The Corbin Handbook

of

Bullet Swaging,

No. 8

by

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1. Introduction to Bullet Swaging

Good morning! I'm Dave Corbin, and for more than 20 years, I've been helping people make the state-of-the art bullets you read about in articles and magazine ads. Nearly every custom bullet maker in the world started with equipment developed at the Corbin die-works. Yet, it seems that only yesterday my brother, Richard, and I were debating whether there was any possibility that someone could use our equipment to make a respectable living, producing custom bullets.

All you have to do is scan the pages of nearly any magazine catering to handloaders, and you'll see that the pages are full 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 major name brands of ammunition (the premium offerings, of course).

Corbin Manufacturing publishes a book called the "World Directory of Custom Bullet Makers" listing hundreds of individuals and firms whose names you will recognize if you like to read gun magazines. When I read the list, I remember people's enthusiasm for the new bullets that we were able to design tooling to make, and figure out a good way to market, 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 muzzle loaders to custom fin-stabilized shotgun slugs, have come to the die-works where my brother and I have toiled for the last quarter century, some just to improve their already-outstanding achievements, and some to help others become better shooters by manufacturing their own best 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, and other defense-related organization have visited us over those years. 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 a President 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 drug-crazed 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 on the backs of dinner napkins, 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 (as opposed to the RCBS single-die take-apart system); Charlie Heckman, a pioneer swage maker; and so many others whose names probably are 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 much 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 in leading to the products and companies you use today than just that: Hornady, Sierra, Nosler, Barnes, and a host of other mass production operations owe their very existence to the concept of bullet swaging. Today, more than three hundred and fifty 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—make a full-time living by producing specialty bullets.

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 those answers here. If you read through this book and think I have left something out, you are absolutely right: I left out about six 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. And that's why it takes at least six 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 diemakers 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.

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—including most gun writers, unfortunately—never find out, 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 350 times so far!

2. Principles of Bullet Swaging

When we say “bullet”, the projectile or part of the cartridge that is propelled through the air is indicated. The news media in the United States often refers 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, notably England, 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 the general news media seems inclined to do. The bullet is inert metal without any explosive or propellant involved, which means that it should be treated as a precise metal product, not some dangerous, risk-laden component subject to transportation restrictions and tariffs.

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 the 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.

Bullet swaging is the process of applying extremely high pressures (from 15,000 PSI for soft, unjacketed bullets to as high as 200,000 PSI for solid copper bullets) to bullet metals 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 holsters through mail order!

It concerns me that some people don't bother to learn the difference between a die and a punch, and consequently have a string of fouled-up orders that must be carefully untangled. But then, I'm an old curmudgeon and can grouse about anything I like, 'cause that's the rule for curmudgeons (Rule 109, look it up in the curmudgeon book).

My foreign friends, whose mastery of the English language is far superior to anything I could claim in their native tongues, may be forgiven for such errors. It is interesting how seldom someone from a Spanish, French, Portuguese, Italian, Dutch, Afrikaans, Greek, Arabic, or Hebrew speaking country ever makes these basic errors: I'm afraid I have to point the accusing finger at my British, Australian, Canadian, Kiwi and 'merican speaking mates as the worst benders of terminology.

It wouldn't be any bother to me at all, if I didn't have to figure out what a person really wanted. For casual conversation around the campfire, no harm is done if someone calls a revolver a pistol or a die a punch. But a person who really wants a die and gets the punch that they actually ordered isn't usually very happy about it.

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 very special conditions are observed. Usually the difference in diameters has to be within 0.005 thousandths of an inch when you reduce finished bullets by drawing. Jackets can be drawn *much* more than this.

Bullet jackets properly designed for 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 pushed a jacket into a die that was 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, and can also result in loose cores.

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.

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 have set up. 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. If you do that, you have 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.

On the following pages, you'll see an illustration of a LSWC type die. 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 down. It can be pushed by a pin incorporated in the design of the press (with a Corbin swage press), or it can be pushed by a plunger or a special ejection tool (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 is where you push in the material to be swaged. Obviously, that end has to be fitted with a punch that comes out all the way. Otherwise, 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). The external punch fits into an adjustable "Floating Punch Holder", in the press head or top. 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, half-jacketed 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, we know you don't really 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 .307 inches on the outside before swaging. The wall thickness of the jacket might be .025 inches at the base, so the core would have to be no larger than .307 minus twice .025 (twice the wall thickness), or .257 inches

You would cast scrap lead in a core mould, or cut pieces from a spool of .250 inch diameter lead wire to easily drop into this .257 bore die, swage them up to .257 inch diameter, and then they'd fit nicely into the bullet jacket. (There would be two more steps to expand the core inside the jacket, blowing the jacket out like the skin of a balloon, and then forming the ogive on the bullet to finish it).

But if you wanted to make a lead .308 diameter bullet for a .30 Mauser, 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 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 LSCW 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 ogive curve from shank to tip. 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).

A straight-hole kind of die uses a punch, with a cavity machined in the end, to form the bullet nose. The edge of the punch would strike the edge of a jacket and crush the jacket. A punch edge must be .02 inches or more thick to stand up to swaging forces: making the punch edge "paper-thin" so that the jacket might stand a chance of jumping over it doesn't work for long, because the thin punch edge soon cracks and falls off under the high pressure. You wind up with a ragged .02 inch edge anyway!

There are only a few dies that use this semi-blind hole design. One is the "Point Forming" die, which we abbreviate "PF" die. It 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 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 without using a special LT forming die. You have a finished product. 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. Again, no problem. 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, let the ejection pin deform it somewhat during ejection, and then use a "lead tip forming" die, or "LT" die, to shape up and shear off 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 just minutely larger than the point forming die, perhaps only .0001 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 surplus will be sheared off neatly, leaving only a neat lead tip with a very slightly different ogive curve from the rest of the bullet. It will look very nice.

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.

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. 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.

I would love to launch into a long-winded mathematical discussion about why a rebated boattail beats a standard boattail, but let me just give three fast ones:

First reason: 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 an extra 15% improvement in accuracy sound as one reason to use the RBT design?

Second reason: 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?

Third reason: 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 semi-blind hole style 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.

Neither my brother nor myself wants to fool with the BT after all these years of match-winning, record-setting results, so we don't make regular BT dies.

All this is documented in greater detail, with mathematical proofs, in a 1970's era report by Dr. Fitzgerald of Scotland, who conducted a study at the Lapua (Finland) factory. Lapua first developed the RBT design, or at least made it popular among target shooters. The good doctor was kind enough to send me a copy of his work "way back when". The paper is primarily for people with a strong calculus background, and isn't especially easy reading, but the conclusions are clear enough.

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 just cut the bottom of the jacket). You could also seat the bullet as usual and then reform the base in this die.

A lead bullet 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.

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". My brother Richard and I 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 .14 to .458 in the hand presses, or from .224 to 20mm 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. No other firm builds as many different styles of swaging presses, or matched systems of dies, and that is one reason we have been buried in orders for decades, sometimes with backlogs that went back two years or more! We built a new plant in 1984 primarily because the waiting list for our dies had reached nearly three years, and hardly anyone wanted to cancel their orders. The new die-works helped, but demand has grown constantly, steadily, and sometimes with big spurts (just after the 1986 gun laws and the Brady bills went into effect, we had more orders in a single month than in the previous quarter).

For years, so many people have been making a living with this equipment and setting world records of every type with the bullets that there is no longer any reason to doubt that the process works better than any alternative method (such as casting or lathe turning) and the business aspects of custom swaging are viable. If you know anything about modern bullet design, you have already heard about the Corbin Hydro-press, since nearly every custom bullet maker in the world uses one. There are six other Corbin swaging presses, including three hand operated models and three other hydraulic/electric models. We'll cover them individually along with the dies in later chapters.

Remember these swaging principles:

1. Never swage down; always swage up in diameter. *Punches and components should slip into the next die by hand, or else they shouldn't be put in at all.*

2. Use only enough force to expand the material to the diameter of the die bore and then stop. If the material won't completely fill out the die with normal pressure, there is something else wrong. *Look for excess trapped lubricant or too hard an alloy of lead for the particular shape and method.*

3. Work carefully and be gentle when moving the ram. Don't whip the handle up and down as fast as you can, because you will surely slam the punch into the face of the die sooner or later and wreck it. *You can get better speed with a nice steady pace rather than brute force!*

4. Pay attention to instructions that recommend the use of soft lead, or annealing the jacket, or using the right lubricant. There's a good reason. *All the downstream steps are affected by missing one upstream.*

5. Use the correct thickness and type of materials for the particular dies or punches, and use the right punch in the right die. *It is amazing how many times the only problem is that someone used the wrong punch, or material.*

6. Read about the process before you try it, to save time, needless investment in the wrong tools, and frustration. *Corbin publishes eight books and many software programs to assist you. That's far more than was available to the shooters of the past. It's a good time to be a bullet-maker!*

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 secret from you, since it might affect their own income if you knew.

The most common misconception about bullet swaging is that only a few people really have the money and expertise to do it right—that the 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.

Horse-feathers!

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, through an interview and an article, all about your business, would you tell them "Hey, 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 long and hard about it and then say "Man, it's tough: 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. Forget for a second that I'm also selling products and services: that's advice from me to you on a personal level. 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.

Often the connection is two or three layers deep: the writer might not be "on the payroll" of the person about whom he is writing, but perhaps the owners of the media he is selling the article through have a vested interest in protecting advertising revenue from someone who might be harmed if the absolute truth were printed instead of a slightly shaded version.

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.

Long ago, I sold a successful electronics company and was able to spend a few years playing with various ideas before getting serious about starting another company. I loved writing historical articles about the firearms field. Firearms played a much larger part of our unique national history than just their dramatic involvement in winning the West. They are woven into the very fabric of our industrial, technological and financial history in a very positive way.

Like space research and computers today, firearms contributed to our technology and general well being in many ways during the early development of the United States. I wanted to do something worthwhile to help shooters, and to be involved on a day to day basis in the field that I enjoyed so much.

I decided to devote my time to the development bullet swaging. I did it to preserve an art that I felt was worthwhile and on the verge of dying, as well as for my own enjoyment, and to make a living by helping others start their own bullet-manufacturing firms.

I had made enough money in my other business activities so that I didn't need to earn very much for several years, and could afford to spend the time as needed. I divided my time among writing, developing new businesses for other people, and building what was eventually to become the world's largest bullet swaging tool company.

This latter activity would keep me honest regardless of any other motivation, since there simply are not enough people who meet the criteria to be commercial bullet-makers to build a business based on anything other than repeat business from people who are successful. Being successful at the development of swaging equipment meant more than just selling tools to handloaders:

it meant developing the commercial market for specialty swaged bullets and helping handloaders become successful bullet makers. The repeat business from their growth was necessary to fuel the continued growth of my company.

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 would have to be successful, and continue to purchase equipment and supplies as they grew, or the swage die business would not work well enough to be viable. Although I had earned enough so that I could afford to try this, I certainly couldn't justify running it into the ground! Only a fool wastes money on ventures that have no chance of success.

After more than two decades of providing income for six families of Corbin employees, it's fairly obvious that there must be something 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.

You'll probably read things here that I say are not practical today, and perhaps years from this writing they will be. Maybe you are reading this years from when I wrote it, and I will contradict the literature published at that time. New ideas and products will develop to make those changes. That's progress! But by and large, the principles are well established by now, even if some techniques and tools will change.

I have promised my clients that I will not compete with them, or reveal their own secrets regarding discoveries they have made on their own about how to make better bullets for some special purpose, and I don't. It is extremely tempting to manufacture custom bullets myself. If I had known how very profitable the field was going to turn out to be, decades ago, I would probably never had made any equipment for other people. I would have made dies and presses for my own use and just manufactured exotic, highly profitable bullets. What better product to sell than one for which the sole purpose is to use it up in a one quick shot and then get another one!

But back then, I didn't really think there was much chance that the gun writers, editors, publishers, and the general handloading public who read their work would pay serious attention to custom bullet makers. I assumed my own success would always be limited to a handful of loyal clients because the firearms media would be interested in preserving the advertising income from mass producers, and the limited size of each of the custom bullet markets would mean a custom bullet maker wouldn't count for much with the firearms press.

No matter how much better bullet a person working in their garage could build on specialized, low-volume swaging equipment, I felt that Winchester, Remington, Speer, Hornady, Sierra, and maybe a handful of other big advertisers would always be featured in articles and stories, press releases and new product reports. They'd get all the coverage, and thus almost all the sales. The "little guy" making special purpose bullets would be on his own, with just me and perhaps a few enlightened gun writers to help spread the word. For a lot of years, I was partly right. In the past ten or so, I have been mostly wrong!

Today, you can hardly pick up a gun magazine without reading something about one of my clients who makes a better custom bullet. Of course, the big advertisers still get the lion's share of the praise, but that's life. And it's rare for one of them to make anything that isn't touted as the answer to every handloader's prayers, regardless of how mundane the design really might be in comparison to the products of custom bullet makers. Still, the public and the press have elevated custom bullet making from a dark art to a serious, mainstream part of the firearms industry.

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 to avoid losing face, and in some cases have purchased bullets from my clients instead of trying to come up with their own. The fact that more than 350 people (as of this writing) 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 that are now being made for them 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 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!

Regardless, there are some facts that you should know, because there have been so many myths and smoke-screens thrown up by people who either don't know any better, or have a vested interest in keeping you in the dark about swaging. Bullet swaging puts aside the final barrier between you and the performance of your firearm. It steps right in and hands you the power to find out what works, and what doesn't, if you have the mental capacity to do scientific studies (anyone with good horse sense has that ability: it means comparing "apples to apples", using reasonable control samples and conditions for valid comparisons, and judging performance based on a wide enough base of experiments to be meaningful).

This is damaging to the hype artists. If you can easily find out for yourself that some over-touted design fails to perform as well as your own, it takes the wind out some very costly promotional sails (yes, and *sales*, too). If you have been reading for years how only some master match-winner turned bullet-maker can possibly make bullets good enough for your rifle, and then you find out in one weekend that your own bullets can outshoot them, there may be a sputtering noise as a highly publicized ego deflates. All of a sudden, you start looking a little harder at what the "big boys" and the experts have been repeating, and maybe you question some of those statements.

The same thing happened when handloading began to look threatening to the commercial ammunition makers decades back. They fought the idea that people could handload their own ammunition. Some of the gunmakers voided the warranties on their guns if handloads were used (since gunmakers also sold ammunition). But handloading was too powerful a tool to fight for too long. After all, muzzle loaders were "handloaded". People made their own bullets and wads, and the advent of cartridges and smokeless powder just continued expanding the possibilities.

Bullets which are cast are not a threat to the large bullet makers because there is so little profit in competing with them. Bullet casting businesses come and go all the time because of the slim margins and intense competition. A cast bullet is a piece of frozen lead. There isn't too much you can do to make it "exotic" or enhance the value and performance.

Swaged bullets open the floodgates of design. The process can be used to make almost anything you can imagine in a bullet. Swaging is the process used by mass producers. You are tramping into their territory. They know that given the right tools, you can make better bullets because the process is only limited by constraints of time and material quality, both of which you can control with less regard to final cost than they must exercise in the mass market.

Those with an interest in protecting their commercial territory would like to see as little as possible in print about swaging. What has been in print in the past several years is just the tip of the iceberg: a great deal more has been going on with bullet design, with private individuals building successful bullet manufacturing operations, and with development of ideas that go far beyond those of mass producers. You have heard a tiny amount compared to the actual state of the art, unless you're involved in swaging already.

There are also a number of myths which are based partly on a desire to keep people out of the field and partly on misunderstanding of the facts. I would like to point out something that you should know about metallurgy, to avoid being "taken" by misleading advertising and opinions of people who don't know what they are talking about. 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 word that is turned into an advertising catchword.

There is no such thing as a single kind of 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, 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. The 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 that have fair shock resistance, 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! And it might run 100,000 miles a lot smoother and cooler with fresh oil.

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.

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.

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 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 even 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. The prices would be different, but the relative prices would be the same between carbide and tool steel. 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. *Hogwash.* 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.

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.

Unless you are operating a high speed punch press, there is no point and less value in brittle carbide as compared to tough, high-carbide-content die-steel. A person who understands the materials and their actual benefits can make an informed decision. 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! But for the past 20 years I've been proving over and over that it isn't necessary and it isn't good value for this application.

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 across. 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, Richard and I 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:

◆ 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.

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, or else you need to sacrifice some weight to use conventional jacket lengths in the extremely long ogive designs. As a practical matter, this might mean making your own jackets from copper tubing or with Corbin's bullet jacket maker kits using flat strip. There is nothing wrong with this, but it runs up your equipment expense as compared to using a conventional shape, and eliminates the possibility of using off-the-shelf jackets for normal and heavy weight bullets.

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.

There can be a significant difference in accuracy, however, 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 same size ones, and oversized bullets tend to shoot a little better but 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.

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 miss the point of it all: shooting. If it works, it must be right by definition.

Another secret is that many factory barrels are so far different from each other that you wouldn't believe it, and 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 a precise bullet if the bore isn't 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 varys 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.

What about the pressure ring myth? 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 you call about, and the technical support person claims is actually a feature: it's supposed to work that way, didn't you know? It's designed to crash!

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 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.

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. 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!

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 .14 to 20mm. 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.

There certainly are a lot of myths to debunk! I don't think this book is big enough to handle all of them, but those are a few of the important ones that might keep you from trying something that would actually help you. I think one of the most important myths is really a whole grab-bag full of related ones about strange, mysterious things you might have to do in order to get your bullets to shoot accurately. 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.

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? Oh, my, it's time for a refresher course, Logic 101.

Once Friday I made a pile of bullets and wanted to shoot a good group so much that I spend all afternoon weighing and sorting them into two piles. The first pile had almost no weight variation that I could measure: those suckers 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 them up 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.

One more myth: the correlation between bullet weight variation and bullet "quality", which generally means potential accuracy. This one is partly true and partly misunderstanding. 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. One of the gunsmith/die-makers on the Corbin team has built an accurate .22 Hornet rifle for testing this in a quantitative manner. He has loaded bullets to serve as control for the average groups, and will be conducting a long series of experiments to see just how much weight variation of both eccentric and concentric type is required to affect the group size.

(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.) I suspect we will 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, but we'll get some hard facts and numbers and then write about it later.

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.

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.

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 probably 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, 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: we make errors like anyone else. I'm sure that at NASA or Sandia Labs or Cal-Tech there are tools of greater precision than we can justify or 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. You could put a ten decimal place readout on your car odometer, but the wide tolerance in the little gears and cabling to the engine or transmission would limit the usefulness to whatever mileage reading you normally get without all the decimals.

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. 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

Besides the swaging dies to make bullets, there are also jacket making dies. You can buy ready-made jackets (the cups or empty skins for the bullets are usually made from a copper alloy, from 100% copper to 80% copper and the rest zinc). 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. 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.

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 in a hand press only for jacket lengths of about half an inch (or less), 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 draws that exceed the half inch jacket length, in order to get full power at the start of the stroke.

Copper Tubing Jacket Maker Sets (CTJM-1-M, -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! Prices of from seven to twenty cents for material, depending of course on the source, quality, size, and length you need, would be a good range in 1996 as this is being written. Of course, if you can get a reasonably good quality of tubing surplus, from contractors or plumbers, and the wall thickness variation is not too bad, you might get by very cheaply indeed.

Regardless of the size or type, you would cut it to length, deburr one end, put the piece over a precision punch and round the end over in one of our end-rounding dies (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.

The advantages are (1) tooling is quite reasonable in price, (2) the number of operations is relatively small and not hard to learn, (3) tubing is fairly low cost and you might get even lower priced deals from building contractors just finishing up a big apartment complex, (4) the process makes very tough bullets for big game shooting. And there may not be any practical alternative, if you need a high performance hunting bullet.

In a Corbin hydraulic-powered press such as the CHP-1 Hydro-press, or CSP-2H Hydraulic Mega-Mite press, using the -H family of high pressure dies, you can completely close the base so no hole appears. In the -M and -S family of hand press dies, which fit the Corbin Silver Press CSP-3, or the Series II Press, CSP-1, or when using an -H die in the Mega-Mite CSP-2 hand press, you 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, so it 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.

Partitioned jackets can be made, in either the CSP-2H Hydraulic Mega-Mite or the CSP-1 Hydro-press: the tubing is compressed between two punch shoulders while supported internally by smaller diameter punch tips, leaving only a short space between the punches for the jacket to fold inward and create a double-thick partition. I don't recommend it if you can use Corbin Core Bond instead, which is inexpensive, fast, and works much better in actual big game hunting than a conventional partition design.

The disadvantages of tubing jackets are:

(1) the walls tend to be straight, rather than tapered, so that without special operations the jacket will not be the "controlled expansion" type...

(2) tubing jackets 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), and...

(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!

Four types of Copper Tubing Jacket Maker sets:

CTJM-1-M (Copper Tubing Jacket Maker, type -M) uses 3/4 inch diameter dies, and fits either the Silver Press (CSP-3) or the Series II press (CSP-1). This set can make jackets up to 1.2 inches long, although you must move the punch holder back and forth to load longer pieces and form them. The wall thickness is limited to 0.035 inches (the standard type L copper tubing normally has 0.032 inch thick walls). Only copper tubing is recommended. Jackets can be made from .25 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 O.D., 3/8 inch O.D. and 1/4 inch O.D. without paying for costly custom drawn production runs. These can be used to make all calibers in the range mentioned (as well as calibers up to .512, but not in -M type dies).

CTJM-1-S (Copper Tubing Jacket Maker, type -S) uses 1 inch diameter dies, and fits the Series II (CSP-1) swaging press, or the Hydro-Mite Hydraulic Bench Press. This set can make jackets up to 1.2 inches long, and may require some moving back and forth of the punch holder to load the parts. The same wall thickness and diameter limits apply, but the dies are stronger and less likely to be broken if you apply more than the required force. Although I don't recommend or guarantee it, some clients have had good success with brass and aluminum and even mild steel tubing in the -S dies. Proceed at your own risk, though.

CTJM-1-H (Copper Tubing Jacket Maker, type -H) uses 1.5 inch diameter dies, and fits the CSP-2 Mega-Mite press, the CSP-2H Hydraulic Mega-Mite, 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.

CTJM-2-H (Partition Tubing Jacket Maker, type -H). If you should wish to make a partitioned or H-sectioned bullet, this is an option to consider. Bonding the core will actually give superior performance, in regard to retained weight. But the fame of the Nosler Partition Bullet* and the earlier German H-Mantle design has made people aware of the genre. That alone is enough reason for us to offer tooling to make it.

The process is quite simple. It is only possible with the power of the Hydro-press, or the Hydraulic Mega-Mite press. Two punches fit into the cut tubing, one from either end. Both have a reduced diameter tip section that just fits inside the tube to support it internally, and of course the die wall supports it externally. But the length of the punch tips combined is just short of the specified tube length.

When you place the tube in the die, and the punches begin pressing on either end with their narrow shoulders (which can only be the wall thickness of the tube), the tube material is supported everywhere except in the middle, between the punch ends (because there is a gap between them). The tube folds inward upon itself, and the punch ends come together on both sides of the fold and compress it into a pressure-welded band.

After this is done, two short cores are made, one for either end. The tube is drawn to the right diameter in a draw die, and then put into the core seating die. A special core seating punch with a probe tip supports the partition from inside, while you seat one of the cores in the opposite side. Then you turn the tube over, change to a new punch with a shorter probe section (just barely inside the jacket, where the core comes almost but not quite to the end of the jacket).

A second core is then put into the remaining end, and a normal core seating punch presses it in place. This punch is the same one that seated the other core. So, you can see that there would be two core seating punches, normally both of the internal type, and only one external core seating punch. The bullet, at this point, is a cylinder with lead in both ends, one lead core being just below the jacket end and the other can be just about anywhere in relation to the jacket. The core just below the jacket edge will be the base section.

To close the base, you would put the bullet into the point forming die backward (base first). Using the core seating punch, you would press on the nose section to force a small curve on the base, just in the length of jacket that protrudes pas the core. Then, you would turn the bullet over, putting it nose section first into the point forming die, and changing external punch to a full-diameter point form punch. This punch presses on the curved base edge and flattens it, while the nose is shaped in the curve of the point form die.

You would normally make a run of each operation, then change punches to continue with processing all the jackets through the next stage. I explained it as if you were only going to make one bullet. It's a good idea to make one bullet, before you start a run.

You then know what the end result will be before you make hundreds of components. If you don't take the time to finish one, you have only yourself to blame if your big pile of almost-done bullets turns out to have too small a core or too large a tip, or too much lead to let the base roll around and flatten properly. It is still much faster than casting, and a great deal more safe.

It isn't necessary, nor is it practical, to form a totally solid wall between the two chambers of the jacket. Normally, there will be a hole left in the partition. The jacket will be nearly doubled in thickness from the folding upon itself, and the hole may be only one eighth of an inch or so in diameter. If you want to make a totally closed partition, you can put a small copper rivet or a copper disk inside and flatten it in the hole with the core seating and partition supporting punches.

This design of bullet still has some slight flexibility so it is no harder on your barrel than any other bullet made of the same material. Don't worry about the partitioned area being a solid copper band that may increase pressure compared to the thinner walled jacketed bullets. It isn't, and it won't.

Having told you all about the partition jacket maker, now I will tell you that if it were my decision, I would save my money and not buy it, and would instead make "bonded core" bullets, which outperform the partition design by a wide margin! All you have to do to bond the core to the jacket so it cannot separate (which is the whole purpose of the partition) is to swage a core that drops into the jacket with a slightly loose fit, put a drop of Corbin Core Bond liquid in the jacket along with the core, and heat the jacket with a propane torch or in a furnace until the lead melts. Let the bullet cool, wash it in baking soda and hot water to clean and remove the last bit of core bond material, and then seat the core as usual. Your bonded core bullet will outperform any partitioned bullet, and you save money and time building it.

A tip you can use: to keep molten lead from running out the hole in a tubing jacket, get a block of potter's clay and push the jackets down into it to hold them upright (only enough to support them, not even a quarter of their length). Drop in the core, which must fit easily by hand or it is too large. Put in a drop or two of Core Bond, and heat the jacket with a propane torch until the lead melts. The clay will probably harden into a little plug in the bullet's base hole and seal it, but in any case it keeps the lead from running out. You can squash the block again and use it until all the clay is gone or turned hard. You could also wipe a plug of clay into the base holes and then use something else to support the jacket. Leaving the tiny dot of clay in the base is not a problem. It weighs next to nothing and looks interesting.

Changing lengths and tubing dimensions

You can change the length of a tubing jacket, if you also purchase two additional punches per length. The two punches are (1) the end rounding punch, which 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, and (2) the end flattening punch, which likewise has a probe-like section that fits inside the rounded, drawn and annealed tube just far enough to compress the rounded end and make it flat, within your existing (not part of the set) core seating die. Sometimes you can use the same end flattening punch, depending on the amount of change in length. 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 about a quarter inch or so longer than the length of the smaller diameter of the punch (so it projects that far past the punch tip). Another way to look at it is to make the tubing about half a caliber longer than the punch tip length, since you are going to fold it over half a caliber per side to close up the base. The length of the cut tubing is marked on the punch. Length is critical to within about 0.01 inches for a given punch.

Selecting the right tubing

The standard sizes of tubing that are available, and which we stock for resale, are 1/2 inch O.D. and 3/8 inch O.D. We can also make custom diameters. Three other useful diameters are 7/16 inch O.D., 5/16 inch O.D., and 1/4 inch O.D. They are more difficult to find than the first two, but we can draw them for you.

In each case, the closest larger diameter of tubing is selected as the starting point for a caliber you want to make. 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 two punches for each length. You can't make jackets shorter than the punch design without striking the punch end against the bottom of the die, which fails to fold the jacket over to make a base. Longer tubing will tend to buckle.

The wall thickness of standard tubing is 0.032, 0.035, 0.049, and 0.065 inches, depending also on the diameter. Some diameters are simply not available in a given thickness of wall without custom mill runs (translates into a big order and lots of money). If you want anything else, it may be available if you can buy a mill run. We can not make jacket maker sets without having the tubing you plan to use. Each jacket maker is a complete development effort, trial and error, to make sure it does the job right. We can not do it "by the numbers" because tubing tolerances are not that close and our die and punch tolerances are extremely tight. We have to have some material on hand to work with.

If you plan to use our standard tubing, then there's no problem. 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

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 .515, such as .600 Nitro, .577 Snyder.
1/2:	.510 and .458 down to .400 diameter.
3/8:	.375 down to .318. Best in .375, .358.
5/16:	.314 down to .264 caliber. Best for .308.
1/4:	.257 down to .224 (but free .22 cases are available)

You need to know how to cut tubing to length without wasting too much effort, or damaging the ends with burrs and crimps. A tubing cutter usually rolls the end so much it won't fit over a punch. 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. We use a turret lathe and an air feed. We can chop up accurate lengths with one end deburred in runs of 500 or more.

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.

You must anneal the tube *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.

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.

If you bond the core using Corbin Core Bond, you will melt the lead in the jacket in the presence of the bonding agent, and this will heat treat and stress relieve the copper, but it is not a full anneal. 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. Failure to anneal tubing before drawing can cause the same thing.

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. But the scale can and should be removed.

We make the BPK-1 Bullet Polisher Kit for this purpose. It is a kit consisting of a vibrator motor prewired with thermal cut-out, 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.

5. Drawn Strip Jackets

A second form of jacket making uses flat strip instead of tubing. This is the method used by the factory bullet maker. Strip 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 about half an 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 my brother Richard has done in bringing the costly high-speed production system down to an affordable, lower-volume operation. Until his research and experimentation brought about the JMK- series of tools to make flat strip into quality bullet jackets, you would have been faced with rebuilding very 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.

Jacket making, in the traditional way, is a commercial venture for people who want to invest at least fifty thousand dollars up front, spend a year or more getting the bugs out, and then keep someone on staff who could go elsewhere and earn a comfortable living. The traditional equipment is far to complex and touchy to just buy it and run it, like a blender or a TV set. You have to constantly fiddle with it to make good parts and keep it running, and sometimes that takes a very skilled fiddler. Besides which, if you want new equipment that can be put on line in a few months and has any sort of guarantee of working, the price tag jumps into the half million dollar range. And the profit on jackets isn't so great that I would feel comfortable with the kind of return that investment could generate!

But now, with a considerably smaller investment, you can make every bit as good a jacket, perhaps 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 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. Ours is one of the few systems of jacket drawing that works well with 99.995% pure copper strip. You no longer have to use copper tubing to get the large mushroomed bullets that don't crack apart on impact.

The cost of these tools is less than a tenth of what you'd have to pay for a used punch press system, including the Hydro-press (which can be quickly set up to make lead wire and jacket, coins, medals and fishing tackle if you so desire). Because the alignment system is in the press head itself, rather than being built with each die set in a "die shoe", 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 would 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 home and takes days to tool up, so you must make hundreds of thousands of the same part once you have it working. Otherwise, the setup 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's a day or two in punch press production time.

If you need millions of jackets, the cost and time involved make good sense. If you need a more moderate quantity, they 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. We do that for you, to help stabilize the price. 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.

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 400 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.

Someone who earned about six dollars an hour would certainly be able to punch the buttons and make the bullets once you set up the job and adjusted the process for them. This is being written at a time when less than five dollars is minimum wage. It doesn't require a brain surgeon to run a Hydro-press, once you have set up a given operation. You just have to come back every so often and set up a new task.

The one hour labor costs you six dollars, and the material for twenty bullets times 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? What do you get at the bank now, five percent a year? During the high inflation times, we used to earn twelve percent on a two-year certificate of deposit. Think of the difference, investing in yourself and your own products! You are the most important investment you'll ever make, and the most secure, since no one else will pay as much attention to it as you will.

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 inch lengths. We provide our standard .030-thick deep drawing grade pure copper, in a 1 inch width. If we have open and partly used coils of other widths and thicknesses on hand, from making special sets, then you can purchase just five pounds of these other sizes. The only one we stock, however, is the .030 inch wall, 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 in lengths up to half an inch, and the smaller rifle jackets up to perhaps .257 caliber.

CU-100 (Copper Strip, 100-lb coil). The second package is the flat, pancake coil. The most economical weight is the 100 pound size, which we stock in several widths and thicknesses. There is a slightly higher price per pound for a 50 pound coil, and we do not stock this size but can provide it on special order. Larger sizes than 100 pounds are difficult to handle, although you can buy them directly from a copper mill in minimum quantities of 500 pounds. The 100 pound coils are a flat, pancake coil with a large "eye" or center hole, which fits 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 "unattended" 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 so far, and the press shuts off when material runs out.

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, sometimes over two years. 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 Series II Press). Corbin CSP-1 presses make up to .5 inch long jackets from .030 inch 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, which typically run from .75 to 1.3 inches in calibers below the .50 Browning. 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 half an inch. Sorry: that's just physics. If people were made with 20 foot long arms, then we could build hand presses with bigger strokes.

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 specific number of draws and any special strippers or punches are specified and explained. These sets are custom tools made to produce the jacket you want, and generally are not stock items. We may have some in the more popular sizes.

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 or the CSP-2H 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 combined draw and trim. The jacket is reduced at least twice its wall thickness, while a punch that just fits into the die at one point, and has a tip that fits inside the -drawn jacket, pushes the jacket through the die. When the shoulder of the punch comes to the die mouth, it shears off the jacket at that length. One length of jacket can be made per punch. Additional punches can make shorter jackets from the same starting point.

Each jacket maker kit is designed around one specific caliber, wall taper, and length of jacket made of a specific material. It may be possible to change the final draw and trim punch, to make shorter jackets, provided the trim is in a portion of jacket that is under about .030 inches in wall thickness. Thicker wall sections are very difficult to pinch trim. This means that a straight-walled .050 inch thick wall jacket may have to be drawn near the mouth to less than .030 inch wall thickness in order to trim it evenly (or else, you would have to arrange for some other trim method). In this example, it would be unlikely you could make a shorter jacket simply by changing a die or punch, because the initial starting blank thickness and width would be designed to result in a heavy walled jacket of a given caliber and length.

However, if you were to make a .458 rifle jacket that tapered or had two different wall thicknesses, say .050 inches for half its length and then .030 inches tapering down to .015 inches at the mouth, this could be pinch trimmed fairly easily in the tapered section to almost anything you wanted, just by buying additional pinch trim punches for each length. 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 hate 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 contraption. It has a jacket conveyer belt with a motor, 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 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 100 pound coil to the press head over a six to eight 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 is 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 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 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 pinch 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). And finally, you can buy just the final pinch trim punch to make shorter jackets (but not longer ones) than the main design called for. 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.

There is a special liquid lubricant that we provide for the automatic lube system on the JMK-2-H. This lubricant feeds from a glass reservoir down onto felt roller wheels, which in turn apply a film of lube to both sides of the strip. This is necessary to maintain the die life and reduce sticking. I can't tell you how long a set of dies will last because we have not been making them for enough years.

So far, none of them have worn out. If the punch wears out at the shoulder after five or ten thousand bullet jackets, I would not be surprised. I do consider pinch-trim punches to be more or less a consumable item, considering the tremendous strain applied to their edge. No, I can't make them out of "carbide" because any of the carbides that are significantly harder are also much more brittle and would pop off like an icicle. We do work with exotic coatings, which are a trade secret. Let's just say that there are heat-cured dry film and penetrant compounds which will do far more than carbide to extend die life.

Corbin publishes a manual called the *Guide to Jacket Making* which is incorporated into the larger book, *World Directory of Custom Bullet Makers.* If you are interested in manufacturing jackets from tubing or from copper strip, you would benefit from reading it. The *World Directory* 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.

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", lets 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 to make the washers scrape all the fouling from the bore on each shot, and eliminate the need for lubricant, 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 had plenty of copper strip, which was much easier to work at high accuracy than zinc. The disks were coming out of our simple disk-punching die set with a little cone shape because we combined the center hole punch with the cookie-cutter punch. First the little pin punch would poke a hole about one sixteenth inch in diameter through the strip, and then the rest of the punch would come down against the strip and punch out the correct diameter for the caliber.

Except, as I said, the disks came out slightly cone shaped because the force of the little pin punch bulged the strip into the much larger caliber-sized die hole. We almost tossed out this idea for the disk-making die, but on second thought, we realized that if the disk were cut slightly oversized and it were made a cone shape, 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.

By accident, 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 received their final diameter from the swaging action, within the same die, at the same moment.

A second benefit was that the disks would work in a slightly 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 our .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.

My friend Jim Crane, who used to market our Bore Cleaner and introduced me to Metallic Silhouette Pistol shooting, and is a world record shooter in that game, used a .44 Magnum pistol with full loads in a match, with these Base-Guard bullets. After the match, he said the bore was just as clean as before it started. That was years ago, of course. Now, thousands of shooters are using the Base-Guard bullet. It has been to regional, national, and international competitions of all sorts, including Practical Pistol matches of every flavor.

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 personally made four hundred bullets in just under an hour, including cutting the lead wire, swaging the bullets and making the Base-Guards! This was for a match, so they had to be loaded in the next hour.

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-M, or BGK-1-H Base-Guard kit (the -S type doesn't exist because it would be identical to the -M, since the die fits into the press head and must be the same size for either the Silver Press or the Series II press).

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

The Silver Press or the Series II vertical steel press both can use the -M type die for making Base-Guard disks. 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. There is no type -S because it would have to be identical to the -M.

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

This set is similar to the -M type, except that it is made with a longer stroke and somewhat tougher components. Both dies screw 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.

You can set up a short, automatic stroke operation in the CHP-1 Hydro-press, and slow the ram travel to a comfortable cycle rate with the flow-rate throttle. Just turn the knob to get an up and down cycle which gives you plenty of time to move the strip to the next position. Keep your hands away from the moving punch and wear tough leather gloves to avoid being cut on the edge of the strip (it is rare, but could happen).

BGK-2-H (Automatic Base-Guard Machine)

If your custom bullet business involves Base-Guards, you may be interested in obtaining one of these high speed production machines to make the Base-Guard disks. This is a very specialized machine, which only makes Base-Guards, but can be tooled up to make almost any caliber.

The BGK-2-H uses a CSU-1 Corbin Strip Uncoiler to handle the 100 pound coils of 1 inch width, .030 inch thick copper strip. It lubricates the strip, feeds it automatically, and punches out from one to four disks at the same time, depending on the caliber. You can set it to make a certain number and stop. It will automatically stop when the copper runs out. Sensors detect the presence of strip in the feed mechanism.

A second, optional CSU-1 can wind up the punched strip so that you can sell it as a secondary product (in some cases: not all calibers provide an efficient pattern of holes that leaves enough web for coiling strength in the scrap). Copper strip punches full of holes makes great grounding strap for lightening protection, radio towers, microwave relay stations, and other electrical grounding applications. It is light and carries a great deal of current, and can be fastened easily by any number of means including embedding in construction materials.

The BGK-2-H comes with one set of dies in your choice of caliber. The CSU-1 is optional, but either it or something just like it is necessary for reliable automatic feeding. Additional dies can be obtained in virtually any caliber from .224 to .58 Minie. The most practical calibers are the .25 ACP to .45 Auto, and the .45-70 Rifle. The BGK-2-H is built using similar components to the CHP-1 Hydro-press, but it uses a smaller and faster cylinder mounted on top of the press head, rather than a large drive system below. It cannot be used for anything other than making Base-Guards, washers, or disks. But it does that job exceedingly well and for a very reasonable cost.

Production rates range from about 1,000 to 4,000 parts per hour, depending on the number of punches that will fit across the strip in a diagonal pattern. Special versions using wider strip and more stations can be made, for an additional cost. The press is available with both 120 volt 60 Hertz single phase (standard USA household current) power, and in a 240 volt, 50 Hertz single phase export version.

Base-Guards offer an attractive alternative to both hard cast and lubricated bullets, and to gas checks, half-jackets, and even full jackets when used at velocities up to 1,400 FPS. The bullets are quick to make, much faster than casting. They are precise, especially if you double swage by either making the core in a separate CSW-1 core swage die and then forming the nose and applying the base in a CS-1 core seating die, or else by first swaging the core without a Base-Guard in the LSWC-1 die, then dropping in the Base-Guard and applying it in a second stroke.

You can add the Base-Guard option to any of your existing sets of dies, just by ordering the appropriate base punch. And really, 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. If you have a .45-70 paper patch swage die, or any other die where the diameter is not the same as the caliber (since paper patched 45 caliber bullets are usually swaged at .448 inch diameter), be sure to specify the actual diameter, not the caliber!

For any JSWC-1 set (Jacketed, Semi-Wadcutter two-die set), you would want (1) PUNCH-M (or -R, -S, or -H), Internal, BG, and specify the diameter.

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 -M sets (and type -S is not made since it would be identical to type -M). 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 both the Silver Press -M and the Series II Press -S).

There is no -S category in draw dies. Use the -M for both. The -H dies, however, are different. There is more stroke, more power, and a longer alignment section. Also, we utilize tougher materials that stand up under the greater force and speed possible. 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.

JRD-1-R, -M, -H (Jacket Reducing Dies)

A way to produce special jackets is to draw down an existing larger caliber of jacket 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. Jackets can be drawn to the next smaller caliber in one pass (generally speaking—there are always some exceptions).

A .45 caliber jacket can be made into a .44 in one stroke. A .44 can be made into a .41 or .40 caliber. By making several reductions in sequence, 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.

If you want to draw the jacket down at least twice the wall thickness, you can use a special jacket drawing set that pinch trims the jacket to shorter lengths. You cannot pinch trim the same diameter. The pinch trimming die set uses a stepped punch. The tip of the punch fits inside the jacket after it passes through the draw die, but the larger diameter only fits inside before the jacket is reduced. The larger diameter portion fits through the ring die snugly by itself, leaving no room for the jacket walls, and the jacket is thus pinched off as you push the punch on through.

There is a special die set called the ET-2-M (or -S, or-H) which expands and then trims off the expanded portion of the jacket. This gives the effect of pinch trimming at the same diameter, since you start with the same caliber you eventually have at the end. But in reality, a die and punch are first used to swell up the part you wish to cut off, so it is large enough that another punch with a shoulder can fit inside it, and then only the shoulder alone can fit through a matching ring die, shearing off the jacket material. This set cannot be used with extremely thick jackets, because the force and shear angle become too great. If you need to trim a piece of virtually solid copper, use a saw or lathe.

A ring of jacket material is left on the punch when you pinch trim a jacket. It can be pushed off during the return stroke by using a disk and tube ejection system. The disk is a large diameter washer that fits over the larger diameter portion of the punch. The tube fits around the press ram loosely. When the ram is retracted, the disk is drawn back with the punch until it is stopped against the top of the tube. The ram continues back, forcing the cut part of the jacket off the punch. This ejection method is also used in the .224 and .243 rimfire case jacket maker dies, to push the formed jacket off the punch.

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.

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

Now, you won't be one of those who try pushing a .323 bullet into a .318 swage die, will you? Instead, you'd get a BRD-1 Bullet Reducing Die (a ring die) and DRAW the bullet by shoving it through the hole, which is probably a .3165 or .31754 hole, depending on the amount of springback in the particular bullet used to make and adjust it.

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 at least two or three times the wall thickness, easily.

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. What works a few dozen times during limited trials may fail in long term use because of unexpected wear or slight changes in the materials due to normal tolerances. Perhaps what works in one specific instance only worked because the materials were exactly right. It might not be so easily repeated.

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, but in hunting, 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, and 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. But the odds are overwhelmingly in favor of 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, finger-strippers 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 half an inch may not be practical in a hand press.

RFJM-22 -R, -M, -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. Many 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 Silver Press or Series II press. We don't make a -S version, because it would be identical to the -M type in every way. The -R differs from the -M version only in the punch.

In the reloading press, the punch has a T-slot head or button, like a shell-holder. In the -M version, to fit our two hand smaller hand presses, 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.

There is a tube with a disk attached to one end, and a hole through the disk that just slips over the punch. This is the ejector disk and tube, which slips over the ram. If your press does not have a ram that will fit inside this 1-1/8 inch tube, such as a bar-type or progressive press, it won't work for making jackets in this way. You are a bullet maker now, and you should have a real bullet making press! Put the disk and tube assembly over the punch, with the open end of the tube pointing down toward the press frame.

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.

When you find this point of adjustment, you have two choices. Either you can process all your cases at this setting, at which point they will probably stay on the punch and be ejected by the tube and disk assembly, or you can adjust the die carefully so that the jackets (they are turned into jackets now) will come all the way through the top of the die on two or three strokes (pushed up by the two or three cases that follow).

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, if you settle for processing in two passes, one to iron out all the rims, and then a second with the die adjusted lower, to push all the cases through one after another. Or, a firmer one hand shove will get them through in a single pass, but only if you find the exact point where one case will push the next one without mashing the mouth.

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 do get it dead soft, that is fine. But 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.)

A jacket drawing die is also the second die included in a set of copper tubing jacket makers. In this case, the die is made to reduce the standard diameter of the tubing after you have rounded the end of the tube in the CTJM set's first die (the "end rounding die"). There is a limit to the amount of reduction that can be done in one step, based on the pressure it takes to unfold the rounded end of the tube (since the draw die's punch presses on this rounded end from the inside, to push the tube through the draw die). There is no specific number for the reduction possible. It depends on many factors, such as the wall thickness of the tubing, the hardness and grain structure of the particular lot of tubing, and the angle and polish of the die surface. Reducing dies are designed partly by experience and partly by testing and adjustment for your particular set. Arbitrary changes may not work: only the reduction which has been tested is guaranteed to work.

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.

You can purchase lead wire in 10 pound spools, LW-10, from Corbin in sizes from .125 to .390 inch diameter, or you can extrude your own wire with Corbin's equipment. 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".

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 a hard lead for swaging, because swaging gives you so many other ways to eliminate bore leading.

Corbin makes two kinds of core moulds, and two kinds of core cutters. For diameters of cores in the range of .185 to .365 inches, the CM-4 four-cavity adjustable core mould can be used. In this same range of lead wire diameters, plus diameters for the sub-calibers (.14, .17 and .20 caliber) which use .105 to .125 diameter wire, the PCS-1 Precision Core Cutter is recommended. The PCS-1 handles the range from .125 to .365 without any special parts.

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.

If you prefer to cast your lead cores, the CM-4 four-cavity core mould can be adjusted for any practical weight of core by setting the displacement of four pistons in their matching, honed steel 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 held firmly in a 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-4 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 solidly, on screws, the motion of opening the sprue cutter can also be used to tip the mould over so the cores fall out into a box.

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 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.

For casting cores larger than .365 inch diameter, the CM-3 three-cavity Magnum Core Mould is available. It can be made in custom diameters up to .500 inches. It has three piston and cylinder units, instead of four, because of its great size and surface area. Heat radiation becomes too large when a fourth piston and cylinder is added, making it difficult to keep the mould hot. But with three cavities, this mould forms and ejects over 900 cores an hour, ready to be swaged.

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.

Lead wire is not commonly available in sizes over .390 diameter. You can make your own in any size, using the Corbin LED-1 extruder kit in either the CHP-1 Hydro-press, or the CSP-2H Hydraulic Mega-Mite press. None of the hand operated presses can extrude lead wire in calibers larger than 0.125 inches in practical lengths. You need hydraulic power for this.

However, if you do use the LED-1 and extrude your own wire, you can make virtually any diameter up to about 0.5 inches and cut it with the PCS-2 core cutter to the desired length (and weight). The pressure required to extrude lead goes down as the ratio of original slug size (billet diameter) to final wire size goes down. This means that it takes no pressure to push a 0.75 inch billet of lead through a 0.75 inch hole, but it takes a tremendous amount of pressure to push it through a 0.10 inch hole.

The smaller the wire diameter, the higher the pressure needed to extrude it. This should make intuitive good sense to you. Large diameters, then, can sometimes be made from slightly harder material in the same die that would not begin to extrude that material in a smaller diameter. But generally speaking, only pure soft lead is extruded in the LED-1 set.

The LED-1 Lead Extruder Kit comes with four LED-D extruder die inserts (for your choice of four wire sizes), two BMT-2 billet mould tubes, a BMT-Base billet mould tube mounting base so hold the tubes vertical so you can fill them with lead, the extruder die body (which screws into the 1.5 inch diameter threaded top of the CHP-1 press), the extruder punch that presses on the lead and forces it through the die, and a hardened retainer bushing to hold the die in the top of the extruder body.

To use the extruder kit, you would first either buy or cast soft lead billets of about .75 inch by 4 inch diameter. (The tubes and base form a simple mould to do this.) Then you would lubricate the billets liberally with Corbin Swage Lube, and insert them into the extruder body from the bottom, put the punch in the press ram and align it in the body, and insert the desired size of extruder die into the top of the body. Finally, screw in the retainer bushing, and move the ram up.

At no point should any part of your body be over the top of the die! It is possible, but rare, for trapped air to shoot a piece of lead out of the top of the extruder with lethal force. I have a hole in the ceiling of my shop where this happened once. When the lead begins coming out of the die, let it droop over to one side under its own weight, and then, wearing a glove (because the lead comes out hot from friction) guide the wire where you want it to go.

Lead wire does not "join together" well, so cut off the small remaining disk left in the die and insert a new billet. You won't be able to make one continuous long strand of wire by putting in another billet. The pressure required to extrude the billet depends on the diameter of wire, but generally about 1900 pounds of pressure on the gage is indicated when the wire begins to move. If it does not move by then, your wire may be too hard to extrude with the LED-1. Only soft lead is recommended. Try it with the largest size die you own, and if it still won't extrude, it is too hard.

Corbin also builds a LED-2 lead extruder for making short lengths of very small diameter wire in either the CSP-1 or CSP-3 hand presses. It could also be built for the CSP-2 Mega-Mite press using a special punch. The LED-2 comes with interchangeable dies to produce wire for the .14, .17, and .20 caliber jacketed bullets. It cannot make practical lengths of wire for the .224 caliber.

You can purchase lead wire from Corbin for the .14 and .17 calibers (.105 and .125 inch diameters). You can also purchase .185 inch diameter for use in the .224 to .257 calibers. All these calibers take the same size wire, with some exceptions for thick jackets. If you use a jacket drawn from a larger caliber jacket, it may be too thick to accept the standard .185 inch wire which would fit into a normal jacket. In that case, we have a .170 inch wire for the core.

Copper tubing jackets also use smaller cores than usual for the caliber. The way to determine the correct core diameter is to subtract twice the jacket wall thickness, at its thickest portion, from the caliber, then take off anywhere from .005 to .015 inches additional clearance. The result is a core diameter that should not only fit into the jacket, but also fit into a core swaging die which is slightly larger than the original wire size and slightly smaller than the minimum required to fit into the jacket.

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. But 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:

CALIBER	WIRE/CORE SIZE
.142	.105
.172	.125
.204	.170
.224	.185
.243	.185
.251-.257	.185
.265-.277	.218
.284	.218
.308-.338	.250
.355-.375	.312
.400-.412	.340

.429-.458	.365
.475-.500	.390

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.

Lead wire larger than .390 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 .390 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 plan to make swaged lead bullets, either with or without a Base-Guard, then the best diameter of core is just slightly less than the caliber, or the diameter of the smallest die used in your process. For instance, 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.

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. You can swage cores without lubrication, just as you can drive your car without lubrication—for a while! You pay for it eventually. 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. The two lubricants serve entirely different purposes. 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 and pharmaceutical firms.

It does form 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.

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, then you might want to use the -R dies.

Reloading presses have these drawbacks, however:

1. A reloading press die is built only for use with pure soft lead cores, not alloy lead. If you use alloy lead, the pressure will be considerably higher, and could break the die. If the die breaks from excess pressure, it is not a warranty problem and you will need to get another die (and hopefully not use so much force, which generally means going to a softer lead).

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 one of two methods: either 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), or purchase the Corbin PE-1 Power Ejector unit which slips over the top of the type -R die, and gives you a compound leverage ejection system. (Actual swaging presses have automatic built-in ejection 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. Corbin swaging presses such as the Series II or the Mega-Mite travel on roller bearings with the rams guided in long oil-impregnated bushings. This extends the life and lowers the friction. In addition, most loading presses have sufficiently heavy frames but rather weak, soft screw-stock rams and pins which are often 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 we build from alloy steels, with chrome-moly support rods. The Series II 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.

6. Because the whole idea of making swage dies that fit existing reloading presses, instead of the correct design of swaging machine, is to save money, we assume that if you want a type -R system your main goal is to get into swaging as cheaply as possible and still make reasonably good bullets. Therefore, to keep the cost down, we make only larger runs of standard calibers and shapes, and do not make custom shapes or diameters for the -R dies.

The additional tooling cost for custom work negates the savings in getting a die to fit an existing loading press; your custom bullet designs are more economical in one of the proper swaging systems that have a press designed especially for bullet making. One type of -R die comes in any standard caliber from .224 to .500 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 “Econo-Swage” dies. They are only made in the design of a core seater, not point form, lead tip, core swage, or lead semi-wadcutter.

You can get flat base, cup base, dished base, or hollow base styles, or the Corbin “Base-Guard” base (which I’ll explain later). 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 only: .224, .243, .257. They are also available in 3/4-E ogive shape (handgun or carbine style) in these calibers: .251, .308, .312, .314, .355, .357.

Please note that you can make a .30 caliber rifle bullet in these dies, but only up to about 150 grains total weight, and only with the various wadcutter, semi-wadcutter, or round nosed ogive shapes. This is ideal for carbines and handguns, but isn’t suitable for long range match competition. For that you need to step up to one of Corbin’s swaging presses and the dies to fit it. If you use type -M dies, there is no difference in die cost, but only the press itself.

Why do we make type -R dies that can go up to .50 caliber using soft lead, and a semi-wadcutter shoulder, but stop with .357 diameter when it comes to the smooth ogive point forming die?

A reloading press has very little leverage compared to a swaging press, so there are limitations as to the amount of work you can do at various points in its stroke. With a lead bullet which has formed in the cavity of a punch (thus the little shoulder), almost all the work is done at the end of the stroke, where the reloading press has sufficient power.

But with a jacketed bullet and a point forming die, almost half the die length is the ogive in a typical rifle bullet. That means your full diameter seated core and jacket have to be aligned inside the die, and the external punch aligned at least one caliber of its length inside the same die, before the edge of the jacket starts to enter the ogive section. This puts the ram position down in the very low leverage operating region, where you almost have to jump on the handle to make it work. I wouldn't want anyone falling off a handle and breaking their neck!

For those with no sense of humor, it's really because the process barely works in some calibers and styles: its another of those situations where you can get by with something in some circumstances, but you couldn't build a business based on it working every time for every caliber. So, we just make the things we know will work every time. There are far better alternatives for the calibers and styles which are marginal in a reloading press.

I know that other people have made these 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 probably see Corbin swaging tools mentioned in those articles, from way back in the "old days". Try to find those firms today. There are not in business now, you say? Really! And they used those same designs that Corbin will not make?

Now, I wonder if there is something to be learned from that? There will always be a few firms springing up with the same re-invented square wheel, who will shine in the spotlight of publicity and win a few converts, then become scarce as the years pass. It is always sad to see someone fail in business—which is why I am happy from talking to my clients (with their 98% plus success rate).

What kind of reloading press can you use? 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.

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 parked 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.

We make a die that turns fired .22 cases into either .224 or .243 caliber jackets by ironing out the rim and drawing the case to a different diameter. This is the RFJM-224R or RFJM-243R rimfire jacket-maker die. The punch for this die fits into the press ram, and there is a steel disk with a snug hole (like a large washer) that fits over the punch. Then, there is a steel tube that you would drop over the ram, before you put the punch and disk into the ram slot. This tube is about an inch and a half high, and has an inside diameter of just about one inch. It's purpose is to contact the edges of the disk, when you lower the ram, and slide the disk up so that if the jacket sticks on the punch, it will be extracted on the down stroke.

If you have a press with a ram diameter larger than one inch, this obviously won't work. Most reloading presses use a ram diameter from 13/16 inch to 1 inch A few have larger rams. For those, you will need to buy the separate, optional "Big Max" adapter, which is a heavy duty steel tube with a much larger diameter and a larger disk. It will fit over these larger rams.

Here are the calibers of -R dies that we make, and the styles of bullet swages along with their catalog numbers:

Calibers..................... .224 .243 .251 .257 .308 .312 .314 .355 .357

Dies:

CSW-1-R	**Core Swage**
CS-1-R	**Core Seater**
PF-1-R	**Point Former**
LT-1-R	**Lead Tip Former**

Calibers........................... .375 to .500 (soft lead only)

Dies:

In addition, Corbin makes virtually every sort of bullet and jacket reducing die, plus the dies to turn fired .22 rimfire cases into .224 or .243 caliber jackets. The EC-1-R Econo-Swage is normally used for paper-patched bullets, so we supply it with a cup base and a 1-E round nose ogive punch for rifle calibers unless you specify something different.

Another popular use of the EC-1-R and the CS-1-R dies is for centerfire pistol and blackpowder rifle Base-Guard bullets (the fouling-scraper disk that fastens to the base, using a "BG" bottom punch). Generally, a pistol swage set would be supplied with a Keith Truncated Conical (TC) nose style and a BASE-GUARDbase 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 half-jackets (which cover about half the bullet shank) or 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 (they cost more and don't work nearly as well).

General instruction for swaging in a reloading press

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.

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. Squeeze a few drops of lube out, onto a lube pad. Just 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.

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.

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.

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 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 knurled-head knockout rod into the top of the die and tap it firmly with a plastic mallet. Or, if you prefer to use Corbin's power ejector unit (PE-1), install it on the die and just pull down the handle to eject.

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!)

If you have been swaging the cores, 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 EC-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.

Swage as described in steps 6 through 10. 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.

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.

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 EC-1-R Econo-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).

Full-jacket Open Base (military style) Bullets

Just 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. 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, just 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 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.

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 EC-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 purchases 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) for a small extra charge.

Boattail and Partitioned Designs

Those are best done in the swaging presses and larger dies, 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 activity. Corbin builds the RFJM-224R 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.)

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. The lead core, after seating, should be longer than the jacket. How much longer depends on how much lead you desire to be exposed.

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, expands faster yet.

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.

With the jacket finished, you can either cut a piece of lead wire or cast scrap lead into cores with a Corbin Core Mould (CM-4, four cavity .185 inch diameter cores). Both the .243 and the .224 calibers use the same size core. Lead wire of .185 inch diameter is available from Corbin in 10 pound spools (LW-10). It can be cut to length with the PCS-1 core cutter, which has a stop screw to set the correct length for the weight of bullet desired.

The cores can be swaged in the CSW-1-R core swage die for a more precise control over the weight, or used as cut or cast. The variation in weight from cutting or casting is normally about 2% of the total weight. A 40 grain core might vary as much as 0.8 grains from 40.8 to 39.2 grains. This is quite insignificant for most shooting. The core swage will bring this variation down to perhaps one-half percent of total weight. It doesn't get much better than that, no matter what you do except for sorting bullets by weighing each one, an exercise in futility that satisfies some people more than others. The difference in drop due to a variation of 0.2 grains or less is primarily seen on a calculator, not on the target.

In order for the core swage to operate correctly, the press must be run in such a manner that every stroke goes to the physical limit of the ram travel, to leave precisely the same volume in the die between the two punch tips on every stroke. Then, using this same fixed end of stroke position for each core, a small amount of lead must be extruded from the cores. If any core does not extrude some surplus lead, it will probably be light. Cores cannot go over the upper limit, but in that case you may find some that go under and are too light. You can tell by the resistance on the press handle whether the core was extruded slightly or not. If not, toss that core aside for making lighter bullets. The cores are ejected using the standard knockout rod which comes with each set of dies, and a plastic mallet (not provided), or the optional PE-1 Power Ejector device, which fits over the top of Corbin reloading press dies.

Lubrication (Corbin Swage Lube, CSL-2) should be used consistently but sparingly on each core, and then washed off with hot water or any normal organic solvent before the cores are put into the jackets. Corbin Cleaning Solvent, CCS-16, is available for removing all traces of lubricant from cores and jackets. You can use alcohol, acetone, or any of a dozen other solvents as well. Hot soapy water works well, too, but you need to dry the cores before going on.

The jackets are already clean but may have lubricant inside from the drawing process. They may need a final hot water wash or a sloshing around in solvent to remove the lubricant. Any lubricant left inside the jacket only serves to unbalance it and to prevent the core from becoming "one" with the jacket under high pressure. For maximum accuracy, you want the core and jacket to have intimate contact with each other, and nothing else between them to keep the core from slipping as the jacket is spun by the rifling.

Once the cores are safely placed into the jackets, you can then put a little lubricant on your finger tips and, as you pick up each assembled core and jacket, give it a little twirl to spread a film of lube on the outside surface.

The core is put into the jacket and pressed firmly by using the appropriate external core seating punch, in the CS-1-R core seating die. Use only enough pressure so that the core expands the jacket and makes the pair stay within the die. If too much pressure is used, the die will be broken. Gentle, one-hand pressure that feels about like sizing a pistol case is all you need to use.

You can easily bend the punch, crack the die, or spurt lead past the punch through the small air gap if you don't observe proper technique. Swaging is just like loading: the pressures are the same or higher than inside a rifle chamber, and you always want to work up slowly, little by little, to accomplish the goal and then stop. More pressure is worse than useless: it is destructive.

Eject the core by putting the knurled knockout rod (a quarter inch diameter straight rod about two and a half inches long with a knurled head) into the top of the die and tapping it with a plastic mallet. You could also use the Corbin PE-1 Power Ejector, which is a miniature compound leverage press designed "upside down", to apply gentle pressure and push the seated core and jacket out of the die. The PE-1 fastens to the top of the reloading press die, so that a circle of three set screws lines up with a groove in the die body, just below the knurled head portion of the die body. With the PE-1, you can get almost the same speed from the reloading press as you could with the self-ejecting Corbin swaging presses. The PE-1 comes with a straight piece of quarter inch diameter rod that is used instead of the regular knockout rod.

With the cores seated, you would then remove the core seating die and its punch (which fits into the jacket mouth for open tip bullets, or fills the die bore for lead tips) and install the PF-1-R point forming die in its place. Don't forget to change the bottom punch (external punch) to the correct, larger diameter punch which fits more closely into the bore of the PF-1-R die. If you forget, you'll get off-center fins extruded around the punch and the bullets won't be very accurate.

Apply another thin film of swaging lube to the jacket as you pick it up, and push it up into the PF-1-R point forming die. It should slide in easily, by hand. It may stay there under the slight grip of the lube film. Raise the ram, and push the jacket into the die gently, taking care not to strike the punch against the face of the die. If the slot on your reloading press is full of primer residue, the punch may not center or float properly, and you may find that the die gouges into the side of the punch as the punch tries to tip and can't straighten itself up, in line with the die bore. In extreme cases the punch may even bend. (Some reloading presses are so out of line that cleaning the slot does not help. If this is the case, you are better off to obtain a Corbin Swaging Press, such as the Silver Press, and sell the type -R dies to someone with a better reloading press.)

The point forming die has a small ejection pin pushed back by a spring. Put the ejection rod into the top of the die and tap it with a plastic mallet to drive the bullet out. This should be almost, but not quite, comfortable enough to do by hand without the mallet. Don't smack it with a blow that would drive nails! Hold the mallet firmly so that it won't bounce back: the internal spring will push the knockout rod up. If you let the mallet bounce, the knockout rod will be tossed out and clatter across the floor!

If the bullet moves down but does not fully eject, and you can feel spring pressure when you press on the knockout rod by hand, it means the tip is still too open and the bullet you are making is a little too short or light to eject at that particular tip opening. If you want to make a wide open light weight bullet, you can use a small pair of side-cutting pliers (diagonal electronic wire cutters are ideal) to gently grip the projecting part of the bullet and pull it out. But normally you would want to close the tip a little more. Just lower the die slightly and raise the ram again. Lower the ram and try to eject again.

If the bullet has a little teat on the end, with parallel sides, this means you have pushed the bullet jacket up into the ejection pin hole. Back off the die a quarter turn or so and try another bullet. The adjustment is quite sensitive: you will find that a quarter turn of the die can make the bullet look great, open the tip considerably, or put this little extrusion on the end. With lead bullets or lead tips, you will find that this extrusion is quite pronounced if you push too far (die adjusted to close to the ram at the top of the stroke). But the LT-1-R lead tip forming die can put the extra lead to good use.

Soon you'll have a relatively small opening in the bullet tip and the ejection pin (about 0.081 inch diameter) will be able to push against the end of the jacket, instead of trying to go inside and push on the lead core. Ejection should be easy and complete. If the knockout rod stays down and has no spring after you attempt ejecting, it means the pin has stuck into the bullet core. The spring is compressed and held. This is a nuisance but not a major problem to the experienced bullet maker. You just need to find a little lower setting of the die before trying to eject (or use slightly more lead in the jacket, more lubricant on the jacket, or find out if the seated core is oversized and is being reduced by the point forming die).

To un-stick a bullet, remove the knockout rod, unscrew the die from the press, and remove the die insert (the actual hardened die itself) from the black, threaded die body. The die insert unscrews. If there isn't enough of the insert sticking out of the die body to grasp, you can use a finished bullet: stick the bullet into the cavity and use it like a spindle to turn the die. Or if there is a small amount of die insert protruding from the die holder body, you can grip it with pliers (the hardened die insert, not the softer black die holder) and turn it.

The die will unscrew and bring with it the internal punch (ejection pin, spring and punch head). Grasp the head of the internal punch, and gently twist it while pulling out. Normally it comes out without too much fuss. Put the die down with the threaded end against the bench top, and insert the external punch in the die mouth. Use your plastic mallet to tap the punch and drive the bullet further into the die, closing the hole where the ejection pin penetrated the core. Then find a large enough nut or make a large enough hole in a piece of wood so that the bullet could easily drop through it, and place the die mouth down on top of the nut or wood. Put the ejection pin back into the top of the die, but without the spring. Use the mallet to tap straight down (don't bend the pin). You may drive the bullet out. Or, the pin may penetrate again.

If the bullet remains stuck, just continue this operation five or six times and eventually you will fatigue the bullet jacket, make it lose its grip on the die walls, and it will pop out on one of your ejection attempts. Don't try to use brute force: you'll only bend the ejection pin. Each time the pin penetrates the core and you close the hole, you move the jacket slightly back and forth and weaken it. You can use this technique even if you pop the bottom off the jacket and knock a hole right through the bullet. Just push it back in harder and try to eject again and again. Eventually it works.

Don't use a drill bit or tap extractor! Don't melt the lead out with heat! Don't try to pick, drill, or gouge out the stuck bullet! You may get away with it once or twice, but sooner or later you will wreck a perfectly good die this way, and it is not necessary. Be calm and patient, and you can easily get a stuck bullet out of the point forming die no matter how badly it appears to be stuck. Remember that pushing it in a little further is the key to getting it out.

In extreme cases, you may need a short piece of the same diameter of oil-tempered spring wire that we used to make the ejection pin. This piece may have to be driven through the bullet, and perhaps another one driven through to get it out. But the same technique works: push it back in, try to eject, clear the stuck pin, push it back in, over and over until the jacket gives up. Hey, who's got more patience, you or a dumb piece of brass? The most attempts I have ever had to make (in over 20 years of doing this) were ten. I did have to make a couple of short pieces of wire to avoid bending the longer and more fragile ejection punch.

If you ever get a bullet stuck so badly that you don't think you can get it out, send the die back to us and all it will cost is the shipping back and forth for us to clear it. Don't let the Devil tempt you to resort to hard tool bits or heat! Those techniques will only generate more revenue for Corbin when you find out you ruined the temper of the die or put a deep scratch in the finely-finished interior. (Wait a minute: What am I saying? Shouldn't I keep quiet? Well, no... you paid for *helpful* advice in this book, not for advice to help Corbin's income statement! There are plenty of *other* people who won't follow it, anyway.)

I dwell on the bad things that might happen because the good things don't require explanation or assistance. Just don't jump to the conclusion that swaging is any harder than reloading or casting just because the manufacturer himself is willing to discuss the problems instead of pretending they don't ever happen. You know there are all kinds of things that go wrong with casting and reloading, too.

Generally you won't have any more difficulty with swaging than you do with any other activity that requires some knowledge, patience and care. It is not an activity for mindless oafs, but neither is handloading: you probably handload now, so I'm sure you'll find swaging is a similar process with slightly different tools and rules.

Your rimfire .224 or .243 bullet may be finished now, with an open tip or with the lead right up to the edge of the jacket, or it may have a big lead tip with a doughnut of lead on the end. The LT-1-R lead tip forming die is similar to the core seating die, because it has a straight hole through it. The bore is larger than the finished diameter of the bullet, however, whereas the core seating die has a bore slightly smaller than the finished diameter. The internal punch has a cavity machined into the end which matched the curve desired on the bullet tip.

By gently pushing the bullet up against this punch, the tip of the bullet can be reshaped without deforming or expanding the rest of the bullet. A nice radius or a sharp point can be formed in the lead. Any surplus lead will be pushed down against the jacket and pinched between the jacket and the edge of the punch, shearing it off. You must be careful to use very gentle pressure, or at least adjust the die so that you can't generate any significant pressure. Otherwise the edge of the punch will be pushed into the jacket, forming a shoulder.

If you get very small lead tips that don't completely form, and appear to be partially void on one side, this means you are attempting to form a lead tip without sufficient exposed lead. There is a minimum amount required, below which the process doesn't work because there is not enough lead to fill the space in the punch cavity. Also, if you attempt to close the jacket too tightly at the end, the stem of lead that connects the tip with the body of the lead core will be nearly sheared through. The jacket material may be thin, but it does have some wall thickness, and this doubled thickness pushes in from both sides against the stem of lead. Lead tip bullets need to have a fairly wide jacket opening to maintain a secure connection to the tip.

The LT-1-R die uses exactly the same external punch as the PF-1-R die. You can also use the PF-1-R die's external punch in the CS-1-R die to form large lead tip bullets, provided the particular set you have accepts this punch by hand. One of the bad things to do is force an oversized punch into a die that won't accept it with firm hand pressure. The die will usually draw down the punch. The punches are made softer than the dies to save clients money in case they decide to test one against the other (punches cost less than dies to replace).

The use of the -R type dies in any caliber follows the same procedure outlined here. The limitations of the press, which limits the size and alignment of the dies and punches, and the fact that better results can be obtained using a swaging system designed specifically for making bullets, means that many more styles and designs of bullets are offered in Corbin's -M, -S, and -H type dies. These types use the Silver Press, the Series II Press, the Mega-Mite or the Hydro-Press (and variations of these basic models), which permit designs such as the Rebated Boattail, solid copper, and various kinds of jacket making (from strip, or from tubing).

In the Corbin swaging presses, the swaging die always fits into the ram so it is extended forward during swaging, and thus has nothing around it to block extrusions. This means we can design dies that adjust the lead volume during swaging of the bullet, such as the LSWC-1 (Lead Semi-Wadcutter, single die set). The CSW-1-M, -S, and -H dies have bleed holes in the die wall, at 120 degree increments, rather than attempting to bleed from one end of the core (through the punch).

This gives you a more evenly distributed pressure relief port, and greatly strengthens the punch as well. We can't use this design in the dies made for a reloading press, since the die has to fit into the press head. The ram stroke on a reloading press has to stop just below the press head, in order to work with reloading dies and full length sizing. When the end of the stroke is reached, the swaging punch will be positioned so it requires the die to be in the press threads at the point where the bullet is being formed. Bleed holes in the die wall would spurt lead straight into the threads of your press! Angled holes and a smaller die body were tried early on and they weakened the die so much that it would break far too easily with the slightest misuse.

If you want to make the more exotic variations of bullets, faster production speed (up to 300% more bullets per hour), and use an easier and more satisfactory method of making bullets, then by all means skip the reloading press phase and go directly to one of the systems designed from the ground up just for bullet making. You won't regret it.

10. Bullet Swaging Presses

Corbin builds six standard models of bullet swaging presses and one experimental model for labs and special projects. The standard press each have a range of capabilities, and dies of a size that match those capabilities.

The Corbin Presses are:	**Using die type:**
CSP-3 Silver Press	.... -M
CSP-1 Series II	.... -R, -M, -S
CSP-2 Mega-Mite	..............................-R*, -H
CSP-1H Hydro-Mite	.... -R, -M, -S
CSP-2H Mega-Mite Hydraulic	..............................-R*, -H
CHP-1 Hydro-press	..............................-R*, -H
CSP-2 X-Press	.... -R*, -H*, -X

** with optional adapter kit only*

Die Types:

-R	Reloading press, 7/8-14 threads with T-slot ram (soft lead)
-M	Corbin Mity-Mite, 3/4”-OD with 5/8-24 threads (soft lead)
-S	Corbin Series II, 1”-OD with 5/8-24 threads (to Bhn 10)
-H	Corbin Hydraulic, 1.5”-OD with 1”-12 threads.
-X	Corbin Custom Experimental Dies, up to 4”-OD 2”-12 tpi

The smallest swaging press is the CSP-3 Silver Press. It is Corbin’s horizontal swaging machine, designed to use the type of dies having catalog numbers that end with -M. The -M stands for Mity Mite: the original Corbin Mity Mite swage press was the model for today’s Silver Press. If you find old literature that refers to the Corbin Mity Mite, the same operating technique applies to the Silver Press.

(We call it the Silver Press because it was our first model using the rugged stainless-steel powder and black baked-on polyester finish, which gives it a silvery-black appearance. Don’t be fooled by cheap imitations: Corbin never has built an aluminum or pot metal press.)

The Silver Press is unique in several ways. It has a horizontal ram. It has a concentric power system, with the leverage centered along the ram axis to eliminate side torque. It ejects automatically on the back stroke (a feature shared by all Corbin presses). It accepts the dies in its ram, not in the press head, and uses a floating punch holder in the press head (as with all Corbin presses).

Although the Silver Press is the lowest cost Corbin swage press, you need not feel at a disadvantage to use it for the calibers and materials for which it was designed. Even industry giants such as Nosler Bullets have purchased it, for developing prototypes of bullets on the inexpensive type -M dies, before investing many thousands in punch press tooling.

These are some of the advantages of using the Silver Press instead of a reloading press:

1. *Self-ejection on the back stroke.* The Silver Press uses dies which fit into the ram, and which can 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, where is gently drops to the back of the press, cutting several seconds from the time required to make a bullet. Those seconds add quickly!

2. *Self-alignment of external punch and die.* The Silver Press holds the external punch 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 hardened steel ring, placed over the punch between the hex bushing and the solid head, allows a certain small amount of "float" to take 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. *Twice the leverage, over 200% more strength.* Most reloading presses use a 4 inch ram travel and are cast from 35,000 PSI grey iron or aluminum alloys. The Silver Press uses a 2 inch ram travel with the same amount of handle travel, doubling the available ram thrust. It is cast from a ductile iron with 80,000 PSI tensile strength, more than double the advertised strength of even the largest reloading presses (yet the Silver Press is more compact and lighter weight, and takes up less bench space).

4. *Over 300% faster operation.* With a reloading press, you must pick up a mallet and tap a plunger to eject the bullet, and then catch the ejected bullet before it drops to the floor. To swage another bullet, you have to push the components into the die and then get your finger out of the way while slipping the external punch past. With the Silver Press, the die is horizontal: just put components in the die and they sit there, with gravity as your friend and not your enemy, waiting for the one-two stroke that swages and then ejects automatically, with half the effort of a swage press. You can make more bullets in the same time.

In addition to the press itself, the type -M 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. We know that three lengths of dies will cover the entire range from .14 to .458 caliber, for example, and with combined ogive and shank lengths of up to 1.2 inches, in the type -M family of dies.

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 Silver Press instead of trying to buy custom reloading press dies is that the price of the Silver Press and a complete set of dies to fit it, is usually less than half the cost of any other alternative. Those who make "benchrest" swage dies generally charge from $1200 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, and how much better and faster your work would be, if you just purchased the Silver Press and the dies to fit it, instead!

The Silver Press was designed for calibers between .14 and .458, using only soft lead cores and jackets of .030 inch thick (or less) annealed copper, in lengths up to 1.2 inches Regardless of the shape or weight, if the design exceeds .458 inch diameter, or 1.2 inch length, it is outside the appropriate range. If the material requires more pressure to form than pure 5.0 Bhn lead or uses a jacket that forms only with more pressure than a soft copper jacket of 0.030 inch or less thickness, you're working outside of the specified range.

The CSP-3 Silver Press uses a high strength cast iron frame with 80,000 PSI tensile strength. Most reloading presses are built of aluminum or grey iron with only 35,000 PSI tensile strength. Since the Silver Press is horizontal, it cannot be used to reload ammunition even if you were to adapt the 5/8-24 tpi ram to a shell holder. It is designed for optimum speed and ease of use in swaging bullets.

Series II press, CSP-1 model.

This is the most popular press today, because it not only accepts the original type -M dies, but also a 1 inch diameter type -S die (same threaded shank size, 5/8-24 tpi) in the ram. The Series II press is a vertical design, with the floating punch holder in the press head. It is the same FPH-1-M floating punch holder that is used in the Silver Press. In fact, all of the tools that have a -M designation in their catalog number fit the Series II press as well as the Silver Press.

The Series II press looks like a Roman numeral II from the front. It is designed from steel, not cast iron, so it is smaller and lighter than iron presses, which have up to five times less tensile strength and half the power. A set of four roller bearings in the links provides smooth operation. Bearings surround the ram.

Bullets from .14 to .458 caliber, with a length limit of 1.2 inches, are well within the range of most small arms calibers, and are also within the capability of the Series II press. The advantage of the Series II press over the Silver Press is the greater strength (up to 130,000 PSI versus 80,000 PSI), slightly higher leverage due to the full 180 degree arc of the handle travel, 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-M 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 larger than about .308 with any chance of using lead that isn't pure, soft Bhn 5 material, because you could then choose the type -S dies, which hold more pressure than the regular type -M dies. The hardest material suggested for use with type -S dies is Bhn 10, which is similar to many casting alloys, such as a 1 percent antimony content).

As the caliber gets closer to .458, you should consider the type -S dies more strongly (because they are more strong than type -M dies). As the caliber gets closer to .14, you can relax a little more and consider the type -M dies, because there is more metal around the hole and thus the die is stronger even though it has the same outside diameter. There is no absolute cutoff point: we make .458 dies in type -M and type -S, and we can even make type -S dies as small as .14 caliber (but it is a waste of your money in most cases and we'll try to tell you not to do it).

The guiding factor is the lead hardness, your tolerance for being careful, and the odds of breaking the smaller diameter die doing experiments. If your lead is pure soft lead and you are a fairly careful worker, and plan to use techniques that are recommended, the type -M dies should be fine. 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 -S dies are a much better choice. One broken type -M die will more than pay for the cost of getting type -S in the first place.

In neither the type -M nor the type -S dies should you try to swage solid copper, or lead harder than Bhn 10, or jackets thicker than .035 in annealed copper, or any other operation that would take greater pressures than recommended. If you want a caliber over .458, or a length of bullet over 1.2 inches, or a hardness of material over Bhn 10 (such as a steady diet of wheel weight alloys or linotype) then you want type -H dies and the larger presses that use them.

The Series II 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.

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.

Mega-Mite Press, CSP-2 Model

The Mega-Mite is a huge version of the CSP-1 Series II press, weighing over 70 pounds and having a dual stroke of 3 and 5.5 inches. The press also uses roller 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 an optional reloading adapter kit. The press head is removable, as it is in the Series II 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 Silver Press (-M) and Series II (-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 a 12-gauge shotgun slug (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 cannot make a typical jacketed .512 for the .50 BMG caliber because the normal bullet is too long to allow sufficient leverage early enough in the engagement of the power stroke. It hurts nothing to screw a set of .50 BMG dies into the Mega-Mite, but you can push all you like without forming a bullet.

On the other hand, 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).

It is difficult to give a sudden cutoff point where the press works and then doesn't work. This is because many factors influence the amount of force you can apply with any hand-operated press, which gains power as the end of the stroke approaches. Any operation requiring much force at the start or middle of the stroke probably requires hydraulic power, whereas most operations requiring maximum force only at the last half inch or less of ram travel can probably be done on the Mega-Mite, if the diameter doesn't become too large.

With the most blunt nosed, soft lead bullets, a .600 caliber short bullet (under 1.5 inches) can probably be swaged, as can smaller ones. Some shotgun slugs, such as the .410, 28 gauge, and possibly even some short, blunt 20 gauge soft lead slugs, may be made on the big hand press. But a 12-gauge slug, any sort of exotic design of 20 gauge or 16 gauge slug, any bullet with an ogive more than a caliber long, or any bullet over about 1.5 inches in length, probably will require hydraulics.

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. Thus, jobs that require much pressure before the last half inch of ram travel may not be practical on any size of hand press.

The Mega-Mite press is available with the same CSP-S Floor Stand as the Series II press. Both of them have 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). It 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.

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. There are three bars, which are hardened and ground steel. They are different heights.

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, gives a uniform overall length. Internal punches come in three 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 to get the bar under the spring.

Some 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 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 on the down stroke.

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 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 Series II press (not the Silver Press). You cannot use -M or type -S dies and punches in this press, however: the cost of adapters for all the punches and dies would exceed the cost of getting the right dies in the first place!

Choose the Mega-Mite primarily if you need to swage hard lead, reload .50 BMG, make bullets larger than .458 diameter yet not too large, long, or hard for a hand press, or plan to get a hydraulic press later and want to use the same dies now.

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 Series II press, but is equipped with a 3/4 HP 120 volt AC remote controlled power system. The smooth, quiet operation makes long jobs of jacket drawing, bullet swaging, or case sizing go quickly with almost no physical effort.

Although the press itself can generate somewhat more force than the 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), consistent adjustable pressure, 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 bullets 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, or seating many cores. Any job you could do on the CSP-1 but wish to do more quickly and easily, in longer runs, would be an ideal candidate for this press. 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 very 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.

By the same token, if you put a solid piece of copper in the die and tried to swage it with low enough applied force, the die wouldn't break even if it were a thin-walled .458 -M type. It isn't the material hardness that breaks the die: it is the internal die pressure going beyond the tensile strength of the die.

The ram travel can be up to four inches, which allows an inch for loading, an inch for drawing, and two inches for die and punch parts and clearances. It can be blocked at 2 inches for use with the swaging dies.

Neither the CSP-1 Series II 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 far 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 huge volume discounts Corbin already has earned and buy one of the standard presses for which parts are readily available.

Hydraulic Mega-Mite, Model CSP-2H

The Hydraulic Mega-Mite press looks almost identical to the famous Corbin CHP-1 Hydro-press at first glance. You notice the colorful top, the color-coded indicator lamps and buttons, heavy chrome-moly ground and polished guide rods and space-age ram and guide plate bearings. The difference is in the additional logic and control circuits, transducers and sensors found in the Hydro-press.

The purpose of the CSP-2H is to fill in the gap between the CSP-2 Mega-Mite hand press, which uses the same dies, and the more versatile CHP-1 Hydro-press. If you don't need to add automatic strip feeds, or semiautomatic stroke cycle, or let the press finish a bullet while you inspect and package the last one (giving you almost twice the production per hour), then the CSP-2H is a good choice.

With a 2,000 PSI drive pressure, adjustable down to 500 PSI, and position detectors for the ram, you can set not only the correct pressure to use, but also the ram position at the top and bottom of the stroke. This becomes important because it means you can define the stroke, adjusting for various die and bullet lengths to give you optimum speed and minimum wasted ram travel.

If you want to extrude lead wire, make 12-gauge or 10 gauge slugs, stamp out medals or coins from thick strips of silver, copper, brass, or bronze, make copper tubing jackets up to .125 inch wall thickness, or form certain kinds of solid copper bullets, then the CSP-2H may be the most economical choice. If the caliber is larger than .458 or the material hardness exceeds Bhn 10, or the bullet length is between 1.2 and 2.5 inches, such as the .50 BMG bullet, you can choose between this press and the CHP-1 Hydro-press.

There is no other reason besides cost not to get the CHP-1. The CSP-2H is identical in power, stroke, cabinet and head design and takes the same dies and punches (-H). The CHP-1 adds adjustable ram speed, automatic pressure reversing, programmable stroke controls, automatic loading position, adjustable top-of-stroke dwell time, stroke counter, interface and control for automatic strip feeds, ability to use the semi-automated processes such as jacket making from strip with the first two steps combined into one automatic operation, and the speed of having certain parts of the operation initiated and run without further operator manipulation (so you can do something else during the cycle).

Instructions for operating the CHP-1 press are found in the book “Power Swaging”. The same instructions apply to the CSP-2H, except for those controls and features that are not present, of course.

The stroke is adjustable up to 6 inches, with configurable start and end points set by position sensors. The system pressure is 500 to 2000 PSI, adjustable, with top panel gauge readout. This is applied to a 3.25 inch cylinder, for ram thrusts up to approximately 20 tons. This can translate to hundreds of thousands of pounds of internal die pressure, depending on the die bore and contact area. The book “Power Swaging” gives tables of maximum internal die pressure versus gauge pressure readings, to help avoid die breakage. The computer software program “DC-DIES” is a fast, easy way to calculate the breaking point of any die, figure ram tonnage and internal die pressure from the gauge pressure, in any caliber of die.

The CSP-2H weighs about 300 pounds and is shipped only by truck or Air Freight. It can be exported, using a 240 volt 50 Hz or 220 volt 60 Hz supply. The domestic version uses 120 volt 60 Hz single phase power (standard household current) at 20 amps maximum for the 1.5 HP motor.

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 CHP-1 has an adjustable stroke of from zero to six inches, making it capable of loading the largest cartridges (up to 20mm) 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 solid copper rod.

Naturally, there is no limit to the lead hardness or alloy you can swage in the Hydro-press. 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 without going to the huge X-Press (CHP-2), which uses a larger cylinder and a 2-HP 220-240 volt AC motor. Such dies are quoted individually depending on features needed.

The Hydro-press is the world's most powerful bullet swaging press in standard production. 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 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 on a small conveyer belt!

The JMK-2 connections let the CHP-1 shut down when the last of the coil is turned into cups, and provide power to the automatic lubricator/feeder/die-head/conveyer system. 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 .390 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 over a decade 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 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 two 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, ask for the booklet "Opportunities in Custom Bullet Making". It comes with other information regarding return on investment, capitalization of labor, market size and so forth. The negatives are spelled out clearly, but I will summarize it here:

You need to be a shooter and know about handloading to sell and market bullets (a business person is at a disadvantage without this skill), and the market size is limited so that the average custom bullet business will only produce about twice the average wage-earner's income. It probably will not become a big business. Only a few do over a million dollars per year gross. The good points are that relatively few people are in the field compared to the potential buyers, the return on investment is extremely high (typically around 500% per year) and the capital risk is minimal provided you follow a proven, low-overhead plan I outline in the booklet. Plus you can do it at home with the family and have fun!

X-Press, CHP-2

The Corbin X-Press (we call it our experimental model, because the only people who need it are on the cutting edge of experimental bullet designs) is a huge version of the CHP-1. It has more power (2-HP 220-240 volt motor). It has much larger ram and head assembly, and directly accepts huge composite -X type dies. These dies are made by a process of extreme cold and heat, reinforced with a thick band of 4140 steel pressed on while red hot, on a frozen inner cylinder. They are heat treated in special gas atmospheres, salt baths, and by other methods to achieve the necessary strength.

Solid copper or brass bullets in calibers as large as the 50 BMG are made in these dies. A "Top-Gun" 3 gun aggregate 50 caliber bench gun winner, Carl Matts, made the first of the solids on one of the first of these machines and took the winner's position with the bullets it produced. Others have built interesting and unusual bullets that required more pressure than the -H dies would handle, or more ram thrust than the CHP-1 would produce. It is not “better” than the CHP-1 and I would not want anyone to purchase it thinking it was a step up in general. It is a special purpose machine that was built to fill certain needs, and not as a “deluxe” version of anything.

The reason I want to make this clear is so that you won’t say, “Well, if I’m going to go for the CHP-1, I might as well spend a little more and get the CHP-2. It isn’t that much more and I might need the extra power someday.”

The CHP-2 is so much larger that the regular -H dies have to be fitted with adapters in order to work in it. This isn’t a big thing, but it makes the press slightly less convenient to use for “normal” work. Also, the size of the head makes it impractical to adapt the JMK-2 automatic jacket drawing head. It would just cost too much, and you’d be far better served by spending the same amount on a second press (a CHP-1) that is designed to handle the jacket maker head.

This is not to say you couldn’t make jackets on a CHP-2. Oh, no. You could do that. But you would need to use either custom built dies, or adapt the JMK-1 dies with a bushing kit so they fit both the ram and the press head. The JMK-2 is out of the question. It fits only the CHP-1 press, period. We spent ten years developing it, and getting the dimensions and interface just right, and I don’t think you’d want to pay for a whole new development just for the CHP-2 when you could get the CHP-1 for less.

So, why would anyone want the CHP-2? It costs about 20% more than the CHP-1, but that isn’t prohibitive: anyone who can afford the one, can probably afford the other. The main reason you’d want it is for solid copper bullets, aluminum bullets, stamping and drawing heavy strips into coins or cups (heavier than .125 inches, or tougher to punch than .125 inch thick copper), or for fabricating products that simply are too large or hard to swage for the -H dies or the CHP-1 press.

I said products, not just bullets. Many people use our presses for things other than bullet making, although that is their main purpose. Lead extrusion, hollow lead tubing, primer cord, transmission line connectors, bass lures, fishing tackle and sinkers, calcium carbide capsules for emergency lamps, flare gun cartridges, rocket motor housings, even punching holes in truck leaf springs for mounting bolts... there is so much a powerful, controllable press can do. But bullet making is the main thing.

If you want to make a 1 inch projectile with soft lead core and a thin copper jacket, the CHP-1 will probably do fine as long as you use a custom 2.5 inch diameter die. But if you change the specifications to a harder lead alloy, keep the same inch diameter, or want a brass or steel jacket, then probably the CHP-2 is a better choice, along with the big dies that fit into it.

The X-Press is only slightly heavier than the Hydro-press, at about 380 pounds (more steel, bigger cylinder, larger motor). You need 220 or 240 volts single phase power for the most standard of the designs, but we can build just about any kind of version: that is why it is "experimental". Bear in mind, though, that if you drop the power back to 1.5 HP so you can run it on 120 volt single phase power, the speed will drop considerably on the ram travel.

Total horsepower is a product of the speed of travel times the amount of pressure available. If the press is very slow moving, you can get more power with the same motor. If it moves as quickly as you would probably want for reasonable production, and has more pressure than the alternative press, it must have more horsepower applied.

You can use up to a 3 HP motor on a 220/240 volt single phase circuit. If you want more power, you must go to 3 phase circuitry. We can furnish the X-Press larger motors for a differential in price. To gain an advantage by doing this, we also need to size the gallons per minute flow rate of the pump, and its maximum rated pressure, to utilize this power. If your operation doesn't require more pressure or speed, no more power is needed either. It is just a matter of operating efficiency, whether you need to draw that much or not.

The X-Press is available on a custom basis, and isn't usually kept in stock except for the one we have for testing dies (no, sorry, it isn't for sale: we have to keep one on hand all the time for our own use, or we could not do repairs and test the dies!). If you think you want or need one, let's talk it over and see if the CHP-1 would do the job, first. Then if it becomes obvious that it would not be adequate, we can build an X-press just for you, the way you want it.

11. Base-Guard, Half-Jacket and Paper Patch 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.

One of the most common misconceptions is that a person 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 that way. 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 half-jacketed 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 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, OK?

In the -R (reloading press) dies, we have the EC-1-R Econo-Swage, which is almost the same thing without any bleed holes. 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 EC-1-R Econo-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, not hanging down below it, 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 EC-1-R die, you adjust the weight by casting or cutting the lead as accurately as you can before swaging.

In any of the Corbin presses, you would put the LSWC-1 die into the ram, along with its internal punch. With the type -M and type -S dies, in the Silver Press or Series II 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 (which goes in a slot in the ram, but the slot is only in one side of the ram). The bar for the press is made in three 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. The range of bullet lengths in the smaller presses is not so extreme, so we can get by with one stop pin position even with slightly different punch and die lengths.

The external punch always goes into ram in a reloading press, just like a shell holder. But in Corbin presses for swaging, the external punch fits into a threaded body called the "Floating Punch Holder" or "FPH-1". The same kind of 7/8-14 tpi FPH-1 is used in both the Silver Press, and the Series II press. It is designated the "FPH-1-M". 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.

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 FPH-1 up and down. The external punch is held in the FPH-1 by a retainer bushing. In the type -M and -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. There 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).

The type -H sets use punches so massive that their own weight assures alignment as they hang down vertically from the punch holder. 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) in, 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.

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.

Cast or cut a piece of lead to approximately the right weight, plus a few grains (unless you are using the EC-1-R, 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 forward so the punch enters it, pressing on the lead core.

I like to adjust the punch holder so that there is no contact with the ram all the way forward, then 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 child's play. 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. 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 EC-1 die, this isn't necessary because you generally make lead bullets as the final product. But in a core swage 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 EC-1 die, however, the bullet is finished when it comes out of the die, and there are no more operations to perform on it. If you want to make a hollow point cavity in the nose, 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 by careful adjustment and inspection until you have the shape exactly right with the desired cavity size, or you can use the regular nose punch first and then push a HP punch only part way into it (since pushing it all the way would totally change the nose shape into a flat-end hollow point wadcutter).

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 0.0005 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. If you ever get stuck with a quantity of oversized jackets, Corbin makes JRD-1 jacket reducing dies that can be used to pull them down to slightly less than the final bullet diameter. 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.

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.

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 shape or dimension you wish, for a custom fee). 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 1/16 inch). 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.

In the Hydro-Press or Mega-Mite Hydraulic press, you can swage fairly hard lead in a LSWC-1-H die. 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 past 22 years of my experience, but it is possible, so wear eye protection and keep your face back from the die while swaging.

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.

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.

As a practical 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 EC-1-R Econo-Swage we reverse this only 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.

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.)

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.

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 -R, -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.

We'll discuss that one 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, in fact, just 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 very slightly under (perhaps .0005 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 sometimes does not let you make certain shapes very 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.

To make a bullet in any die set that uses the CSW-1 core swage, follow these steps:

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 bushing and ring go around the punch and screw into the front of the long, threaded punch holder. The -H punch does not use a ring, but only a retainer bushing.

Put the lubricated core into the die, and run the ram forward 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.

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 in the Hydro-press or CSP-2H press.

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. You probably 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 of course specify other shapes, standard or custom.

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 alloys, and type -H generally handles any lead you can put into them.

Using the JSWC-2 2-die set to make semi-wadcutter style bullets also gives you the option of adding one more die and expanding the set to a full 3-die package, which eliminates the need to have a shoulder between the jacket and nose, and permits the production of soft point, open tip, or full metal jacket styles where the jacket curves away from full bore diameter. This cannot be done with jacketed bullets in the LSWC-1 type die, because the die is made to combine core seating and core swaging. A long enough jacket to form a full jacket style bullet would cover the bleed holes in the die and prevent the core swaging operation from working.

All you have to do is add the point forming die, but it isn't that easy for the die-makers, who must match the point forming die to within a few ten thousandths of an inch to your core seater—and YOU have the core seater, if the point former is an add-on sale! There are three ways to do this.

First, you can send back the core seater along with its punches (please! - otherwise we have to make the punches just to test the die), and we can test both the core seater and point former together and make sure the diameter difference is correct. Second, you can just send back some lead slugs and some seated jackets and cores from the core seater, in the weight you intend to be making when you get the point form die. This is not quite as good for us as having the die here, but at least we have a good chance of getting the diameter right if you send enough cores (a dozen or so) and they don't become damaged in shipping.

Third, you can throw caution to the wind and just order the die off the shelf, so to speak. We can do it that way, but the odds are fair that the particular die we ship may not be the best critical match to your particular core seater, in which case you will either get tapered bullets or difficult ejection with some sticking in the point form die. Nothing is wrong with either die, usually. It is just a mismatch in diameters. Either one would work fine, if it had the proper mate.

If you send samples or the core seat die, then the fit and function of the point former are guaranteed by us for the jackets and core that you send us to use (or we will tell you if there is any reason it won't work correctly, so you can decide what to do from the reasonable options). But if you order the die without allowing us to test and adjust it to fit your core seater, there really is no way we can guess what will happen, and so while we are more than happy to make adjustments, you'll have to bear the costs of shipping back and forth. Fair enough?

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 kind of thing is the most fun for a lot of bullet makers: 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 Sabre punch (as in the Sabre-tooth Tiger). This punch has a number of saw-teeth cut into the steel of a concave curved surface. It's a real challenge to make one, since they must be hand polished on every surface and angle. But the results are dramatic. You get a sort of buzz-saw bullet that zips through targets. It is a crowd-pleaser, assuming the crowd 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 Sabre-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). The only thing wrong with it is the strange appearance.

Core seating dies (and core swage dies, too) 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, since the head is not right at the end of the punch. It is a larger portion of the punch at least 3/16 inch further along than the end. We call the 5/16 inch end of the punch its “tail”, on type -M and type -S dies. The type -H dies do not use a stop pin, so there is no “tail” on them to contact it. Instead they rest on a hardened steel bar that slides through a slot in the ram.

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 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 cores, and a longer head is used with lighter cores. 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 on 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 Corbin Mega-Mite Hydraulic model, allow you to use one height of ejection bar. The manual-powered Corbin Mega-Mite (not the hydraulic model) only ejects at a fixed position at the bottom of its stroke. Thus, three different ejection bars are provided with the press. The overall length of the ejection bar height 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 step.

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 it that because of the general style, full-jacketed, flat base 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. 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. That means we can use external core seating punches that do not have to have a cavity in them to form the nose. 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 air space inside the tip. You can fill this with a plastic "Bullet Ball" or leave it open. That's the open tip. All it takes is a normal open tip core seating punch, supplied as a standard item with rifle caliber 3-die sets.

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 work orders.

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 normally is of the soft point variety, and is supplied with pistol caliber sets. 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 any HP punch ordered as a soft point type that 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 soft point, or a soft point hollow point. It would not be possible to make an open tip soft point: those two terms contradict each other. Either the lead is longer than the jacket (soft point) 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.

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, this means 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 to expand the jacket, or sticks tightly in the jacket. 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 up to as much as 20 percent 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.

This figure of 20 percent (plus or minus 10) of the bullet weight is quite rough, depending on the amount of taper in the jacket wall. 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 longer core, a shorter jacket, some filler in the bottom of the jacket, or a larger diameter core seating punch. Any of these things will seat the core at a point inside the jacket where the punch fits right.

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. If it is too large, it will contact the jacket wall firmly before you can create enough force to fully compress the lead core. This can stop the punch too early, so that there isn't enough pressure developed in the core to expand the jacket properly. This causes 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.

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.

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.

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 flattened.

Press firmly enough so that the base is flat and 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 that is supplied with all PF-1 dies. 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 that important step.

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.

The more we know about the bullets you intend to make, the better we can design the set to do it. In some cases, you may need more than one point forming die if the requirements of two different designs conflict greatly. 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 .032 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 greatly. 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 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.

14. Lead Tip Bullets

The LT-1 lead tip forming die is available in type -R, -M, -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 probably don't even 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 amount of a mark which the punch makes in the bullet nose. Normally it is quite 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.

Any extra lead will be sheared off against the jacket, because 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 and act as a shear to pinch off any extra lead left over from the deformed tip, after the tip has been properly formed.

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. 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 .032 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 .064 inches in width, so this means no matter how hard you push, you will never succeed in getting the tip smaller than .064 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 0.164 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 0.164 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 so 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. All they make is 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 do both kind of bullets. The same is true of the "L", which only 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 very 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.

In all these dies, a punch that fits by hand into the die is probably the right punch to use, and one that will not fit by hand is never the right one for that die. External punches either fit the die bore, or they fit into a jacket, depending on whether their job is to seat a core inside the jacket or push on the jacket or core from the outside. In every operation except for core seating, the external punch fits the die bore, and so does the internal punch.

Internal punches for point forming dies and for rebated boattail forming dies are not necessarily as tight a fit as those for core swages and core seaters. They provide for air escape and do not press against a lead core (except to eject it). Threads on swage dies are usually undercut slightly so they have a loose fit in the ram, and all the force of swaging is taken up by a shoulder on the die (not on the threads). Reloading press dies are an exception, as they must accept swaging pressure on their threads. This is one reason for the style and caliber limitations in reloading press dies, as opposed to dies made for proper swaging presses.

15. Rebated Boattails

A flat-base bullet can be made in the same die that makes cup bases, hollow bases, dish bases and Base-Guard bullets. These kinds of bases are essentially made the same way, taking their shape from the end shape of an internal punch. In the EC-1-R Econo-Swage die, the external punch forms the base because the alignment of most reloading presses isn't so good that we would trust the fragile edges of the nose forming punch to the rather variable positioning that takes place in the slotted ram.

You can just buy an inexpensive HB punch to turn a flat base bullet into a hollow base. This would be done in the core seating die, and then you would want an external punch to match that shape if you followed this with a point forming die operation. The same punch would work in a lead tip die, if you used one, so there would be no need to buy two external HB punches. This also holds true for any of the other basic base shapes mentioned.

But the Rebated Boattail is special. It requires a pair of dies and a matching base punch for use in the PF-1 die (and LT-1 die, if used). Some handloaders are not familiar with the difference between the RBT and the ordinary BT or Boattail style. Most of the mass production, factory bullets are of the ordinary BT style, having from eight to twelve degrees of angle at the base, and turning to a flat base in less than one caliber length. This leaves fifty to eighty percent of the base still flat.

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. The net effect is close enough to think of drag this way.

An angle on the bullet shank near the base, shaped rather 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 or curve would do as well, but these would not have as much effect on reducing drag.

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 FPS 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 travels 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 atoms and 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.

That takes a lot of energy! 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 a 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 just 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 25% 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 60% of total velocity loss. This means that pistol bullets, which travel much closer to subsonic speeds, and rifle bullets for black powder and muzzle loaders, would 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.

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 results 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 fires 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.

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.

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 that 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.

To build a good rebated boattail bullet, two dies are used. 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 and jam against the bottom of the jacket. The jacket would be ripped or crumpled. First, we have to form a conventional boattail. Then, in a second die, we get the base of the bullet past the shoulder and expand the jacket into the shoulder at 90 degrees, again using lead pressure with a second core seating operation.

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 "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.

Rebated boattail die sets are made in the type -M, -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. In other words, this is too precise for using a reloading press. 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 -M, -S, or -H for a complete catalog number.

Because the boattail base angle is formed 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.

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

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, it will require either the CSP-2H Hydraulic Mega-Mite, CSP-1 Hydro-Press, or CSP-2 X-Press. There is no way, no how, you're going to make a shotgun slug for anything bigger than a 28 gauge on a hand 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 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.

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 make 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 Sabre-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 1.5 to 2 times the normal price of a three-die set. Compared to the selling price of these slugs, it can be a very profitable investment: such slugs often bring $2 to $3.50 each and cost under 25 cents to make (1996 prices).

There is a great deal of similarity in design between certain shotgun slugs and air gun pellets. In regular -M or -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.

The .410 Shotgun slug is a different matter. You can swage these on any hand press, even a reloading press using the EC-1-R die. But the best designs can be made in a real swaging press with dies that adjust the weight while forming the nose and base (LSWC-1). After all, the .410 slug is just a variation on .41 caliber bullets.

A dumb-bell 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 waiste 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 hour-glass 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.

17. Bullet-Makers' Tools

Some bullet swaging operations require special dies for unusual jobs. One of these is the Dual Diameter Sizer die, or 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.

The DDS-1 die is a final step. It is used with other dies, not by itself. 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.

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.

Another kind of special die is the ET-2 Expand and Trim set, for turning one length of jacket into a shorter length of the same caliber. Pinch-trimming requires that there be a reduction in diameter that is at least equal to twice the wall thickness of the jacket. The ET-2 set first expands the jacket to twice its wall thickness, and then pinches off the expanded portion. The net result is you get a shorter jacket in the same caliber.

The ET-2 set consists of an expander die, which is similar to a core seating die with a punch that flares the mouth and a die having an adjustable stop so you can set the distance for expansion, and a pinch-trim jacket reducer die designed to snip off the appropriate length of jacket.

While you can adjust the first die for various lengths, the second die has a fixed length punch and the only way to change the final jacket length is to get another punch. (Making the punch adjustable only works on paper, where even the thinnest threads have no stress on them. In real life, the thin parts and small threads needed would be stripped off just as fast as the jacket itself.)

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. There are two kinds of Corbin cannelure tools.

The Corbin Hand Cannelure Tool, HCT-1, handles calibers from .224 to .458. 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.

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.

The PCM-1 Power Cannelure Machine can process up to 100 bullets a minute, as fast as you can feed them into one side of a rotating wheel. This production-quality machine features a 1/4 HP 120 volt 60 Hz motor running an oil-filled transmission, coupled through a heavy thrust spider drive to a shaft mounted in a strong thrust bearing. The unit weighs about 70 pounds, or 31.8 kilograms, and is about a foot high with a six by eight inch footprint. Cooled by forced air, it is designed or continuous operation.

The PCM-1 uses six standard diameters of wheels to cover the range from .224 to .475 caliber. Custom wheels and back plates extend the range up to 4 bore (.998 inches). A special knurling back works in conjunction with knurling wheels in the same range of calibers as the cannelure wheels, to put diamond-pattern knurls on lead bullets.

Multiple grooves can be rolled by ordering the cannelure wheel built to order. There is no special charge for making any kind or number of grooves on the wheel. 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.)

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 1850 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 five by five by six inches deep. It has a low thermal density ceramic liner that allows rapid heating and fast cycling time.

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.

Corbin also builds custom dies. 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.

Over time, we may make adjustments in the length of a pistol nose or depth of a cavity-forming punch, according to what seems to work the best for the largest number of clients. These standard punches are described by drawings on our order form or price list as well as in our books.

If you need exact dimensions, such as a hollow point punch that is precisely 0.35 inches long and has a root diameter of exactly .030 inches, then this is a custom part. To guarantee specific dimensions for punch shapes or ogive curves other than those we stock, or to specify the diameter rather than to accept industry standard diameters for a caliber, would mean you are ordering a custom die instead of a stock die.

Specify that you want a punch tip .25 inches long, not "a little longer than the last one". With a staff of die-makers, machinists, shipping and order desk personnel, it isn't possible to remember every order in such minute detail as the exact length of a certain punch. But you have the punch, so measure it and you'll be able to order exactly what you want by dimension. This would of course be a custom made punch, and the standard pricing would not apply.

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 many bullet moulds 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 1-E or even 2-E nose shape for a handgun. This almost never works out: the elliptical nose curve is not practical for rifles at two calibers length, and certainly a one caliber long elliptical nose curve is beyond the practical limit for most revolvers and autoloaders.

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.

The typical spitzer bullet has a nose curve that is a segment of a circle. You can draw it with a compass or trace it with a pair of dividers swung in an arc. The distance the dividers or compass points are spread when you swing the arc is the measure of the curve, in calibers.

The drawing point of the compass begins exactly at the shank of the bullet, with the pivot on a line exactly 90 degrees perpendicular to the shank and the center line of the bullet. The compass is spread apart to the number of calibers you wish the curve to measure. For instance, a 6-S .308 describes a spitzer (German for "pointed") shape drawn with the compass points six times .308 or 1.848 inches apart.

The tip of the bullet is called the "meplat" and is the necessary width made up by the wall thickness of the jacket plus any opening in the tip of the bullet.

The smallest caliber of radius for a spitzer bullet is 0.5 inches. If you set the compass points exactly half a caliber apart, they will swing a half circle that touches the other side of the shank. Anything less would not connect. A 1/2-S ogive is a true round nose. Only experienced big game hunters in Africa usually want this shape. Most other shooters want something more streamlined.

The 1-S ogive has an actual point, and is different in appearance from the 1/2-S. A 4-S ogive is longer yet, and the standard rifle ogive for most calibers up to .375 is the 6-S. This gives the widest range of weights without losing too much energy to drag. As you increase the S-number above 6, you gain less and less with each increase. There is little difference between a 10-S and a 12-S unless you bring the very tip to a sharp point. Then you can see it is a little longer. The longest practical spitzer is the 12-S. Anything longer is just pencil-line width different.

The more blunt the bullet nose, the wider a range of weight you can make in the die and still have a bullet that will fly. This is because the lightest bullet you can make still needs some shank to align in the bore. A blunt nose will be shorter than a sharp nose, and take less lead to fill the volume.

With a longer nose on the bullet, there is a higher minimum weight of lead need to fill it up, so the minimum practical weight goes up. The shank needs to be roughly in balance with the nose length so the bullet will fly straight. This means that a long nose implies at least a moderately long shank, adding even more weight. Yet, the overall length of the bullet may be limited by practical considerations of the gun.

This means that if you make the nose very long and thin, probably half the bullet is effectively reduced in diameter and holds less lead than the same length of bullet with a blunter nose. So, the maximum weight you can make is higher with a round nose than a long spitzer. Both the maximum and minimum weights possible are extended as the nose becomes less pointed.

To make the most efficient possible bullet that is still practical to shoot, Corbin developed the Ultra Low Drag bullet many years ago. Today this name is thrown about with abandon, applied to anything that is supposed to sell better, but with us it refers to a 14-caliber ogive that is not tangent, but secant in its junction to the shank, and is offset by 0.014 inches from the tangent. A tangent ogive describes a specific instance of the nose curve joining the shank. A secant ogive can be any shape that uses an arc for the nose curve but joins the shank anywhere but tangent!

It takes two numbers to describe the secant: you need to know the radius of the curve and also the distance it is offset from being tangent to the shank. The actual length of the nose is determined by both of these numbers. The secant curve is an attempt to use the longest possible nose and join it to the shank earlier than required by a tangent junction, and the trick is to make the angled junction slight enough so that no extra shock wave is generated as the bullet breaks the sound barrier.

The elliptical ogive is measured in a different way. The elliptical curve is a constantly changing radius, not a fixed radius like the spitzer ogive. Therefore, it is meaningless to specify the radius of its curve. What does have meaning is the axis length of the ellipse. In reality, the bullet nose is half an ellipse, because an ellipse is an oval shape.

An ellipse is measured by two lines. One is the minor axis, which in our case is the caliber of the bullet. The other is the major axis, which in an ellipse reaches across the longest part of the oval. Since we only use half the ellipse for the bullet nose, we use a half or semi-axis length to measure the size. A 1-E ogive has a nose that is one caliber long, from the shank to the tip. If the bullet has a flat tip or hollow point, the measurement includes the imaginary line that would complete the curve where the flat or HP cuts it off.

A 1/2-E and a 1/2-S ogive are exactly the same because a half-caliber length and a half-caliber radius each result in the same hemispherical shape. Most pistol bullets with a round nose have a 3/4-E ogive. A .452 caliber pistol bullet with a 3/4-E ogive would have a nose that is 0.339 inches long. A 1-E ogive is typically used on the 1886 and later rifle bullets. Most old Winchester and Sharps illustrations show the 1-E shape. A .452 pistol bullet with a 1-E ogive would have a nose measuring .452 inches long. When you consider that the entire pistol bullet is probably about 0.7 inches long, that leaves less than a quarter inch of bearing surface, barely adequate.

The 1.5-E ogive is sometimes used on Kynoch rifle bullets for double barrel rifles. A .458 caliber bullet with a 1.5-E ogive would have a nose that is 0.687 inches long. If the bullet is only about 1 inch long (typical for the average weight of bullet), then this leaves 0.313 inches of shank. A 1-E ogive would be .458 inches long and leave 0.542 inches of shank.

You can see that a tiny change in the elliptical number makes a huge difference in the length of the major semi-axis (or bullet nose length). The only standard, practical sizes are 1/2-E, 3/4-E, and 1-E. While we can make longer elliptical ogives, they are custom job for special purpose bullets.

18. Lubricants and Chemicals

Corbin offers a number of chemical products, including **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 two 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 has been used by top shooters at Wimbledon and Camp Perry for many years, long before recently introduced and heavily marketed cleaners became popular. 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 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. **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 is 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 also prevents corrosion. It can be applied by dipping or spraying. The carrier is naphtha, which is a flammable petroleum product. If you should ever happen to leave the cap off the bottle and the lubricant becomes too thick, you can thin it with more naphtha (available in most paint and hardware stores, or from lubricating oil companies who sell solvents and fuels).

Dip Lube can be applied to wood or metal to repel water and protect the surface. It drys to a slightly foggy finish that can be buffed lightly to a high gloss. 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. It should not be used around open flame or sparking electrical devices, and should be used with adequate ventilation. Breathing naphtha fumes is not as toxic as most of the complex hydrocarbon carriers used for bullet dip lubricants, but it isn't good for you. Some people may have a reaction to contact with naphtha, such as a rash or burning sensation. I recommend wearing rubber gloves and eye protection, just in case.

Corbin Bore Lap 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. **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 is available in pint containers. It 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. The catalog number is FSO-16.

Corbin Core Bond makes bullets that expand and retain their weight far better than any partitioned design. To use it, you would 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.

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 (no jokes about bullet soup are permitted during this process). 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 best if you do not use the best guest towel.

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.

Once you have all your jackets secured in a vertical position with a core in each one, 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. 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.

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 of the lead 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.

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. 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.

A word of caution, again. Core Bond can cause serious injury if it gets in your eyes or mouth. Please be careful. Wear gloves and eye protection. 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. **Corbin Core Bond** comes in 2-ounce, pint, and gallon sizes, under catalog numbers CCB-2, CCB-16, and CCB-128.

Corbin Cleaning Solvent 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. **Corbin Cleaning Solvent** comes in pints and gallons, as CCS-16 and CCS-128.

Corbin Silver Lube 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 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. It is packaged in one pound bags, Cat.No. WS-1. One bag comes with the kit.

Corbin Hydraulic Fluid is used in all Corbin hydraulic presses. 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.

19. Books and Software

"Re-Discover Swaging" is a textbook containing the history of swaging, detailed use of swaging tools and techniques, custom bullets, and even die-making. It is an expanded version of this handbook written to cover the principles rather than a specific brand of tooling. The current edition has over 240 pages with photographic and line art illustrations. If you only have one other swaging book, this is the one to get.

"Technical Bulletins, Volume 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.

"Technical Bulletins, Volume 2" is a collected set of papers that were published in magazines over a ten year period, relating to bullet swaging. Specific experiments and 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 done by Dave and Richard Corbin.

"Technical Bulletins, Volume 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.

"Power Swaging" covers the use and operation of the CHP-1 Hydro-Press, as well as other information about the use of power presses for bullet making, jacket forming and lead wire extrusion. Information on the design of power presses for bullet making is also given along with charts of die strength versus maximum safe pressures and other technical data.

"The Bullet Swage Manual", by Ted Smith, is the first manuscript to be published in book form about bullet swaging. 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, Ted Smith, inventor of the first powder trickler and the original Mity Mite swaging press.

“The World Directory of Custom Bullet Makers” is a collection of several booklets under one cover. 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.

Corbin also produces software for personal computers that operate on the MS-DOS or 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 is a Bullet Engineer’s Design Kit of software. It consists of the following four sets of programs:

DC-1001 is the basic tangential ogive design program, that gives you the stable twist rate, BC, sectional density and physical parameters for any bullet in the .12 to .999 caliber range.

DC-1002 is the Corbin Handbook on disk in ASCII format, for easy computer browsing. Included is a limited license to copy and use the information in your own work.

DC-1003 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 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 has can be used in many ways to understand performance.

The CEDAR Billing System (CEDAR) is a mail order oriented invoicing and inventory control package for bullet makers. It tracks clients, notes, orders, receivables, account aging, and prints mailing labels, statements, invoices, packing slips, and a wealth of other information. You can use it to write letters to clients without typing their name, address, or your return address and date: just write the note and let the program format the letter, and save it as a form letter you can use for another client.

When you sell a box of bullets, the program can automatically figure out how much lead, how many jackets, lube, labels, boxes, and other materials are used up, and subtract them from inventory, keeping you posted of the material requirements for your business. You just enter an order and ship it, and the program does all the other paperwork and accounting. Catalog number is DC-CEDAR.

Corbin Simplified Maillist (CSM) keeps track of writers and editors of gun magazines, potential clients from mailings lists, and other names and addresses, offering easy entry, merging of lists and purging of close duplications, sorting by any criteria, and printing in many label formats. The program keeps track of how many times you have sent a mailer to a given writer or client, last date of contact, and free-form notes about anyone on your mailing lists. Up to a billion names can be stored, sorted and coded for group printing. Catalog number is DC-MAIL.

DC-DIES is 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.

DC-LEAD is a set of lead wire extrusion programs that calculates lengths of any diameter wire from any diameter of billet, extruder pressure required, and other parameters. Even hollow lead tubing extrusion is covered.

DC-LABELS is a set of programs to print mailing and inventory labels quickly and easily.

DC-NAMER is a program that helps you come up with good names for products or new firms. It is used by ad agencies for brainstorming sessions, and is very inexpensive.

DC-SHOP tracks the output of your production shop by product and time, helping you remember what you made and when, for whom, and for how much.

PC-DS is the **Powder Coating Data System** for powder coating job shops, a full client, part and production tracking and billing system with automatic cost estimation. And there are more: ask for the software brochure.

20. 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.

Backlogs can run as long as two years, at times. 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.

A great deal of work and planning is required in order to get an order "in the works" because the special metals and supplies must be ordered months in advance. The various kinds of machines and skills of different people must be scheduled around the number and type of dies pending. Each day, another piece of the puzzle is built, until it all comes together for you as a finished set of tools. At any given time, hundreds of people have been waiting anywhere from a day to a couple of years for their order.

The Corbin die-works is one of the few places in the world where you can get benchrest quality equipment for a fraction of the price that was common before we developed our system of making swage equipment. Consequently, we are buried in orders and have been for over two decades. The few others who build good swaging equipment make a limited range of dies for benchrest shooting: Corbin builds more dies per month than the rest of the industry combined makes in a year!

We make custom, specialized tooling and develop not only the bullets that you see advertised daily as the latest new ideas but also figure out the tools to make them. Looking at a pile of orders, we cannot tell if it represents ten weeks or ten months of work. Each order, as it unfolds, presents its own challenges to be solved. Some are standard, but some have never been attempted before.

A few simply cannot be done, as we discover at our expense (unless we have already stated that we think the idea is unworkable, and were asked to proceed anyway at the client's expense). The difference between our operation and most commercial machine shops is that we know the technology well enough so that we can figure whether a design is practical or not. We work out the solutions so you don't have to.

Because of the Corbin develops tooling, instead of just building it to client specifications, a great deal of the financial risk in building custom bullets has been eliminated. If you have a good idea for a bullet, you don't need to spend thousands of dollars developing the way to build it.

The price of becoming a custom bullet maker is low enough so nearly anyone can afford it. Part of the price is patience. If a person can't afford the patience to wait until we have the time to build the dies, then they only have part of the necessary currency.

I have heard that some firms will take a "rush fee" to push your order ahead of clients who have been waiting longer. That does not happen at Corbin's die-works. Orders from Lockheed-Marietta, Naval Weapons Research Center, Sandia National Labs and famous shooting champions as well as gun writers on short deadlines take their turn exactly as they were received. If your order is first, then it goes out first, unless we can do it with an even earlier order and ship both without putting anyone else behind.

Threats to cancel or promises of big orders to come are all beside the point. For the past several decades we have taken tremendous satisfaction in helping people enjoy a new aspect of the shooting hobby, a new source of income, and in some cases, a new life-style, based on the tools and concepts developed here.

That is the real payoff. If the money was my biggest concern, I'd shut down the die-works and spend all my time writing books and software, making excellent profits with a lot less risk. But helping people to become bullet makers for their own enjoyment and security is a source of satisfaction that has no price tag. If that makes me seem "independent", so be it.

The bottom line is that by keeping our prices as low as possible, taking custom work that is more a labor of love than a sensible business decision, and offering everything for swaging from one source including supplies no one else finds profitable to keep in inventory, we are simply not able to predict when a specific order will be shipped unless we have it on the shelf when you call.

I do not know how to guess the length of time it takes to solve unknown problems, until we solve them. If I were to make an estimate that was just two hours short, then multiply that error by the five hundred or so orders that might be in various stages of processing at any moment, by the time I got to your new order I might be off by 1,000 hours! That is 100 of our 10-hour work days, or about half a year on the calendar.

What good does it do to say your order will absolutely be ready in six months, plus or minus half a year? But that may be the truth. It might be ready tomorrow or in a month or in 90 days, if we happen to have a similar set done at that time and made a spare. That is the only instance where you will be "put ahead" of someone who ordered earlier, because it doesn't put anyone else behind.

We cannot guarantee delivery at any specified time or by any specific date. All orders are taken in good faith that they will be shipped in the sequence in which they are finished, and finished in the order in which they were placed, and will be accepted and paid for when ready. Backlogs of up to two years can occur. At any given time, our average backlog can be stated, but it is not a promise of delivery within that time frame. Backlogs can change rapidly and are only rough estimates at best.

Under no circumstances will Corbin Manufacturing & Supply, Inc. be responsible for any economic loss which may occur because you made contracts or promises based on receipt of equipment prior to any given date. Wait until you actually have the equipment before entering into any such agreements.

No one wants you to have the equipment more than we do, believe me. In the first place, unless you ordered custom equipment where we ask for a 50% deposit with the order, we probably will not be paid until we are ready to ship. It is to our advantage to ship as fast as possible. Nothing is gained by delay. Every order is shipped as quickly as possible, whether or not we get calls every month, week, or day inquiring about them.

The conversation I often have with clients who don't wish to believe these facts 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."

"I can't promise delivery before any given date: I can say that it is likely but not certain that we will be able to deliver everything within the next six months. Make no plans based upon delivery by a specified date or within a specific time."

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).

The good news is that we have a good supply of almost all the items, such as presses, jackets, lubricants, and other tools, and generally have a huge inventory of dies. With virtually no limit to the number of calibers multiplied by the styles and specific designs, it would be impractical to have every possible die all the time. Did you know there are over 537 calibers we could make, with dozens of styles per caliber, and hundreds of variations on each style? Just in .45-70 caliber, we've been asked to make over a dozen diameters from jacketed to paper-patched rifle, and the bases and nose shapes would fill this book!

21. 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 is not a defect.)

The number to call is 541-826-5211, Monday to Thursday from 9:00 AM to 5:00 PM. 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 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 handling 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.

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.

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.

The End