contact the face of this concave punch closer to the center than the very edge, and will be curled inward and nearly flattened.

Press firmly enough so that the jacket takes on a radius that matches the curve of the punch face. Process all the bullets this way and then change to the normal flat-faced external point former punch. Put the bullet into the PF-1 die one last time, and press firmly with the flat punch (against the almost-flat base). This finishes off the base, rolling the edge firmly over against the lead core.

If you made the core length just right for the jacket length, the base will be flat and even with a silver circle of lead brought cleanly to the surface, aligned perfectly with the jacket surface at the base. No extra lead will spurt out and be flattened unevenly across the base. No folding or wrinkling of the jacket near the base will occur from lack of sufficient filling of core. Chances are it will take you a couple of trys to get this ideal combination, and the weight may not be precisely what you intended (a grain or so either way usually makes the base come out perfectly).

To use a standard length jacket, and still make whatever weight of FMJ bullet you desire, you can use Corbin’s plastic Bullet Balls in the tip, or you can fill part of the jacket with compressed corn starch to adjust the weight and maintain proper core length. If you just made the open base in one step and shot it, the gas pressure at the muzzle would flare the jacket open, and you would be shooting a bullet that had an asterisk shaped base, easily determined by looking at the ragged holes in a paper target. You might be able to skip the final, flat-faced punch operation if you like the appearance of the “base-turned” bullet, but you should never skip the “base-turning” step.

Bullet tip closure and ejection pin size

Point forming dies have an ejection pin that is designed for the minimum tip closure possible, consistent with long punch life and proper ejection. If the ejection pin is made smaller than the optimum design diameter, it becomes very weak in relation to the required ejection force for the caliber, ogive shape and material. You will experience bent ejection pins too often in that case.

There is no problem with making the ejection pin too large except that you cannot close the bullet tip any smaller than the ejection pin diameter. If you want to make flat or blunt round nose lead tip bullets, a big pin is actually desirable since it has less tendency to penetrate and mark up the soft lead nose. Using a die designed for the sharpest possible spitzer tip and minimum jacket closure on open tip bullets to make lead tip bullets can be a problem, since the ejection pressure might exceed the strength of the jacket or lead tip. In that case, the pin will penetrate into the bullet instead of pushing it out of the die.

If you feel the need to close the tip smaller than the standard ejection pin diameter for the die, we can either build a custom point forming die, or you can use the lead tip forming die to gently nudge the tip of the open jacket closer together. Remember, though, that the minimum tip possible is twice the jacket wall thickness! Sometimes it is better to go to a lead tip if you really want a sharp point without any special expense or trouble. If you want a harder tip, drop a chilled lead shot into the open jacket and swage that into a lead tip. A bullet ball can be put into the tip of the jacket, if you allow enough open space between the core and the end of the jacket to hold the ball once the ogive has been formed (rather like a ball-point pen design).

Each caliber or range of calibers is matched to a standard size ejection pin, which is based on the industry standard sizes of oil-tempered spring wire. There is nothing about a .080 diameter ejection pin that would make any practical difference from the standard .081 size, for instance. It would be wasteful of your money to specify small differences, since that would put your order into the custom category, require special non-stock dies and additional labor, and if you needed replacement parts, the margin for error is tremendous unless you specify exactly what you have (whereas we would know from experience and the standard charts what size to send you if you had a standard caliber and left it to us to determine the pin size for it.

Ejection pin sizes usually vary in 0.010 inch increments, as that is about as small a difference as makes any significant difference in strength, and it is also the standard differential size in readily-available spring wire stock. We match the caliber to the nearest wire size that would make a reliable ejection from the die, assuming that most people will want to close the tip as small as it is practical to do without having to put up with too many bent pins or penetrating the core if you forget to use enough swage lube. Naturally, the smaller the pin size, the less area is supporting the ejection force under its tip, and therefore the greater the chance for a "dry" bullet to stick in the die and cause the small pin to push into the bullet core, penetrating it and possibly even going through the jacket base.

Removing a stuck bullet

If a bullet should stick in the point form die, don't panic! The first thing to do is to stop, take the die out of the press, and gently turn and pull the ejection punch out of the die. If it is stuck too hard to pull out, it may have to be driven out by pushing on the wire tip, but usually you can twist and pull carefully, and free it from the stuck bullet. The next thing to do if you want to ruin the die and buy another one, is to get out a drill or tap extractor or a torch, and drill, tap, or melt the bullet out. This is the best way to insure a good retirement income for the die-makers, because it normally ruins the die surface or temper of the carefully heat treated die. It seems to be the first thing inexperienced bullet-makers do, other than panic and break the ejection punch by continued attempts to eject the bullet.

The right way to get the bullet out is to push it in further! Leave the ejection punch on the bench, and put the die back into the ram without any internal punch. Use the normal external (top) punch to push the bullet down just a tiny bit further, which closes the hole in the bullet, pushes the jacket edges at the tip closer together, and gives the ejection pin (if it were present) something to push against. Then unscrew the die from the press, and use a short piece (about an inch long) of the same diameter wire as the ejection punch to drive the bullet out of the die.

If you have a micrometer and can compare the ejection pin size to a small nail or other suitable round wire, you can probably locate an inch-long bit of the right diameter material. If not, contact us and ask for a bit of the same diameter spring wire as your ejection pin (if it is a standard die, we know by the caliber what size to send, but if it is custom, with a special ejection diameter size, you need to let us know what you have. Do not pound an oversize wire, nail, or hex key wrench into the hole! You probably will just make the problem worse in that case.

Once you have obtained the right diameter of wire to use, set the mouth of the die over a hole that will let the bullet drop free of the die, and put the wire into the ejection pin hole (at the threaded end of the die). Then use a small hammer to tap the wire into the hole and either drive the stuck bullet out, or drive the wire into the bullet but leave at least a quarter of the wire length sticking out of the die. If the bullet comes out, the job is done. If the short wire simply penetrates the bullet, you have more work to do.

Grasp the end of the wire that you did not drive entirely into the die with a pair of Vise-Grip pliers, or clamp the end of the wire in a bench vise. Turn and pull the die to remove it from the wire. In some cases a flat screwdriver blade inserted between the top of the die and the device gripping the end of the wire may serve to pry the wire free. Once the wire is removed, put the die back into the press (without the internal punch) and push the bullet back firmly into shape, closing the hole in the tip. Try not to extrude material too far up the ejection pin hole, so that there is no room to put the wire back into it. If this happens, you may have to carefully drill out a short length of the ejection pin hole using the same size drill as the ejection pin diameter or slightly smaller.

Remove the die from the press, put it over a hole in the bench or the slightly opened jaws of your vise, and insert the short wire again, and drive it in part way. If the bullet does not come out, you may have to repeat this sequence over and over again, until the jacket gets fatigued and loses its grip on the die. If you have two or more short wire pins, you may be able to drive the first pin all the way through the bullet with a second one, then remove the second one, and thus bit by bit reduce the volume of the bullet as you push it back into the die and then drive the pins through it again and again. Eventually, this tedious-sounding process works and the bullet almost falls out of the die. Sometimes is actually falls out, after sufficient cycles of pushing it in and poking a hole through the middle.

Of course, you are always welcome to just send us the die and punches, and we will remove the bullet for you at no charge other than the return shipping and insurance cost. Sometimes, I must admit, we do drill a hole in the bullet and screw a self-tapping screw into the hole, and then use a pry to pull the screw and bullet out. You may be able to do that without harming the die, but if the drill or screw is forced against the highly polished die wall, and causes a mar in the finish, it is not a warranty problem (unless we do it ourselves, in which case the die-maker will quietly spend all night making you a new die at his expense and you'll never know he screwed up). I would at least try the push and short pin method first. It has very little risk, and almost always works in two to five cycles.

If you should happen to push an empty jacket into the point forming die, or if the bottom should break out of a jacket, then there may be no core left to push against. You may be able to insert another seated core and jacket, with plenty of lube on it, and use this to collapse the empty jacket into a ball, which in turn provides material under the ejection pin tip for ejection.

Matching the bullet and die length

A point forming die contains a semi-blind cavity, which is full diameter at one end, has a parallel section that must be longer than the longest bullet you want to make, and then has a curved ogive section that comes down almost to a point, joining a small ejection pin hole that passes through the turned-down and threaded shank of the die. The longest possible bullet that can be formed in this die is primarily limited by the length of the parallel section of the hole.

If you try to push a straight cylinder (the seated core and jacket) that is, say, 1.30 inches long, into a die that has a 1.20 inch straight section, there will be 0.10 inches of unsupported bullet sticking out of the die mouth at the moment the open end of the jacket encounters the start of the ogive curve. The main resistance in the point forming operation comes from forcing the full diameter cylinder into this ever-smaller tapered hole. Unsupported, the jacket base may start to mushroom outward in size from the pressure.

If this happens, either the base will be damaged as you try to force it back into the die cavity, or you simply won't be able to push it any further without severely expanding the base (we call it "nail-heading" the bullet). If you don't mention the weight or length of bullet, you will get a die that makes the normal range for the caliber. This die may not make the extreme heavy (or light) end of the scale. If you specify a very heavy bullet, and we know you plan to do that, we can make a longer die (up to the stroke limitations imposed by the press) and we can bring the cavity as far toward the threaded end of the die as strength and safety margin permits.

Sometimes, with very long bullets, we can push the envelope (or design limit) of the press just a bit, by using a quick-change punch holder. This lets you slide a punch in and out of the holder quickly, so that you can put the long component into the die with the punch removed, then slide the punch into position behind it. Normally, the press stroke has to be about 1.54 times the length of the component in order to allow for loading, alignment of the punch into the die, and forming within the die. In other words, if the press has a 2-inch stroke, then a 1.3-inch bullet could be put into it and formed, provided the die and punch were made for this length. Another way to figure it is that the stroke times about 0.65 is the maximum bullet length for that press.

But if you can put the component into the die without having to add most of its unsupported length to the formula, then you could reasonably make a bullet just a little shorter than the press stroke (some stroke is needed for compression of the material and some for alignment of the punch prior to any pressure being generated). Alignment and compression reasonably use about 0.25 of the stroke, so we are left with about 75 percent of the stroke for bullet length. That means a two-inch long press stroke might, under ideal circumstances, form a bullet of 1.50 inch length, with the quick-change punch holder.

Some of these numbers are “soft”, in the sense that they can be subjective to the extent of how much alignment is deemed necessary for the punch prior to any force being delivered, and how much a given caliber or material might compress in expanding to proper diameter. Therefore, we cannot state with authority that they are exact and will always apply to each instance. But we can use them as a general approach, until the specific tooling and bullet lets us refine them more exactly.

The Corbin CSP-2 “Mega-Mite” press uses a 3-inch swaging stroke, which means that with a normal punch holder you can get up to a 1.95-inch long bullet and with a quick-change punch holder, a 2.25-inch bullet. Again, these are subject to some variation depending on the caliber, material compression, and the distance used in alignment. A hollow point or base might limit the bullet length whereas a rebated boattail might allow it to be slightly longer (provided most of the punch is supported inside the die before any pressure is generated).

Rebated boattail bullets, and bullets that form the nose in a punch cavity (such as a lead paper-patch bullet), require the thin punch edge and walls to be well supported inside the die cavity prior to generating any pressure. If you make longer and longer bullets in these dies, eventually you will reach a length where the punch is not adequately supported by the die cavity, and it will expand and crack from the pressure (even if some of the punch is inside the die when the pressure is generated).

Another cause of broken punches is using the wrong diameter of punch, just small enough to let the punch expand along with the bullet so that the punch cracks. The extremely close fit of a nose punch into a lead semi-wadcutter die means that the same punch probably will be just a bit too large for the same caliber of core seating die. And a nose punch designed to make semi-wadcutter bullets with a core seating die may fail if used in a LSWC-1 die, because of the very small difference in diameter (core seaters usually are 0.002 or more smaller than the final caliber, as they anticipate using a point forming die to finish the bullet).

Relationship of die bore to caliber

Point forming dies are not designed by making the die a certain caliber, but by making sure that the materials inserted will expand and then spring back slightly to a specified final dimension. The same die that makes perfect .3080 bullets when used with the specified materials (such as .035

wall annealed copper tubing) may produce a .309 or .307 bullet when you use a tapered-wall commercial gilding metal jacket, or hard copper, or brass.

Changing materials, core seating dies, and sometimes even the weight beyond a certain range can affect the bullet diameter. A point forming die is part of a closely-integrated package or system, designed to work together. It isn't something you can make in isolation and expect to work correctly with any kind of material. This is another reason why so few die-makers offer bullet swaging equipment of high precision.

The client and die-maker need to work closely together on the design, and make sure that everyone understands the weights, materials, and processes that will be used. Then, it is possible to deliver tooling that forms truly outstanding bullets. Otherwise, you may be headed for a frustrating experience because the bullets will stick, come out tapered or in the wrong diameter. Yet the dies may be excellent, when used with the right material, weight range, and style of bullet.

If your bullets come out smaller than you wish, make sure that the materials you are using are the same as those for which the die was built. Using copper tubing when the dies were built for tubing jackets is a start, but you still need to match the temper, wall thickness, and diameter. Often a set of dies that works nicely with a standard hard-drawn 1/2-inch diameter tubing that varies only .003 inches in diameter and has walls of .035 with a tolerance of .002 inches, may fail to produce the right diameter, have stuck bullets, or other problems when the tolerances or temper vary more than this.

The key to getting the proper diameter and operation of the dies is making sure that you send us samples of the same materials you plan to use, or else use materials that we furnish (or exact equivalent). We find that most problems are traced to misunderstanding, rather than material or design defects. The person having a problem believes that his material is the same, when in fact it may be quite different by the close standards of swaging. A shooter new to the sport might protest that he won the match because he hit the target every time, not realizing that "hitting the target" really means putting them all in the X-ring when you get to the championship level. Likewise, a person who is positive that his lead is "soft" when in fact it is Bhn 10 hardness rather than Bhn 5, is both right and wrong. He is right that it is soft by casting standards. But by swaging standards it is hard.

I recall a Woody Allen film in which a psychiatrist asked the girl friend how often she and her partner had sex, and she complained, "All the time! Three times a week!". Then later, he asked her partner the same question, and he complained "Hardly ever: Three times a week...". So it is with many perceptions. People tend to look at issues in light of what they prefer or what is convenient. If a material is easy to get and plentiful, and the basic dimensions are close, then it must be the right thing and any problem has to be something else. In fact, if the dimensions or other parameters are close but not close enough to work with the tools as they are delivered, there is still a good chance that by making some modifications in the tools, that plentiful source of material may still be used. But it is faster and cheaper to do it the first time, using samples of that material. Samples, by the way, need to be in enough quantity to actually make a number of bullets. One inch of the material isn't going to help very much. Usually it takes at least a few feet, a meter or so, to build enough jackets and bullets for a good trial.

Sometimes sample material comes in such bad condition that it is useless for building any dies and punches. If the material is tubing or strip, and it is put into an envelope without much padding, it will probably be so bent, smashed, scratched and otherwise mutilated by the shipping and handling that we will be lucky to determine its original dimensions at all. Package samples with plenty of padding, in a tough enough package so that the ends won't be broken out or the sides torn through if a former quarterback decides to hurl the box into a truck and then pile several hundred pounds of smashed computer monitors marked "Fragile" on top of it.

14. Lead Tip Bullets

The LT-1 lead tip forming die is available in type -R, -S, or -H sizes. It is similar to a CS-1 core seating die, in that the die has a straight hole all the way through, and punches that are full bore size of the die. However, the diameter is just slightly larger than the finished bullet, whereas the core seater is slightly smaller. The internal punch has a cavity machined in the end, shaped similar to the ogive curve of the bullet you wish to form, but with a slightly wider angle.

To make a large round or flat tipped lead nose bullet, you may not need this die. You can just seat the lead core so that it projects beyond the jacket you are using. Then, form the nose in the point forming die, and you'll be done. If the point forming die is designed especially for lead tip bullets, we will have made it with a larger than usual ejection punch. This spreads out the force of ejection over a wider area, and reduces the visibility of the mark which the punch makes in the bullet nose. Normally it is acceptable even if you can see a little circle where the ejection pin pushed against the lead nose.

However, if you wish to make a sharper lead tip, the strength of the tip might not be enough to avoid being mushroomed as the bullet is ejected from the point forming die. This is where the lead tip forming die comes into play. Go ahead and eject the bullet and accept the deformed blob of lead that comes out of the point former die. You want that lead to be enough so it will fill up the cavity in the lead tip forming punch, in the next operation.

The lead tip forming die has a slightly different curve than the actual bullet it is designed to form. We catalog LT-1 dies by the bullet ogive, such as 6-S or 8-S, but the actual curve in the punch might be 5.5-S or 7.5-S instead. This lets the punch meet the jacket at a slight angle, so it can shape the tip before the edge of the punch contacts the jacket and presses a ring into it. This slightly broader angle also lets you use the die to push the tip of an open tip bullet closer together.

Lead tip bullets require that you leave the jacket open sufficiently so that the tip is connected to the main core by a substantial stem of core material. If you try to close the jacket down to a tiny tip, in order to make a very small lead tip, you will push the two jacket walls so close together that nothing is left to hold the tip to the core. It can actually fall off the bullet when you try to load it into the cartridge case, or even when the gun cycles and pushes the cartridge out of the magazine.

To illustrate this, just subtract twice the jacket thickness from your bullet diameter at the end of the jacket, after forming to a small tip. The difference is all that holds the tip to the core. As an example, imagine that you want a tiny lead tip on a .308 bullet, but you want this bullet to be made with a .035 inch thick copper tubing jacket for big game hunting. This is quite reasonable, if you reconsider what "tiny" means in such a lead tip design.

The two jacket walls together measure .070 inches in width, so this means no matter how hard you push, you will never succeed in getting the tip smaller than .070 when completely closed. A lead rod that is .050 inches thick can be twisted apart fairly easily by hand pressure, so you would probably want at least 0.100 inches of lead joining the exposed tip to the lead core.

Add the two jacket walls to the minimum practical stem of lead, and you have a tip diameter of 0.170 inches where the jacket ends. The lead itself can be shaped to a needlepoint beyond the jacket, as long as the diameter across the position of the jacket end is 0.170 or wider. The moral of this story is simply to make sure that you leave a nice, wide opening with plenty of lead protruding from it in the point forming die, so there is both plenty of lead to shape in the tip forming die and also a nice thick stem to hold it onto the core. In other words, don't forget about the jacket wall thickness and how it takes away from the core diameter at all points, including the tip.

The LT-1 die helps do one other operation: it not only shapes exposed lead tips into factory-finished appearance, but it also sizes the base portion of the bullet to minimize the "pressure ring" at the base. This is a very subtle amount of sizing, not the same as removing body taper from a mass production operation by shoving bullets through a ring die (which tends to loosen the cores). It is useful in hunting rifles and autoloading handguns because it helps keep the case neck snug and parallel to the bullet.

Lead tip forming dies can be added to any set that uses a PF-1 point former. Added to the FJFB-3 set, the combination is called the "LTFB-4" which simply stands for "Lead Tip, Flat Base" four die set. It can still make open tip or full metal jacket bullets, of course, just as it did before you added the fourth die. Only now it can also make better quality lead tip bullets.

We have not yet discussed the RBTO-4 set, but that will be covered soon. It stands for "Rebated-Boattail, Open Tip" four die set. It uses a core swage, and a point form die, but instead of the usual core seater it has two other dies. One is a boattail preformer, and the other is a rebated boattail finisher. A four die set, then, is not always a lead tip set. If you added a LT-

1 die to the RBTO-4, you would create a five die set capable of both open tip and lead tip rebated boattail bullets. It would be called the “RBTL-5” five die set.

Please keep in mind that any die set having the “L” as part of its catalog number just means you have got an extra die to make nice lead tips. It does NOT mean you can ONLY make lead tips. Any such set can also make open tips and full jacket bullets as well as lead tip bullets. The LT-1 die just adds one more thing you can accomplish.

There is another kind of five die set. We left the normal flat base core seating die out of the RBTO-4 and also out of the RBTL-5 sets. These two sets make only the rebated boattail base. Suppose you wanted to add the normal core seater (CS-1) so you could also make flat base bullets? Fine, that would be the “FRBO-5” or the “FRBL-6” package of dies. You can probably guess that “FRBL-5” stands for “Flat base, Rebated Boattail, Lead tip” five die set. The “FRBL-6” means you can do everything in regard to “Flat base, Rebated Boattail, Lead tip” with those six dies.

Adding the “F” for flat base does not mean some strange combined flat and boattail base: it means you can make either kind of bullet. The same is true of the “L”, which means you have an extra die that can produce nice lead tips. You can still make open tips, full metal jackets, and anything else that you made with sets having less dies in them. Also, a six die set does not require that you use all six dies on one bullet. It means you might use two, three, four, or possibly even five dies.

You could use two dies (CSW-1 and CS-1) to make a Keith nose pistol style bullet, with the appropriate nose punch. You could use three dies (CSW-1, CS-1, and PF-1) to make an open tip, flush tip, or full metal jacket bullet with a flat, cup, dish, or hollow base, jacketed or lead. If you made a lead bullet, you could probably skip the CS-1 and just use the CSW-1 and PF-1.

You could also use the CSW-1, BT-1 and BT-2 dies (more about these later: they form the RBT-2 pair), and the PF-1 to make open tip, rebated boattail bullets. Finally, in the most complex operation, you would use the CSW-1, BT-1, BT-2, PF-1 and finally the LT-1 to form a rebated boattail lead tip bullet. Each step is similar to the others in how you install the die and punches, how you adjust and work your way up by applying pressure in small increases and inspecting your work to see how it is going, and finally how you lock down the setting of the punch holder and process as many pieces as you need for the next stage.

Changing ogive shapes

The LT-1 die itself is made in a specific caliber (diameter) but the ogive or nose shape can be changed by getting a different internal punch. The internal punch in the LT-1 die has a cavity that matches whatever lead tip shape you desire. If you want a semi-spitzer shape, this means the ogive is a spitzer but the lead tip ends with a very perceptible radius. If you want a spitzer tip, then the lead tip cavity will end with a small radius. Generally, we find it best to make spitzer lead tips with a small radius. This helps the lead fill out to the same consistent length. Lubricant buildup can sometimes block a very sharp cavity, so that some tips come out needle-sharp and others come out with a poorly formed end, either angled or flattened. Unless given other instructions and drawings with dimensions, the spitzer lead tip punch ends with a tiny radius.

To order a different lead tip shape, specify the ogive of the point forming die that you will be using to make the bullet and then tell us if you want a flat tip, semi-spitzer, or spitzer shape, or some special shape. If you want a flat tip or special shape, we will need a drawing with the dimensions or a few samples. One sample is fine except that it doesn't give us any idea of the tolerance range. In the absence of any other instruction, we will use our standard practice as a guide.

All you do to change shapes is change the internal punch. Some people have suggested using a larger LT-1 die for smaller bullets, such as forming a .284 lead tip using a .308 die. It isn't a good practice, because the bullet can be randomly expanded and the tip may not be perfectly centered with the axis of the bullet. It comes under the heading of "Things You Might Get Away With Sometimes". And often, not.

Tip Closers

A tip closing die is a lead tip die equipped with a special hardened punch made of a tough, wear resistant steel alloy. The cavity in the punch is made so that the tip of the open jacket will contact it first, and the force will move the jacket tip inward. Sometimes the jacket will be strong enough to allow the tip to be almost completely closed in this manner. Usually the jacket only allows a reduction in the open tip size, not complete closure, because the jacket will collapse, fold, or take on the edge shape of punch and thus create a shoulder on the ogive.

We designate this die as a LT-1-SC or LT-1-HC, with the "C" meaning custom and indicating that the punch is custom made to close or reduce the opening of an open tip bullet. The die is exactly the same as any other lead tip forming die, other than this special punch being provided. You can add the punch to an existing standard LT-1 die any time.

ULD METAL TIPS

The ULD or "Ultra Low Drag" bullet design was first made by Corbin back in the days of the Viet Nam conflict, for long range sniper rounds. It combined a rebated boattail with a relatively heavy bullet having a secant ogive with a 14-caliber radius offset 0.014-inches from tangent. For any given weight and caliber, this shape provided the best compromise between ballistic coefficient and accuracy within practical recoil and pressure levels.

Fast forward a few decades, and the ULD design has been copied under a half-dozen other names, but all retain most of the features found in the original design (except for the rebated boattail, since so much equipment, advertising, and customer conditioning has been put into the conventional boattail by this time, and the conventional boattail base is easier to load in automatic equipment than a flat or RBT base). But two new features have been developed, tested, and are now available to handloaders and bullet makers.

The first additional feature is a blending of the secant and tangent ogives in a "hybrid" design, which reduces the slight chance that a secondary shock wave might be momentarily generated at the ogive-shank junction under exactly the right combination of velocity and air density. This improves the BC by a very small amount for a given weight and diameter of bullet. (Remember, BC is reduced by the square of the diameter, and increased directly with weight, so you can always get higher BC by making the same design and caliber of bullet heavier or using the same shape and weight in a smaller caliber -- if the internal ballistics and the firearm mechanics safely permit it. Keep in mind also that BC and accuracy will always go in different directions at some point, if you try to increase BC beyond certain limits by making the bullet longer and heavier.)

When you order a standard "ULD" point forming die from Corbin today, you get the hybrid style ogive rather than a conventional secant, although it may be hard to tell much difference by eye. The main difference is the blending of the angle or junction between shank and ogive.

The second additional feature, which is optional and requires some special equipment (different kind of point forming die, extra punches) is the "ULD TIP" design, using a CNC-machined high precision metal tip insert having a needle point. The conventional ULD point forming die cannot seat this tip properly. A special PF-1-ST or PF-1-HT tip seating and ogive forming, with two different ejector punches used in sequence, is employed.

In addition to the ULD TIP point form die, with its two special punches, there are also special punches used in the core swage die and in seating the lead core into a jacket. The purpose of these punches is to create a center hole or alignment dimple in the core that is exactly centered, and then to use this to insure that the lead core is pressed into the jacket in a manner that creates a deeper hole to accept and eventually grip the grooved stem of the ULD tip insert.

The tip inserts are little cones with the precise angle of the ULD ogive as it approaches the centerline of the bullet. This angle is the same for all ULD ogive bullets regardless of caliber. Therefore the same tip inserts can be used on a wide range of calibers, limited only by the diameter and length of the tip compared to the rest of the bullet. At this writing, two different tips are available, the TIP-50 and the TIP-30.

The TIP-30 is made to fit into calibers around the .308 size, usually from about .284 (7mm) up to around .323 (8mm). The limiting factor is appearance and balance on the smaller caliber side: the tip can be too much of the total ogive if the diameter of the bullet is too small. The limit on the upward side is the thickness of the bullet jacket at the open end, which typically is much heavier in larger calibers. The difference between the diameter of the stem on the insert, and the base of the cone to which it is attached is twice the wall thickness of the jacket, or more.

If there is, for instance, .015 inches between the stem and the edge of the cone (start of the actual metal nose projecting from the bullet), then it means the maximum possible amount of jacket thickness that could be used with this tip insert is .015 inches at the end of the jacket. Another limitation is the appearance and ease of assembly. From about .338 up to .510 caliber (50 BMG), the TIP-50 is more satisfactory than the TIP-30.

There may at some future time be smaller sizes, for .277, .264, and other small centerfires. However, at this time, the cost of producing them quickly enough, in high enough volume, in the required high level of precision, prices them out of reason for civilian applications. They can be made, of course, but not on the high speed CNC lathes that allow high enough unit production to keep their cost in line with what you'd feel comfortable paying, considering their benefit for long range shooting. The basic reason is that practical materials will bend or deflect too much when turned with the forces needed for high production volume, making accuracy unacceptable. With the larger two sizes, this has been solved by using specific alloys with the proper strength so that high precision and high production are simultaneous. For now, the ULD TIP design is limited to calibers from .284 to about .510 (or slightly larger).

To produce these special, high BC bullets, you would want a RBTO-4-S or RBTO-4-H die set. Lead tips are of course not feasible or desired here, and flat bases defeat the idea of the highest practical BC. You can either order the RBTO-4 die set with the special ULD TIP point forming die instead of the standard point former, and the special ULD seating and core swaging punches instead of the standard ones, or you can add these items to an existing set (in the same caliber, of course).

Remember, though, that the standard ULD ogive bullet cannot be made using the ULD-TIP point former, and the ULD-TIP bullet cannot be made using a conventional ULD point former. These are separate, non-interchangeable concepts, which use different tooling. The ULD-TIP point former has a large ejection pin, much larger than the typical .081 to .091 diameter pin on a standard .308 ULD point form die. And it doesn't just have one: there are two used in sequence.

There are also two special punches, one for the core swage and one for the RBT dies. The core swage punch is an internal punch, with a "center punch" design. It can be used instead of a conventional flat internal punch in any standard core swage die made for this jacket and caliber, even if you don't make a ULD-TIP bullet. It puts a perfectly centered alignment hole in the end of the lead core.

The second special punch is a ULD-TIP core seating punch, which is made to fit your specific jacket diameter near the mouth area, and has a longer "probe" machined on the end. This extension or probe finds the center hole in the core, when you seat the core into the jacket. It then makes a centered cavity or open tip hollow point in the core. This cavity can also be used as a normal hollow point, if you should wish to use the same punch to seat cores used in any other conventional point form die of that caliber. But the real purpose is to create a hole for the stem on the tip insert.

These two special punches cost the same as the normal flat end punches, and can be substituted for them at no extra cost when you get a new die set. If you have an existing die set, you can simply add these two punches, plus the ULD-TIP point form die.

The jacket and seated core, which now has a cavity formed in it, is put into the ULD-TIP point form die and the die itself is installed in your press with the first ejection punch, which has a small probe or tip machined on the end of a fairly large ejection punch (for example, some are made at 0.210 inches, but this is determined for the actual caliber). You form the ogive up to the point where the jacket just comes up against the larger diameter of the ejection punch, which forces the lead core to form around the smaller machined portion of the punch and create an exact depth and diameter of hole.

Then, you would eject the bullet, make sure it is formed as desired, and process the rest of your run of bullets through this stage. Then unscrew the ULD-TIP point form die, and change the ejection punch for the one having a cavity in the end, shaped like the reverse of the tip insert. Since this punch faces upward in the Corbin press, once the die and punch are back in the press ram you can place the pointed end of the tip insert into this cavity, and it will stay there. Or, if the instructions sent with your particular set don't indicate otherwise, you may put the tip insert into the end of the bullet by hand or with a simple pushing tool (to avoid sticking your fingers with the sharp end of the insert).

Once the tip is set in the punch cavity, or pushed lightly into the bullet, you can then put the bullet into the die and raise the ram, adjusting the punch holder for the base punch (a RBT base punch, usually) to push the bullet just far enough into the die at the top of the stroke so that the tip is seated securely, the jacket is formed to a smooth seamless junction at the base of the tip's cone, and thus the lead in the jacket is squeezed into the little grooves machined around the stem of the insert, holding it securely.

This method both secures the tip, aligns the tip precisely on axis with the bullet, and finishes the ogive curve into a smooth transition with the tip, in one stroke. The bullet is now assembled and is ready to shoot.

Since this concept was introduced, the ULD-TIP bullets have been used around the world in innumerable matches and long range shooting situations (some having to do with paper targets, others involving targets with an additional two dimensions). The feedback has been overwhelmingly positive.

In very rare instances, the accuracy was not acceptable because the bullet was too heavy for the spin rate of the barrel used. This is no different from any other long, heavy bullet. At one point we had tried aluminum alloy for the TIP-30, and this reduced the bullet weight just enough so some marginal load combinations did shoot well in the same twist that failed to stabilize the steel alloy tips. However, the aluminum tips did not have the bending resistance in the .308 caliber size to allow them to be produced on practical, high speed CNC machines at a fast enough rate, and time is indeed money when it comes to commercial production.

The TIP-50 can have a heavy enough stem so that an aluminum alloy works nicely and can be produced at practical cost. The TIP-30 uses a higher strength steel to get reasonable production speed. If you adjust the bullet weight slightly downward, or use a slightly faster twist barrel, the accuracy is restored assuming it was compromised from the weight difference in the steel versus aluminum TIP-30. This is merely a matter of how long a bullet you can spin in, for instance, a 1-10 twist versus a 1-9 twist and achieve stable flight.

The ULD design, with or without a tip, is not a universal cure for every load, caliber, and twist rate. It is simply the highest practical BC design regarding the bullet shape, incorporating about 15% higher potential accuracy due to the reduction in muzzle gas redirection caused by conventional boattails (both flat base and RBT base bullets tend to blow the muzzle gas away in an expanding ring, where as the boattail tends to focus the base or at least some of it into a ball in front of the emerging bullet, causing some buffeting with the turbulence created right in front of the bullet). The conventional boattail has slightly higher BC, but the RBT makes up for that with a bit more potential accuracy or at least partial elimination of a source of bullet dispersion brought about by the boattail.

We've discussed BC at length, and it should be clear that so long as accuracy is acceptable, higher BC is better. But at some point the factors that create ever higher BC reach a level that will adversely affect accuracy. Once you have the most efficient possible shape, such as the ULD-TIP design, then in a given diameter of bullet, all you can do to further increase the BC is to make the bullet heavier. This can be done by using higher density material (tungsten, gold, silver, osmium, uranium, and so forth) instead of lead, or it can be done by using more lead.

Obviously, if you use enough lead, your bullet gets too long to be stable in any practical twist rate. Let me know if you ever find a rifle that will fire the 3-inch long 350-grain .308 and I'll be happy to give you odds that the bullets will not group within one zip code, much less on a foot-square target over 100 yards distant.

But what a fantastic BC that bullet will rack up! Dial this down to something people might actually try, and you can see that somewhere along the sliding scale of BC and accuracy, the two part company. Don't become obsessed with BC for its own sake. It means nothing if you can't hit the target. If I put them all in one hole at the desired range, I couldn't care less about the BC. Now doping the wind -- that's a tale for another day.

Rebated Boattails

A flat based bullet is formed by seating the lead core into a jacket using a CS-1- core seat die. The jacket base is flat. It pushes against a flat punch and stays flat. A rebated boattail refers to a bullet having the base of the jacket formed in a truncated conical shape, with a small step or shoulder between the shank of the bullet and the start of the boattail angle. A conventional boattail bullet has no step. The boattail angle, usually from eight to twelve degrees relative to the centerline, just starts at the end of the shank and tapers back to a smaller flat base about sixty percent of the bullet diameter.

There are two purposes for a boattail. The most important is to reduce the amount of drag that occurs when air rushes back to fill the void left by the moving bullet. Turbulence occurs when the sharp right angle of a flat base bullet passes a given point in the air, and the molecules of air rush in a chaotic way to equalize the pressure back to normal atmospheric levels. In a simplified way of looking at base drag, you could say that moving the bullet through the air creates a vacuum behind the bullet that “pulls back” on the bullet.

An angle on the bullet shank near the base, shaped like a boat prow, helps the air to smoothly flow back together. In effect, this reduces the amount of vacuum or turbulence and thus cuts down on the “pull” at the base of the bullet. As a result, you get less loss of speed over the same range, and more energy on target, plus a flatter trajectory.

A second purpose for the boattail base is to help get the bullet into the case neck without catching the case edge and bending it. A slight bevel would do as well, but these would not have as much effect on reducing drag.

Theory behind base drag reduction

A conventional boattail base is most useful when a bullet is fired over very long ranges, or when a bullet is fired at speeds below that of sound. As soon as a bullet breaks the first sound barrier (about 1130 feet per second at sea level under standard conditions), it compresses air molecules so rapidly that they don’t have time to get out of the way, and they form a dense V-shaped pattern of highly compressed air that seems to travel along with the bullet.

This big V-shaped cone of packed air molecules is constantly leaking off at the edges and picking up new molecules, transferring energy from the bullet to the air at a high rate. The shock wave, which is the extended

V-shaped cone, acts like a big extension of the bullet itself. In effect, you are dragging along the outline of a much larger bullet. The velocity at which this happens varies depending on the density of the air, because it is essentially caused by the mass and thus the inertia of the molecules that make up air.

Even something as small as a nitrogen atom has some mass, which means it has inertia. Air is mostly nitrogen, with some oxygen and other gasses. The average inertia of this thin soup we breathe every day varies with temperature and atmospheric pressure. Sound travels as vibrations through the air, at a speed that depends on how close together and thus how much effective inertia the air has. When a bullet moves faster than sound, the air cannot pick up speed fast enough to maintain a normal density. The molecules that are struck by the bullet are accelerated so fast that they jam into other molecules and those have enough inertia so they are not gently moved aside, but jam into yet others.

At some distance from the bullet, the speed of the molecules and atoms has slowed down enough to let them move adjacent ones more gently. The result is a normal whiz of sound. But if your ear happens to be in the path of the highly compressed shock wave, you hear a very loud and sharp CRACK! The distance you can hear this very loud noise gives you an idea of just how big a cone of compressed air is being moved along with the bullet.

When the bullet goes supersonic, it feeds energy to the air so fast that the base drag is a small portion of the total loss. The base drag is just as big a loss as ever, but now the bullet has something much bigger to worry about. Since you can't do much about the shock wave except to make the bullet as streamlined as possible (which shapes the shock wave to be more streamlined as well), you can work on the base drag.

At high velocity, the base drag component might cause up to 15% of the total loss of velocity, but when the bullet slows down to below the speed of sound, the base drag may cause up to 40% of total velocity loss. Pistol bullets, which travel much closer to subsonic speeds, and rifle bullets for muzzle loaders, benefit far more in total drag reduction from a boattail design than would a high velocity rifle bullet.

On the other hand, a high speed rifle bullet generally is used at longer ranges. This means that even though the boattail benefit is much smaller than for slower bullets, it has a long time to act, or at least a longer range over which crosswinds can work on it. A 40% improvement in ballistic coefficient at 100 yards would only be a few inches of vertical distance on the target. A 15% improvement in ballistic coefficient in a 1000 yard bullet might mean hitting the target or missing it.

Disadvantages of the boattail base

The boattail adds some length to the bullet, and makes a cup or hollow base ineffective for sealing the bore. Very light short bullets might not be able to use a boattail base without losing their small bearing surface. Boattails also contribute to inaccuracy in two ways. First, they tend to direct muzzle blast gasses into sharp focus like the central post of a water nozzle directs water into a stream. The result is that instead of the expanding ring of gas that you get from a flat base, a ball of turbulent gas is blown around the bullet and breaks up just as the bullet flies through it, adding from 10 to 15% more dispersion than a comparable flat base bullet would experience.

Second, the boattail angle tends to focus hot gas in the bore toward the junction of the rifling and the bullet, as gas pressure, acting at right angles to all surfaces containing it, is vectored at 90 degrees to the BT angle and attempts to peel the boattail and barrel junction apart. If successful, the gas compresses the boattail portion of the bullet slightly, pulls the bullet jacket slightly away from the bore, and lets more gas rush past the bullet along the rifling bottom, cutting the bullet and eroding rifling.

This gas-cutting factor can be plainly observed by making a 45 caliber pistol bullet with a boattail angle and firing various loads, then recovering the bullets and examining the edges of the rifling grooves under a medium power lab microscope. The edges typically have solidified drops of previously molten copper deposited along them, showing where hot gas has rushed past the jacket along each rifling groove. A flat base bullet, or a rebated boattail bullet, of identical weight and shape, fired with the same velocity in the same gun with the same loads, shows little or none of this gas-cutting.

Advantages of the rebated boattail base

If the angle of the boattail is interrupted by a small but fairly sharp right angle, just as the boattail joins the rest of the bullet shank, both the gas cutting and the muzzle blast focusing effect are greatly reduced, even eliminated. The shoulder acts as a “spoiler” to the laminar flow of muzzle gas, which tends to follow the bullet outline because of the smooth boattail shape, just as the air follows it in the other direction.

The shoulder also changes the gas pressure vector angle inside the bore, from the complement of the boattail angle to one acting parallel with the bore. This vector has no “leverage” to peel the jacket back from the bore. It can only push gas past the jacket if the jacket is undersized or fouling cuts a groove in the jacket, or the bullet is driven so fast that it “skids” over the rifling and opens a wider than usual engraved path for gas to leak out. In other words, the RBT design captures some of the inherent advantages of the flat base, long considered more accurate for 100-yard benchrest shooting.

A minor advantage to the RBT design over the BT is that the exit from the muzzle effectively takes place much faster. How so? Because a boattail exiting the muzzle is like a tapered cork being pulled out of a bottle of sparkling wine: it releases gas slowly as the gap widens little by little, and any slight difference on one side of the gap changes the pressure acting on the bullet and shifts the bullet path slightly.

The RBT is more like a flat base bullet, in that the moment the rebate edge passes the muzzle, the restriction drops away instantly to a smaller “cork” and gives the gas a much larger orifice for escape. This gives less time and lower pressure for a slight angle or dent in the muzzle area to direct gas unevenly around the bullet, and helps to insure consistent straight exits from the barrel.

Corbin’s precision RBT technique

To build a good rebated boattail bullet, we use two dies. Instead of seating the lead core in the jacket using a straight cylinder die (CS-1), we use a die that has a boattail angle toward the bottom. The normal flat jacket can be used, because it will be shaped by internal lead pressure just like it is in the point forming die.

We cannot use a rebated boattail shape in this die, because the shoulder in the die would catch the bottom edge of the jacket. The jacket would be ripped or crumpled. First, we form a conventional boattail. Then, in a second die, we get the base of the bullet past the RBT shoulder and expand the jacket into the shoulder at 90 degrees, again using lead pressure with a second core seating operation. We are using the internal pressure of the “fluid” lead, at room temperature, to shape the jacket outward into the die wall and receive the desired shape.

To maintain the shoulder during point forming, we make an external punch that has a cavity matching the boattail angle and depth. The cavity depth is important: too short, and the boattail will be compressed and buckled, too long and the shoulder will be torn or forced forward. If the angle is not perfect, the bullet will have two boattail shoulders instead of one, adding unnecessary drag. This RBT external PF punch is included with the two RBT dies.

The RBT die package is called “RBT-2” and can be ordered as an add-on to any conventional flat base set. Any set of dies that includes the letters “R” or “RB” in the catalog number includes these dies and the external PF RBT punch.

If the jacket is thin enough so it will expand into the first boattail die (called the “BT-1”), then you simply use the regular core seating punch and seat the lead core in this die instead of using the CS-1 flat base core seating die. But if the jacket is copper tubing, it normally will be too thick to flow nicely from internal lead pressure and will not form a good boattail angle before the end opens up.

In that case, we provide a punch shaped like the boattail core. It is used inside the jacket, without a lead core, to shape the boattail angle. Then, the core is seated as usual in the BT-2 die with the regular core seating punch. If you are using copper tubing jackets and commercial drawn jackets in the same dies, you will probably need the boattail forming punch only for the tubing jackets. Seating the lead core in the drawn jackets will work much better to form them because they have a solid base that can stand more pressure and because they are thinner and can expand more readily.

Adjustable seating punches

Soft copper tubing makes a fine jacket, but it may flow forward when you try to form the RBT. The thick tubing material extrudes toward the only point of relief for the pressure: the open, unsupported space ahead of the jacket mouth. If the jacket only grew longer as a result, you could live with that (by allowing for it or trimming it). But the material comes from the base section, which gives up material and becomes thinner, until eventually it separates. And that no bullet maker can live with!

To avoid breaking out the base when forming a RBT bullet with soft jacket materials, such as copper tubing, you can use a shouldered punch. The shoulder blocks off the only pressure escape route in the die by pressing against the end of the jacket. Now the jacket cannot flow forward, cannot grow longer, and will not separate. But a solid machined shoulder on the core seating punch only allows one specific depth for seating the core. You probably will want to make more than one bullet weight. Rather than buying an assortment of core seating punches with shoulders of different lengths, you could use a single, adjustable shoulder punch.

Adjustable punches are made in two pieces. The shoulder turns on the threaded tip, so that the amount of tip that extends beyond it can be precisely set to any position. The hardened precision honed parts that make up the adjustable punch are more time consuming to make than a solid punch. The cost of one adjustable punch is less than four solid punches, so if you are certain that you will never want to make more than three weights or lengths of bullets, the solid punches are more cost effective. If you think you may want to make four or more weights or lengths, the adjustable punch is a better buy.

Available RBT die sets

Rebated boattail die sets are made in the type -S, and -H dies, but not in type -R because of the fragile point forming punch edges and relatively poor alignment of the slotted reloading press ram and head. If you want to make RBT bullets, you are getting serious about swaging and need a real swaging machine.

The die sets that make rebated boattails include the RBTO-4 (Rebated Boattail Open tip four die set), the RBTL-5 (Rebated Boattail Lead tip five die set), the FRBO-5 (Flat and Rebated Boattail Open tip five die set), and the FRBL-6 (Flat and Rebated boattail Lead tip six die set). These would need the final die type designation of -S, or -H for a complete catalog number.

Because the boattail base angle is formed in a tubing jacket by putting a steel punch all the way to the bottom of the jacket, and pressing it into the BT-1 die, it is not practical to make a partition style tubing bullet using a rebated boattail. The partition is formed by pressing both ends of the jacket against a shoulder on each of two punches inserted inside them, inside a straight-walled core seating die. Once the partition has formed, it is impossible to put the boattail punch to the bottom of the jacket.

A better answer than partitioning the jacket is to use Corbin Core Bond and make a bonded core. Since bonded cores are formed by melting the core in the jacket, and then seating the core after the jacket has been cooled and cleaned, it may be necessary in some cases to seat a short core first, at the base of the jacket, in the BT-2 die, just to form the RBT base. Then the rest of the core can be inserted by hand, bonded, and finally swaged again in the same die. This would only be necessary if the jacket material and thickness made it difficult to expand the base once the full core had been inserted and bonded.

Rebated boattail pistol bullets

A short pistol bullet such as the .45 ACP can sometimes be made as a rebated boattail by seating the core in a truncated conical (TC) shape point form die, just as you would to make a FJM bullet, but then using a Keith nose punch to push the bullet backward into the same die, open end first. The solid end of the jacket, having already been formed into a fairly good boattail shape, fits down into the Keith punch well enough so that it can expand sideways and take on the shoulder. The open end takes on the shape of the point forming die.

This simplified, low cost way to make a RBT bullet does NOT work if the ratio of bullet length to diameter is much over 1.7 to 1. That is, a .452 inch bullet that is less than .7684 inches long probably will form a reasonable boattail without too much taper in the shank portion. But an inch-long .458 probably will not. This is a short cut method, which doesn't always work, but is worth a try anyway. If it works for your particular bullet, you've got a cheap and easy way to produce RBT bullets. Otherwise, no harm done and you just need the right equipment.

16. Shotgun Slugs and Airgun Pellets

Shotgun slugs are just bigger calibers to the bullet swager. Everything I've said about other bullets applies to them. You can make jacketed slugs using 3/4 inch O.D. copper tubing or pipe caps for jackets, or you can draw jackets from strip copper. You can make lead slugs of conventional or exotic designs. But regardless of what you make, if the slug is 16 gauge or larger, it will require -H type dies and one of the larger Corbin presses. The more simple shapes, in soft lead, can be swaged in the Mega-Mite hand press, even as large as 12 gauge. Small shotgun slugs, such as the .410 gauge, are below .458 diameter and can therefor be swaged in the S-Press.

The 20 gauge, 16 gauge, 12 gauge, 10 gauge, 8 bore, 6 bore and even the huge 4 bore can all be made rather easily using any of the hydraulic presses that accept type -H dies. We can even build special dies that make helical fins on the slugs, to spin them from the muzzle blast gas flow and keep them spinning all the way to the target. These use punches with built-in ejectors, not a standard set of tooling by any means, but entirely practical. A number of successful businesses have been founded on the use of these tools. You can find their products in mail order catalogs and on the internet, as well as in some better-equipped gun stores.

Lead cores for such big bullets can be made using special single cavity core moulds or three-cavity adjustable moulds. Lead wire isn't usually practical because it is too large to coil and hard to cut. Lead shot or thin coiled lead wire wound around a spool and then swaged into what appears to be a solid slug makes interesting fragmentation bullets.

In most cases, you would want to swage the core in a CSW-1-H core swage die, then put it into a CS-1-H core seater and form the special features such as a post in a hollow base (keeps the wad from being blown inside the cavity) or a Saber-tooth hollow point. Finally, you might put this into a PF-1-H point form die to shape the ogive.

A simple style of slug such as a hollow base round nose or wadcutter, with or without hollow point, can be made in a single step in the LSWC-1-H die. Slugs that carry a payload in a hollow cavity are formed by making a deep cup in the CS-1-H die and then filling it with material to be delivered to the target, and finally rolling the walls around in an ogive shape in a PF-1-H die. We have made airfoil-stabilized (finned) slugs this way with good success. The usual cost of special shotgun slug dies having fins and other fancy features is from 2 to 3 times the price of a standard three-die set. Compared to the selling price of these slugs, it can be a very profitable investment: such slugs often sell for 400 percent more than they cost to make, because it is a special and limited market without a lot of competition.

There is a great deal of similarity in design between certain shotgun slugs and air gun pellets. In regular -S dies, the air gun pellets can duplicate the slugs. But the airfoil-stabilized design is just too delicate to work in a scaled-down version. The parts become far too fragile compared to the required swaging pressure (works fine on paper, however). Dual diameter pellets offer excellent performance in a design similar to a Foster type shotgun slug, but with a short Keith SWC nose.

A dumbbell or "diablo" style shotgun slug can be swaged by using a split sleeve around a lead core, the assembly of which goes into a CS-1-H die. The larger head and base are swaged to the diameter of the die, and the split sleeve maintains a smaller waist in the middle. After forming and ejecting the slug and sleeve, a thin-edged tool is used to pry apart the two halves of the sleeve, revealing the slug with the hourglass shape. This does not work for small calibers because the sleeve becomes too fragile for the pressures, but it works well enough for shotgun slugs.

Airgun pellets differ from other lead bullets in respect to the propelling pressure and velocity, which is generally much lower than with either modern cartridge guns or blackpowder muzzle loaders. Pre-charged high power airguns are moving toward these levels, however. Today, we make dies for airgun projectiles that fit .25, 9mm, .45, and .50 caliber airguns. Most of these larger bore airguns carry compressed air in a reservoir that is filled from SCUBA tanks, with pressures of 2,000 to 5,000 psi and higher.

The main concern of the airgun pellet designer is obturation with minimal friction. Working with relatively low pressure, the airgun pellet must put as much of it to work as possible. Sealing the bore immediately against any pressure leaks around the pellet (obturation) is critical, but so is minimizing the amount of friction produced by forcing the pellet through the bore. Because the pressure is relatively low, the pellet typically needs to be light weight for the diameter. These design parameters point toward a deep hollow base with thin edges.

Two designs have proven themselves in international match competition, and the choice between them is a subject for debate. One is the straight-sided hollow base with a thin base edge, having a fairly sharp internal angle near the base that joins a more gentle angle as the walls become thicker, toward the nose. The shape of the hollow cavity can be a radius at the end, a flat, or even a sharp point (for heavier pellets).

The sharper inside angle near the open base helps direct the air pressure to push the thin "skirt" of the pellet into the rifling quickly, so that very little air pressure escapes before the base is sealed. Making the angle too sharp reduces the effective area and thus decreases the total force pushing the skirt outward, whereas making the angle too shallow or blending it into the same angle as the rest of the hollow base cavity vectors the air pressure force closer to the axis of the bore, so that a point is reached where the total force acting to expand the skirt at the open edge is again reduced, and air pressure escapes around the base.

The ideal shape is subject to mathematical analysis to find the best angle, balancing the area against the force vector acting to push the skirt outward. But even so, there are compromises with skirt thickness versus muzzle pressure at exit, which might flare out a very thin skirt, and issues of bore roughness or fouling versus tearing off portions of a very thin skirt in the bore. Debate and opinion still reign over strictly scientific methods, partly because there are so many variables that it is impractical to factor them all into the equation. Even changing from one brand of gun to another, in the same caliber, can shift the point of maximum return. A thicker skirt and sharper angle in one gun might prove more accurate, whereas in another gun a thinner skirt and a shallower angle might add a few feet per second to the velocity without changing the accuracy.

Fortunately, airgun pellet swages are inexpensive experimental tools compared to exotic shotgun slug shapes. A simple LSWC-1 die and low-cost base or nose punches can be tried without undue cost, and the best design for each gun in one's arsenal can be determined experimentally. The simple, single diameter pellet that is essentially a lead semi-wadcutter hollow base projectile may work best with the flat tip, round nose shape or even the truncated conical (or Keith) nose.

Regardless of the hollow cavity and nose shape, the diameter is extremely critical to obtaining best results. The ideal diameter of pellet varies with the pressure, as well as the rifling depth and bore size. Unlike most of the cartridge gun calibers, there is a considerable variation in bore diameter and rifling depth among makers of airguns. Commonly used calibers, such as the .177 and the .221, typically depend on a bore-riding projectile that can be as small as .169 for the .17 caliber, and .214 for the .22 caliber. The thin skirt expands almost immediately into the bottom of the rifling (this is the purpose of the design, at least) and causes both obturation and engagement of the rifling at the rear of the bullet, while the rest of the pellet expands less or not at all, depending on the pressure.

Airgun pellets represent a challenge to the person ordering their dies in this regard: diameter is entirely up to you. There is no way the diemakers can guess what will be best for your gun. Even with the same brand and model, there are enough variations in manufacturing to void any suppositions about what might prove to be the most accurate diameter. Generally, the best starting point for a custom die would be the diameter of an existing pellet that seems to work well in it. It is not uncommon for a custom pellet maker to order two or three different diameters of dies for a given caliber of airgun pellet, since some guns will work best with one diameter and other guns with another.

One solution is to order a set of tools for the largest suitable diameter, and then to get bullet reducing dies to bring this size down for guns that work better with a smaller pellet. The cost of a good bullet reducing die is the usually close to or the same as the cost of a simple swage die, but if one has a large number of nose and base punches fitted to a given die, then reducing the pellet is far less costly than duplicating all the punches in another diameter. This is especially true of the second kind of pellet, which is also very popular: the dual diameter pellet.

Dual diameter pellets are made either in two dies (the standard LSWC-1 as described above for the single diameter pellet is the first operation, followed by a DDS-1 dual diameter sizing die), or in one special pellet forming die that combines the weight adjusting features of the LSWC-1 with the dual diameter features of the DDS-1. This is called the DDS-1-SC or DDS-1-HC, depending on which press it is made to fit. The custom die has both weight adjustment, and adjustable ratio of the length of the two diameters. A special adjustable length internal punch controls the position of the nose within the die, which in turn controls how long the minor diameter section will be compared to the major diameter or skirt section.

The dual-diameter pellet is designed to sit atop the rifling for most of its length, engaging the rifling with the larger diameter band at the base. Whether it is first swaged in the LSWC-1 die at full diameter, or formed all at once with both diameters in the custom DDS-1-SC or DDS-1-HC type die, the end result is that you can adjust the height of the driving or rotating band, and the over-all length of the bullet to make a bullet that has exactly as much obturation and engagement as you wish. You can change the length of the bullet (and thus its weight) as well as the length of the major diameter section.

This design does not depend on chamber pressure for the amount of obturation and friction, since the skirt is designed to be at rifling depth before pressure is applied. By making the walls of the skirt section thicker than with the conventional single diameter pellet, the amount of additional expansion is controlled or stopped entirely, so that regardless of the pressure (up to a reasonable point) the pellet will still engage the same amount of rifling along its length, that being the length of the major diameter driving band.

In this respect, the dual-diameter pellet is much like a conventional artillery shell with a driving band (which is raised, and made of a softer material such as brass or copper, compared to the bore-riding body of the shell which is made of steel or iron). Whether the additional cost of the dual-diameter die is worth the results is a matter of debate. Some shooters say that it is, because it gives a more consistent engagement with variations in air pressure. Others say that hardly matters, because variations in air pressure are going to change the point of impact as much or more than the amount of rifling engagement. It is likely that some guns, with a closer fit to the pellet, benefit from the dual-diameter design more than others, depending on how well they match the bore dimensions.

My best advice would be to try the lower cost solution first. Experiment with weight, nose and base shapes, and then with diameters. When the best combination of these factors is found, see if the results are good enough or if a possible improvement in bullet design would actually have a noticeable effect on the score. If you are already shooting 499 out of 500 possible, and are fairly sure that sometimes you throw a shot by improper technique, then it may be a waste of money to try to make a better pellet. If you are getting lower scores and are fairly sure that your own ability and technique would deliver better ones if it were not for the unexplained flyers now and again, perhaps a different bullet design will prove to be useful.

I know when I shot on a military pistol team, my practice sessions almost always resulted in very slight improvements in score, even when I thought I had done badly or just the same as last time. The improvements were small, steady, and usually a surprise, because I concentrated upon whatever it was that made some of the rounds miss the x-ring, and tended to forget about all the ones that went almost through the same hole. Working to improve put the emphasis on the shots that were not right, so by the end of the session, those thoughts were the only ones which stood out. The aggregate score just marched along on its own, seemingly oblivious to whether I felt good or bad about one particular practice. When it leveled out, I felt that my equipment or load needed work, and usually, it did. As long as I was improving, I didn't change the tools!

17. Bullet-Makers' Tools

Some of the dies and equipment that bullet makers use are not necessarily part of a basic swaging set, but are used to make special features in the bullets and may be used with several kinds of basic swaging sets. Features such as the dual diameter, or serrated jackets, or cannelures, can be added to nearly any style of bullet. New ideas are constantly being developed, so there may well be other tools now which are not described in this book. But here are the ones currently being made as I write....

Dual diameter sizer die (DDS-1)

This die is made for all of the Corbin presses, in type -M, -S, and -H. The purpose is to form a bullet that has two diameters. The nose or ogive section of the bullet rides on top of the rifling to align and guide the bullet with very little friction, while the rear portion of the bullet is left full diameter to engage the rifling.

This is a much better design than a tapered bullet, which only aligns properly at two points. A dual-diameter bullet aligns full length, first in the bore and second at the bottom of the rifling grooves. Compared to a tapered bullet, it is far more stable in the bore, giving consistent friction from shot to shot without as much affect from the "upset" of the bullet caused by its inertia when the charge goes off.

The DDS-1 die is a final step. It is used with other dies, not by itself, except in special custom versions for pellets and lead bullets. You first make the bullet at its major diameter. Then you push it into the DDS-1 die to whatever length you wish to have reduced. You can reduce nearly the entire bullet, or just a little of it.

An internal punch, with a matching cavity to the bullet nose shape, ejects the bullet. You can change the internal punch for different nose shapes of bullets in the same caliber. The base punch can be the same one you would use in the final point forming die, but generally a special punch with a stop shoulder is used, so that you cannot accidently push the punch into the smaller section of the die bore and ruin the punch or crack the die.

A typical use would be in making an air gun pellet. First, a LSWC-1 die forms the basic hollow base SWC style bullet. Then the bullet is pushed into the DDS-1 so that most of the bullet is drawn down to slide on top of the rifling, leaving only a small driving band. Another example would be a heel-type bullet. In this case, the bullet is pushed backward into the DDS-1, and the internal punch matches the base shape while the external punch matches the nose.

To make a DDS-1 die, we need to know four things: (1) the major diameter (bore plus twice the rifling depth), (2) the minor diameter (bore size), (3) nose shape, and (4) base shape. A few sample bullets are important, so we can test the die with your materials and make sure the base and nose are proper, and for jacketed bullets, that the jacket springback has been considered in the size of the die cavity.

Jacket trimming die (ET-2)

The ET-2 die makes it possible for you to precisely trim a long bullet jacket to shorter lengths. High quality bullet jackets are expensive to produce and stock, making it more likely that a company could stay in business by making the longest practical jackets for each caliber and stocking them, than by investing in every possible length in each caliber. You can easily trim the longest jacket to make any shorter length, using the ET-2, making it unnecessary for you or the jacket company to tie up money in more than one length per caliber. You may be able to get enough of one length to break into the discount volume, and the jacket company may be able to stay in the jacket business (most of them have dropped out of it for economic reasons).

The ET-2 comes in -S and -H versions, for any Corbin press. To use it, adjust the internal punch length so that it leaves the desired length of jacket in the die. A simple polished rod and collar with a little thumbscrew come with the die, and act as a transfer gauge. Set the collar on the rod so that one end of the rod is exactly as long as you want to make the bullet, then insert the rod in the die mouth and adjust the punch so it will drop back exactly that far when the press ram is raised. The punch has a head that rests on the internal shoulder within every Corbin press ram.

When the shoulder is exactly the same distance from the die as it would be in the press ram, the body of the punch can be screwed up or down in relation to the shoulder (which in -S dies is a self-locking hex nut, and the end of the punch is fitted with a hex wrench cavity so you can hold it easily with the provided Allen wrench).

The -H type die is really the -S with an adapter kit for use in the larger presses. You can get one adapter and several -S dies, and use them all in your -H type press. The external punch is a very fat, rapidly tapered short punch that fits into the floating punch holder directly. It screws in, replacing the normal retainer bushing. The die is raised all the way up with the ram, to the end of the stroke. The punch holder is then screwed down until the punch just touches the die mouth.

A jacket is then pushed down into the die (by hand). It should fit easily. If the jacket requires much force, it is too large and needs to be reduced (by passing through an appropriate size jacket draw die). Corbin jackets will be the correct size and will fit easily by hand. In order to get the jacket into the die, the ram will need to be raised part way, dropping the internal punch.

The portion of the jacket that will be trimmed off projects out of the die mouth. The ram is raised until the pilot or reduced guide section on the external punch enters the jacket mouth. The jacket needs to have a wall thickness that allows this to happen: if you have a jacket with such thick walls that the pilot will not fit into it, then the ET-2 cannot be used with it. A different punch may solve this, but such thick jackets might require a modified die set as well.

Run the ram up to the end of the stroke. Chances are the jacket will expand and perhaps split in the portion to be cut off, but will not be cleanly trimmed yet. Adjust the floating punch holder down, very slightly, to increase the contact. The jacket will be pinched between the hard die mouth edge and the tapered hardened punch so only a very thin film holds them together. They can be separated easily by tumbling, or a light twist with the fingers or small pliers.

The ET-2-S and ET-2-H are for moderate to light use, for the home bullet maker and for prototype runs. For high production use in a custom bullet business, the ET-2-HC is recommended. This is very similar to the ET-2-H in appearance, but the materials are considerably harder and more time consuming to machine, and the heat treatment takes considerably longer. This makes the ET-2-H more expensive to build, which is why if you don't really need high production we offer lower cost versions that do just as good a job but would not last as long if you started making, say, a thousand bullets a day.

We even make a jacket trim die for use on a reloading press: the ET-2-R. This is a different design, upside down to suit the press design. The trim die is in the press head, and is not self ejecting (a plunger pushes the bullet out). The trim punch is in the ram. Therefore, this kind of die only works with reloading presses that have a design to the RCBS Rockchucker. If you have something else, you probably need to consider getting an actual bullet swaging press.

Cannelure, knurling, and bullet grooving tools

Cannelures are serrated grooves rolled into a jacketed or lead bullet, either to help identify the bullet, to strengthen the jacket, to use for crimping the case mouth, or just to tighten the bullet's grip on the case. The word is pronounced "CAN-a-loor", which might make a good name for a Canadian Fishing Lure company. There are two kinds of Corbin cannelure tools.

The Corbin Hand Cannelure Tool, HCT-1, handles calibers from .172 to .458. A new version introduced in July 2002 has an extra set of holes for the pivot shaft, which are raised to allow the caliber range to extend beyond .458, all the way to a .72 caliber, so long as the bullet length doesn't interfere with the crank handle. You can assembly the tool with the upper section hinged by either set of holes, for two ranges of overlapping calibers.

It can put adjustable depth and adjustable position cannelures on copper or gilding metal jackets as well as hard or soft lead bullets. The HTC-1 Hand Cannelure Tool uses a roller V-way to support the bullet, and a padded handle that pivots a U-shaped channel down over the bullet, and presses a hardened roller wheel against the bullet shank. Turning a crank shaft rolls the cannelure into the bullet in one or two turns. I can usually do four or five bullets a minute with one.

A special version of the hand cannelure tool is used to make a waffle-pattern or knurled surface on lead bullets, which holds far more lubricant than a ring. This tool is called the HCT-2 Lead Knurling Tool. The main difference between it and the HCT-1 is that the HCT-2 has three diamond pattern knurling wheels instead of a pair of smooth V-way rollers and a single cannelure wheel. A number of firms have used this pattern, including Hornady and Buffalo Bullets, in their lead swaged bullets.

Another version of the hand tool is the HCT-3 Bullet Grooving Tool. This tool rolls two grooves at a time onto the bullet. The grooves are wider than those on the cannelure tool, which is really made for jacketed bullets or straight pistol cases. I like to swage a lead bullet in a die that is a little smaller than the final caliber, or even just in a core swage die, knurl or groove it, apply bullet lube, and then swage it to final size in a core seating or point forming type of die. This maintains perfect lube grooves with no air pockets in the lube, compressing them slightly and bringing the lube right to the surface of the bullet so it looks like it was machined instead of squished in.

When you roll a groove into a bullet, the material is moved, not removed. It has to go somewhere. The volume of lead displaced from the groove usually shows up as two higher rings around the groove (in other words, if you make a groove that is .020 inches deep, you will probably have two .010 high rings around the groove). If you know this, you can either use the grooving or knurling process to increase bullet size depending on how you set the depth, compensating for it by buying a smaller swage die, or you can handle it by reswaging or drawing back to precise diameter again. Reswaging works reasonably well. Using two diameters of dies is even better, because you always push the diameter straight out rather than pushing it back, as with drawing or reswaging in the same die.

The PCM-2 Power Cannelure Machine can process up to 50 bullets a minute, as fast as you can feed them into one side of a rotating wheel. This production-quality machine features a 120 volt 60 Hz or 240 volt 50/60 Hz motor coupled through a heavy shaft mounted in a strong thrust bearing. The unit weighs about 23 pounds and is about a foot high with a six by eight inch footprint. Cooled by forced air, it is designed for continuous operation.

The PCM-2 uses different diameters of wheels to cover the range from .19 to .510 caliber. Custom wheels and back plates extend the range up to 4 bore (.998 inches). Knurling wheels in the same range of calibers as the cannelure wheels put diamond-pattern knurls on lead bullets.

Multiple grooves can be rolled by ordering the cannelure wheel built to order. If you don't specify, the wheel will come with a standard .050-tall straight knurled groove. (Actually, the wheels have a raised ridge that creates a groove in the bullet.) The PCM-2 processes bullets so quickly that many commercial bullet makers incorporate it as part of their production line, with their own automatic feeder dropping bullets into it.

To increase the reliability of automatic drop feeders, we do make a carousel device that supports each bullet individually and keeps it from tipping over. This is a "spider" design with a number of notches in a thick, round metal plate, with hard steel rods or pins that project downward, parallel to each other, from holes beside each notch. A bullet can be dropped into the notch, and the steel fingers will support it as it moves through the canneluring track (a half circle gap between the backing plate and the cannelure wheel).

The PCM-F feeder is not a complete automatic feed device, but a manual feed guide that greatly reduces tipping, falling, and speeds up the process of feeding bullets, especially bullets that are very long for their caliber or have boattails. Any bullet that tends to fall over easily can be fed much more rapidly by slipping the proper caliber of PCM-F over the shaft of the PCM-2. Each feeder device is made for a given bullet caliber. However, if the difference in diameter is but a few thousandths, such as a .355 or a .357, the same device could be used. It wouldn't work to use a .308 feeder with .277 bullets, for example, while it might work with .284

and would probably work reliably with .300 diameter. If you tell us in advance what you plan to use with it, we may be able to fine tune the dimensions to give you more versatility. After all, these are hand made tools.

Heat treatment oven

Melting lead cores for bonding to the jacket, and heat treating either jackets or lead itself can be done in the HTO-2 Heat Treatment Oven, which features a digital control with thermocouple sensing and feedback. The oven normally runs on 120 volts AC, but can also be ordered in a 240 volt model. Capable of up to 2100 degree F. temperatures, the HTO-2 offers gunsmiths and tool makers a convenient, fast-heating furnace that can melt gold, aluminum and lead alloys or heat treat tool steels. The furnace has a cavity size of about 4.5 x 5 x 6 inches deep. It has a low thermal density ceramic liner that allows rapid heating and fast cycling time, and is highly desirable for fast cycle time so you can process a lot of jackets in a hurry at low operating cost.

Flameless heat gun

A handy way to generate up to 1000 degree temperatures at low cost without flames is the Flameless Heat Gun, FHG-1. Like an overpowered hair dryer, the FHG-1 uses a fan and electric heating elements to blow a stream of superheated air for annealing, bonding, and heat treatment. It is slower than a propane torch, but also heats more evenly without risk of going over temperature and burning the parts. The heat gun runs on 120 volts AC.

SDD-1 Serrator Draw Die (full length)

The SDD-1 is a “crown-of-thorns” draw die, with small, sharp adjustable points projecting inward. A bullet jacket is typically placed over a drawing punch and pushed through the die. The points cut a fine, shallow groove in the outside of the jacket, so that it will tend to separate and peel back in evenly divided petals along these stress-relief lines.

Typical applications include making fragmenting bullets, which have limited penetration. These might be used in security and police work, as for example in a prison where a ricochet is almost certain among all the concrete and steel with conventional bullets, or in varmint hunting, where the bullet needs to disintegrate when it hits the ground to avoid skipping off over the horizon and punching a “cancel” hole in the shooter’s welcome ticket to that particular farm.

The design of the SDD-1 is similar to a jacket drawing die, except that it usually does not reduce the jacket diameter. The serration points raise a slight ridge which would cause problems fitting the jacket into the core seating die, except that the SDD-1 has a close-fitted reducing section near the top, where it redraws the ridges back to normal size, pushing the material back into the groove so that the grooves are just barely visible and cause no problem with obturation or gas sealing by the bullet.

SDD-2 Serrator Draw Die (adjustable, partial length)

Sometimes, a person wishes to make a bullet that opens quickly and reliably with good even expansion, but then stops expanding about mid-way or just past the ogive. A jacket thick enough to resist expanding may also resist opening, especially at lower velocities (which may be the result of long range impact or perhaps just a low muzzle velocity). Subsonic rounds with boattail bases and blunt round noses may fall into this category. So do many conventional hunting bullets.

The answer is to serrate only the forward portion of the jacket. This can be done two ways. A special broaching punch can be made to cut into the jacket from the inside, as you push it down from the open mouth toward the base. This works if the jacket is thick and tough enough to withstand the force, without collapsing in front of the broach teeth. Most copper tubing jackets can be serrated this way.

But thinner, more conventional drawn jackets would accordion fold from the necessary cutting force. To make precise serrations, the jacket needs to be cut from the outside. The SDD-1 has no provision for ejecting the jacket, and must push the jacket all the way through the die. The SDD-2 is built more like a core seating die, and fits into the press ram. Usually, the core is seated into the jacket first, in the conventional CS-1 core seater, or the rebated boattail core seating set. Then the jacket is pushed mouth first into the SDD-2 die.

The distance that you push the jacket into the die determines how much of the ogive will be serrated. This is precisely set by the floating punch holder position. A flat-ended punch within the die (internal punch) pushes the bullet back out again, and irons the ridges flat. This die, like the SDD-1, is made for a specific diameter of jacket rather than a caliber of bullet, except that in cases where it is made to fit the jacket after a core is seated, it is very close to accepting the final caliber size. The SDD-1 on the other hand accepts the jacket prior to seating a core, which means the die bore is usually several thousandths of an inch smaller than the final caliber.

The six hardened steel points are individually adjusted for depth when the die is built and tested. They are replaceable, and adjustable, but unless there is good reason it should not be done. Without an alignment probe, which fits the bore and has a reduced section held concentric with the bore against which the points can be gently run to set them, it is difficult to get the points set the same depth. Some people try to set the depth to cut further into the jacket, but this is not wise because the metal displaced by the cut has to go somewhere, and the force and wear on the points becomes much greater as you go deeper. There is no practical advantage to cutting more than a shallow groove in the jacket, since even a shallow cut will channel the impact force and concentrate it along the stress lines.

DCD-1 Disk Cutter Die

The disk cutter die is used to make round disks out of flat strip. It can be made to cut copper strip, cardboard or felt to make wads. The copper disks are sometimes used as a seal, pushed to the bottom of a tubing jacket to close off the little hole that may be left, for purposes of bonding the core. Cardboard and felt may be cut into disks to make grease wads, over-powder protection wads for lubricated bullets, or shotshell wads.

The typical disk cutter die is built for a given material thickness and width. Some materials can be cut even with the power of a reloading press, while others may require a Hydro-Press. The dies are similar in design, however. They screw into the press from the bottom side of the head, which is different from nearly all other kinds of dies. In other words, you would hold the die below the press head, and put it up into the threaded hole, rather than screwing it down into the hole from the top (the normal way).

A slot is cut more than halfway through the side of this die, near the bottom end. The material to be “coined” is fed in a strip through this slot, which should be fairly close to the thickness of the material. A punch, which fits the press ram, is carefully inserted into the hole in the bottom of the die, and the press is operated so that this punch never has to drop out of the hole. That way, there is no chance that you will accidently smash the punch into the lower portion of the die and snap it off (since it is only held on by one side, below the slot).

All the force of cutting is between the punch and the solid, threaded top section of the die, above the slot. If the die were to be installed upside down, with the solid threaded portion facing the punch, not only would the wrong edge of the hole be used to cut the material, but the stress of cutting would be against the part of the die that was separated from the main body by the slot.

The remaining connection would be put under huge stress, like a hinge that wasn't meant to be opened. Sooner or later, the part of the die that is now above the slot would snap off. So, to keep the die in one piece, install and operate it in accordance with the instructions. It will punch out thousands of disks for you, which will pass up through the threaded portion and out the top.

BGK-1 Base Guard™ Maker

The Base Guard maker is similar to the disk cutter die, except that it uses 0.030-inch thick copper strip, and the cutter punch has a small pin projecting from the face which penetrates the strip just before the disk is cut free.

The use of Base Guard disks has been covered in previous chapters. It scrapes fouling from the bore with each shot, and helps keep the bore clean, while sealing the chamber gas behind the bullet to prevent gas cutting and leading. It is a sort of "super" version of a gas check, only it is easier to make and uses slightly less copper, and helps clean the bore instead of just protecting the bullet. BGK-1 dies can be built in type -R, -S, and -H, for all types of suitable presses.

The BGK-1 die goes into the press from the bottom side of the top plate or head, just exactly the same as the disk cutter die and for the same reasons. Since you only need to punch through the strip and raise the disk past the top of the slot, the stroke can be very short. Operating the press so that the punch never pulls completely out of the die until you are finished and ready to put it away is a good way to insure against putting undue force on the face of the die, and breaking the junction between the lower guide portion and the main die body.

BSK-1 Ball Swage Kit

The ball swage kit can be made in type -S or -H. It consists of two dies, a CSW-1 core swage die with rounded concave punch ends and a special hemispherical guided swage die. Each size of ball swage comes with instructions that tell you the proper weight of lead to make a given perfect round ball out of pure lead. You can adjust this weight slightly to compensate for slight differences in lead density.

Once you have formed the proper weight of cores, they are lightly lubricated and placed in the lower half of the hemispherical die. The die is an assembly with two sliding halves, guided by a pair of rods. The top part of the die screws into the floating punch holder (without the usual retainer bushing) and the lower part screws into the press ram. Specific instructions come with each die, and supercede any earlier printed material, since it is possible that improvements and changes may be made from time to time.

The press is operated up and down, according to the instructions, and a round ball is formed between the two hemispherical halves of the die. You can pick up the ball, turn it 90 degrees on a horizontal axis, and swage a second time, to insure absolute roundness. If there is too much lead, it will spurt out a tiny bleed hole or notch between the two hemispheres. If there is not enough lead, the ball will not completely form and you will probably see that it has flats or unfilled areas.

Balls from .25 caliber to 1-inch diameter have been made in various BSK-1 die sets, with a degree of perfection seldom found in casting. The speed of operation, even using three strokes of the press, far exceeds the total time required to make an equal number of balls by melting lead, if you consider the total project time and not just the pouring of hot lead into the mould. With the BSK-1 you do not have to melt any lead, nor do you have to wait for equipment to cool down so you can clean it up and put it away. Even if it were not for the more perfectly formed, sprueless balls, that would be enough to convince me!

FX-1 Bullet Fixer Kit

The FX-1 can be made in type -S or type -H. It is for the enterprising person who has purchased a truck load of pulled military bullets of the conventional lead-filled variety (not pyrotechnic or explosive rounds, nor armor-piercing ones that have a core too hard to be moved around), and wishes to make them more accurate, to remove or minimize the pull marks, and to improve the appearance for resale. It is also for the person who has a quantity of bullets that have been in some way damaged, such as culls or pulled bullets from a commercial loading operation, who wishes to fix them.

The bullet fixer can appear to perform miracles when circumstances are right. Not every damaged bullet is repairable, but we have processed bullets that have actually been fired, and made them shootable again with reasonable accuracy. We have processed surplus 50 BMG bullets and 7.65mm bullets, not to mention 5.56mm, into nice looking accurate shooters, when they were badly marked with deep gouges and ridges, were badly out of round, and had uneven, partly filled bases.

The kit consists of two dies, a bullet reducing die (BRD-1) that may or may not require a custom spring-loaded guide punch depending on the bullet base design, and a high pressure two-piece die that forms a special pressure chamber, applying tons of force through the bullet base, into the core material, and pushing outward into the sealed vessel.

In order to build the kit properly for a give lot of bullets, we need half a dozen samples of the worse damaged. There are special “tweaks” that we make to the set depending on the bullet design and the nature of the damage. In each case, the set first makes the bullet as round as possible, and then squares up the base (with open base military boattails, it squares up the material within the boattail while maintaining the boattail shape) while pushing out any dents or depressions in the outline of the bullet. The shape of the bullet can be changed, with certain limits, as well. In some cases, the bullet can be completely reversed so that a full jacket becomes a soft point (but this depends on the core material and bullet jacket).

The FX-1 can be a complete business opportunity in itself, under the right circumstances, but we should talk about it and get samples before deciding whether it is worth going forward with a business plan! There are some bullets such as hard metal core armor piercing designs that simply cannot be reformed under any reasonable pressure, and others with pyrotechnic charges or explosive military payloads that would be too dangerous to subject to high pressures in a closed die.

Other Tools and Dies

Lead wire extruders, core cutters, and core moulds were discussed back in chapter on making lead cores. Jacket and bullet draws dies were covered, and so were the copper tubing and strip jacket drawing dies. Gas checks and Base Guards were discussed. I think that only leaves one thing, and it entails more of a service issue than merely a product discussion, so I will save “Custom Dies” for a new chapter!

18. Custom Tooling

Corbin also builds custom dies and tools. The published prices are for standard calibers and nose shapes which are our own designs. We are glad to make custom diameters and shapes of punches, which have an additional custom work charge because they are made individually to your specifications by a die-maker, rather than programmed into our normal production runs and made by the hundreds all at one time.

If you want to make a custom shape of bullet, send us a drawing with dimensions indicated. Use our fax number or the mail, or send us a sample of a bullet you want to duplicate. You can even make a model out of wood, aluminum or plastic if you wish, or send us a photocopy of a picture from a gun book or article. However, it is time consuming and sometimes impractical for us to go find a certain picture of a bullet in a certain book you happened to read, especially when we are picking up the phone about as fast as it can ring all day long.

Making a bullet “just like the Hensley and Gibbs number such and such” can be a confusing order, too, because specifications may change over time. As an example, the H&G 68 shape has changed at least three times that I know about over the last two decades, and our sample or picture might be from a different time period than yours. Again, instead of referring to something that we may or may not have here to look at, send a drawing, sketch, picture, sample, or write down the dimensions. If we can’t figure it out, we will make our own drawing of what we think you mean and put question marks on it for the dimensions about which we are in doubt.

Very often we receive custom orders that have mutually exclusive dimensions indicated. Just the other day I got an order for a bullet that was .577 diameter with a hollow base indicated. The client wanted the width of the hollow base cavity to be .357 inches across, which is small for that caliber but not remarkable.

In the accompanying letter, he also said that the skirts or width of the base walls surrounding the hollow cavity should be 0.020 inches thick to allow for easy expansion in the bore. Again, this is quite reasonable for a black powder bullet with a long barrel and consequently low muzzle pressure (a modern load might flare out the thin base walls upon exit from the barrel).

But adding the two skirt dimensions together gives 0.040 inches, and added to the width of the hollow cavity gives only 0.397 inches. Oops! The caliber is not 0.397 but 0.577. Where did the client expect us to hide the extra 0.120 inches? I called to find out. After a few minutes of vigorously defending the skirt width and desire for a small diameter hollow cavity, the client suddenly stopped talking. The phone appeared to go dead.

"Hello?" I said. "Are you there?"

"Yeah, I'm here...", the answer came back. "I meant to say 0.537, not 0.357. I have a lot of .38 pistols that are .357 diameter and I guess the number just sticks in my mind."

A commonly requested custom item is a 2-E or even 3-E nose shape for a handgun. This almost never works out: the elliptical nose curve is not practical for rifles at three calibers length, and certainly a two caliber long elliptical nose curve is beyond the practical limit for most revolvers and autoloaders. A 1-E nose is pushing it, for handguns.

On paper, long elliptical noses look good. But in three-dimensional reality, so much weight is shifted to the nose that the bullet becomes massively heavy and long. Elliptical curves are not measured in the same way as spitzer (tangential ogive) curves. Elliptical noses are measured along the axis. Spitzers are designated by the radius of the curve forming the ogive. Big difference.

More is not always "better". Sometimes it is impractical. This is just a very simple example of something that looks good on paper but may not be practical when you try to actually build it. The limits of tooling strength in thin sections or small diameters, the great pressures needed to flow metal perfectly through small areas, and the fact that the bullet has to come back out of the die after swaging it to shape often cause design issues that must be solved. And solving it is a service we offer in three stages.

Three stages of custom design

First, there is the feasibility study, to make sure that the tooling has any chance at all of working and that there isn't already a better way to accomplish the goal. Second, there is the research and development stage, to work out the dimensions and the engineering math, possibly to make some preliminary tests with mock-up tooling built to try concepts out without spending any more than necessary for longevity or speed of operation. Third, if the first two stages have not ruled out the idea for technical, economic, production speed, or some other reason, then there is the actual production of the prototype tooling, testing and refining and possibly some redesigning of it after testing, and the resulting final product.

What to expect

Our work is limited to developing the tooling that can produce your design of bullet. We do not, cannot and will not make any promises or guarantees concerning the performance of your bullet in regard to accuracy, marketability or legality. The performance of a bullet is subject to massive influences by the shooter, the other load components, the firearm, the conditions of firing and the kind of target struck. There are just too many variables for us to guess which ones might not be exactly the same as those we could duplicate here for testing, so we don't even try.

Marketability includes such issues as whether someone else has a similar design, a patent (which gets into the legality aspect as well), or whether we think there is a great market for your new idea. I may or may not think so, and if you ask I will give an opinion that is strictly just that, an opinion. I will not make any guarantee or warrant that your bullet will be a good seller, will not violate any laws or patents, or in any way be held responsible if for any reason you cannot sell the bullet. All I can do is guarantee that if we make the tools, the bullet can be built using them. Of course, if I am convinced that the idea has been done before or is patented or if I believe that the product itself would be illegal to make or sell without proper licenses, I would certainly mention it.

You are entirely responsible for obtaining the proper licenses, patent releases and permissions, and for complying with state and federal laws regarding the making, using and selling of the bullet. We will not knowingly help anyone break the law, nor will we do it ourselves. There are products which are legal to make, possess, and sell to the right people if the proper licenses and permissions are obtained. It is up to you to obtain them, and to make sure your clients also meet the requirements for legal purchase.

We are not a law firm, and can offer no legal opinion. Go to a lawyer for legal advice. If we think the product is likely to be misused or might reflect badly upon us, regardless of whether our opinion is correct, we reserve the right to decline the order. I would rather lose the sale than risk our reputation or help someone get into trouble with the law.

If I believe that the bullet would be a colossal failure, in regard to not performing as the client believes it will, then of course I would try to talk the client out of making it. But I want to make it perfectly clear that, just because I do not bring up any objections to developing the tooling, it does not mean I am making any guarantee that it will sell, be legal, not infringe another person's patent, or perform to the expectations of the client. I may think it has a good chance, or I may think it has no chance, and that is all I can say. You have to proceed based on what you think, and not rely on my opinion. Reasonable and prudent people will never proceed based on one person's opinion, but should study the field and determine for themselves the likely competition, applicable rules and laws, probable market and then never invest more than they can afford to lose.

I expand so many words about this because, in decades of doing this work, there have been a few people who are so blinded by the brilliance of their idea that they cannot see past the imagined riches it cannot possibly fail to produce. I am reminded of Thompson's Seedless Corn. There wasn't much of a market for instant cobs, with the advent of toilet paper. (I made that up, by the way.) Thompson's Seedless Grapes worked out OK. Too bad about the Skinless Watermelon, though, not to mention the pathetic sight of the Boneless Chicken slithering around the barnyard. I won't mention backpacker's dehydrated water packets.

I have been browbeaten by clients who can only hear the future *ka-ching* of cash registers, not the present reasons why the idea is too similar to a dozen cheaper alternatives. When it becomes obvious that there is no getting through the exuberance to the core logic, and there is even a chance that the idea may in fact do something remotely similar to what the client expects, who am I to crush the dream, darken the rainbow, snatch away the promise of a life of luxury and ease? I'll probably give up trying and do the project. And who knows, it may actually be as good as the client said all along! It has happened before. I'm not omnipotent in matters of judgement. Ask my wife. My opinion is not a guarantee.

What we guarantee is that finished tooling will make a bullet that is, within standard practice in our industry, to the dimensions ordered. If you order tooling to make 160 grain .333 diameter 7-S spitzer bullets with a 12-degree boattail base, then the tooling will be able to make those bullets if operated according to instructions. We do not guarantee that anyone can create a match-winning, trophy-elk killing bullet with tolerances beyond NASA lab specs using this equipment. We only guarantee that the equipment makes the bullet shape and weight you ordered, within our normal tolerances, when operated properly.

If you send us specifications that say "must produce groups within 0.1 inches at 100 yards" or some other silly, out-of-our-hands specification, then you might as well forget placing the order, because there is no way any reputable and honest die-maker will make any kind of guess about what some other person with their own gun and load will do with any bullet, even if the same bullet just won the Nationals last week. Otherwise, why bother to hold matches at all? Just buy the bullets and claim the prize, because obviously they are guaranteed to win anyway.

Those kinds of ideas are not silly, of course, when taken as goals rather than specifications. They are the reason you want to make a special design of bullet in the first place. But it is your design, and the die-makers cannot guess how it will perform other than in a general way. Any reasonable design can be highly accurate, or not, depending on how carefully you make the bullet, the quality of material put into it, and the matching of the bullet with the rifling twist, velocity, range, and a myriad of other technical and personal skill factors.

The silly part is in expecting the die-maker to bless the whole operation up to and including the target. Often, we could get away with doing that, because so many of our clients do have excellent ideas, and we make excellent dies. Still, I cannot rely on someone else's skill or ideas for our reputation. If you win the nationals, you deserve all the credit. If you lose, guess what? Either way, the tools you use are going to be the same quality.

People around the world know we deliver tooling that does what it is supposed to do. Whether or not the bullet does what you think it should, based on your design ideas, is entirely within your realm and outside of ours. If it wins the match or gets the trophy, you get full credit. Our credit is that it makes the dimensions you specified, whether or not those dimensions add up to a success for a certain use. Here is a breakdown of what you might expect if you called about building a custom product:

Feasibility Study

This could be as short and sweet as my pointing out some error in design that would prevent the bullet from being formed or from performing, in my opinion, as you expect. I won't guarantee it will perform any certain way, and I won't say that it absolutely cannot perform that way, either, but I will give you my best estimate of whether it has any chance of doing what you want.

This is NOT a guarantee of performance. I'll proceed if you are convinced it will work, unless I am convinced it is dangerous, or perhaps that something about it lies too far outside our field of expertise, such as requirements for some kind of machine work that we are not equipped to perform. Also, if we have too much work pending to give you delivery within a time you consider reasonable, I may have to decline the work.

In the case where you just want some other angle or shape of nose, or a different kind of hollow point that really doesn't vary all that much from what we've done before, then of course the word "study" is overkill. I can just say "Yeah, we can do that." We've probably done hundreds of previous studies and made that custom design or something close to it before, so we can dispense with any formal work that requires billable hours to come up with the answer.

Here are some of the things I will need to know in order to go forward with a feasibility study:

1. Physical dimensions with maximum acceptable tolerances.
2. Samples of the material to be used, if we do not provide it.
3. Minimum acceptable initial rate of production.
4. Maximum acceptable initial cost per unit.
5. Acceptable time for project completion.
6. Available budget for development, and for equipment.

If you say, "OK, go ahead and let me know if it is feasible or not," then we ask for a deposit for two hours at current shop rate. This is a consulting fee, some of which may be applied to the next stage if the project looks feasible after some study. The worst that could happen at this point is that we will spend two hours and discover some reasons why the design cannot be made, and produce a report for you outlining those reasons.

The report could save you hundreds or thousands more dollars, because you might see from the report exactly why the idea is not practical. The reason might be economic: perhaps it could be done, but the tooling would be more than you said you wanted to spend. It might be technical, such as too great an ejection pressure or short tooling life. It might be production related, such as the only way to do the job would be with too many steps. Perhaps we could not possibly deliver the development and the production of tooling within your time limit, once we know what it will require.

You can see that there are many reasons a project might not work out for you, and some of them have nothing to do with the actual bullet performance. The most important ones are usually economic, either for initial tooling cost or for the production rate within your investment limit. But until someone spends the time to think of various ways to produce your bullet, and then calculates the approximate production rates and estimated costs, it is all just a wild guess. You don't want to proceed or stop on a wild guess.

Like going to the doctor and paying $200 to find out nothing is wrong with you, it is a mixed blessing to find out your project is not feasible. But hearing that you do not have a fatal disease, after all, is worth something, is it not? So is knowing that a typical contract die shop might have charged hundreds or thousands of dollars to make tooling that, in the end, probably would not have worked.

But let us assume that, after having tried hard to find anything that might jump out and bite us, we have not found anything. Then we can write a proposal for you with an estimated cost and suggested starting point for tooling. You can decide whether to proceed or not, based on the estimations.

If you decide to proceed, then we go to the next stage. If there is unused time from the feasibility study fee, this will be carried forward to the next stage.

Research and Development

The R&D stage starts with the proposal from the feasibility study. Payment for the estimated development cost, as outlined in the proposal, will launch this stage. Having decided that it is practical to try to build the tooling, after a careful study of your production, cost, and time requirements, and of the physical parameters of the bullet, we begin the engineering and construction of initial models, try out the ideas, see if they turn up any problems that were not evident before, and work on solving them.

Changes in methods or tooling design, or perhaps suggested changes in the bullet itself, may come about as a result of this stage. Of course, every standard product we produce has gone through weeks, or months, or sometimes even years of the R&D stage before being offered for sale. The R&D stage really never stops for our standard products, because even after a successful tool or die is developed and sold for years, new materials and techniques may come to light, new ideas may be developed, which could improve the product.

Usually, this stage is immediately prior to production, and flows into it. If the idea is successful and substantially is the same cost and design as the proposal suggested, with only minor changes, then the next thing you hear is the doorbell when the delivery man brings your new tools.

If the R&D turns up some problems, or suggests more substantial changes which could modify the price or procedures in ways that you need to approve, then the next thing you would receive is a report with this information, asking if we should proceed based on the new information. At this point, the doubt is largely gone, and you can be fairly certain that the tooling can be built to make your bullet. Now it is just a matter of getting through all the prior orders in the queue. I don't know how long that takes, because most of those jobs are like yours, unique. Ask a researcher how long it will take to find a cure for some disease. He doesn't know because it hasn't been done yet. I don't know how long it takes to come up with excellent solutions to two or three hundred design problems and then manufacture the dies for each of them, until they are done. That's about how many orders we probably have pending at any given moment.

On the other hand, some of these ideas do use similar machine setups, and so we do get openings where we can finish a year-old order and do at least part of the work for a current one on the same setup. This doesn't put the other orders behind, and it speeds up some orders by months. But it is quite unpredictable, because people do change their minds and what was planned may become different in an instant.

The bottom line is, I do not know how long an order takes. It takes however long it takes. If you need a time, figure three years. That ought to cover it. But if you really do need it sooner, and do not mind the overtime cost, I can ask the die-makers if they would give up their weekend and finish your order instead. That almost always takes less than 45 days, sometimes as little as a week.

You can expedite an order to "rush overtime" basis at any time. The order will then be guaranteed to be finished by a certain date, depending on how many other rush orders are scheduled and how many die-makers are available to do your work on a given weekend. We close during the Christmas season for a two-week period, so this would not be the best time for a rush order. But it is always possible that your order might be ready soon enough in the regular order queue. If we doubled the prices, we'd still be charging less than shops with far less experience in bullet swaging, and I'd be able to hire more die-makers and get the orders done sooner. But you see, you can already have faster delivery for that price. Hiring more die-makers would take away the lower priced option (50% discount, if you want to look at it that way).

Now assume that we launched the second stage, spent hours working out the math and designing the tooling, built some test models and tried it, and found that it almost worked, but something popped up that no one expected. The project came to a screeching halt, while we tried to work around the issue. Maybe it was a hollow point cavity so large that the material left was too thin to support nose ejection, or maybe the shape you wanted sticks fast in the nose die because there isn't enough of a draft angle. In reality it would probably be far more obscure than these problems: these are ones I can already think of, so we would have covered them during stage one.

So we spend a few more hours studying and testing other ideas, and we come up with a few, but all of them violate one or more of your initial criteria for cost or production speed. We have put considerable time into the project, because it appeared to be feasible. But now it turns out to be otherwise, according to your criteria. What do we do?

We contact you, and give you a report. If you decide not to pursue the project, then we refund the payment except for the actual hours used in reaching this point. For example, let us say our shop rate at the time of your initial order was $80/hour. The first stage, or feasibility study, was for two hours or $160. But after only 1 hour we could find nothing further that looked like a problem, and so we had $80 in the first stage cost. The proposal estimated that the development cost would be $2000. You had $80 credit left, so you signed a development agreement and sent the difference, $1920.

So now, after spending four hours working hard on the development stage, we are at a decision point. If you decide that the cost of additional tools needed or the lesser production rate that the tools will produce is a stopper, then of the $2000 advance, we have only used $320 in shop time and materials. You get a report of what we have done, any prototypes or test parts that might be useful in case you wanted to pursue it further on your own, any samples produced, and a check or bank card credit for the unused balance of $1680.

No one believes that their project could possibly fail. Everything is simple and obvious until you start to cut metal and apply pressures of 30,000 to 100,000 psi. Then things happen that were not obvious. Materials start to behave in ways that they never did in a drawing. And sometimes, a potentially great idea just does not work out in real life. If you know this is possible from the start, then it is not quite such a blow. But if you are already planning how to spend your first million from sales of your new product long before the ink is dry on the sketch, it becomes a bit more traumatic to bring the project to a halt.

Fortunately, by the time we get to the development stage, most of the potential problems have been solved, or else they will be solved by experienced engineering. So, it is extremely rare to see a project stopped during R&D. I only mention it because it is possible.

It is also possible that we may discover a faster or lower cost way to do the job. In that case, we would make sure the new method does not compromise any of the initial criteria established in our proposal. The R&D stage ends as soon as the best design is developed, any decisions that would cost additional amounts to implement or would violate any of the original criteria are resolved, and the project is either ended or is ready for production. At this point, you receive a report of what we have discovered, and usually a quote for production of all the necessary custom tooling, including the supplies and standard equipment that you will need.

If you get a quote for production, you might say that you have gambled and won. It means we are fairly sure we can build the tools to make your bullet design, and we know what it will cost and are willing to guarantee the production for that price. You do not have to proceed. You may want to use this report and quotation as the basis for selling your idea to someone, because they now have independent verification that the production is practical under written terms. It is no longer speculation whether the bullet can be made with practical tooling of known cost.

If the research turned up reasons not to proceed, you have gambled and perhaps won in another way. Now you have reasons why the idea could not proceed, based on concrete evidence and specific criteria. The report may even have turned up ways to work around the problems by changing certain criteria. Perhaps you cannot initially use Kryptonite cores, at least until you can find some. Perhaps using tungsten or even lead will work in the same design. Or maybe the cost is too high but if you change one of the features, it drops. Now you know it, while others would have to spend time and money to discover it. What you do with the knowledge is up to you.

Production stage

In this stage, there are many drawings made, with material and people allocated for the various operations to make the components. We have a very good idea of what should work best. The amount of work put into planning, buying materials, making calculations and drawings for the die-makers, and recording the results of experiments and tests is, by this time, extensive. The price quotation included a certain amount of nonrefundable deposit to cover some of the work that would not be readily marketable to someone else.

I mention this because, rarely, a person will call during the production stage and say they had a run of bad luck, got a divorce, or fell off a horse—for some reason they would like to cancel now and get a refund. But actual expenses have been incurred, and must be deducted. The non-refundable deposit has in most cases been used by now and there is nothing left to refund. It may be better to go ahead and finish, if the idea had any income potential. The temporary problems will go away, but the earning potential of a good idea only gets better as you develop the market.

Semi-Custom Tools

Some items are only slightly different from our regular, stock production, and do not require the full custom development cycle. For example, changing the ogive from the standard 6-S to a custom 8-S or 10-S shape does not require any feasibility or development time. All it takes is a set of reamers and laps, which we build by hand, in order to cut the die cavity and finish it with diamond powders. This means a few hours work making the tools, but we've done it a thousand times before and know it will work. You pay a custom price for the die, which is already established, to help cover some of the cost of the special tooling to make it.

Likewise, a specific shape of nose or base, or a specified boattail angle, or a certain shape of hollow point cavity that is different from our stock on the shelf will require a custom charge because it is far more expensive to make just one part to order than to build a quantity of them for stock to our normal specs. Part of the cost will be the time to make dimensioned drawings with tolerances, since this time is used entirely for the one custom part, whereas our stock parts are made from a quick photocopy or computer printout of a standard design drawing, and the time is amortized over hundreds or thousands of identical parts.

Then there are those stock items which are more time consuming to produce than a similar stock item, so they cost more. These would include adjustable punches, saber-tooth punches (which put a series of teeth on the edge of a hollow point bullet), and commercial versions of the draw dies, jacket trim dies, or other dies that are built with harder than usual materials, which cost more to machine and use a more expensive heat treatment process, but are only necessary for heavier production work. These items are not really custom, but they are a bit more than standard. I guess you could call them "semi-custom". At least, that seems a good way to classify them.

This category of custom items has a listed price, and does not require any development or other experimental fees. Examples are priced catalog items which end with the letter "C", which can stand for "Custom" or "Commercial Grade", meaning that if we offer two versions, one with the "C" prefix, then you have a choice of two levels of strength, wear-resistance, and durability. Why not just make one with the toughest design, material, or heat treatment? Well, it is a matter of value.

Value is the benefit for a given cost. If an item costs less for the same benefit, then the value is higher. It is a simple math ratio, with admittedly subjective overtones. The problem with spending far more time and effort to build something even tougher than it needs to be for a given amount of work is that the price goes up as a result. Something that takes two days to machine and heat treat probably is going to cost almost twice as much as a version that only takes one day. If the lower cost version will do the job for you, and last as long as you will probably use it, then it is better value. But if your application is for so many bullets per day that a tougher version, costing perhaps twice as much, would last three times as long, then it is the better value for you.

It is nice to have a choice. I do not want to force anyone to buy a more expensive version, if the lower cost one will do just as well for a given set of circumstances. None of the lower cost versions are built in a less satisfactory way. They are more than adequate for the vast majority of our customers. But every so often, someone has a higher volume requirement, where the life expectancy of the standard tool isn't enough to give good value. That is why there are commercial versions of a few tools. The rest are already tough enough so that the need has not come up for anything tougher. If it does, we'll make it!

19. Lubricants and Chemicals

Corbin offers a number of chemical products, from lubricants to cleaners, that we feel are better values or more suited to the swaging field than somewhat similar retail products. These are not available through chain stores or distributors.

Corbin Swage Lube

This high pressure, clean lubricant washes off easily with hot water and soap, yet withstands tons of pressure to protect the die surface from fouling and galling.

Each operation, from drawing a jacket to seating a core, requires a thin film of CSL to reduce friction and improve the surface finish. No other lubricant is guaranteed to work the Corbin Swage Dies; some may, but we know from decades of experience that CSL does the job correctly.

Application is simple: touch your finger tip to the lube and spread a thin film on your thumb and fingertip. Then when you handle the jackets or cores, just roll them slightly back and forth as you pick them up. That's all it takes. Wipe your fingertip over the punch as you swage each bullet.

Once you have swaged cores, clean them in hot water and detergent and dry them, then put them into clean jackets with clean hands before you begin seating cores. This keeps lubricant out of the jacket insides, where it does not help accuracy., and keeps it on the outside, where it extends die and punch life, lowers friction and pressure, and prevents fouling of the dies. It is NOT a bullet lubricant and should not be left on the bullets when you load them. It can be left on bullets that are to be stored for a long time, unloaded, because it prevents corrosion.

Although the ingredients in CSL are medical grade cosmetic components, a few people may have a reaction to them such as a rash or itching. If this occurs, wash immediately and use rubber gloves. This would be extremely rare but possible. Most people will find that handling CSL actually softens hard skin and is beneficial in preventing hangnails. **Corbin Swage Lube** comes in 2-ounce and 16-ounce containers, Cat.No. CSL-2 and CSL-16.

Corbin Bore Cleaner

Used by top shooters at Wimbledon and Camp Perry for many years, long before recently introduced and heavily marketed cleaners became popular, Corbin's Benchrest Bore Cleaner is treasured by a select group of shooters, and virtually unknown to the rest. We have only made small lots for top shooters and our own clients, which includes police, professional gunsmiths and the military. It works by mechanical scrubbing: leaving it in the bore will not cause rusting or corrosion.

Millions of tiny (20 micron) flat plates of synthetic sapphire crystals align with the bore under pressure, and shear off any projections such as rust, powder, lead, plastic, or even the rough edges of machine marks left in the bore. It is an oil-based product, which contains no ammonia or corrosive salts.

One pass on a cleaning cloth wrapped around the next smaller size of bore brush does the job: move forward two inches and pull back one inch, until you reach the muzzle. Then follow up with a cloth patch dipped in either Corbin Dip Lube or Corbin Five-Star Gun Oil, to remove the bore cleaner and the particles it has loosened.

Do not repeat this more than three times: that is more than enough to remove anything that needs to come out. If that doesn't do the job, you may need to use Corbin Bore Lap instead. **Corbin Bore Cleaner** is available in 4-ounce, 16-ounce (pint), and 128-ounce (gallon) containers as catalog numbers CBC-4, CBC-16, and CBC-128.

Corbin Dip Lube

Also known as "liquid jacket" because it forms a tough, clear film of hard wax on the surface of lead bullets, which helps reduce leading and friction and prevents corrosion, Dip Lube can be applied by dipping or spraying. This product has been completely redesigned as a non-flammable, water-based solution that is safe to handle, ship, and will not burn.

Dip Lube can be applied to wood or metal to repel water and protect the surface. It drys to a slightly foggy finish. I also pour a little of it in the seam between the sold and upper leather of my hunting boots to water proof them, use it on wood screws in fences and gates where it eases entry and helps prevent splitting of the wood as well as retarding rust, and as a carrier for mixing with molybdenum disulfide powder. This latter mix is messy but gives excellent anti-leading protection to a gun barrel: coat the bullet with it and fire the bullet after it drys.

Corbin Dip Lube is available in 4-ounce bottles, pints and gallons, as catalog numbers CDL-4, CDL-16, and CDL-128.

Corbin Bore Lap

This is a 40 micron synthetic sapphire compound for smoothing barrels and actions. It is much smoother cutting than valve grinding compound, which is typically made of silicon carbide crystals. Bore Lap lasts longer and is less aggressive in removing metal. In extreme cases of fouling it can be used to clean the barrel of all lead, copper, plastic, and powder residue, but do not use it as a regular procedure or else the bore will be lapped to a larger size over time.

Some manufacturers of bore cleaners use a natural aluminum oxide particle of 40 micron size as their main ingredient, but the flat crystals of synthetic sapphire that we use in Bore Lap do not cut in all directions, and are safer to use in a bore. They tend to line up parallel with the bore under the pressure of the lap, cutting more off the surface than digging into it like a rough natural crystal does.

The way to use the product is to find a brass bore brush that is either one caliber smaller than the bore, or else has been worn down so it no longer fits the bore properly. Then wrap this brush with a cloth patch that covers the bristles completely with one layer. Use a cotton sheet material, not a synthetic fiber.

Dip the cloth-wrapped patch in Bore Lap, and squeeze out excess liquid against the bottle mouth. Make sure the breech mechanism is protected with cloth or plastic wrap so that excess lap will not run down into it. Push the patch into the bore, and move it forward two inches, then pull it back one inch. Repeat this for the full bore length until the patch emerges from the barrel. Remove the patch, and replace it with a clean patch that has been lightly oiled. Pull the oiled patch back through the bore. This will remove rust, fouling, leading, copper streaks, and just about anything else that projects from the surface of the bore.

Do not repeat this process more than three times: if you have not solved the bore problem by then, it isn't solvable this way. Further lapping only increases the bore size, which is not desirable in most cases. There are barrels which are beyond help! But for the rest of them, **Corbin Bore Lap** is available in 4-ounce, pint, and gallon sizes. The catalog numbers are CBL-4, CBL-16, and CBL-128.

Five Star Gun Oil

This is the same high grade ISO-15 oil we use for lathe spindle oil and for lubrication of our presses, a non-gumming, purified oil that handles low temperature well, Five Star Gun Oil saves you money over the price of those little 1-3/4 ounce containers, where most of the cost is the container. You can use it for firearms or to lubricate our presses and dies for storage. Corbin Swage Lube also is a rust-inhibiting lubricant for presses and dies, but it is more of a soft grease than an oil. Five Star Gun Oil is available only in pint containers. The catalog number is FSO-16.

Corbin Core Bond

This product makes bullets that expand and retain their weight far better than any partitioned design. You have probably used bullets that were made using Core Bond: nearly every custom bullet maker in the world uses our process today. Very simply, you melt the lead core in the bullet jacket, in the presence of the Core Bond, which turns to vapor and induces the lead to penetrate into the copper, forming an alloy junction by diffusion, the same general process used in making semiconductors. All you need is a propane hand torch and a fireproof block to hold the jackets. We offer a ceramic block kit that gives you two blocks, one to act as a reflector for the flame and one to drill as a 32-hole support block (the light ceramic material drills easily with an ordinary wood bit).

Swage a lead core that is a loose fit in the intended jacket. This is important. If the core fits tightly, it may be blown out when you heat the lead, often with a loud pop. Also, no bonding will take place where the lead is jammed tightly against the jacket. An important part of the bonding mechanics is the way that the hot bonding agent flows by capillary action and surrounds the core, moving it to the center of the jacket when the liquid expands and turns to vapor.

Clean the jackets and the lead cores in a good solvent or by boiling them in hot water, detergent, and a little vinegar and salt (be prepared for jokes by bystanders about bullet soup). Rinse the jackets and cores in clean, boiling water to remove the detergent, vinegar, salt and any debris, and spread them out to dry on a rough towel. It is wise not to use the best guest towel, even if you are the guest.

The material should dry from its own heat in short order. Then, place a core inside each jacket, and place them in a fireproof holder made either from a magnesium oxide fire brick with holes drilled in it, or pack the jackets into a box built from four fireplace bricks pushed up against each other and placed on top of three or four other bricks to protect whatever is under them. A block of potter's clay can be used to hold copper tubing jackets: the clay will plug that little hole in the base and keep lead from running out. Or use the previously-mentioned heat treatment block kit that consists of two ceramic blocks and a drilling template, so you can make your own high efficiency holder for about 32 jackets at a time.

Now, at this point if not before, you need to have a pair of goggles or other eye protection suitable for chemical and mechanical protection, and probably should be wearing gloves that are at least moderately chemical resistant and heat resistant. One way to get both cheaply is to slip on a pair of thin plastic gloves, such as the disposable type used for paint or chemicals or even dishwashing, and then cover those with a pair of thicker flame-resistant woven gloves. If you do not wear gloves, be careful not to reach over and straighten up a jacket that you just heated! It is easy to forget and just react automatically. At least with gloves, the smoke you see rising from your fingers is just charred cotton.

Do not let the Core Bond touch your skin. It is powerful agent and must not be gotten into your eyes, taken internally, or left where children could play with it. If any of this should happen, apply plenty of water and see a doctor immediately. If you get it on your skin, wash it off quickly. I have gotten it on my skin frequently without any ill effects, but some people may have more sensitive skin. We use an improved formula now that does not become very active until it is heated, reducing the risk both for shipping and handling. Still, the eyes, mouth, ingestion... those would pose a serious health risk.

Once you have all your jackets secured in a vertical position with a core placed loosely by hand into each one (NOT swaged into the jacket—how will the bonding agent get between the core and jacket wall?), place two good-sized drops of Core Bond in each jacket. Let the liquid run down around the cores. There must be a slight gap between the jacket and core to allow this, or bonding won't take place.

Use a propane torch to apply heat as evenly as you can to the jackets, moving the flame slowly back and forth so that the lead is heated to the melting point as quickly as possible. The idea is to melt the lead before all the flux boils away, so there is hot Core Bond vapor between the molten lead and the copper jacket wall. This lowers the surface tension of the lead so much that it can actually penetrate between the copper atoms and form an alloy junction.

The diffusion junction, similar to the concept of doping silicon crystals to make transistors, is stronger than the lead core, forcing the bullet to open in the core rather than separating from the jacket. When the jackets have cooled, you should have a hole or depression in the middle of each core and should see the edges of the lead core rise up along the jacket wall to a small extent. If you see a domed core with the edges pointing down, it means that there is a poor or no bond. If the bonding takes place correctly, a shrink hole will appear in the middle of the core, because the edges of the hot, expanded core are held fast to the jacket. When the core cools, the only place for the material to shrink is in the middle. I like to use a hollow point punch to clean up this shrink hole, when I seat the core (later).

You can easily test the bond by cutting one of the jackets in half lengthwise with a fine-tooth saw, then attempting to crush the jacket in a vise until the core pops out. If you are successful in popping out the core, you do not have a bonded core. If you can mash the jacket into a square and still the core will not separate, you have a bonded core. If you did it right, there will be no possibility of removing that core unless you melt it out.

When you have finished, and the cores have cooled, place them all in a pot of boiling water and add a tablespoon of baking soda to the water. Let them boil for a few minutes to neutralize any remaining flux and wash off the dross. Then add a couple of tablespoons of salt and a half cup of strong vinegar and boil for a few more minutes to remove discoloration. This is optional and has no effect on the bond or bullet quality.

Finally, dump the water and boil one last time in plain water to remove the salt and vinegar. If you skipped the salt and vinegar, you can skip the final boiling rinse as well. Spread out the jackets to dry on your big fluffy old towel. They ought to dry quickly from their own heat.

Now, seat the lead cores in the usual way. Again, I like to use a hollow point core seating punch because of the shrinkage hole in the middle of the core. The punch evens up the hole and makes it look like we meant to do it all along. If you do not want a hollow point, just close the tip down in the point forming operation and the cavity will be pushed shut or nearly so.

When you are heating the cores, make sure that none of them is pressed snugly down into the jacket. Trapped air and liquid will turn to vapor, building pressure under the core that can blow it out with surprising speed. One issue that can arise is the snug fit of a core at the bottom of a jacket, especially a copper tubing jacket that has thickened slightly toward the base. The normal size core fits fine, but if you try to make the bonded core it will trap lube under the core and then blow the core out when you apply heat.

An easy way to avoid having to buy a smaller core swage die is to get a punch for the core swage, having a conical cavity machined in the end. This punch will create a core with a conical tip, and usually the length of this tip will raise the main body of the core above the tight spot, preventing the undesired seal. **Corbin Core Bond** comes in 2-ounce, pint, and gallon sizes, under catalog numbers CCB-2, CCB-16, and CCB-128.

Corbin Cleaning Solvent

This is used to remove oil, grease and lubricant from bullet components. It also strips dried oil from the interior working of guns, removes leftover bore cleaning compound from the barrel, and prepares metal surfaces for a fresh film of new oil. If you don't want to boil bullet jackets in hot water and detergent to clean them, you can use a little Cleaning Solvent in a can and slosh them around in it, then drain them with a mesh scoop or strainer. This is a “hot” solvent in the chemical sense: it can cause burning and rashes so wear eye and skin protection. Wash immediately with plenty of water if you get it on your skin or in your eyes. It is flammable, so do not use around open flame. **Corbin Cleaning Solvent** comes in pints and gallons, as CCS-16 and CCS-128.

Corbin Silver Lube

This is a high temperature lubricant that can withstand the heat of molten lead, and is used to lubricate the hinges and pistons of core moulds. A thin film of this silver colored lubricant will protect against seizing, rusting, and galling. Available in 4-ounce containers, **Silver Lube** is Cat.No. SL-4.

Walnut Shell Media

This is not exactly a chemical, but more of a bullet-making aid. It is a ground walnut shell polishing media for use in vibratory bullet polishers such as the Corbin BPK-1 Bullet Polisher Kit. One bag comes with the kit. You can purchase any weight, ten pounds, fifty pounds, or a ton if you wish. The discount is the number of pounds, from 5 to 50. That makes it easy to remember. Less than five pounds is standard price, fifty pounds and over is half the one-pound price per pound. **Walnut Shell** is packaged in one pound bags, Cat.No. WS-1.

Corbin Hydraulic Fluid

This is used in all Corbin hydraulic presses. It is the equivalent of Chevron AW46. You do not normally need to add more to a new press, and the original fluid lasts for years of normal use, but if you should happen to need more, CHF-128 comes in gallon cans.

Atomized Copper

Fine copper powder with a .25% lithium stearate coating flows and compacts into a solid, lead-free projectile inside a bulet jacket, or can be used without a jacket if heat treated (sintered) to fuse the grains together. Copper powder may be mixed wtih tungsten to increase density. Copper also binds well with powdered tin. Compressed at 20,000 psi, the copper forms a solid that can be handled without breaking. However, it requires sintering to withstand shattering when subjected to pressure without support of a jacket. When compressed into a jacket, the resulting bullet can penetrate deeper than a lead core bullet at the same velocity. Weight is about 3/4 that of a lead bullet of the same volume. Available in 8-oz (wt) in a 2 fluid ounce bottle, 4-lb or 64-oz (wt) in a pint bottle, or 100-lb canisters. Catalog numbers are CUP-8, CUP-64, and CUP-100.

Jacket Drawing Lube

Jacket drawing lube is the product that works in Corbin JMK-2-H automatic jacket drawing equipment, for the copper strip lubricator. It flows through the system and saturates felt roller pads, which transfer a film of lube to the copper strip on both sides prior to blanking and cupping operations.

This lube could also be used for other kinds of jacket drawing operations, but it is an oil rather than a thin paste like our regular swaging lube, and is therefore more messy to use by hand. The regular swaging lube is water soluble in hot water, and is made of cosmetic grade materials that most people find good for the skin rather than the contrary. (Some people may be allergic to lanolin, one of the components of our swage lube, but it is a rare thing.) The JDL-16 drawing oil is neither water-soluble nor is it a cosmetic ingredient. But it has the ability to flow easily at room temperature in an automatic lubrication system. And that is the primary reason we offer it here. **JDL-16** comes in pints.

SIM-TEST^{tm} Ballistic Test Media

Testing bullets in a media that is stable and simulates animal muscle tissue is the purpose of this product. It is a flexible gel that melts at about 180 degrees F., pours and re-casts into blocks, and is made using beef protein with stablizing and anti-bacterial agents for long shelf life without refrigeration. Available in either 10-lb. blocks or cartons of six blocks, SIM-TEST^{tm} gives you a realistic simulation of animal muscle tissue without the refrigeration and mixing requirements of ballistic gellatin. **ST-1** is a single block, and **ST-6** is a carton of approximately 60 lbs.

20. Books and Software

Technical Bulletins, Volume 1

TB-1 is a collection of newsletters or bulletins that was sent to subscribers of the old "Corbin Technical Bulletin" years ago. The chapters address questions about specific technical issues in bullet making, such as a comparison of casting and swaging for time and cost of making bullets. Most of the information is still valid today, though some of the tools and ideas have been greatly improved and updated.

TB-2-E Technical Bulletins, Volume 2

TB-2-E is a collected set of papers that were published in magazines over a ten year period, relating to bullet swaging. Specific experiments, technical articles and monographs, some published only in foreign magazines, are all translated to English and reproduced with permission of the publishers. These are articles written by Dave Corbin about experimental work that lead to many commercial products you see offered today by Corbin clients. Published on CD-ROM.

Technical Bulletins, Volume 3

TB-3 covers the calibers from .14 to .50 BMG with a chapter on each range of calibers, explaining the things that you can do in that particular range to make better bullets for different purposes. There is a detailed study of an experimental long range big bore, notes about the wildcat .22 Flea (a reloadable .22 Magnum built in both a Browning FN 1922 Model autoloading pistol and a Remington Rolling Block rifle) and other interesting features.

TB-4-E Power Swaging

This e-book has been a guide for other bullet swaging tool makers for decades. It describes the math and principles used in developing both dies and presses. Discussion of both mechanical and hydraulic, electric and pneumatic presses is included. If you wish to build a swaging or extruding press, read this e-book on CD-ROM.

TB-4-E covers the use and operation of the CHP-1 Hydro-Press, as well as other information about bullet making, jacket forming and lead wire extrusion. Inclujdes charts of die strength versus maximum safe pressures and other technical data.

The Bullet Swage Manual

One of the first swaging books, by Ted Smith, dating from the start of modern bullet swaging. This book covers the old S.A.S. Dies and early Corbin swaging tools from the viewpoint of the old master die-maker, inventor of the first powder trickler and the original Mity Mite swaging press.

WD-1-E The World Directory of Custom Bullet Makers

This is a collection of several booklets under one CD-ROM. It includes sources for copper tubing and strip, lead wire and ingots, and information on the world's custom bullet makers, marketing and testing of bullets, how to design and specify bullets, and how to build jackets by four different methods. Included in the book is "The Corbin Guide to Jacket Making" and the names and addresses of hundreds of custom bullet makers.

TIII Turning Ideas Into Income

The condensed knowledge of 40 years of marketing and business management are made available to custom bullet makers, inventors, investors, or people who deal with them. Subjects such as marketing methods, partnerships, non-disclosure agreements, patents, consultants and salespeople, and ways to turn your idea into a stream of income using or avoiding some of these tools are exposed with a straight-forward honesty sure to offend some and enlighten others.

This is also a guide to mental preparation for building a secure financial future and keeping life enjoyable while you balance priorities, apply proven principles and become wealthy as a direct and inevitable result. It explains clearly why many people feel they must ignore the very things that can make them financially secure and provide a happy life. Available as an e-Book on CD-ROM.

HB-9-E

You are reading it now! The condensed how-to info with a little business advice, warranty info, product descriptions, and more.

BP-7 Multi-Media Pack

This is a special package of information with all the technical bulletin publications, handbook, swage manual, and a DVD movie showing the production of jackets and bullets on several Corbin tools, with detailed close up explanation. You get printed books, e-Books, and video, a collection of seven titles, at a discount price.

Software

Corbin produces software for personal computers that operate on the Windows system. Included are programs to design bullets, calculate the parameters for extruding lead wire, determine the breaking point of dies and the ram thrust and hydraulic pressures of presses

DC-1015

This is a Bullet Engineer's Design Kit of software. It consists of the DC-1001, DC-1003, DC-1004 and DC-TWIST software . Self-starting with automatic installation menu, or can be run from the distribution disk without installation, if desired.

DC-TWIST

Twist rate calculator on CD-ROM, for Windows, goes beyond the limits of the Greenhill formula. Calculates stable twist rates for bullets made of any materials, including lead-free designs, in any caliber. Includes density tables, metric/English conversion, printed reports to include with custom bullets, and calculations that include any kind of plastic or metal tip.

DC-1001

Bullet engineering 101 might be a better name for this powerful software package. Select any of the basic nose shapes, enter the ogive length or curve, bullet weight and caliber, select the desired base design and tip form, enter the desired jacket parameters (for jacketed bullets), and the core material. The program then calculates the various parameters such as twist rate, nose length, boattail length, and ballistic coefficient over a range of velocities. Graphic images illustrate the various shapes. Both rifle and handgun shapes are included, as well as boattail, rebated boattail, flat, cup, hollow, heel base, and tangent, secant, spire, elliptical, wadcutter and semi-wadcutter noses. For Windows, on CD-ROM.

DC-1003

This is the paper patch and multiple materials bullet design software, which calculates diameters and weights for bullets to fit various bores with different patch thickness, or parameters for bullets made from up to four different core materials in the same bullet.

DC-1004

This program plots the real time air resistance (drag) and shows a number of parameters such as BC and Ingalls coefficient on a chart of distance travelled versus velocity. It fires any bullet you wish to design straight up, plots the drag until the bullet reaches zero forward velocity, then drops the bullet so you can see how much force is generated when it strikes the ground. Used to calculate lethality of falling bullets fired over friendly troops, it is a new tool to understand bullet performance. You can quickly change one parameter and see how the drag functions change in proportion, with any caliber, weight, or shape.

DC-DIES

Not an obituary, but the catalog number for the die pressure calculator, a program which figures out safe die pressure and bursting point for any diameter or caliber of swage die, the ram thrust, the internal die pressure, and the cylinder or system pressure using various sizes of cylinders. This is useful for the person who wishes to avoid breaking dies or wants to build their own press. Windows-based software on CD-ROM. Highly recommended for users of hydraulic presses.

DC-LEAD

This is a lead wire extrusion calculator that figures out the pressure, volume, and lengths of any diameter wire from any diameter of billet, with various sizes of hydraulic cylinders. Also calculates the length of lead wire for any given caliber or diameter of core, of any density alloy, for a given weight. Windows-based software on CD-ROM. Very convenient for determining the length of wire to cut for any weight of bullet.

DC-SALES

Helps custom bullet makers determine their cost, distributor, dealer, and retail pricing based on packaging, labor, and material costs. Calculates the price per bullet and for a box of any quantity of bullets from either material price per pound and bullet weight or from combinations of price per pound and individual item price (jackets, cores, additional components). Figures in the cost of boxes, labels, packaging time, construction time, and other factors automatically. For Windows, on CD-ROM.

DC-WEB

If you want all of our published brochures, operating guides, technical tips, and the content of the Handbook of Swaging in PDF format with free Acrobat Reader software, you get that and more on this CD-ROM. It also contains the entire content of our extensive web site with hot links that activate when you connect to the internet (log onto the BAFT licensing site or see the latest firearms news stories, among other things... view road cameras on Oregon roads, get local weather for hunting and fishing, search for words and phrases on our website, or use the megabytes of color images and illustrations in your own bullet-making business with the limited license agreement provided.

DC-JPG-1

Royalty-free bullet images for your advertising or website, on a CD-ROM. Higher resolution than downloading from our website, always at your fingertips when you feel creative! In the standard JPEG format.

DC-JPG-2

Royalty-free inages of landscapes, forrests, game animals, dramatic skys, mountains, waterfalls, and more. Need a picture of a deer looking right into the camera? A black bear? A great background from Montana or Oregon mountains or forrests? It's here, no need for credits or royalty payments. Release and right to use agreement included.

21. Delivery Information

Corbin Manufacturing is a small, family business. The tools and dies are hand built in our plant in White City, Oregon. Corbin equipment is used by nearly every custom bullet making firm in the world, as well as defense agencies, research and development labs, Olympic champions and international world championship level competitors, with backlogs that can run over a year at times, sometimes two or three years even.

Although we try to keep inventory on hand, some items are sold faster than they can be replaced. To be fair with everyone, we work on the oldest order first. Clients are served in the sequence that their orders are entered. There is no way to tell how long some of these orders will take. They might take a day, or they might take two weeks to finish. Some are for a simple punch or die that we have made thousands of times before and can build in a few hours, once we get to it. Other orders are for new concepts that have never been tried before, and may be tens of thousands of dollars worth of equipment.

Therefore, it simply isn't possible to predict when the 200th or 300th order will be ready. It will be done when the orders that came first are finished, or perhaps it will be close enough to one of them to "double up" and make it alongside the earlier one, using the same setup time and thus saving everyone time in the waiting list.

We can make no promise of delivery by any given date, nor within any specific time period, for orders built on the normal sequence or queue, for which the standard prices are published. Once you place the order in the regular queue, it is understood that delivery will take an unknown amount of time, and you should make no commitments based on delivery that could result in any economic loss to yourself or others. Corbin is not responsible for any such potential loss of income based on any assumptions about delivery.

In short, don't go out and sell ten thousand bullets and promise you will deliver them by next month, when you don't have the equipment to make them yet. Wait until you have equipment, learn how to use it, and then knock yourself out with sales, production, promotions, whatever. Don't try to browbeat me into saying I might have the equipment ready next month when I have already said that it is not possible to accurately predict when a given order will be done. I'd rather not have the order in the first place, than to have someone calling me every few days to beg, whine, threaten, and cajole. The orders will all be done eventually. The less time I have to spend saying that over and over again, the sooner they will be done.

I can easily give you faster delivery by raising the price several times. This would push the price of equipment beyond the reach of some clients, leaving more time to make your order. If you don't mind paying three or four times as much as the current prices, then that would be a good option.

Other dies of similar quality to ours do cost from six to eight times more, and that is another reason why we are constantly buried in work. But I've always felt that bringing the price of thousand dollar swage dies down to the hundred dollar level was a good goal, and the only way we could do it and maintain the world-class quality for which we are famous is to limit ourselves to a small staff of highly motivated and skilled people. That translates into longer delivery times.

There are three sides to the production triangle: price, quality, and speed.

If we make products faster, it takes more people and the price skyrockets to pay the salaries, taxes, buy more machinery for them to operate, and cover the benefits and other expenses of having more people making dies. Price and speed of delivery are locked to each other, if quality is to remain high. Faster costs more. Slower costs less. These are handmade products, and the economy of scale really doesn't kick in until we get into much higher volumes of identical items made at the same time.

With presses, accessory items, standard supplies, and even to some extent on a few standard size and shape dies, we have already achieved an optimum speed/price point and usually have all these things in stock for immediate delivery. It is the dies, which are made in over 500 calibers and millions of possible shape/size combinations, that introduce the uncertainty in delivery.

This isn't strictly true for each individual order. If we are making a 258 die set with a 8-S ogive that has been pending for six months, and there are two more orders just like it that came in yesterday, there isn't any harm done by making three sets at once. No one is put behind, because the biggest amount of time is the preparation, paperwork, setup of machinery, allocation of people and time, procurement and allocation of materials... actually making the product is one of the least time consuming stages. The people who have orders that come in the next day are, in fact, moved ahead that much further since we won't have to go through all that setup two more times for the other two similar orders.

So, while I cannot guarantee or even estimate that we might have your new order done with someone else's by next week, it could happen. Even though I may have to say that we have, say, thirty months of work pending, that does not necessarily mean the orders that come in today will all take the full time to finish. It just means they might, if no other similar jobs are in the queue ahead of them.

Why can't I just look at the list and see if there is something pending like your new order? I can, but it doesn't mean by the time we get to that order, it will still be the same. People call and change their orders, which wastes a lot of our preparation and planning work, but it happens. I cannot say with any certainty that the order just like yours that is coming to the shop floor tomorrow will, in fact, not be changed or cancelled before it gets there. So I cannot promise you anything about delivery other than that it will happen with the certainty of the sun rising, even if it isn't the sunrise that ushers in tomorrow.

Overtime "rush" orders

However, if you do not mind paying for overtime work, which doubles the cost of the items which are not in stock and must be built with overtime labor, we can sometimes schedule a weekend or nighttime job over several evenings and give you not only fast delivery but a guarantee of delivery by a certain time.

I do not and cannot guarantee that we will have people available to do overtime work for any future order, but if a die-maker is willing to give up his weekend or evenings to finish your work on a tight schedule (for overtime pay, which with taxes and payroll-linked benefits and shop overhead brings the labor cost to twice that of regular jobs) then we can promise delivery on most die sets within 45 days.

Overtime or "rush" jobs do not put anyone else behind. They are done using time that would not be otherwise worked. If a die-maker, or a team of die-makers for larger jobs, comes in two weekends in a row and works 20 or 30 hours on overtime, that has no effect on the orders in the regular queue, except perhaps to get them out faster because now there is one less order in front of some of them.

Therefore, if you want to "bump up" your pending order to overtime status, all it takes is prepayment of the order to get it going for the very next available weekend. If we know by Wednesday of that week, we can probably talk someone into giving up their weekend and working on your dies instead. If you wait until Thursday, it is usually too late, plans have been made, people are not going to want to tell their wives and kids sorry, can't go on that trip after all. There is more to life than just business.

Why prepayment for overtime? Well, for one thing, if you change your mind after we have put in overtime work to finish the job, or the credit card is overdrawn when it comes time to ship it that coming Monday, then we have overtime expenses in an order that we can only sell to someone else at regular price. The die-maker still gets his overtime pay, and the IRS still gets their cut on top of that.

Without the certainty of payment, we are just too small a business to take the risk. After surviving nearly four decades, I'd like to be around for the next one! Besides, overtime indicates the order will be going out shortly and would have to be paid for anyway, so it should not be a problem.

You do not have to place the order initially on overtime basis. You can place it on regular basis, and see if delivery comes fast enough that way. If you suddenly get a big order potential and want to take advantage of it, and the income would more than cover the overtime rate, give us a call at that time and see if we could do the job on overtime. If so, you can bank on it and make your deal. If not, do not make any commitments based on a possibility. The word implies its own negation. If something might possibly happen, it also might possibly not happen.

But, you know, people do this all the time to their ultimate regret. That is why I am hammering away about it. If you had seen as many upset, crushed, despondent, suicidal clients as I have, all because they wished something to be true so hard that they could only hear what they wanted to hear, you'd join the chorus and help spread the gospel. Wait until you have the means of production in your hands and have learned how to use them before you make any deals. Unforeseen events can happen. And they do. Your order is only accepted with the condition that you understand and agree to the uncertainty of delivery time. Overtime rush jobs are the one exception since, for the space of at least a weekend, your order is the only order in the queue.

The conversation I have with clients who engage in wishful thinking goes something like this:

"When will my dies be ready?"

"I don't know. We have an average backlog of six months right now. Probably sometime within the next six months."

"Well, will they be ready in a month?

"I don't know. We have about 550 orders in the works right now and yours is one of them. It could be much sooner, or it could be that some of these will take much longer than estimated and our six month estimate may be too short."

"Will they be reading in two months, or six months?"

“I don’t know. All I can say is that they will be ready when their turn comes up, and my best guess is about six months worth of work is pending, and the oldest order is about a year old at this moment. You placed your order today, so in theory it could even be a year. But more likely it will be in the next six months.”

“You mean it will take six months to get anything?”

“No, we have lots of things on the shelf that could go out today. But one of the dies on your order is not on the shelf, so we have to build it. If you want the other items, we can ship them today. And it may not take six months for your die. I just can’t tell. It depends on how fast we can develop new tools for the custom orders ahead of yours, and how fast we can make all the other standard tools that we don’t have on the shelf but for which there are prior orders pending.”

“Well, I need to be making bullet before hunting season.”

“Then, place your order on rush overtime basis. Those items we do not have available will be done on the next available weekend, guaranteed within 45 days, and those will be priced at 2 times standard rate. Everything else that is in stock is still at standard price, of course. May I have your bank card now so we can get started?”

“What! Twice the price! No way!”

“It is your choice to minimize delivery time or price. Check around and you’ll find that our overtime price is still a lot cheaper than other comparable quality dies... and if the dies are any good, they’ll take just about as long as ours to make anyway. If this were not so, we wouldn’t have backlogs with people willing to wait.”

This conversation could drag on and on, with the client trying to pin me down to a guaranteed delivery date that I have already stated I have no way of knowing. Instead of spending money on the phone to have this conversation, clients so inclined can just read it here at their convenience, and we can use the time to work on dies (every call just slows us down that much).

If someone really will suffer terribly without the dies before this hunting season, then overtime rush is a good solution. All they have to do is say, “Well, do it on overtime, then. Here’s my bank card to use...”.

Lest some unkind person accuse me of excess greed for offering overtime work, let me be quick to point out that this would be true if I charged three times or four times the regular price, for then we would be actually getting additional pay ourselves. But to charge twice the regular price only pays the actual costs incurred. The die-maker isn’t even being greedy when he gives up his weekend for you, because the Federal Wage and Hour Laws and the Oregon Department of Business and Industry (or whatever department name gets attached to the agency currently administering the so-called "Labor Relations" laws) insist that any hours over 40 shall be paid at time and a half.

Then the various payroll tax agencies, of which there are an amazing number with more joining the party every year, take their additional slice on top of that new and improved payroll. And of course the normal benefits that are a percentage of payroll, such as unemployment insurance and workers compensation insurance and.... well, you get the picture... are all made larger as a result of the overtime. So, when you add up all the petty and not so petty additional costs, overtime is much more like two times regular labor cost.

It is the work of the die-maker that turns a few dollars worth of material into a tool worth many times its raw material cost. In addition, you have the use of heat treating compounds, furnace power, the various tools and reamers which can only make a certain number of dies before they have to be thrown out, and a tiny portion of the huge investment in land, building, and machinery that gives the die-maker a place to work and tools to do the work. You rent hundreds of thousands of dollars worth of assets for a few dollars. But of all these factors, direct labor for a skilled die-maker is by far the largest.

My point is, it really doesn't make any difference to the business bottom line whether you get the die on regular time, or overtime. Either way, you are paying what it costs to build that tool. The margin built into the price is the same. Speed, cost, quality: pick any two, but leave the quality high! When you put your order on overtime rush basis, it helps the people who ordered later, since your order is moved out of their way, so to speak. The time that would have been spent during the regular work week is now available for the next person on the list. So it is with those ahead of your order, who decide to go to the overtime rush basis. Your order moves up the list for every person who does that.

It seems the most fair, honest, and equitable way to take care of people's needs. If you do not need the speed, you can take a 50% discount in effect from the overtime rate, and the trade-off is a nonspecific delivery time. If you need guaranteed delivery by a certain time, then the trade-off is a higher price that pays for the labor to do it. No one is being "pushed aside" or delayed to make room for someone with more available money. Quite the contrary: those who elect to spend more for speedy delivery actually move out of the way of those who don't, and inadvertently give them a little boost in speed of delivery as a side benefit.

Everyone wins. And it is all the same to us, other than the particular die-maker who trades the possibility of a grumpy spouse for a little higher paycheck that week. If you need speed, it is available. If you prefer lower cost, that is also available. Time is the proof of ideas. This has been working for decades.

22. Warranty

Corbin equipment is warranted against defects in material and workmanship. If you receive a defective product, do not try to remedy it yourself. Call, write, or fax for a Return Material Authorization number. Include a legible return address inside the package, along with a brief description of the problem or defect and the RMA number. Corbin will replace or repair such defects without charge other than shipping and insurance. (Normal wear or abuse is not a defect.)

The number to call is 541-826-5211, Monday to Thursday from 9:00 AM to 6:00 PM Pacific Time. The fax number is 541-826-8669. The mailing address is CORBIN, PO Box 2659, White City, Oregon 97503 USA. For UPS delivery, ship to CORBIN, 600 Industrial Circle, White City, OR 9503.

Items which you ordered by mistake or about which you changed your mind may be returned within 30 days in unused condition. A 15% checking, cleanup, and repackaging fee (also called a restocking fee) may be deducted from the refund to cover the cost of the extra work.

Be certain that when you order, you specify the diameter rather than just the caliber. A .45 caliber bullet could be .452 for the .45 ACP, .454 for the .45 Long Colt, or .458 for a .45-70 rifle. Or, it could be .448 for a paper-patched .45-70 rifle bullet. When you order a die or punch, specify the family type (-R, -M, -S, or -H).

When you order a punch, state which kind of die it fits (such as CSW-1, CS-1, LSWC-1, or PF-1) and whether you want the internal or external punch. If you ask for a diameter that later turns out to be incorrect for your application, it may not be returnable if it is a size that is not commonly built, or may incur a restocking fee if returnable.

Airgun pellets are notoriously the “wrong” size on arrival, though they were the “right” size when ordered, built and shipped. If you order a .221 diameter pellet and it turns out that your gun actually works much better with a .218 pellet, we can help you sell the .221 die by offering a free ad on our web site. Of course, if someone else just called and ordered a .221 pellet die, we would be more than glad to make an exchange, but otherwise not. If you ordered a .218 and we sent you a .220 or a .217, that is a warranty situation, and our responsibility.

If you order the wrong item by misusing the terminology or catalog number, this would not be a warranty problem and a restocking fee may apply. Please call the items by their proper names. A die is a die, and a punch is not a die, rod, stick, shaft, or anything other than a punch. If you order a die and really want a punch, or order a punch and want a die, then we may or may not be able to exchange it, depending on whether it can be sold in unused condition as a stock item.

Tools or dies broken from excessive pressure, bent or cracked from improper use are not covered by warranty. Any die can be broken by the application of excessive pressure, regardless of the hardness or softness of the material put into it. You can put a piece of steel in a swage die, and if you do not apply a force that would burst the die, the die will not burst. Likewise, you can put a ball of cotton in a swage die, and if you apply enough force to it, you will break the die. Dies break because they are operated beyond their pressure limit. Improper operation is not a warranty situation.

In no event will Corbin Manufacturing or its associates, officers or representatives be responsible for any damages including but not limited to lost profits or other incidental or consequential damages arising from the use of or inability to use any Corbin product. It is expressly stated and made a condition of sale that delivery cannot be guaranteed for any specific date or before any specific period of time. Corbin makes no representation whatever as to the performance of any bullet made by a client in our dies. Accuracy, penetration, performance on game, and similar issues of performance are subject to outside influences beyond the control of the die-maker, and are not a proper subject for warranty.

Corbin tools and dies are held to our customary close tolerances. The bullets produced are warrantied to be of a given diameter and shape within the bounds of these tolerances when used with the materials recommended and used to test them, and operated in the approved manner. Improper operation or the use of materials other than those specifically used in testing and development of the tooling may cause out of tolerance dimensions on the finished bullet or component, and are beyond the scope of warranty.

Any dimension, angle, or tolerance not specified by the client in writing to Corbin prior to the production and delivery of the tooling shall be deemed acceptable at the dimension, angle, and tolerance Corbin provides. Standard shapes and diameters for stock calibers of dies and punches are subject to minor change over time, depending on changing market acceptance and manufacturing improvements. Dimensioned drawings with tolerance range must be provided when ordering custom shapes and calibers, or the dimensions provided by Corbin in lieu of such written specifications shall be deemed acceptable.

Any shape or dimension ordered to client specifications is a custom part, and subject to custom production fees. A non-custom, standard, or stock item is one which can be taken off the shelf at random and shipped, subject to the customary and usual tolerances and dimensions for Corbin's standard production runs, and is deemed to be acceptable if it meets the general description of the item as published in our handbook and price list, subject to changes from time to time which may supercede older published information.

Standard shapes and definitions of named styles or dimensions are provided on Corbin's web site. If there is any doubt about what you are ordering, ask for a picture or drawing before placing the order. Often there are photos or drawings of standard shapes, on the web site, that will do what you want without the cost of custom tooling.

In most cases, Corbin makes the even-numbered spitzer ogives, such as 2-S, 4-S, 6-S, 8-S, and 10-S radius rather than the odd-numbered radius lengths. The difference between a 6-S and a 7-S, or between a 7-S and an 8-S, is so slight that it would have no practical effect on flight or accuracy. The even sizes are usually "stock" in the sense that the reamers and laps to make those cavities are more likely to be build and ready to use. That means we don't have to charge the tooling fee for the custom shape, and the odds of faster delivery are higher as well.

A warranty replacement of a standard shape, as defined on our web site, is also faster than a custom shape since the custom shape may require re-making the tooling. Tooling for standard shapes, which are used frequently for a large number of orders, is more costly because it is built to last longer for more production, compared to a one-off custom shape.

The tooling to make a special or non-standard shape is usually built to make one or two dies before wearing out, because that reduces the custom tooling cost. This is why it is not true that if we've ever made a certain custom shape in the past, we'll forever afterward have that tooling available to make another die. The custom, one-off tooling doesn't last very long in actual use.

The standard tooling is built to last, and costs more but the cost is spread over a larger number of dies. The custom fee does not cover the entire cost of making special tooling, since we sometimes can make a second die. In summary, the costs are averaged over typical production life, and are not subject to negotiation on a case by case basis. They are as fair and as low as we can make them and still offer the service of custom tooling. The alternative is simply to not offer a service that costs more than it is worth to provide.

23. Nondisclosure Agreements

(This information is covered in detail in the book “Turning Ideas Into Income”. But I will discuss it here since you may not have that book yet.)

Sometimes we are approached by a person who has what he believes is a potential wealth-creating new idea for a bullet design or application, and the first thing he wants is to have us sign a nondisclosure agreement so he can see what we think of it and have us produce some prototypes to show investors. I have to decline for these reasons, some to protect us, some to protect him:

We do not know if we may have already worked with this idea until we see it, and if we cannot see it until we sign a nondisclosure agreement, we are saying we won’t do something that we may already have done! In fact, if the idea is actually practical, we probably have produced something like it before.

After all these years, thousands of inventors and ideas, and hundreds of successful businesses arising from them with our help, it is highly likely none of us can even remember if we saw the idea before or not. I can hardly remember whether I saw my wife’s note to bring home a carton of milk or not (at least the handwriting still looks familiar...). After all these years of helping thousands of people with their projects and never stealing any of them, I can only say that if our reputation for honesty isn’t enough assurance, then our signature on that paper would be equally worthless.

A person looking for investors (which is nearly always the motivation behind the nondisclosure paperwork, the patent filings, and so forth) is attempting to sell an idea in a mature (you could say “ancient”) market which has achieved a high level of success with the ideas that have already evolved over the past 200 years of firearms history.

What we would rather do is help someone turn one of those ideas into a product, and sell the product themselves, proving the idea has an actual market and is profitable in production. Then, if he is inclined to find investors, he has a much more attractive set of options, including selling a business opportunity rather than just a design concept. A going business is far more marketable than an idea for a bullet, no matter how good the idea may be.

Everyone has an idea for a better bullet. The only profitable ideas are those that get produced. Very few custom bullets are unprofitable when marketed in a reasonable way, whereas very few bullet ideas—as ideas only—are marketable at all. For us to encourage the whole "intellectual property" marketability concept by participating in the trappings, such as nondisclosures and so forth, is a bit of a sham and I'd rather not do it.

We specialize in the custom bullet market and have so many clients who need our help that we cannot afford to waste resources in the field of mass marketing. Firearms is a very conservative, slow-moving field at the mass market level, where the technical merits of a new bullet can be far down the list of desirable features. At the top would be low-cost high-volume production, which means not making significant changes to the tooling or the marketing system.

Mass producers have already spent over 200 years, in some cases, building a product line, distribution system, and brand image. It works fine, so why buy outside ideas? (Products, maybe: you may sell a mass producer 100,000 special bullets a year for a niche market, since it might be just the ticket compared to them developing the idea and producing it themselves in such low quantities.)

Again, getting involved in legal paperwork that is primarily of benefit and concern in regard to the mass market, when our specialty and reason for existence is something else, would just complicate our lives unnecessarily and imply support or participation in an area where we really have no expertise to offer.

If you think it is likely this idea is original with you, and we've never seen it before, and if we did see it you would need some kind of legal protection to keep us from disclosing it to others, then please don't even bother to bring it around. Take it to a mass producer straight away and let them sign. If they steal it, you can have all the fun of suing them, and your lawyer can have all the fun of billing you by the hour... for years to come!

We don't make bullets for a living: we help others do it, and most likely we have seen anything that is likely to work many times before. We have yet to steal any of them and get rich and retire in the Grand Caymans beyond the reach of the local attorney who drew up the nondisclosure paperwork. If that had happened, would I be writing this now? Here's a flash: people who make custom bullets seldom get rich. They can make a nice living, maybe even better than average. But get rich?

The incentive to steal your idea is nonexistent. See that file cabinet, over behind the reception desk? Yes, that five-foot tall beige one with four drawers. Well, it is full of ideas of our own that have no risk of belonging to a client. I don't have time to work on more than a tiny fraction of them each year.

What do we need with more ideas? Give me more die-makers; those are worth stealing away from you if you happen to bring one along! But ideas? Please, we're overstocked. We give them to clients, free. Here, take a bag full! Then disclose as much of it to as many people as you desire...the only thing that makes money is selling the bullets, not thinking up more designs.

I can't even count the number of people who have sat across the desk from me with fevered eyes and breathlessly whispered their secret, get-rich schemes based on an idea will never make them a dime, but will help pay for various lawyers' next vacations, and help enrich patent attorneys, providers of non-disclosure boilerplate, contract printers, and business plan developers.

All of it will come to nothing for the poor fellow bubbling over with excitement at the greatness of his idea. Meanwhile, someone else who actually gets some equipment, makes some bullets, and markets them, will be doing just fine. Not getting rich, mind you: just making a nice living doing something he or she enjoys. This is the person I can actually help.

And there is no need for a patent, nor contracts. You just need a willingness to be patient, keep plugging away, and eventually build a nice market for the product that the idea produces. And yes, perhaps someone with far more money may buy the business out later. Meanwhile, it is established beyond a doubt that the idea works, and you will have made money instead of just spending it, even while waiting for the deep pocket buyer who may or may not ever show up. The bullet maker is a winner either way. This is our kind of customer. Together, we manufacture success.

The End