- ***Chapter Four Paper Jacketed Bullets***

Introduction

At one time no one would have given a second look at a cartridge that was loaded with a paper patched bullet. These cartridges and bullets were part of everyday life, not taken for granted, but not considered out of the ordinary.

For the hunter the paper patched bullet provided clean, reliable one shot kills as the pure lead bullets penetrated well and expanded flawlessly. For the target shooter the paper patched bullet gave fine accuracy without leading. European armies marched off to glory confident that the ammunition they carried would not fail them.

Then the metal jacketed bullet appeared. The paper patched bullet was quickly forgotten. Why this happened is partly because of the development of the semi and full automatic weapon. As the military of the world armed its troops with these fast firing weapons the bullet and cartridge had to be able to withstand the rough handling in the feeding mechanism of the self loading gun. The metal jacketed bullet was without doubt superior for this purpose.

In addition the caliber of the guns constantly decreased making applying the paper patch more difficult. At the same time the need to produce millions of cartridges in the shortest time possible and at the least cost became a critical requirement. Since the paper patch is usually applied by hand, production simply couldn't meet the demand.

Sporting arms development tends to follow advances and trends in the military, so the metal jacketed bullet quickly took over the target and hunting ammunition used by the sportsman. The paper patch was quickly relegated to the museum or forgotten corner of the loading room.

And yet is it any less effective than it was in earlier days? Game of all types has been taken with this type of bullet. Deer, elk, Kudu, Gemsbok have all been successfully hunted with the pure lead bullet wrapped in paper. Just as lion, tigers, and other dangerous game have fallen to it. For Cape Buffalo, elephant, or other heavy game a hardened paper patched bullet was used with results equaling or surpassing the metal jacketed bullet.

For the target shooter the paper patched bullet gave fine results and still can. This bullet is at home on a 100 yard range or a 1,00 yard range. Choose the cartridge to suit the competition and remember that the paper patched bullet isn't limited to cartridges such as the .50-110-450. A paper patched thirty caliber will give surprisingly good results.

Another consideration to ponder is that the paper patched bullet is made with materials that will always be available. On the other hand commercial bullet jackets have always been expensive and have always been in short supply. Those who only use metal jacketed bullets are at the mercy of the big bullet and ammunition makers. Will they make the bullet you need and at a price you can afford?

What is a paper patched bullet? In short it is simply a bullet that uses a paper jacket instead of the metal jacket. The paper jacket serves the same purpose as the metal one; to prevent leading and fouling of the gun bore and to allow higher velocities.

Properly applied the paper jacket or patch will prevent leading and do so without leaving any other fouling to be removed. Velocities that can be achieved with the paper jacket are respectable. A velocity of 2,200 feet per second (fps) is possible and this can be increased to 2,500 fps in some rifles. The paper patch isn't limited to blackpowder velocities.

Why is this bullet called "paper patched"? It's hard to say at this point in time. Probably this came from the use of the patch on the round lead ball of the Kentucky rifle. A cloth patch was applied to the round ball as it was loaded to better seal the bore, prevent leading, and improve accuracy. Since the paper wrapper on the improved cylindrical bullet serves the same purpose why not use the same terminology? In fact, for a short time, metal jacketed bullets were referred to as being metal patched.

Whatever one chooses to call the paper patched bullet it really is a jacketed bullet, a different jacket material, but jacketed none the less. One you can make, use at less cost, and without concern about jacket supplies not being available.

The Bullet Diameter

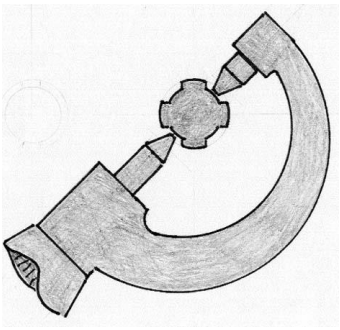
When loading ammunition using the metal jacketed bullet things are pretty simple. You just choose the bullet diameter and a type as provided by the bullet makers. If you are shooting a .358 Norma you just get a box of .358 bullets off of the shelf and go home happy. Happy unless you have a rifle that does its best work with a .357 or a .359 diameter bullet. Happy if you could find the type of bullet and weight down at Joe's Megasports Emporium.

The home swaged bullet and especially the paper patched bullet will let you make exactly the bullet you want and need. However you'll have to do a bit of homework first. When you swage your own bullet you can pretty much write your own ticket. You can choose the base type, ogive, diameter, and the bullet weight you want. You can match the hardness of the bullet to suit it's purpose.

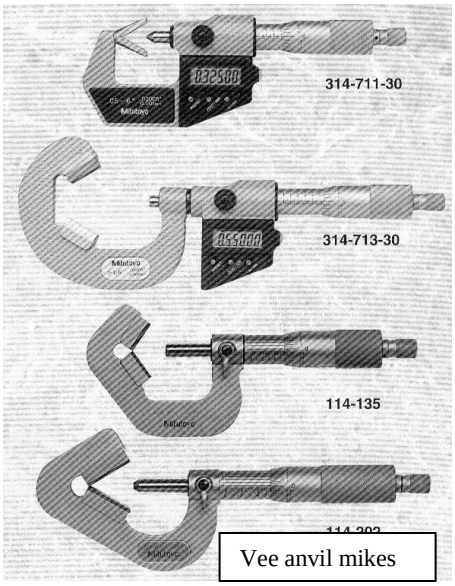
Probably the most important thing is the bullet's diameter. Unlike a metal jacketed bullet that is selected to fit the groove diameter (assuming you can find the correct size factory bullet) the paper patched bullet's diameter is determined by the bore diameter of the gun. So, before you can do anything else you need to measure the bore diameter. This can be done by recovering a fired bullet that isn't damaged or by pounding a lead slug into the barrel. Slugging the barrel, if carefully and correctly done, can give a good result. Much more often the lead slug is not expanded fully and the measurements taken from it are not quite correct. There is also the chance of damaging the barrel when expanding the slug.

A better method is to make a casting of the barrel using a product known as Cerrosafe. This is available from Brownell's, Inc. and a few other suppliers. This material melts at a very low temperature and can easily be removed from the barrel. There is almost no chance of damaging the barrel and the casting is a very accurate representation of the bore. I like to make the casting about one and one-half inch to two inches long.

The next step is to measure the casting. If your barrel has an even number of lands and grooves the procedure is simple. Remember that the large diameter of lands on the casting represent the grooves of the rifling. The small diameter is the bore of the barrel and is what we need to measure. If you have a micrometer or mike that has pointed anvils or small diameter anvils you can measure the groove diameter on the casting (the rifle's bore diameter) without difficulty. If you have a standard micrometer the anvils may be so large that they contact the corners of the lands on the casting and don't contact the grooves on the casting. If this is the case you can carefully file or trim away the corners of the lands on each side of the groove until the mike can contact the top of the groove. Just be careful not to damage the surface of the groove but if you do the casting can be melted and recast.



Pointed anvil mike used to measure a barrel casting



Vee anvil mikes

If you are unlucky and have a barrel with an uneven number of rifling life will be a little harder. An ordinary micrometer or dial caliper cannot be used to measure the casting. A special Vee anvil micrometer is needed. To make things more interesting a five groove barrel and a seven groove barrel will require two different mikes be used as the angles are different. These mikes are rather costly but you might find a fellow shooter or machinist who has one. If you do, the casting can be measured as you would an even numbered barrel.

If not you can use a lathe to measure the casting. This is done by making a ring gauge out of aluminum or some other soft material. You chuck up a piece of aluminum, then drill and bore a hole in it. Slowly increase the size of the hole until it is a snug slip fit onto the casting. Then you can measure the inside dimension of the gauge, subtract one-thousandth of an inch, and that is the groove diameter of the barrel. Then hold the casting in the lathe, check and adjust the runout of the casting to near zero. Put a dial indicator on the cross-slide of the lathe and zero the indicator on the large diameter of the casting. Put the lathe's gearbox in neutral or release the tension on the drive belt and slowly roll the chuck around. As the casting turns the indicator will drop into a groove on the casting. This will give you the depth of the rifling. Multiply the rifling depth by two, subtract this from the large diameter of the casting and you'll have the bore diameter.

Now that the bore dimension is known it is time to decide on the bullet diameter. The next question is whether blackpowder or smokeless powder is to be used or both. This is important because blackpowder, and most blackpowder substitutes, will expand the bullet more violently and to a larger degree than will smokeless powder. Bullets used in black powder loads will need to be smaller to account for the increased 'slugging" of the bullet on firing.

If blackpowder is to be used the unpatched bullet should be .003" to .004" smaller than the bore diameter. If smokeless is used the unpatched bullet diameter should be about .001" larger than bore diameter.

If heavy loads are used the smaller diameter will be best. If a hardened bullet is used then the diameter should be a little larger. When both types of powder will be used the bullet should be made for smokeless powder and a bullet resizer die used to resize the bullet for blackpowder.

The patched bullet used for smokeless may seem too large but unless the rifle has a tight chamber it will work fine and give the best accuracy. Your loading technique man need to be changed to accommodate the larger bullet diameter.

Muzzleloading rifles also work well with paper patched bullets. Custom guns usually come with the gunmaker's recommendations regarding the bullet, loading info, and should be followed. Factory built guns that are intended for use with a cylindrical bullet or Minie ball can also be used with a paper patched bullet. The trick is to make the patched bullet diameter as large as can be easily loaded into the barrel. I like a deep cup base or a hollow base and fill the cavity with a soft grease. If heavy powder charges are used a flat base can give good results. A grease wad under the bullet will help to keep the blackpowder fouling soft.

The Bullet Shape

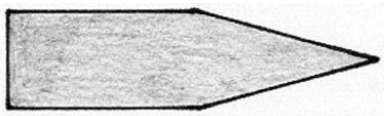
Things get a bit more complicated now. One advantage to swaging bullets is that you can make just about anything wanted. Unfortunately the wide range of possibilities can be a bit confusing.

The first thing to do is to decide on the type of bullet to be made. This can be broken into two groups: the semi-wadcutter and the smooth ogive bullet. The semi-wadcutter is made in a die that has a highly polished hole completely through the die. Two punches are used to form the base and ogive (nose) of the bullet. A piece of lead is placed into the die and the external punch is moved into the die. The lead is trapped between the two punches and the die wall. This allows pressure to be applied to the lead piece, called the core, and the bullet is formed. The bullet is swaged and then removed from the die. Bullets made in this die can have nearly any base style or ogive type wanted. The bullet will always have a small shoulder or step where the ogive and bearing (straight section of the bullet) meet. The step is formed by the end of the nose forming punch.

The step will not harm accuracy but for shooting beyond four or five hundred yards a smooth ogive bullet will probably be better.

The smooth ogive bullet does not have the step that defines the semi-wadcutter type of bullet. There are three basic ogive styles in the smooth ogive group. These are the secant ogive, the spire point and the tangent ogive. The tangent ogive can be further broken down into sub-groups such as the round nose, spitzer, and variations of those two types.

The spire point isn't used much but it makes a good bullet. A spire point looks like a sharp pencil. A variation of this ogive is used for pistol bullets or lightweight bullets and is known as a conical ogive. It is simply the spire point but with a wider included angle which makes the ogive shorter.



Spire point bullet

Both the spire point and the secant ogive have an abrupt change where the ogive and bearing meet but there is no step or shoulder. The secant ogive is often used when making VLD (very low drag) type bullets. It permits the use of a very sharp point on the bullet while keeping the ogive length within reason. It is a useful design but mostly seen in long range metal jacketed target bullet or some military bullets.

The tangent ogive can be a spitzer or a round nose but it always has the ogive blend smoothly into the bearing of the bullet in such a way that it is hard to see where the ogive and bearing meet.

Spitzer ogive bullet Secant ogive bullet

Spitzer bullets have the radius of the ogive specified or called out in caliber of radius. The radius of the ogive would be the diameter of the bullet multiplied by the number of calibers. An example might be a .458 bullet with a four caliber curve. The ogive would have a radius of four times .458 or 1.832 inches. Long spitzer ogives have proven advantages at long range but can be difficult to get to shoot well in lead bullets. The longer ogive also requires a heavier bullet be used in order to have the bearing and the ogive length in balance. Two variations on the spitzer that are useful in lead bullets are the flat tip spitzer and the semi-spitzer. Both of there have some of the advantages of the true spitzer while the modified point keeps the ogive length within reason.

The round nose bullet is usually specified by the length of the ogive in calibers. A .400 caliber bullet with a one caliber ogive would have an ogive length of .400 inches. A one-half caliber long ogive in the same diameter would be .200 inches long. It would be a half ball. Round nose bullets are usually a modified elliptical curve but many round nose designs are simply what the die maker filed the cutter to look like and are not possible to describe mathematically. Round nose bullets have long been used very successfully with lead bullets and have many advantages. The round nose bullet is a proven game getter and is usually easier to get to shoot well.

Base styles for the paper patched bullet can be flat, cupped, dished, hollow, or boattail. The hollow base is most often used for muzzleloading rifles. The boattail or the rebated boattail isn't often seen yet has many advantages for long range shooting. The boattail bullet is a bit harder to make and requires a little more care when paper patching it but it can be worth trying.

The dish base is a shallow concave depression in the base of the bullet. The cavity is brought to the edge of the bullet. This is slightly useful in some metal jacketed pistol and military rifle bullets but the base is easily damaged and is of little use with a lead bullet.

The cup base is the traditional base for a paper patched bullet. The cavity is usually 3/32 of an inch deep and leaves a flat area or skirt on the bullet base that is about .050' to .075" wide per side. It is about what you'd have if you pressed a bearing ball into the bullet's base. The purpose of the cup base is to provide a cavity into which the tail of the paper patch can be stored. This is important if a card wad is used under the base of the bullet. Without the cup base the card wad would press the patch tail into the bullet's base, distorting the base and harming accuracy. The card wad needs to be made of thick, stiff material so that it will not be driven into the cup and damage the bullet.

The flat base is also used and works well. If a card wad is used with a flat base bullet the tail of the patch is trimmed off or the patch is applied so that no tail is formed.

Swaging the Bullet

Swaging the paper patched bullet is a simple process and is in many ways faster and less trouble than casting the bullet. The bullet is best swaged using a special swaging press such as the Walnut Hill

press. Swaging dies for use in reloading presses have been made but it is possible to damage the reloading press, the press doesn't have adequate power for the task, and the swaging press produces much better bullets.

There is no question that the special swaging press and dies for it are easier and faster to use. In addition the swaging press can produce a wider variety of bullet types and can swage much heavier and larger bullets than could be made using a reloading press.

The swaging press has a much shorter stroke, ram travel, than a reloading press and so has much greater leverage or power. The Walnut Hill press has a dual stroke system so that the short ram travel is available for swaging and the stroke length can be changed to one suitable for reloading by moving one pin in the press toggle.

To use the swaging press the die and internal punch are screwed into the press ram. Even though the die is threaded 7/8"-14 it cannot be used in a reloading press. The external punch is placed in the punch holder in the top of the press.

The press ram is raised a little and a lubricated lead core is placed in the die. The press ram is raised all of the way up and the external punch enters the die to apply pressure on the core. This forms the bullet. The punch holder is moved up or down to control how much pressure is put on the core. Excess lead is bled off through a small hole in the side of the die to control the weight of the bullet. The press ram is lowered and the bullet is ejected from the die. Bullets can be made about as fast as the press ram can be moved up and down.

Bullets made in the swaging press can be of the semi-wadcutter type or any of the smooth ogive styles. Special bullets such as hollow bullets, bullets with fins, or two piece bullets can be easily made using the swaging press and dies.

Before the bullet can be made you will need to make cores that will be swaged into bullets. If you have bullet casting equipment you will probably want to use a core mould and cast the cores. If the core is one-quarter of an inch in diameter or larger casting cores is practical. If the core is less than that it is much easier to use lead wire. In fact for most bullets lead wire is a better and easier way to make cores.

To use lead wire a wire cutter, called a core cutter, is used to set the length (weight) of the core and to cut the wire. Most core cutters are simple shear devices which do a good job but do not produce an accurately cut core. The core will need to be swaged to provide an accurate and repeatable weight.

The cores will be cast or cut a little too heavy. This may be around ten grains more than the finished bullet. Some extra lead is needed to fill in voids and wrinkles in the core as the bullet is swaged. When the cores are ready they are very lightly lubricated with swaging lube. Only a little lube is needed.

If a semi-wadcutter style bullet is being made only one die will be needed. The lubricated core is placed into the die, the press ram is moved up to swage the bullet, and the finished bullet is ejected from the die when the press ram moves down. The bullet is inspected and as many as needed are made.

A smooth ogive bullet is made in a special die called a point form die. This die has the shape of the bullet machined and polished into the die. A small diameter hardened steel pin, the ejection punch, is fitted into the ogive end of the die and pushes the bullet ou6 of the die. The bullet will be made in either a single die or a two die set will be used. A single point forming die that has a bleed hole in it, a combination die,

can be used to form the bullet in one step. This die is similar to the semi-wadcutter die in that it forms the bullet and bleeds off excess lead all in one operation.

If the very best bullets are wanted a two die set is used. The first die forms a flat ended lead cylinder and bleeds off the excess lead while the second die forms the lead slug into the bullet. The two die set allows a little more control over how the bullet is made and permits the use of more pressure to form the core which makes for a denser and more uniform core.

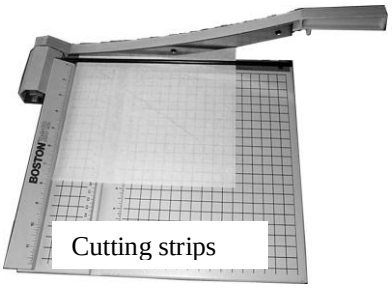
Once the bullets are finished they should be cleaned with a solvent such as MEK or Acetone. This will remove the swaging lube and leave the bullet ready to be patched.

The Paper Patch

The best paper for the patched bullet has a twenty-five percent cotton content. Higher percentages of cotton, up to one hundred percent can be used but these papers are more difficult to work with and are more expensive. A suitable paper, such as Eaton Air mail paper, can be purchased at stationery or office supply stores. Quite often the paper will have to be ordered as it is not popular and seldom stocked. Other papers that are of use are found at art or graphics supply stores

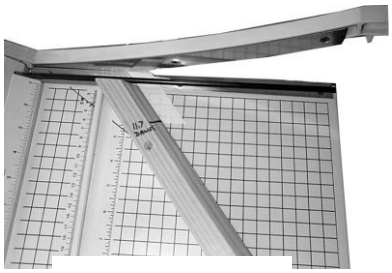
Papers are classified by their weight with computer printer paper being in the twenty to twenty-four pound range. This paper is too thick for our needs and would be hard to use. A paper with a nine pound weight is a good choice. This should have a thickness of .0025". I take my micrometer with me when I buy paper and measure the thickness before I buy it. I have found that the weight designation doesn't always mean that the thickness will be the same.

Sometimes you might be able to find a cotton paper that has a thickness of .003" to .004". This can be a useful paper to have if you want to experiment with the patched diameter of the bullet. Going the other direction you can use dressmaker's pattern paper for reducing the diameter of the patched bullet. For the advanced paper patched bullet user other materials such as Teflon tape, adhesive computer labels, or copper foil can be tried. Copper foil, available at stained glass shops, has a great deal of potential and allows higher velocities than will paper patches.



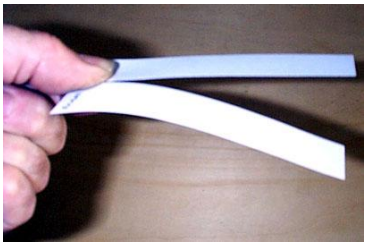
Cutting strips

In older times a person would make up a steel or brass template the size of the patch. The template would be placed on the sheer of paper and a razor blade would be moved around the template to cut the patch out. This still works but it is a little slow if many patches are needed. A better way would be to get a good paper cutter and use it. Spend a few more dollars and get a quality, ruggedly built cutter. It will do a better job than the cheap plastic ones. The cutter will let you quickly cut the paper into strips of a uniform size.


Cutting the patch

A wood or metal strip can be fastened to the paper cutter and set for the angle needed which is commonly forty degrees. Threaded inserts can be put in from the underside of the cutter board, which will permit the guide strip to be easily removed or installed. A series of marks can be made on the guide to indicate the patch length. The paper strip can be placed against the guide strip and moved from mark to mark, quickly cutting the patch to the correct length and angle.

Paper has a grain direction just as wood does. Sometimes you can determine the grain direction by holding the paper up to a strong light and looking for the watermark. The grain is supposed to run ninety degrees to the watermark direction. I'm not convinced that all paper has a watermark or if it does I can't always see it. An easier way to determine the grain direction is to cut two strips of equal length and width from one sheet of the paper. The strips should be about the same length the patch would be. Cut one from the length of the sheet and cut the other across the sheet. Then hold each strip of paper by the very end and see which one sags the most. The paper that sags the most is cut across the grain. The paper strip that is cut in the same direction as the grain is stiffer and stronger so will sag less.



Testing for grain direction

While the grain direction isn't very important the paper strip that is cut across the grain will be a little easier to apply to the bullet and will shrink a little tighter to the bullet. The main thing is to cut all of the patches in the same direction.

Most patches are cut in a parallelogram shape. This is traditional and works well. It is also possible to cut the patch in a rectangle and this will also do a good job. When the end of the parallelogram patch is twisted into a tail the patch will tighten on the bullet a little more than the rectangular patch will. Either method will work but I prefer the angled patch as it has a classier look on the bullet.

Rectangular patch & bullet

At one time the direction the patch was applied was important. The rifling was supposed to unwrap the patch as the bullet traveled down the barrel. If you have an original Pope rifle this will be a consideration. Modern rifling cuts the patch into strips, which then leave the bullet as the bullet exits the barrel. As a rule of thumb the patch angle should be the same direction as the rifling twist but with the deep, sharp modern rifling this isn't especially important. Do apply all of the patches in the same direction.

The patch is dampened before it is applied to the bullet. This can be done by simply popping the patch into your mouth and pulling it gently between your lips. This will dampen it enough but if a person is handling many bullets the question of lead poisoning does arise. A better method would be to dampen two sponges and draw the patch between them. The idea is to wet the patch enough so that it will be limp, flexible, and stick to the bullet easily. As the patch dries it will shrink tightly to the bullet. The patch must be damp enough so that it will roll onto the bullet easily but not so wet that it will tear or stretch too much. There is no way to specify exactly how damp the paper must be but once you've done a few bullets you'll develop a feel for the process.

You can use the kitchen table or your workbench as a place to patch the bullets but a better way is to make up a patching board. The size of the board isn't important, just make it large enough to be easy to use. I made mine out of strips of maple and glued them together to make a laminated board, then gave it a couple coats of urethane varnish. However a piece of smooth plywood would so just as well. Near the bottom edge of the board cut a shallow groove to keep the bullet from rolling off of the board but the groove doesn't' need to swallow the bullet. Then cut another shallow groove ninety degrees to the first groove on the right side of the board. Or left side if you are left handed. Or both sides if you are undecided.

The groove at the bottom keeps the bullet in position while the vertical groove provides a guide for the patch. Lay the dampened patch on the board with one end of the patch extending off of the bottom of the board a little. Align the patch along the vertical groove and then place the bullet on the patch. You can then pick up the end of the patch that is hanging off of the board and easily and accurately roll the patch onto the bullet. Once the patch is on the bullet give the patch tail a little twist to tighten the patch and set the bullet aside. A useful tool to have is a piece of wood with a series of holes drilled into it. The patched bullets are placed nose first into the board and left to dry. This helps to speed up the drying process. If you are in a hurry a hair dryer can be used or the kitchen oven can be employed to dry the patches.

Usually two wraps of the nine pound paper will be used. The paper will shrink a little as it dries so that the diameter of the finished bullet will be slightly smaller than expected. If the paper is .0025" the patch will add .009" to the bullet when the patch has dried.

The width of the patch should be enough so that the patch will extend over the ogive of the bullet far enough so that no lead will contact the barrel. This should not be overdone however. If the patch covers too much of the ogive the rifling will not shred the entire patch and some of the patch may cling to the bullet when the bullet leaves the barrel. This can harm accuracy. If you know the groove diameter of the barrel you can set you micrometer to that dimension, then hold the bullet nose against the mike's anvils. Turn the bullet while lightly pressing it against the anvils. This will make a mark on the nose of the bullet. The patch should extend about 1/32 of an inch beyond this mark. This can be adjusted as you gain experience but it's a good starting place.

The patch will also need to extend beyond the base of the bullet. The traditional method is to make the patch long enough so that you can easily hold the end of the patch and twist it into a tail. If the bullet is to be used with a car wad the bullet is usually made with a cup base. The tail of the patch is tucked neatly into the cavity in the base of the bullet to prevent the card wad from driving the tail into the base of the bullet and distorting the base.

The patch tail can be cut off once the patch is dried. This has the advantage of allowing the patch to be tightened onto the bullet by twisting the patch tail. Removing the tail eliminates the problem of the tail damaging the bullet's base. If a card wad is not used either method is fine.

I usually use a flat base bullet. In this case you could make the patch width long enough to make the tail and then cut the tail off later or the patch width can be a little shorter so no tail is made. The patch is folded over the base of the bullet, the bullet is pressed lightly against the patching board, and the bullet is given a turn or two in the direction of the patch angle. This flattens the patch and tightens it a little on the bullet. I don't try to cover the entire base of the bullet with the patch. There is about one-third of the center of the base exposed. I almost always use a card wad under the bullet but even without the wad leaving a little of the base exposed doesn't hurt anything.

The length of the patch can be determined by using basic math but an easier way is to cut a strip of patch paper that is long enough to cover the bullet with three wraps or more. Wrap the dry paper onto the bullet tightly. While holding the paper on the bullet take a razor blade or razor knife and cut into the paper at the bottom of the bullet. Make the cut deep enough so that all the layers of the paper are cut. Then remove the paper and gently straighten it out. The distance between three cuts on the paper is the length the patch should be. However the damp patch will stretch a little as it is rolled onto the bullet so the patch length needs to be shortened about 1/32 of an inch. Properly applied the damp patch will have two wraps on the bullet with the ends of the patch almost but not quite meeting. While this might sound difficult to do it really isn't. It is better to have the patch a little too short than too long though.

Once the patched bullet are dry they can be handled and usually are lubricated before loading. I lube them just before loading but it could be done before hand if the bullets are stored in a container that will keep them dust free. As to the type of lube used the old stand-by is roughly a 50-50 mix of beeswax and petroleum jelly (Vaseline). Adjust this until you have a soft but not runny lube, then wipe a little of the lube onto the patch. I go by the appearance of the patch. As you apply the lube the patch will darken some. When the patch has a uniform color enough lube has been applied. Wipe the lube on in the direction the patch is wrapped to keep from unwrapping the patch.

It is possible to use the bullets without lubing the patch but try lubing them first. Usually this will give the best results.

Loading the Patched Bullet

Paper patched bullets are loaded in a similar manner to metal jacketed bullets except that an extra neck flaring operation is needed. Personally I find that most reloading dies size the case neck excessively, even for metal jacketed bullets, and I usually polish out the die to better suit my rifle and cases. I don't like to have a really tight fit of the case neck to the patched bullet except for ammo that is to be used in repeating rifles. Don't crimp the patched bullet. The crimp can tear the patch and damage accuracy. If a crimp is absolutely needed try a taper crimp.

If you don't want to polish the neck of the die larger you could try using a larger expander ball to reduce the grip on the bullet. The Lyman M die is a useful tool to have when loading lead bullets or paper patched bullets. I like to use a tapered neck expander that gently flares the case mouth. The expander stem in most die sets can be modified to do this or a new stem can be made. The stem should have a couple degrees of taper per side and simply gives a slight funnel shape to the case mouth. This permits the patch bullet to be started without the edge of the case catching and tearing the patch. If the patch is damaged accuracy will be lost.

Blackpowder or smokeless powder can be used with the patched bullet but the bullet diameter must be chosen correctly as mentioned earlier. Consult the loading manuals or call the powder company for loading information. Remember when loading blackpowder or a blackpowder substitute there must never be an air space between the bullet and the powder charge. If a lighter load is needed use card wads under the bullet to reduce the case capacity.

When loading blackpowder I always use a grease wad, called a grease cookie, under the bullet and a card wad under the grease wad. The grease wad will soften the blackpowder fouling which will permit more shots to be fired between brushing the bore and will improve accuracy.

For hunting loads the bullet can be waterproofed by dipping the loaded bullet into melted beeswax. Dip the bullet and a little of the case neck into the melted wax and then set the cartridge aside to dry. Always use a double boiler to melt the was and remember not to over-heat the wax. The wax vapors are flammable so take precautions to avoid accidents. There is a little concern regarding applying the hot wax to a loaded cartridge but the work goes very quickly and there isn't enough time to allow the cartridge to become too hot. Some care is still needed when doing this.

Another method is to dissolve the wax in VM&P Napatha. This solvent is available at most hardware and paint stores. You will need to use a glass jar or a metal can to hold the mixture. Naptha has a very small molecule that will pass through the wall of most plastic containers leaving you with a lump of squishy beeswax instead of the thick paste desired.

Drop a piece of yellow beeswax into some Naptha and let is sit for a few days. The wax will slowly dissolve into the solvent. You can adjust the consistency of the mixture as desired but I like to have a thick liquid about like melting ice cream. Then the bullet can be dipped into the mix and the cartridge set aside to dry. Excess wax can be wiped off before it is dry. The wax forms a fairly hard, not too sticky coating that can be handled without too much concern. Keep the treated ammo in a box to keep it clean.

Conclusion

While the paper patched bullet may sound like a lot of trouble to make and use it really is quite simple. Once you've made a few of them the work goes much faster and more easily than one would think. It is a little slower to load than the metal jacketed bullet but no more so than loading lead bullet pistol ammo. The advantages to the paper patched bullet include reliable performance on game over a wide range of velocities, much longer barrel life compared to the metal jacketed bullet, and freedom from component supply shortages.

Also your paper patched ammo will be a certain attention getter when you show up at the range. You may have to learn to deal with being considered an expert handloader and source of knowledge.

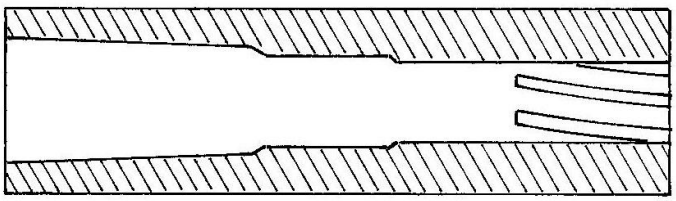
Supplements

Since this was originally written additional study of original blackpowder cartridge rifles, both hunting and target rifles, has demonstrated the absolute need to know and understand how the rifle is chambered, throated, and what the barrel dimensions are. The best way to get this information is to use the Cerrosafe compound to make a casting of the chamber and some of the bore in front of the chamber.

What will be found is that some of the older rifles and some replicas will have a very long throat that allows a full diameter bullet to be seated out of the cartridge a considerable distance to permit the maximum powder charge be used. The long throat also allows the use of straight sided bullets that have rather blunt ogives. The straight sided bullet can be seated out a long way before it contacts the rifling.

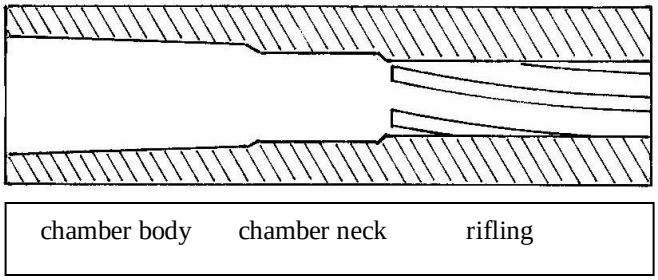
Other rifles will have a very short throat or none at all. A full diameter bullet would have to be seated very deeply into the cartridge case in order to chamber the round and that would reduce powder capacity considerably. One way to deal with this problem is to use a dual diameter bullet, also known as a bore rider bullet. The smaller diameter of the bullet rests on the rifling while the larger diameter is held in the cartridge case. The bullet can then be seated out as far as desired. But dual diameter bullets are a little more difficult to make and paper patch properly.

The drawing to the right illustrates a modern chamber and throat. Note that the rifling is removed for a short distance beyond the neck area of the chamber. Because of this a full diameter bullet can be seated out of the cartridge case for maximum powder capacity without contacting the rifling.



The old timers solved the problem by making the patched bullet as if it were to be used in a muzzleloading rifle. The bullet with the patch is sized so that it is a very light press fit into the barrel. Ideally the patched bullet should have a little resistance to being pushed into the barrel but not so much that the loaded cartridge cannot be extracted without leaving the bullet stuck in the barrel. Probably it is better to err on the small side than to take a chance on having a stuck bullet.

The drawing on the right illustrates an old style chamber. Notice that there is no throat as with most modern rifles. The rifling begins almost immediately after the neck of the chamber. This situation requires the bullet to be small enough to rest on the rifling or a bore riding bullet could be used.



Rifles that have no or very little throat should use bullets that are made from soft lead. When fired the bullet will slug up to fill the grooves in the barrel and accuracy can be quite good. Generally one-third of the bullet will slug up, sometimes more, and this creates a bore riding bullet similar to the swaged bore rider. It can be a very good arrangement providing we remember that these rifles were built during the days before smokeless powder and best results will be had using blackpowder or possibly a blackpowder substitute.

Smokeless powder can be used in these rifles and good accuracy is possible with modern propellants. The bullet will have to be made as if blackpowder is to be used. If a throated rifle were used the bullet would be slightly larger for smokeless powder as smokeless does not slug the bullet up in diameter as much. But the larger bullet can't be used if the rifle isn't throated for it so the smaller bullet must be used and some degradation in accuracy may result. Probably the best thing to do is to use blackpowder in these old rifles, both from a desire for best accuracy and as a safety concern.

There are a few modern replicas that are not throated. Why this practice is continued when it would be easier for the shooter and likely better to throat the barrel is a mystery. One theory is that the gun builder simply wants to keep the rifle as authentic as possible. But regardless of the why, the modern rifle that is not throated will need to have the bullet made as described above.

What it finally comes down to is: Know Your Rifle. Barrels will vary in size even if made by the same manufacturer with the same machinery. Some rifles will be throated, some will not. Some rifles will have a short throat, some much longer.

Make the Cerrosafe cast and find out how your rifle is made and then you can better match the bullet to that rifle. A modern rifle firing a metal jacketed bullet is pretty simple to get to shoot reasonably well. A blackpowder cartridge rifle, especially one that is one hundred years or more old, is a mystery waiting for you to solve. It will be harder to find the right combination of many variables but when you do the rewards will be worth it.

Barrel Wear and Patching Paper

Occasionally the question comes up, "Is paper abrasive?" or "will using paper patched bullets cause barrel wear". The short answer to this is yes and no. Shooting the rifle will cause barrel wear. That's

unavoidable and it will happen regardless of what bullets are used. If the barrel is to last, don't shoot the rifle. But like most things there is more to the story.

Paper is treated with various chemicals during the pulp making process and during the paper making process. Some of the chemicals are left in the paper after processing and some are added to the paper to produce desired effects such as lower cost, higher brightness, or to provide a sharper printed image.

There has been much written and said about this imagined problem on chat rooms, forums, and at the range. Usually the concern is with what is called ash in the paper. Paper does not contain ash. Paper may contain inorganic compounds that after burning the paper leave a residue referred to as ash. High grade filter paper and some writing papers will leave little or no ash after burning it. Newsprint will typically leave 12% ash. High quality writing or photographic paper may leave as high as 30% ash.

Newsprint is not usually treated to improve the quality of the paper so there is less inorganic material in the paper and so less ash after it is burned. High quality paper, known as Fine Paper, leaves more ash because it has been treated to produce sharper print and better images.

Could it be that these chemicals are harmful to the rifle barrel? The answer is no. The inorganic materials in paper have a hardness rating of less than 4 on the Mohs scale. Mohs is used to rate hardness of minerals from Talc, to diamonds, and abrasives. Barrel steels typically run between a Rockwell C (Rc) of 28 to 40. This roughly corresponds to a Mohs hardness of between a Mohs 4 to a Mohs 4.5.

Mohs cannot be converted to other types of hardness tests or scales but to get a feel for the scale an approximate conversion can be used. Each number on the Mohs scale is not just one more than the last in absolute hardness. Talc, Silicate of Magnesia, has a Mohs number of 1 and an absolute hardness of 1, Gypsum has a Mohs number of 2 but an absolute hardness of three, Topaz has a Mohs number of 8 but an absolute hardness of 200. Corundum, a natural aluminum oxide used for metal working has Mohs number of 9 but an absolute hardness of 400, and Diamond, used to lap dies and carbide, has a Mohs number of 10 but an absolute hardness of 1,600. A hardened knife blade might have a Mohs number of 5.5 and an absolute hardness of about 60.

Each higher number on the Mohs scale increases in absolute hardness rapidly so that something that has a Mohs number of five is quite a bit harder than something that has a Mohs number of four.

It is known that abrasives used to grind or polish steel need to have a Mohs number of 4.5 or greater. The harder the steel the harder and sharper the abrasive needs to be. A rifle barrels for .22 rimfire cartridges are usually around a 28 Rc which would be an approximate Mohs number of 4. A barrel for a centerfire cartridge would be often between 32 Rc and 40Rc with some barrels even a bit harder. This would be roughly a Mohs of 4.5 to perhaps a Mohs 5.

A common material used to treat paper is Calcium Carbonate, also known as China Clay. This mineral improves printability and is used to lower the cost of the paper. It can be a mild abrasive and is used in kitchen scouring powders (note that scouring powders contain other abrasives as well). It has a Mohs hardness of 2 to 2.5. Since steel will not be abraded by materials with less than a Mohs 4.5 rating Calcium Carbonate with a number of 2.5 will not harm the barrel.

There are a few other inorganic materials in paper that are abrasive but all are well below the 4 to 4.5 number needed to scratch steel. Some will polish soft materials like aluminum or brass but not steel. Other inorganic materials in paper are not abrasive or corrosive and pose no possibility of barrel wear.

Paper patching paper is almost always a cotton based paper so there is not likely to be any tiny bits of wood in the paper. But if there were, what of it? Wood is far less hard than steel and not abrasive. It

might be that once in awhile there might be a tiny amount of bearing material in the paper but this is something that the paper maker works hard to avoid. Bronze or steel dust in the paper is an impurity, degrades the quality of the paper, and is not a routine problem. Old time bullet casting alloys often used copper and other soft metals in the alloy in an attempt to harden the alloy and reduce barrel fouling.

Most of the paper that is suitable for patching bullets will have a very limited amount of inorganic compounds in the paper. The purpose of the coatings and additives is to improve whiteness, reduce ink spread, stiffen the paper, and to make the paper glossy. Photographic paper would make a terrible patching paper. High quality presentation paper would be too stiff and slick to be useful.

Onion skin has none or very little additive, no coating and is the most used paper patch paper. It is probably safer to use a paper patched bullet than a lubricated lead bullet that has been lying around on the loading bench for several days. The dust in the air that collects on the bullet contains as much abrasive as paper might.

If the paper absorbs water easily, if ink tends to spread out on it making letter a bit fuzzy, and if it can be easily rolled onto the bullet the paper likely has few additives in it. But even if the paper does contain a few inorganic materials they are very unlikely to be of any concern.

Shooting the rifle with a metal jacketed bullet, a lubricated cast bullet, or a paper patched bullet is going to wear the barrel. Smokeless powder will cause far more barrel wear than a paper jacketed bullet. Blackpowder is death to a barrel if not properly cleaned.

If the rifle is an irreplaceable antique shooting it might not be a good idea anyway. If the rifle is a new replica then the barrel can be replaced like any other barrel. Barrels will wear out. With metal jacketed bullets and smokeless powder five thousand shots is about it. With blackpowder and paper patched bullets double or triple that number. And that's a lot of shooting.