

MAKING SHOTGUN BARRELS



MAKING SHOTGUN BARRELS

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We have many good Mini and other books on Gunsmithing, Knife making, History, Out of date, and Crafts books. The purpose is to give you the basic information on subject that is covered here. I hope you enjoy and learn from these books. H. Hoffman

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1

Zaibatsu Release

I am the alpha, the omega,
the beginning and the end

MAKING SHOTGUN BARRELS



ABOUT THE AUTHOR

Harold Hoffman has through his 30 plus years of experience as a Gunsmith, Toolmaker and Custom Knife maker has passed on to you through his books information that soon may be lost or forgotten. His books are not intended for the person wanting to make a complete firearm, but for learning basic shop tool making. The information found within his books is for instructional purpose only. -- The titles DO NOT actual cover gun repair on firearms, but how to make needed parts for firearms which is about 40% of all gun repair. Without this information you will be severely limited in gun repair.

He first started gun repair when he was 18 years old doing minor repair for the farmers and local hunters in the Bucklin, Kansas area. His main interest was how to make rifle barrels, as he was an avid hunter. Moving into a bigger shop he bought a lathe and proceeded to learn how to use it.

He wanted to find out how to make rifling buttons to rifle barrels, tool making, and learn everything about making barrels. Over the years he became an expert toolmaker and how to build most everything that was needed in the shop. The information found in his books will show you how to make most of the equipment and tools needed in most shops.

After an eye accident he quit Gunsmithing and started writing books on everything that he knew. He had so much difficulty finding any information that he wanted all this information that he had learned in over 30 years to be available to everyone otherwise it would be lost.

His books are now about the only books available on Gunsmithing/Tool making, as most publishers do not publish Gun or Gunsmithing books anymore.

MAKING SHOTGUN BARRELS

INTRODUCTION

When I first interested in how barrel were made, I was a full time gunsmith in Bucklin, Kansas. I was doing a lot of barrel work, such as chambering and fitting actions.

I started to research the subject in all the different books that I could find. One thing that I found out real fast was that there was not any information on the process of making shotgun barrels.

This was in 1956, and I was always getting shotguns in that had damage or pitted barrels that needed repair. I was manufacturing rifle barrels at the time so I tried my luck at making the shotgun barrels. Except for different tooling and process, shotgun barrels were easy to make.

Many of the processes and methods used in the shop had to be learned as I went along, as I could find no information on them.

In 1962, I gathered all my notes and started putting together a manual on barrel making. I included every process that I used in the shop. At the time, I had a very good business making barrels in Bucklin, Kansas.

My main idea in writing this book is to give the readers an idea how gun barrels are made. This book may seem to be a little vague at time, but once the reader starts making the barrel, etc. it all falls in place. In my shop, most of the equipment that was used had to be made in the shop. I used a 12-inch Clausing Lathe with a 3' bed for the deep hole drilling and a 6' bed South Bend lathe for making the shotgun barrels.

If the reader follows the instructions, a first class barrel can be made, that will compete with the best. I have many readers tell me it sounded to simple. Well making barrels is a simple process, much simpler than other barrel makers would like it to be known. If you decide to make barrels, all that is required is the basic machines that are discussed in the book.

Harold Hoffman

MAKING SHOTGUN BARRELS

LOADS, CHOKES AND PATTERNS

When hunting nowadays and the hunter has trouble killing game within reasonable shotgun range he cannot lay the problem on the manufacturers of guns and ammunition. Most of our full choke 12-gauge guns now produced will consistently kill birds at 60 yards, and very few will fail to kill with certainty at 55 yards. However, only a few shooters can hit with a reasonable amount of regularity fast flying birds within these limits.

Fifty-five to sixty yards are considered long ranges when targets at these distances are seen over the barrel of a shotgun. To check this out, measure out 165 feet and sight your gun over this distance at an object the size of a bird. You will then realize that many birds within the maximum range of your full choke 12 gauge were passed up. You will then realize that there are very little chances of hitting at distances that actually measure 50 to 60 and most of your kills will be made at half this range.

To be able to kill at long ranges, the combination of gun and loads must be in the right combination. First, the gun must be choked tight enough to deliver a pattern of enough concentration or density to insure the target being hit with a sufficient number of pellets guaranteed to kill. Second, the charge or shot load must deliver enough energy to insure penetration. This will depend on the propellant force of its powder charge together with shot of large enough size to maintain a velocity high enough to provide ample pellet energy. Long-range killing must be done by close patterns of heavy shot.

CHOKES

The word choke in itself is self-explanatory. By choking or constricting the barrel at the muzzle, the spread of the shot charge in flight is controlled within certain limits. The tighter the constriction the more condensed will be the shot pattern up to a certain degree, for if a barrel is too constricted or choked, poor patterns will result. Barrels without choke have no more control over shot than a straight tube. To explain the degrees of choke, manufacturers have set up a system of identification based on shot performance over a given distance.

MAKING SHOTGUN BARRELS

Table 1: SPREAD OF SHOT PATTERN IN INCHES AT BORING

VARIOUS RANGES IN YARDS:							
	10	15	20	25	30	35	40
CYLINDER	19	26	32	38	44	51	61
IMPROVE CYLINDER	15	20	26	32	38	44	51
MODIFIED	12	16	20	26	32	38	46
FULL	9	12	16	21	26	32	40

The best way to determine the amount of choke in your barrel is to measure the amount of constriction in the end of the barrel; skeet boring excepted, and then subtract this figure from the actual bore diameter of the barrel. This will give you the number of thousandths of actual choke in the barrel."

The bore diameters of Browning 12 gauge guns run about .725 but those of Winchester and Remington run .730 and their bores are about the same, or .729. The 12 gauge bore diameters run from .717 inch up to .760, and obviously a tube or a choke setting that might give a good full choke pattern with a .717 bore would over choke a gun with a .750 bore. The sizes of the 16 gauges, Browning bore diameters run .665, Remington .673, and Winchester .664. The 20 gauge runs .611 for the Browning, .619 for the Remington, and .614 for the Winchester.

Table 2: COMMON CHOKES AND PATTERN PERCENTAGES

CHOKE	PATTERN	PERCENTAGE
FULL	70-80	PERCENT
IMPROVED MOD. (3/4 CHOKE)	65-70	PERCENT

The full choke standard used to be .040 or 40/1000 inch, or 40 "points" of constriction the barrel makers terminology, but with modern ammunition, a gun with that much constriction is over choked. The full choke barrels today that I have seen have from 28 to 37 points of constriction. It used to be, 30 points of constriction normally gave improved modified patterns, 20 points (half choke) modified or 60 per cent patterns and 10 points (quarter choke or strong improved cylinder) about 50 percent.

MAKING SHOTGUN BARRELS

Table 2: COMMON CHOKES AND PATTERN PERCENTAGES

CHOKE	PATTERN	PERCENTAGE
MODIFIED (1/2 CHOKE)	55-65	PERCENT
QUARTER CHOKE (1/4 CHOKE)	50-55	PERCENT
IMPROVE CYLINDER	45-50	PERCENT
SKEET NO. 2	50-60	PERCENT
SKEET NO. 1 (CYLINDER)	35-40	PERCENT

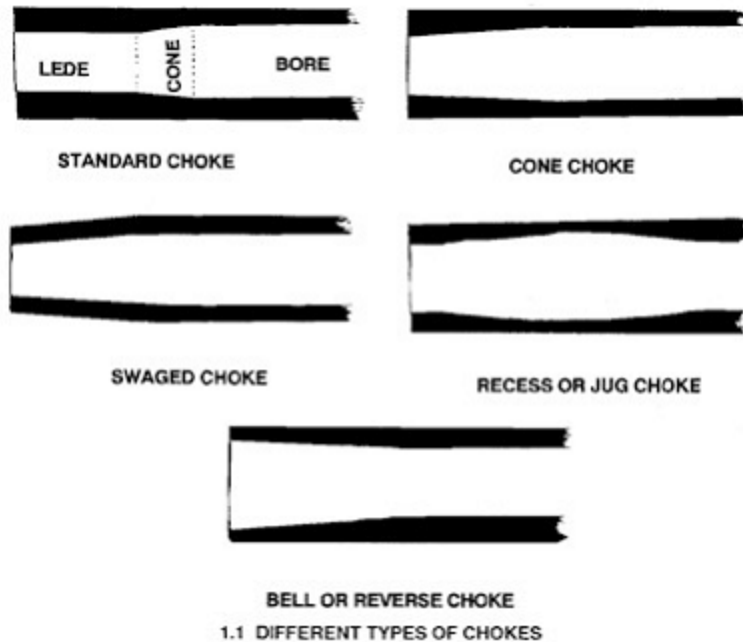
This is what the patterns of the various chokes are supposed to deliver in a 30 inch circle at 40 yards:

The range over which the test for pattern control is made is 40 measured yards, and the shot distribution at that distance is measured by comparing the shot spread over a 30-inch circle. A full choke gun must deliver 65% to 75%, or better, of its shot charge within the 30 inch circle at 40 yards, while an improved modified delivers 55% to 65%, modified 45% to 55%, improved cylinder 35% to 45%, while straight cylinder is apt to be unpredictable as to shot percentages. Note that a full choke requires at least a 65% pattern; however, many guns will deliver a density that will approach 80% or better.

These chokes exceed a regular full choke, so some manufacturers classify them as extra full or long range. The more shot within the given area, the more certain is the chance of hitting a game bird with a sufficient number of shot to guarantee a kill.

While references of chokes were based on 40 yards, a comparable condition results at longer distances, for shot charge in flight takes on a gradually widening area. A pattern that was extra full choke at 40 yards will be relatively more compact than a modified at 60 yards, therefore a bird centered at this last distance will receive more pellets from the extra full than it would from the modified barrel. Therefore, for you to kill at long range, a full choke is imperative.

MAKING SHOTGUN BARRELS



SHOT SIZE

The size of shot is another important factor. The larger the shot the less there will be in the charge, so to insure density of a sufficient nature to contact a game bird with several pellets at long distance, the choke must be tight. With smaller shot, where greater numbers exist, the pattern may be more open and still have as many pellets hit on the same size target. This is another reason for a full choke gun for long-range killing, as the pellets used must be sufficiently heavy to maintain enough energy to kill. It is necessary to have that weight and they must be larger in size and their number per charge considerably less. If your shooting is normally at a range of 50 yards and beyond, it is necessary for the gun to be full choke and the size of shot not smaller than number 5, and number 4 would even be better. At this distance the smaller shot in the full choke barrel would deliver a greater number of hits by individual pellets than the coarser shot, but due to their lower energies would not deliver real knock out punch.

MAKING SHOTGUN BARRELS

Table 3: VELOCITIES AND SHOT SIZES

SHOT SIZE	MUZZEL VELOCITY	VELOCITY (FPS) 40 YDS.	PELLET ENERGY 40 YDS. IN FT.-LBS. (EACH PELLET)	DROP IN INCHES 40 YDS.
BB	1,330	915	16.27	2.4
2	1,330	915	7.98	2.6
4	1,330	815	4.77	2.7
2	1,315	855	7.96	2.6
4	1,315	810	4.71	2.8
6	1,315	760	2.47	3
2	1,295	845	7.71	2.6
4	1,295	800	4.62	2.8
6	1,295	750	2.43	3.1
2	1,240	820	7.28	2.8
4	1,240	780	4.36	3
6	1,240	730	2.30	3.3

The use of heavy or coarse shot, for this can be overdone, as there is little reason for shooting larger shot than 4's on birds, as this size shot will kill as far as needed. If the shot were larger, especially in a 12 or smaller gauge, the number of pellets would be so greatly reduced that at a distance beyond 55 yards it would be possible for the pattern to be centered on a bird and still not make a killing hit. No. 2 shot can be very successfully used on geese, as their larger bodies present a greater area for absorbing, the thinly patterned shot at long distance.

A ten gauge and a ten magnum 2 ounce charge of size 2 shot will contain more pellets than a standard 12 loaded with 1 1/4 ounces of No. 4. This is the reason for the magnums super long range killing properties, for these big guns can throw not only a dense pattern but also one of shot heavy enough to maintain relatively high velocities and energies at long distances.

As the distances fall below 55 yards, the 12 gauges, 23/4" chambered, guns will deliver a killing pattern of No. 5 shot. Satisfactory performances can be had with this size shot on birds at ranges from 45 to close to 55 yards, however it must be shot from a full choke.

The 16 gauge, No. 5 makes a very satisfactory load as there is a sufficient number in 1 1/2 ounces to make a dense pattern with enough energy to kill at the extreme 16 gauge limits.

On all bird shooting just less than 50 yards, No. 6 shot is hard to beat, as the high velocity shells used today will drive pellets of this size with enough force to kill any bird within this distance. The added number of pellets greatly increases the possibility of making one or more hits. This increase in the number of shot per load, the bore of a 12-gauge gun can be improved modified, thereby giving the shooter an added advantage. It will take from 5 to 6 pellets of 6's to kill a bird at about 50 yards or under, and this number can be delivered with certainty from an improved

MAKING SHOTGUN BARRELS

modified barrel. It important for the shooter to use this choke because of the fact that the area, over which this pattern is distributed, is slightly larger than that of full choke. While the full choke at the same distance may place from 1 to 2 pellets more on the target, the extras can be considered excess baggage.

Table 3: VELOCITIES AND SHOT SIZES

SHOT SIZE	MUZZEL VELOCITY	VELOCITY (FPS) 40 YDS.	PELLET ENERGY 40 YDS. IN FT.-LBS. (EACH pELLET)	DROP IN INCHES 40 YDS.
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4	1,315	810	4.71	2.8
6	1,315	760	2.47	3
2	1,295	845	7.71	2.6
4	1,295	800	4.62	2.8
6	1,295	750	2.43	3.1
2	1,240	820	7.28	2.8
4	1,240	780	4.38	3
6	1,240	730	2.30	3.3

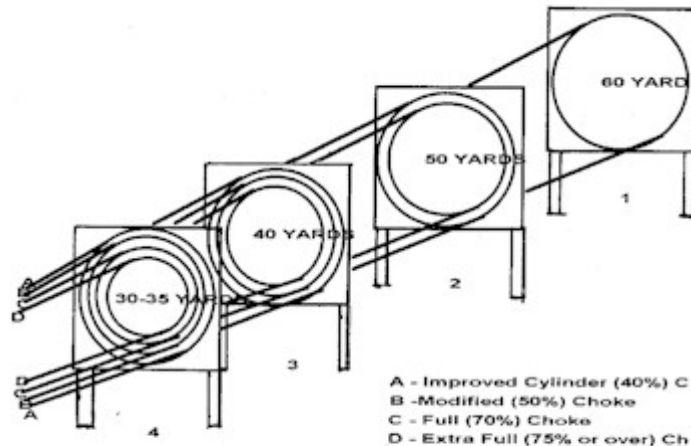
If all the shooters could center their patterns, the full choke would have a little edge over the modified at ranges of 45 to 55 yards. Most shooters have not the skill to do this, so the modified is the better choice.

At 45 to 50 yards the total area covered by full choke, including its crippling fringe, will be hardly larger than the well-distributed killing pattern of the modified choke, minus its ragged edges.

The pellets of the modified will be more widely spaced than those of the full choke and it is advisable, in order to offset this condition, to reduce the size of shot.

MAKING SHOTGUN BARRELS

If the shooter using No. 4 shot in a full choke is to get a pattern of similar density over the wider spread of the modified, it is necessary to shoot 5's or 6's. The number of pellets in the 12 gauges, 1 1/4-ounce load would be increased by approximately 45 with 5's and 112 shot if he were to use No. 6. The smaller will be the better of the two sizes, as No. 6 shot will not only give plenty of penetration at 45 to 50 yards but the pattern will be of sufficient density to kill cleanly.



HOW THE PATTERN SPREADS AT DIFFERENT RANGES

1.2 CHECKING THE PATTERN

The number of shot it takes to kill, that a bird hit with an average of from four to five No. 6 shot under fifty yards is a very dead bird, while one at near 60 yards must be hit with an equal number of No. 4's. What really kills game instantly are shot pellets with sufficient energy to penetrate to a vital organ or completely disrupt the nervous system. It takes the combined energies of at least 5 No. 6 shot to kill a bird at 50 yards, it is necessary to use 4's, with their higher velocities and resulting energy, to kill at 60 yards.

The 12-gauge gun loaded with a heavy, high velocity load is far more desirable when the choke is around 55%, or a strong modified. This is especially true should he chose No. 5's; however if he uses No. 6 he can still further reduce his choke to a regular modified, or about 50%. Killing birds at long range requires a pattern diameter approximately 4 feet or better; with a heavy 12 gauge charge of 1 1/4 ounces of No. 4's, this can be obtained at 60 yards when shot from an extra full choke. The same diameter can be had at 50 yards with a modified choke and in addition, due to its closer range, a denser pattern of No. 6s can be used.

A modified barrel has a quite a bit of advantage over the full on any target at 50 yards or under. By comparing the area of the smaller circle in position 2 with the larger, we can see the handicap placed on the shooter using the full choke. All of that area between the circumferences of the smaller and larger circles would, in the case of a full choke, be lost, or be a crippling fringe. When we go back to position to a point that represents an approximately range of 30 yards, you will be even further handicapped when using a full choke, and that it also exists with improved modified and even modified bore. As most birds shot are shot within this distance, it is better not to shoot tight patterns designed to kill at 60 yards rather select a choke of wide

MAKING SHOTGUN BARRELS

enough spread with shot sizes applicable to the closer distance.

In the 12 gauges double, for shooting at ranges under 40 yards, perhaps the best chokes are a strong improved cylinder (approximately 45%) first barrel and a modified second. With a gun bored to these dimensions and with game at this close distance, the shot size can be further reduced. One of the best killers at 40 yards or under is a combination of 12 gauge loaded with a high velocity charge of No. 7 1/2 shot.

PATTERNS

Many hunters have been led to believe that it takes at least No. 6 or larger to kill birds. No doubt, this idea comes from having associated No. 7 1/2 shot with field loads of lower velocities, and those do not compare with the high velocity shells available today. A bird hit at ranges under 40 yards with a No 7 1/2 load will receive more pellets with a combined energy that is equal, if not greater, than a load of 6's. Due to its larger size, the individual No. 6 pellet will hit with greater force but will not register as many hits on the same area as a denser pattern of No. 7 1/2.

A pattern of No. 7 1/2 shot contains 549 pellets, while the same 1 1/4-ounce load of 6s contains 296 pellets. The difference of 253 pellets in favor of the 7 1/2 represents the materially increased density in pattern; this insures a greater number of individual hits when shot from the same degree of choke. Those who have failed to recognize the ability of 7 1/2 to kill cleanly at ranges not exceeding 40 yards will experience a surprise the first time he tries them on birds.

The birds will be killed with as much certainty with this load as with heavier shot, yet more easily due to its greatly increased number of pellets, the bore of the gun can be opened up giving an even wider killing spread. As the range increases beyond 40 yards, No. 7 1/2 will lose much of their energy.

For a 12-gauge single barrel gun such as the pump and automatic, the bore for long range shooting should be full choke. When doing jump shooting it is well to strike a happy medium between the two chokes prescribed for the double and select a choke of approximately 50 to 55%.

Due to the ranges and conditions at which birds are killed, and the ability of the 12 gauge gun to meet most of them, unquestionably the 12 is the best bird gun. Guns in this gauge are not only light enough to be readily maneuverable, and are capable of delivering killing performances at ranges up to and beyond the ability of most shooters. At close range the patterns can be opened up to a degree that a killing spread of from 3 to 4 feet in diameter will be as dense or denser than the smaller gauges with their reduced shot capacity are capable of delivering.

Many 12 gauges, full choke guns will not kill at 60 yards, but there are very few that will fail to kill with certainty at 55 yards. The 3 inch chambered 12's, many will kill beyond 60 yards. No matter what type of gun, the loads must be of high velocity and of proper shot sizes.

High velocity loads of 1 1/2 ounces of No. 4's or 5's, when shot from a full choke gun, have a killing range slightly over 50 yards. This is the maximum killing range of the average 16 gauges.

MAKING SHOTGUN BARRELS

A modified choke in this bore should give good performances loaded with No. 6 shot at 40 to 45 yards. As the range decreases from 40 yards, it is better to open up the pattern slightly and at the same time, the same reduce the shot size to No. 7 1/2. The 16 gauge is a good bird gun when the shooter will keep his shooting within the range of the guns killing limits.

Since most birds are killed well within the ranges of the 16 gauge, this gun is gaining more popularity in many areas where there is jump shooting. The 16 cannot approach the 12 at a greater distance because of its smaller charge, for what it lacks in the area of a killing spread is somewhat compensated for by the guns lighter weight and easier pointing qualities. Lighter guns are much more easily aligned on a target, and in the case of jump shooting birds the shooter will gain from 3 to 5 yards in getting in his shot.

For the long range shooting 16, the double should be bored with an improved modified or full in the first barrel, while the second barrel should be as full as possible without causing blown patterns. If you can get a gun with the choke of 65% to 70% in the right and 75% or over in the left barrel is perhaps the best long range 16. The pump gun and automatic should have full choke when the shooting is to be at distances generally experienced on pass shooting. For long range shooting, the 12 gauges are recommended over the 16.

When jump shooting, patterns of 45 % to 50% in the first barrel with a 60% choke in the left makes the 16 a good gun. The full barrel should kill regularly at 50 to 55 yards. The choke must be extra full, for to hold shot as coarse as No. 4s with density enough to hit with sufficient number of pellets, the 1 1/8 ounce load has to be fired from a barrel choked at 75% or better.

With the advent of 2 3/4 inch shells with a high velocity one-ounce load, the 20 gauges have definitely been made into a bird gun. In the hands of a good shooter, this little gun will kill at ranges considered long distances for the 12 gauge a few years back.

If the shooter can center its somewhat thin pattern on the bird in flight and its small 1 ounce load must be held to relatively small size shot are important. No. 5 shot at 170 pellets to the ounce is the coarsest size that this gun is capable of handling efficiently. To kill a bird, a charge of 1 ounce must not exceeds killing spread of approximately 3 1/2 feet in order to hit it with enough 5's that establishes the maximum killing range of the 20 at between 45 and 50 yards. In most instances 45 yards will be about as far as a 20 gauge can be relied on to kill birds with any degree of certainty.

The maximum range of the 20 gauges is within the killing limits of No. 6 shot, it is better to rely on this size and gain the advantage of a denser pattern consisting of 225 pellets. Even here, the gun would have to be full choke in order to maintain a compact charge. When the range decreases from 40 yards, shot sizes may be reduced to 7 1/2 and the bore can then be opened up to a modified. This would be the most open choke advisable for use in bird hunting with a 20 gauge. There are exception as in the case where shooting is habitually done over a water hole where the farthest bird would be under 35 yard in this case choke of perhaps 50 % in the right and 60% in the left barrel of a double, with a 55% choke in a pump or automatic, would kill with certainty.

MAKING SHOTGUN BARRELS

The 20 gauge is a good bird gun when the shooting does not exceed 45 yards and the shooter is capable of accurate gun pointing. This is helped by the 20 gauge's lightness and slender sighting plane.

BARREL LENGTH

What does barrel length have to do with pattern and the killing power of a modern shot gun? The answer is nothing, as far as the pattern goes, whether the barrel length is 26 or 32 inches, to be classed as a full choke it must deliver the required number of pellets within a given area. Any barrel sent out by our gun company's marked full choke will do this regardless of its length. The same applies to barrels of varying lengths marked Improved Modified, straight Modified, as they will all meet the standards of the various types and degrees of choke for which they are bored. Certain loads may pattern more evenly in one barrel than in another, and when changing loads there may be a reversal in performance.

There will be a slight difference in the manner in which a barrel will handle varying shot sizes. Where a barrel may shoot a 75 % pattern with No. 6 shot, it may not give over a 70% with 5's.

Shot texture also makes a difference and soft shot will have a greater number of deformed pellets in the charge, consequently give a larger spread than chilled shot that are less subject to deformation.

Long barrels have one advantage for long range shooting that short barrels do not have. This is a long sight plane and the longer the distance from breech to muzzle the more easily it is to aim accurately. When long range shooting on a pass where the gun must be full choked, it is essential that the gun be accurately sighted. This can be easier when the line of sight passes along the unbroken surface of a long barrel or sighting rib. As the range is shortened, the barrels can be bored more opened and the added spread of the pattern will compensate for any miscalculation in gun pointing. Shorter barrels will be quite as effective at close range as the longer barrels are at long range, but shorter barrels encourage faster and easier handling.

MAKING SHOTGUN BARRELS

EQUIPMENT AND TOOLS

In the introduction, I listed a few machines that are needed, to make what you need. What is needed will allow you to make shotgun barrels, but I am not considering speed, number of operations, or number of barrels produced.

LATHE

Your lathe should have at least a 3 foot bed, but a 6 foot bed is better if the spindle hole is smaller than 1 1/2". The hole through the head stock should be at least 1 1/2 inch, as you will need to center the barrel blank in the head stock.

There will need to be a collar on each end of the head stock so the blank can be centered. The collars will need to be tapped for 4-1/4 inch set screws, which will be used to center the blank.

The lathe should be able to turn at least 2000 rpm or higher. It should have tapered bearings in the head stock spindle.

OIL PAN

There should be some type of oil pan under the ways to catch the returning cutting oil, so it can be strained before it is returned to the oil reservoir. This tray should extend full length of the lathe.

For boring barrels, you will need a pump that will turn out at least 400 lbs. of oil pressure. This pressure is needed to clear the chips. More on this later.

TOOL POST GRINDER

If you are going to make your tools, such as reamers and other special tools or cutters, a tool post grinder is necessary. With a tool post grinder, you can cut your expenses down to a very small percentage of what it would be if you had to buy them or have them special made. You will probably not be able to buy any tools for making shotgun barrels so most will have to be made.

You will be able to grind your own reamers and your own chambering reamers. In general, be able to make any gauge of barrel with any desired chambering.

MILLING MACHINE

You will need a milling machine with an indexing attachment for making reamers, however a milling attachment for a lathe should work. A vertical mill would be the best choice, as you can do much gun work with it. You will also need a coolant pump. This can be from an air conditioner pump, the evaporative type.

MAKING SHOTGUN BARRELS

This will be needed in some cases when you grind the reamers. The coolant that you should use is a water-soluble type that can be found at any machine supply house or oil bulk plants.

A good small mill can be bought from wholesale tools. See listing at back of manual under suppliers.

DRILL PRESS

Most shops have these. You will need a drill press for most of your fixture making. There will be quite a few fixtures to be made to drill barrels, and ream barrels.

SHAPER

A shaper is not a necessary item to have but it will save quite a bit of time in making the necessary fixtures that will be needed.

Most of the work that can be done on a shaper can be done on a milling machine. However, some special shapes can best be done with a shaper. It is easy to shape a lathe bit to what you want rather than to try to reshape a milling cutter.

SAWS

A good band or cut off saw is necessary when you are working with barrel steel. It gets old very quick cutting off a 1-1/4 bar steel with a hacksaw. It will come in handy also in the fixtures that you will be making.

Wholesale Tool has a good one that works as a cut off saw or a vertical band saw.

HEAT TREAT FURNACE

This is absolutely necessary to have. There are many small furnaces available on the market that would work for what we want. It should go up to at least 2300 degrees, if you are planning working with high-speed steel.

I have found that oil hardening tool steel (O1) works just about as good. You will need to have good control to hold precise temperatures of the oven. This can be used to draw the temper of the reamers and cutters also. The furnace can be made easy, and a blower from a vacuum cleaner can provide the air. This is well covered in the book *Barrels & Actions*

MEASURING AND LAYOUT TOOLS

The following listing includes all the tools and instruments of this category that are essential to good Gunsmithing and tool making. Some of these precision items are a bit on the expensive side when one has to go out and buy them all at once.

MAKING SHOTGUN BARRELS

Considering the years of good service they will render, if properly taken care of, one can scarcely consider them as being costly.

MICROMETER

You will need a micrometer from 0 to one inch, and one to two inches. They should be of a type so you can read down to ten thousandth of an inch.

MICROMETER (DEPTH)

Most of these come equipped with three interchangeable rods giving a range of measurement from 0-3 inch by thousandths of an inch.

MICROMETER (INSIDE AND OUTSIDE)

These should have a capacity of at least 6" and equipped to give a reading in thousandths.

GAUGES

Some of the gauges that will be needed are a bore gauge for measuring the finished reamed bore of the rifle barrel. There should be a gauge for each caliber that you make.

Each gauge should have a go and no go gauge on it. They can be turned out on a lathe. The no go gauge should be .015 larger than the go gauge.

HEAD SPACE GAUGES

You will also need also head space gauges for each of the gauges you chamber for in the shop. They can also be made in the shop.

ANGLE AND RADIUS GAUGE

Another of the gauges that you will need will be angle and radius gauges. These are not used to often, but they do come in handy when you need them. You will need a thread gauge, as in every barrel you pull you will have to know how many threads per inch there is.

LEVELS

You will need a very accurate machinist level, one that will have the adjustable degree base; so correct angles can be achieved.

TOOL STEEL

MAKING SHOTGUN BARRELS

You will need a good supply of tool steel, (oil Hardening) for your reamers. You can experiment with different makes until you find what will fit your needs. In 30 years, I have found O1 hard to beat.

SILVER SOLDER

You will need a good high strength, low melting point silver solder. As you can see from the above, that most shops have about all the machines needed to make rifle barrels, except for a few specialize tools and machines.

There are a few other machines that you will need. Reamers can if you want to make them can be made from worn out hand reamers. All that is necessary is to regrind them to the size needed. All sizes and dimensions will be given in later chapters, along with all other information and sketches.

I might point out that the drilling of the rifle barrel is one of the simplest operations of all the processes that goes into making a shotgun barrel. This is all covered in Barrels & Actions. It will take about 20 minutes to drill through a 26" steel bar.

If you follow the directions carefully, you will be able to turn out high precession shotgun barrels. They will be as good as any factory barrel on the market, and much better than the ones that are turned out on the new computer machines.

You will also, if you make your own barrels, be able to select a possibly better steel to make your barrels out of as no matter what is said to the contrary.

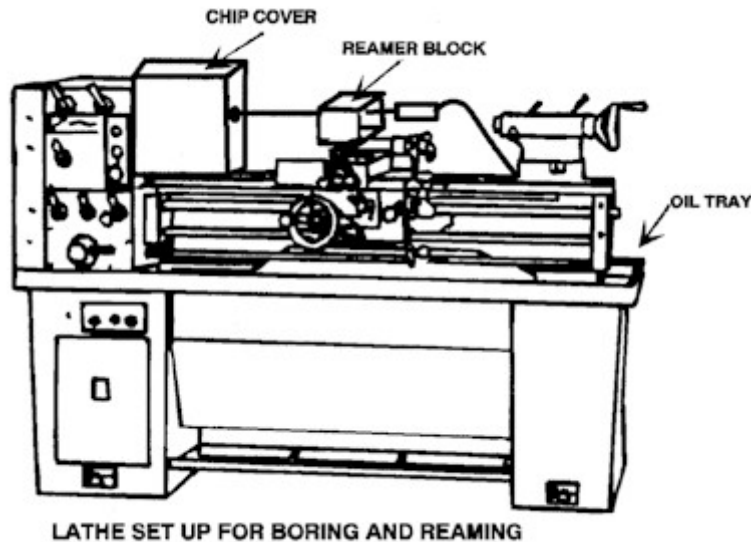
Factories use the type of steel that can be mass-produced with the least amount of inspection and rejects.

In the following chapters, we will break down each step of the operation that goes into making a shotgun barrel.

MAKING SHOTGUN BARRELS

CONVERTING THE LATHE

You will need a lathe with a hole through the head stock of at least 1 1/4 inch. This is so you can take the 26-inch or longer barrel blank through the spindle. If you cannot find a lathe with a 1 1/4" hole in the head stock spindle you will need to find one with a 6 foot bed.



In addition, if you have plans to make quite a few barrels such as .410 gauge, it would be wise to get the right size pulleys to be able to increase the speed of the spindle up to 2000 RPM to handle the smaller gauges. My drilling lathe for reboring was an older South Bend with a 60-inch bed, which I used 8-9 hours a day. This lathe was excellent for reboring and proved excellent for general shotgun barrel making.

You want everything to be easy to change so when you go back to reaming or regular lathe work there will not be any problems.

OIL TRAY

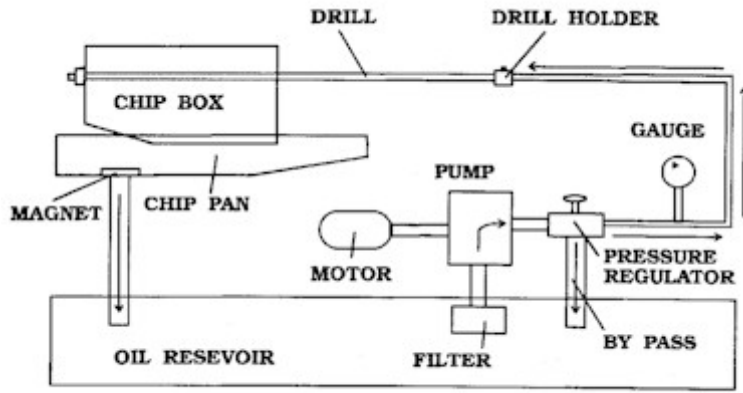
If your lathe does not have an oil tray or chip pan underneath, you will have to construct one. The tray needs to extend a few inches past the head stock spindle. If it does not it will not be too much of a problem to build a cover that will fasten to the lathe or tray to catch the oil from the barrel and return it to the tray. This cover needs to be high enough to cover the spindle hole with a piece of canvas with a hole in it to keep the oil from splattering all over everything.

CHUCK COVER

You will need a cover that will go over the 3-jaw chuck, or collet, as there will be quite a bit of oil

MAKING SHOTGUN BARRELS

thrown out there. This cover can be made to rise straight up and on the front; there should be a long slot to clear the drill or reamer tube. You will also need an oil container, of at least 55 gallons. This can be the oil drum that the oil comes in.



COOLANT SETUP FOR DRILLING

There will also need to be a container of at least 20 gallons to catch the oil and chips before it returns to the main oil container. You will need some kind of baffles that can be 1-inch angle iron laid flat in the tray in the lathe. This is to help separate the chips from the oil, and help to settle the fine chips. From there it goes to a 1 1/2 inch return pipe on the tray, down to about a foot off the bottom of the 20 gallon container. This is done to help separate the chips from the oil. From this container the oil over flows through a 1-1/4 inch pipe to the 55-gallon drum, which is laying on its side?

Table 5: COOLANT VOLUMN REQUIREMENTS

	VOLUME				
	DEPTH OF HOLE				
	6"	12"	18"	29"	36"
HOLE DIAMETER INCHES					
3/16" - 1/4"	2	3	3	3	3
5/16" - 1/8"	4	4	5	6	6
15/32" - 1/2"	5	6	8	10	11
17/32" - 3/4"	7	8	10	13	17

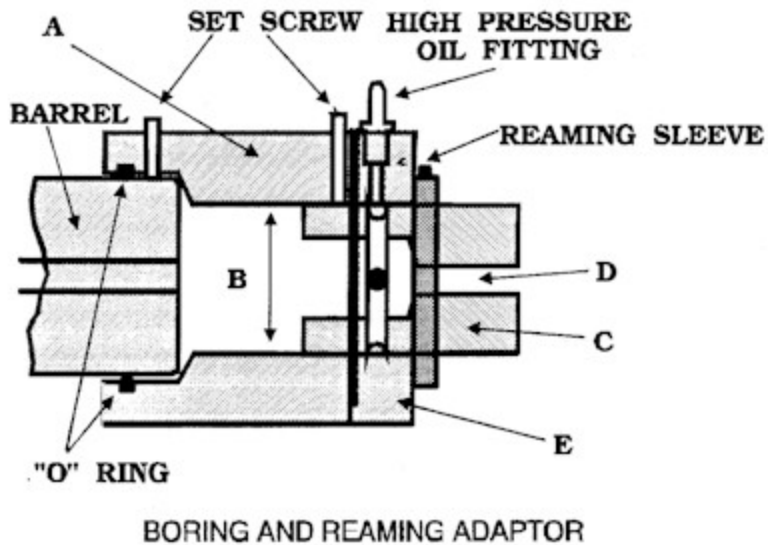
In front of the overflow pipe is a large magnet that will trap the very fine metal that did not have

MAKING SHOTGUN BARRELS

time to settle. This will prolong the life of your pump.

HYDRAULIC PUMP

You will need a hydraulic pump that will turn out at least 500 lbs of pressure, and a good flow rate. You will need the high pressure for drilling to get the required flow to remove the chips. In the reaming operation, you will also need a large volume of oil to keep the flutes clear. Not enough oil flow and the flutes of the reamer and ruin the reamer and barrel.



1.5 OIL ADAPTOR FOR BORING & REAMING

COOLANT VISCOSITY

Coolant viscosity for drill sizes from 1/4 to 3/8 inch should be 80/125 Saybolt Seconds at 100 degrees.

COOLANT VOLUME REQUIREMENT

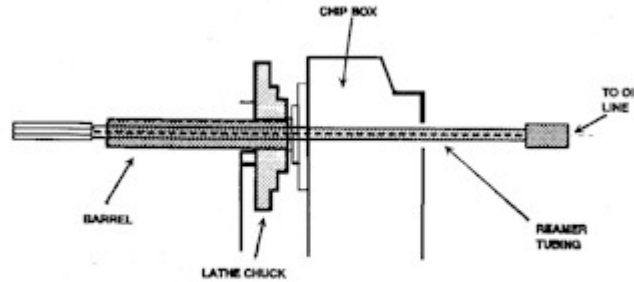
If you have a Farm Supply Store, there you might be able to pick up a pump there, along with other valves, etc. Farm stores carry as well as hydraulic and stock pumps that will work for some operations. If you have 3-phase electric power, it would be wise to use a 3-phase motor of at least 5 horses for the coolant pump. The pump does not have to be a big one as the 500 lbs of pressure is held through a .062 hole, and as the drill size increases, the pressure goes down.

After you have completed the plumbing, connected the electrical switch, which should be very close and handy to where you will be standing, and all electrical connections done.

MAKING SHOTGUN BARRELS

CHIP BOX

The chip box should be made so it can be removed, returned, and still line up exactly in the same place. On mine, I took the tail stock apart and mounted the chip box on it. The purpose of the chip box is to keep the oil from flying all over the shop. If you are planning to drill, your own barrels get the book *Barrels & Actions*.



1.6 THE CHIP BOX COVER IN PLACE ON LATHE

Normally in any reaming or drilling operation, the barrel turns, and the drill or reamer is stationary.

REBORING

Now about the last thing that will be needed is a special Steady Rest to support the reamer tubing as it reams, however unless there is a lot of chatter it is not necessary. This will help cut down the vibrations that will some times start in the reamer.

You CAN NOT allow these vibrations to start. If it does, it can cause the carbide drill tip to chip, and if you do not catch it in time, it can also cause the drill to plug up and twist the tip off. Will give you a good idea of what a Deep Hole Drill looks like.

I want to point out that this boring setup is not limited to just barrels. It can be used for quite a bit of other industrial operations, where extremely accurate holes are needed. In addition, with carbide drill tips, very hard steel can be drilled. For odd shaped items where you are unable to rotate the drill, you can set up the operation where the drill can be rotated using special tooling.

STEADY REST

These will give you the pressure and Viscosity for your Oil Coolant for different types of materials. Do not forget to put the shield over the end of the barrel, so when you drill through the barrel the oil will not be sprayed over the entire shop.

MAKING SHOTGUN BARRELS

TOOLS FOR REAMING

You will have to make a few additional fixtures for the reaming operation now. This will not have to be much of a job, as everything that you have done so far will work with the reaming operation. About the only thing that will be needed is a reaming adapter for the chip box housing. When this adapter is done it will fit in place where the chip box housing was.

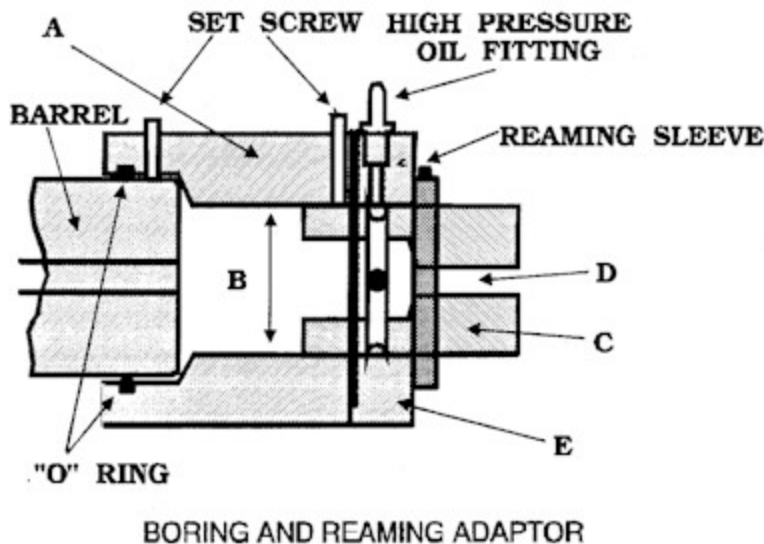
The high-pressure oil line that was fitted to the boring drill tubing or reamer tubing will now be fitted to the reaming adapter (if you are using a solid shaft). The reamer rod will have to be made. Cut it now to correct length. A drill driver will need to be made to fit the reamer rod.

REAMING FEED

With this done and in place you will have to change the feed of your lathe to a faster feed, somewhere in the range of .015 to .030 inch feed PER FLUTE PER REVOLUTION. The speed of the lathe will have to be changed to the back gear for slow RPM. In reaming, the reamer is pulled through the barrel.

REAMER ADAPTER

Now for the construction of the reamer adapter. First, you will need a short bar of steel 1 1/2 inch in diameter if you are using 1 1/8 inch steel for your barrel blanks. This piece when completed should be 7 to 8 inches long. The end that fits over the barrel blank should be a very close fit to the barrel, just a few thousandths larger. Next cut an "O" Ring groove to fit an "O" ring, which is used to seal the oil from leaking.



1.5 OIL ADAPTOR FOR BORING & REAMING

The bore (B) should be bored to .755 to fit the reamer guide (C). This guide should be made out

MAKING SHOTGUN BARRELS

of tool steel. The fit over the reamer rod should be very close as this is what seals the oil. I have in the past tried to use "O" rings to seal the oil but they do not last long. Drill Rod size .750 works very good, as there is no turning of the outside to fit the sleeve (A).

Another way to do this is to bore (D) to 1/2 inch and make a harden bushing to fit inside it, so the bushing can be changed to the different size rods.

When the bushing wears out, it can be easily changed, without the expense of the higher priced 3/4 inch Tool Steel. The bushing bearing (E) is a very close fit in the bushing.

The bushing has a groove turned on the O.D. and 4, 1/8 holes drilled to let the oil be pumped inside (B). The sleeve (E) has a fitting tapped into the outside so the High Pressure hose can be screwed on. There is also a retaining sleeve (F) to hold (E) in place. The sleeve (E) is free to rotate when the lathe is turning.

All the parts when completed are Heat Treated and drawn at 500 degrees. This will just about complete the setup for drilling and reaming.

Except for one other item, you will want to mount a High Pressure oil gauge in the line to the Drill and Reamer fittings. Have this handy so you will be able to see it always. Oil pressure will tell you quite a bit what is going on inside a barrel. If a Drill or Reamer is plugging up the pressure will go up.

MAKING SHOTGUN BARRELS

BARREL TURNING

Now we will take the barrel that you drilled to .500 and turn it into a shotgun barrel. I will try to cover the process step by step up to the finish. I will assume that this barrel is a 12 gauge.

I will give you instructions for a 26-inch barrel. The first thing to do is cut the barrel to 26 1/2 inches long. You will need the extra 1/4 inch in truing up each end, and the final finishing of the barrel.

You have the barrel cut to 26 1/2 inches, so now chuck the barrel in the lathe and face off both ends of the barrel. If the bore has run quite a bit off center, you will need to repeat this process after a few passes on the O.D.

The reason for this is that if the angle on the end of the barrel is off, one side of the barrel will be thicker than the other. In turning, the barrel will probably warp. Now that the barrel is squared, put the faceplate on the lathe. Take a bar of steel that is 26 inches long that has centers in each end and has been turned true.

You will need a trued barrel for each length of barrel you turn. What this is for is to give you a way to duplicate any taper that you want.

Example, if you found that the old barrel that you were wanting to duplicate, had a taper of .125 from the muzzle, to 12 inches from the muzzle.

TAPER PER FOOT CHART

Go to the taper per foot chart. In the taper Per Foot columns at the top, find 1/8. Follow this column down, and when you come to where the left column says - Length of Tapered Portion, at 1 foot, or 12 inches. Where these two meet, find a figure of 0.0104. Now mark the 26-inch bar of steel exactly 12 inches from the tail stock end, to a point in the middle of the barrel. This is the distance you will need to travel with the dial indicator.

Set the dial indicator on the carriage of the lathe, set it to 000, and set the tail stock over a bit. Crank the carriage down towards the head stock to where the mark is on the barrel. Check the reading on the dial indicator, and if it is not right, reset the tail stock and repeat the process until you get 0.0104.

It would be wise to keep all of these figures on notes, or stamp the barrel with the correct figures, for future reference.

Having found the correct angle, set the barrel blank between the centers, and clamp a lathe dog on the head stock end. The tail stock center, as I have found over the years works better if it is carbide. If you are careful, you can use the standard high-speed center. Put a little grease on it that contains MolyKote Z before setting it up.

I have tried to use live centers off and on, but I have found that I get too much chatter, and that will

MAKING SHOTGUN BARRELS

cause stress to build in the barrel, and thus warp the barrel.

TAPER PER INCH FOR VARIOUS INCLUDED ANGLES
The Tabulated Quantities = Twice the Tangent of Half the Angle

Deg	0'	10'	20'	30'	40'	50'
0	0.00000	0.00290	0.00582	0.00872	0.01164	0.01454
1	0.01746	0.02036	0.02326	0.02618	0.02910	0.03200
2	0.03492	0.03782	0.04072	0.04364	0.04656	0.04946
3	0.05238	0.05528	0.05820	0.06110	0.06402	0.06692
4	0.06984	0.07276	0.07566	0.07858	0.08150	0.08440
5	0.08732	0.09024	0.09316	0.09606	0.09898	0.10190
6	0.10482	0.10774	0.11066	0.11356	0.11648	0.11940
7	0.12232	0.12524	0.12816	0.13108	0.13400	0.13694
8	0.13986	0.14278	0.14570	0.14862	0.15156	0.15448
9	0.15740	0.16034	0.16326	0.16618	0.16912	0.17204
10	0.17498	0.17790	0.18084	0.18378	0.18670	0.18964
11	0.19258	0.19552	0.19846	0.20138	0.20432	0.20726
12	0.21020	0.21314	0.21610	0.21904	0.22198	0.22492
13	0.22788	0.23082	0.23376	0.23672	0.23966	0.24262
14	0.24556	0.24852	0.25148	0.25444	0.25738	0.26034
15	0.26330	0.26626	0.26922	0.27218	0.27516	0.27812
16	0.28108	0.28404	0.28702	0.28998	0.29296	0.29592
17	0.29890	0.30188	0.30486	0.30782	0.31080	0.31378
18	0.31676	0.31976	0.32274	0.32572	0.32870	0.33170
19	0.33468	0.33768	0.34066	0.34366	0.34666	0.34966
20	0.35266	0.35566	0.35866	0.36166	0.36466	0.36768
21	0.37068	0.37368	0.37670	0.37972	0.38272	0.38574
22	0.38876	0.39178	0.39480	0.39782	0.40084	0.40388
23	0.40690	0.40994	0.41296	0.41600	0.41904	0.42208
24	0.42512	0.42816	0.43120	0.43424	0.43728	0.44034

STRESS IN BARRELS

It is very important to keep any stress from build up in the barrel (Live centers, too tight centers, dull tool bit, improperly sharpened tool bit, etc.) Now for the tool bit. I have used carbide most all the time in turning barrels. I prefer a good grade of high-speed steel as they are sharper and cut better, but require sharpening every pass, to keep a good edge. I had to use carbide due to the time saved

I ground all my tools to the general shape. On high speed bits I used only about .010-nose radius, stoned on by hand. Set the tool up so it is about .010 above the tail stock center. If I have the time, I usually use a feed of .004, but you will need to experiment to see which feed works the best. Usually I do not take over .020 pass per each side on each pass.

What you have to watch for is that the cut is not heavy enough that it will cause the barrel to spring, especially on the barrel that is half way turned down. This springing causes stress. The tool must cut clean, for if it drags, or it is slightly dull it will cause the barrel to heat as it is turned. When the bit is sharpened right you will get some heat build up, but not much. Watch the chips, as they are coming off the barrel. If they turn a dark blue, you are taking too much a cut, or the tool

MAKING SHOTGUN BARRELS

is dull.

Keep close of the pressure on the tail stock. It must be snug on the barrel, but not tight. As the barrel heats, it lengthens and the tail stock must be loosened. If the tail stock center loosens too much, the tool bit will chatter. After the contour is turned up to where the shoulder will end, you will need to remove the barrel. You will then check to see if the bore is straight, and straighten if necessary.

If you have kept a sharp tool and a light feed, it should be straight. You must, after ever pass from now on the barrel should be checked to see if it is straight. If the barrel has warped, take a lighter pass after it is straighten.

When you start cutting the contour of the shoulder (if there is any), unless you have a tracer attachment for your lathe, you will have to cut it by hand. This may sound hard, but with a little practice, you will get a perfect contour. To this, as you get where the contour starts, you will start to back the feed out by hand. With each pass put a little more contour to the shoulder.

Remember to take the shoulder back a little farther than where it should be when finish, as you have to turn down the shank of the barrel. If the barrel should start to chatter when turning, place a barrel blank on the barrel behind the cutter and that will usually stop the chatter.

When you have finish turning the barrel down to within a few thousands of the finish size, set the feed to the lightest feed. Sharpen the tool bit, hone it very good, and make a finish pass.

MAKING SHOTGUN BARRELS

BARREL STRAIGHTENING

If your drill was properly sharpened, had a good starter bushing, and the starter bushing was in good alignment, the bore should be straight. In most cases the barrel will shoot as good if it is slightly crooked, as it would if it was straight, but if it was very slightly crooked and turned and finish that way, it would tend to move the pattern as it heated up.

In turning a barrel if you do not get the cutting tools sharp, take too heavy a cut, let the barrel get too hot, let the centers get too hot, or out of round, the stress will warp the barrel. Then you will have to straighten the barrel.

I will try to cover the main points in barrel straightening, and give you a guideline as what to do and what to look for. You must realize that barrel straightening must be self-taught, and to accomplish this, it will be advisable to practice on old barrels.

A shotgun barrel is good to practice on as it is big and smooth with no rifling to confuse you. It is next to impossible to straighten a barrel with a rough bore. I will also show you here how to make barrel-straightening equipment necessary to straighten the barrels,

Let me point out that a large percentage of the factory barrels, to the trained eye are not perfectly straight. Any barrel maker will tell you that a slightly crooked barrel will shoot as well as a straight one.

I have gotten several factory barrels in the last few years that when put between centers of the lathe, ran out as much as 1/8 inch on the OD, even though the bore was straight. These barrels would walk as the barrel heated up and throw the pattern one way or the other

BARREL WALKING

This is not usually a problem with shotgun barrels, unless the gun is used for trap shooting. Why does a barrel walk? If the bore is concentric to the outside, the thicker side will lengthen more than the thin side and the barrel will bend. In most cases there was enough metal on the barrel to return the barrel to make it even.

Even with good steel, some times you find some bars with much stress left in the bar. This steel will warp with every pass of the cutting tool. There is not much you can do to stop it, except straighten it on every pass.

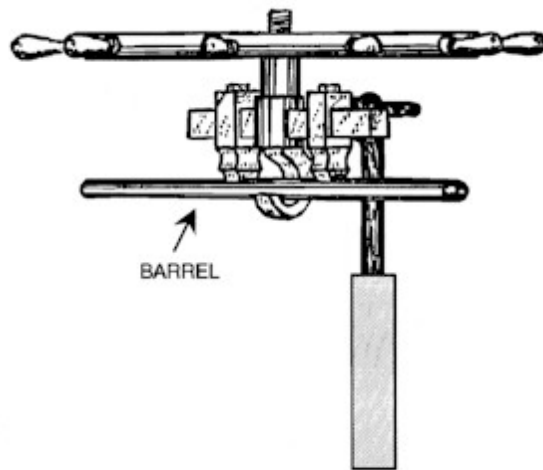
These if you keep them straight up to the final pass will shoot good and will never give any problems later. They are just a pain in you know where. On barrel straightening equipment, the one type that I used is the overhead screw press. You can see the bore as you are making corrections on it.

MAKING SHOTGUN BARRELS

BARREL PRESSES

This type of press can be made quite easily in the shop with nothing more than a cutting torch, arc welder, and old farming equipment. Why the farming equipment? Almost everything needed can be found in used farming machinery. The parts can be cut out and welded in place. The wheel is nothing more than a big flywheel with handles fastened to it.

Another is the type that you use an overhead hydraulic press to make correct it. This is a good type but I have found that it is better if you can feel the pressure when you straighten the barrel. Both will do a good job, but the overhead screw press is faster. If you plan to make quite a few barrels, certainly go to the overhead press.



1.8 Standard Overhead Barrel Press

The oldest method employed by the old time barrel makers was to stretch a fine wire inside the barrel. This is stretch from one end to the other, and touching the sides at each end. One side of the barrel was hammered until the wire touch all the way.

This was used on barrels that was soft and used lead bullets. The methods that I will describe in this chapter will be the one I have used for years, and have found it easy for others to use. Lets put a barrel to test to see if it is straight.

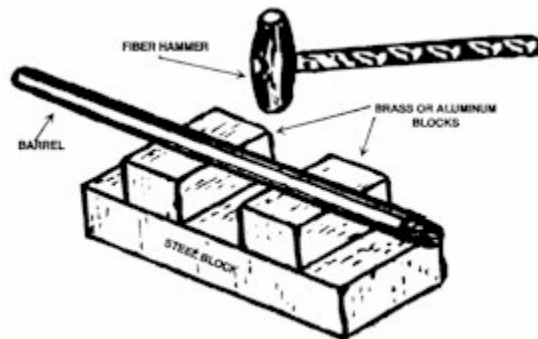
When you look through a bright finish barrel, the interior surface appears to be spread out in a circular disc as far from the eye to the other end of the barrel. As you look through the center of the disk, is a circular (the bore) orifice, and surrounding it, like the rings of a target, at equal distances, (if it is straight).

These circles are well-defined circles around the bore. When you do this look at the edge of a door or window, not an open light. If the second, third, or fourth rings are a perfect circle around the or bore, the barrel is straight.

It will be seen that these images are located at a certain point in the bore nearest to the eye. In

MAKING SHOTGUN BARRELS

two thirds of the length of the barrel, this is the part of the bore that you must direct your attention to in straightening a barrel. This is where by using the reflection, which will show you where the bore is crooked.



1.9 Blocks For Straightening Barrels With Lead Hammer

LONG BENDS

In long bends you will work from 1/2 to 2/3 of the bore, then turn around the barrel and repeat the process. If a distortion of the circle or rings is noticed, revolve the barrel slowly, and you will see what side the bend is on while looking through the barrel. The hardest part is next.

It will take a little practice and time to tell exactly how far, and at what point the bend is. This is done by looking down the barrel, and at the same time touching on the outside of the barrel. When you think you have the correct spot where the center of the bend is, move the barrel so that the center jaw or hook is in that spot, rotate the barrel so the big part of the rings is at the bottom, and apply a little pressure.

If you are at the correct place in the barrel you will see as you apply the pressure, the barrel goes straight. The rings will form a perfect circle around the bore. If this does not happen, release the pressure. Rotate or move the barrel forward or back and repeat the process.

When you get the perfect circle, put more pressure until when you release the pressure the barrel will remain straight. The barrel is like a spring and it will take quite a bit of pressure. When done the interior will look like the above drawings. When you mount the screw press, have it face the window, so you will see half of the edge of the window in the bore.

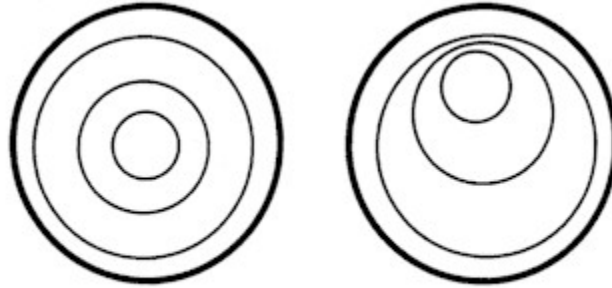
With a little practice, you will be able to straighten the barrel in a few minutes. The second method is with the blocks. This method works fine but is more difficult to get the barrel straight and is time consuming. This method is best used for full size barrel blanks, or if you do not have an overhead press.

A large lead hammer can be used on liners to bend the liner. Find where the bend is, and set the liner on the blocks with the bend to the top. Now give the barrel a good tap with the lead hammer. Check to see if you have made any progress, if not repeat the above with a harder tap.

MAKING SHOTGUN BARRELS

The secret of this process is to hit the barrel hard enough to straighten it past it's elastic limits.

Your skill in using this process lies in your ability to judge by the eye, the exact location where the bend, its proper location, and then slide the barrel to that location.



STRAIGHT BARREL

CROOKED BARR

To straighten the barrel it must be bent past its elastic limits, so when it springs back it will be straight. If you bend it to far it will be bent the other way, then you will have to rotate the barrel and straighten it back.

With a little practice, you will be able to straighten the barrel in a few minutes. The second method is with the blocks. This method works fine but is more difficult to get the barrel straight and is time consuming. This method is best used for full size barrel blanks, due to their large size.

MAKING SHOTGUN BARRELS

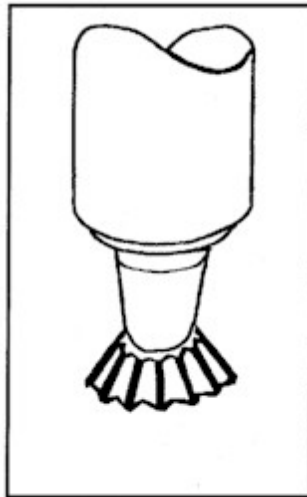
MAKING THE CHAMBERING REAMER

The chambering reamer is no different in grinding than the barrel reamer, except there are more angles, etc. First look at the following drawings to see how to turn the tool steel blank to shape. The blank does not have to have the angles turned on as shown in the drawings; this will be done during the grinding process.

Leave all diameters about .020 larger than shown. The tool steel blank should be cut 6 1/2 to 7 inches long. Use the smallest center drills for center drilling the blank. When turning the shoulder can be left square, but there should be a recess cut in front of the shoulder, end of neck, etc. for clearance when grinding.

ANGLE CUTTERS FOR MILLING FLUTES

The flutes should be milled with a 60-degree x 1 7/8 inch angle cutter. This should be used on all fluting of reamer blanks. The blank should be set up in the indexing attachment on the mill.



1.11 The Angle cutter

When cutting the flutes on the body of the reamer, be careful that you do not go under .062, as this will weaken the reamer. When cutting the flutes on the neck, you will have to go deeper than the setting on the body. Use plenty of cutting oil, and cut about a 1/2 to 3/4 inch past where the neck of the reamer ends.

When you first start grinding, grind the pilot first. You want to decide if you want to have a throat on the reamer or not. If you want a throat, now is the time to grind it. The pilot should be ground about .001 smaller than the bore diameter.

All of these sizes are shown on chamber dimensions. After grinding the pilot to size, grind the angle shown for the end of the neck of the cartridge, going slightly deeper to give a recess.

The angle can be set using the compound on the carriage. From there, grind the neck of the

MAKING SHOTGUN BARRELS

case. The neck can be ground slightly shorter than shown. The reason for this is that when you grind the shoulder, the neck then can be set to the proper length by taking the shoulder back a little at a time.

Table 3: SHOTGUN REAMER SIZES

GAUGE	ROUGH REAMER	<i>FINISH REAMER</i>
10	.740	.775
12	.700	.729
16	.635	.662
20	.590	.615
28	.530	.550
410	.390	.410

The shoulder angle on the rim is next, and it IS **VERY IMPORTANT TO GET RIGHT**, as this is where the head space is taken from on rimmed cases.

This can be set from the taper and angle charts. If you fill that you can set it properly from the angle setting set on the compound of the lathe, do so.

Grind now the taper on the body of the case. This is also set from the angle and taper charts. This is important to have this right so cartridges will fit in other guns of the same caliber. If you are making a reamer for a belted cartridge, this will have to be ground next.

GRINDING THE CUTTING EDGES

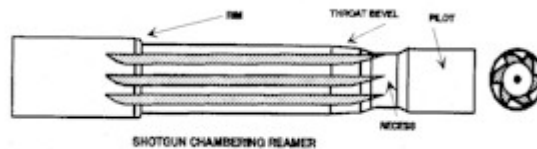
All the edges of the reamer have to be sharpened so the reamer will cut freely. This is the throat (if you use one) the start of the neck, the shoulder, the body of the case, and the start of the belt (if you are making a magnum). It is done the same way as shown in the chapter on barrel reamers. After making one or two reamers, you will understand fully how to do this.

MAKING SHOTGUN BARRELS

This is the most important part of making the shotgun barrel. If you do not have a true and smooth bore you, do not have anything. I will show you how to make reamers for finishing the barrels. On barrel reamers, you will need two reamers. One a rough reamer for removing and cleaning up the drilled bore, and the finish reamer to take the bore to the correct size.

TYPES OF REAMERS

Reamers are made with both straight and helical flutes. The latter provided a shearing cut and is especially useful in reaming holes having key ways or grooves. These are bridged over by the helical flutes, thus preventing binding or chattering. Hand reamers are made in both solid and expansion forms.



SHAPE OF FLUTES

Style and shape of the flute determine its ability to carry away chips and the relative strength of the tooth. For manufacturing, a straight shank may be used. With fluting reamers, the cutter is so set about to the center of the reamer blank so the tooth gets a slight negative rake. The amount is so selected that a tangent to the circumference of the reamer at the cutting point makes an angle of about 95 degrees with the front face of the cutting edge.

When fluting reamers, it is necessary to break up the flute that is to space the cutting edges uneven around the reamer. The difference in spacing should be very slight and need not to exceed about .004 either way.

The manner that you use to break up the flutes is if the reamer is made on a mill is to set the cutter anywhere from .002 to .004 in front of the center of the reamer blank, and changing it a .001 or so on each flute.

The relief of the cutting edges should be comparatively slight. They can be ground close on the tool post grinder and stoned flat with an Arkansas stone. The flat relief is what I have used all along, because the reamer has a keener cutting edge.

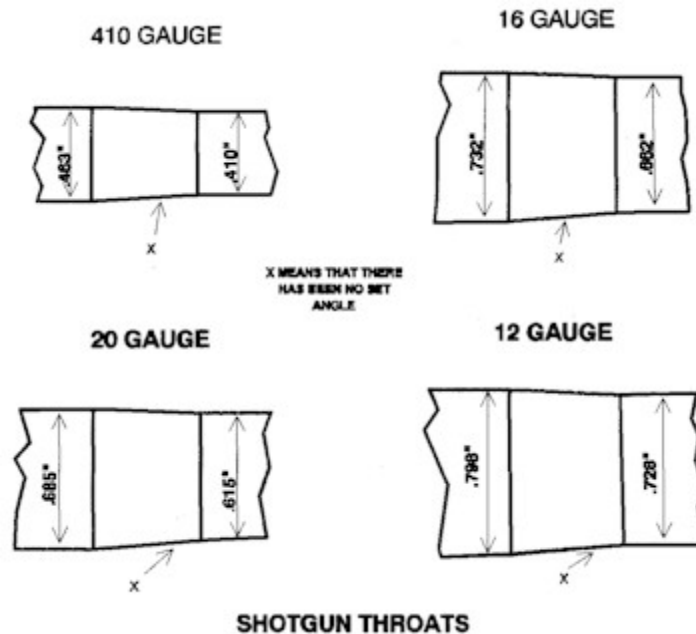
CHATTER

This can be the one thing in barrel making that will cause you the most trouble. Even if the reamer and relief are perfect, you can still get chatter.

The first thing you need to do when using a new reamer is to spray the reamer with layout fluid. If the reamer is chattering, you will when you remove the reamer be able to see if you have enough

MAKING SHOTGUN BARRELS

clearance, etc.



Sometimes a too sharp a reamer will chatter, or it may have too much clearance. If the pilot on the reamer is not a close enough fit, that can cause chatter. Sometimes reducing or increasing the speed or feed will help. I cut all of my reamers on 0 rake and have very little trouble. If you are using commercial reamers, there can be too much positive or negative rake, and that can cause chatter.

In most of my reaming, I find that a good starting point is about two-thirds the drilling speed for a given material. If you ream too slow, it takes too long to ream a barrel, and very few barrels can be turned out. If too high a feed or speed, premature dulling, chatter, and usually a rough or rough finish is the result.

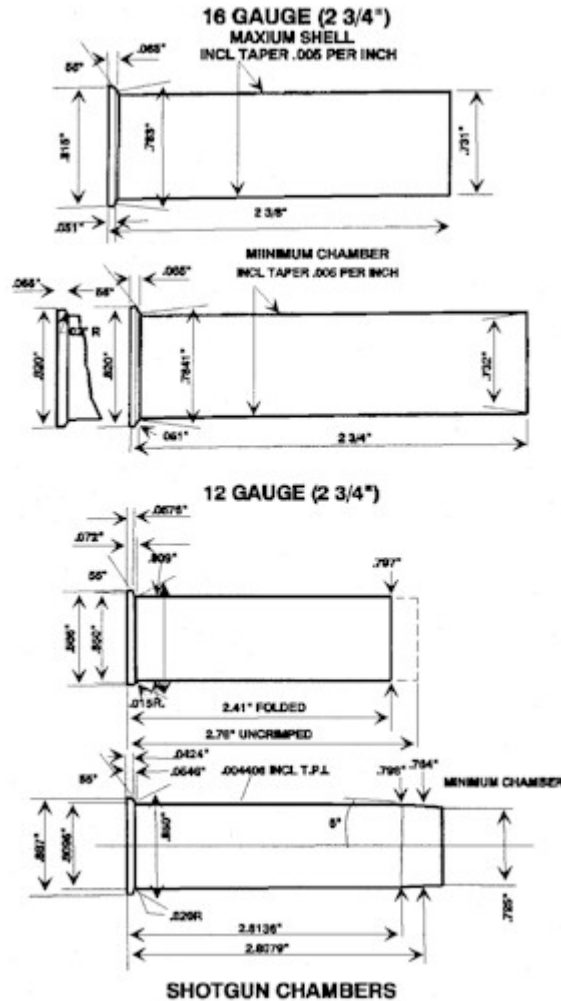
REAMING FEEDS

In reaming, too low a feed may result in excessive reamer wear. Always the feed must be high enough so that the tool cuts, rather than rubs. I find that too high a feed will cause the hole to be oversized, and rough. I also have found that a good starting point is somewhere between .0015 to .004 feed per flute per revolution. I can only recommend that you find the highest feed that will produce the required finish and accuracy.

STOCK ALLOWANCES

This is covered in the chapter on barrel reaming and reamers. This is very an important item in barrel making, as the type of lubricant that you use for reaming will determine the quality of the reamed bore.

MAKING SHOTGUN BARRELS



The lubricant is used to cool the reamer, remove the chips from the barrel, and to improve the finish of the work. Normally for most steel a sulfurize oil, or a high E.P. value mineral oil. Contact a business that supplies cutting oil and they will be able to help you. You will have times when you are unable to get a smooth reamed hole.

LUBRICANTS

When the flutes are not evenly stoned, or flutes cut back of centerline, stoned with too great a clearance. Chips clinging to the flutes - caused by too high a revolving velocity.

CHATTERING

Reamer plugging up by not having enough oil pressure and flow, flutes not being stoned out, and allowing saw teeth to form on the cutting edge. Enlarged holes caused by the reamer being oversized.

MAKING SHOTGUN BARRELS

ARKANSAS STONE

The cutting edge of the reamer is kept sharp by honing with an Arkansas stone over the cutting edges. The reamer should be touched up about every two barrels.

REAMER PLUGGING

The surface speed for reaming should be rather slow, on a regular barrel-reaming machine; the reamer turns, but on the lathe the barrel turns and the reamer is stationary. Instead of using an open belt and higher speed, the lathe is set in back gear, and run at the slowest speed.

FEED RATE

The feed can be made faster than that used for drilling. The barrel reamer is pulled through and used for a greater depth, with more cutting edges in contact with the barrel.

For the roughing reamer you can use a feed twice as fast as that for finishing. After the drills and reamer are made, and kept in good shape, many barrels can be turned out with them. Reaming is a simple operation, and with this information and the tools to produce the barrels, you will turn out high-grade barrels.

Table 3: SHOTGUN REAMER SIZES

Listed above are the Caliber, size of the rough Reamer, and the size of the finish reamer.

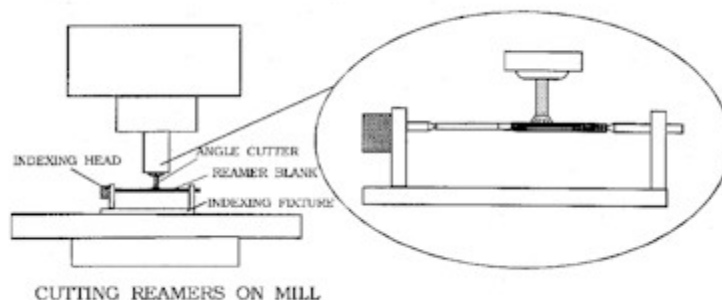
MAKING SHOTGUN BARRELS

BARREL REAMER SIZES

I will go through all the steps of making reamers, from the start of reamer blanks from a piece of tool steel, to the finish reamer, ready to be used to ream the barrel. To start you will need a vertical milling machine, and an indexing fixture. These two items are the two main pieces of equipment necessary to make cutting tools.

I will go through with you on making a complete set of tools for a 12-gauge barrel. You will need 2 each, 1-inch drill rod, 6 inch long. Once you have the 2 - 1-inch drill rod cut, go to the lathe.

Chuck up one of the pieces and using a 1/4 inch center drill, center one end just deep enough to get a good center. On the other end, use a 5/8-inch center, and center it to the outside edge of the drill rod.



The reason for this is that on this end you will attach the pull rod to the reamer. In most reamer operations using the lathe, you will note that tubing is used instead of a solid rod. I use a solid shaft 1/2" in diameter instead of tubing. The reason that I use a solid rod is that, (1) it is much cheaper, (2) it is more rigid than tubing and seems to eliminate the chattering that you get from time to time.

In addition, if the reamer gets dull or it should plug up, with the tubing, it would wind up the tubing and ruin it. With a solid rod, you will be more able to stop the machine before it ruins the reamer.

If it should freeze up in the barrel, the worst that will happen is that the reamer will pull out of the sweat joint that attaches the rod to the reamer.

Then all that is necessary is to drive the reamer from the barrel, sharpen, and sweat the reamer to the pull rod.

Once you have the centers in the drill rod, you will need to drill the end of the drill rod that you centered with 3/8 inch center drill to .500 inch by 3/4 inch deep. You will need to drill the hole first with a next smaller drill size. Then clean it up with a .500-inch drill. Now do the second one and the drill rod is ready for rough turning.

Center up the drill rod between centers on the lathe, with the counter bored end next to the tailstock, with a small lathe dog holding the other end. The .100" drill rod will need to be turned

MAKING SHOTGUN BARRELS

to a diameter of .740 for the .729-fluted end.

The other end where the pull rod is attached will have to be turned. The drilled hole will measure .720 or .700 in the barrel bore when finish ground, so you will end up with a .700 pilot on the reamer. Turn the pilot, (the end where the pull rod is attached) to about .010 to .020 larger than the finish size, and the recessed area between the pilots and where the reamer flutes start to about .600. The pilot area will be on most of the reamers about 1 1/4 inches long. The recess will be about 1/2 inch long for good oil flow. If you make the reamers for smaller gauges, they can be made shorter.

The .410 gauges, the overall length of the reamer would be 5 inches, the pilot would be 1 inch, and the recess would be 3/8 inch wide. The recess should be about .060 smaller than the pull rod when completed, after grinding. The recess is there to get an even oil flow to the flutes when reaming. Make a reamer blank for both the roughing and finishing reamer at the same time.

Once you have the reamer blanks completed, go to the milling machine and set up the indexing head. This should have centers also with some way to attach a small lathe dog to hold the reamer blank solid. If the indexing head supports a collet, the stock can be held with a collet.

REAMER USING OIL TUBE

This type of reamer is made the same as above, with the exception the hole that is bored into the pilot end of the reamer will fit a 1/2" heavy walled steel pipe. When you have the hole drilled for the pipe, you will need to drill another hole 3/16" diameter where you quit on the 1/2" hole. This hole will continue on deep enough to go into the recess area.

In the recess area, you will drill 2 1/8" holes to meet the 3/16" hole at right angles. These holes will provide you with the coolant for washing the chips out.

ANGULAR CUTTER

Next, chuck up a 60-degree angular cutter in the mill. The diameter of the cutter should be at least 1 1/2 inch. Slow down the mill to about 100 to 150 rpm, as the tool steel tends to get fairly hot.

Measure the drill rod on the flute end; in this case, it has not been turned so it is .740. Bring down the cutter on the milling head while it is running and just touch the drill rod and stop.

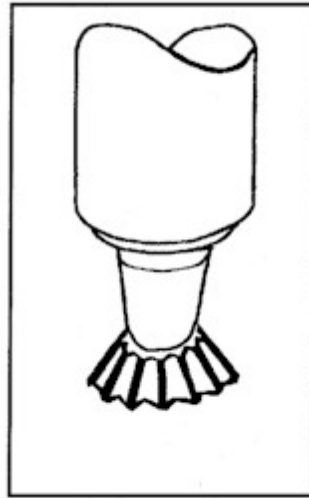
Half of that size is .370, but we do not want to cut the flutes half way, as the reamer would probably chatter.

The first flute should be cut .002 above center, the next should be cut .004 above center, and the third should be cut .006 above center.

After the third flute is cut, the fourth should start back at .002, then .004 and the finish cut is .006

MAKING SHOTGUN BARRELS

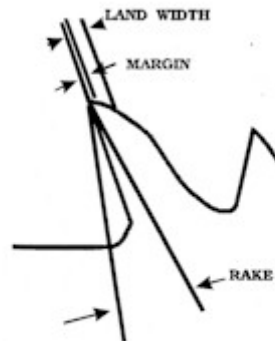
above center.



1.11 The Angle cutter

THE FLUTE THICKNESS

The flute's wall should have a thickness of about .060 to .080. This would of coarse be thinner on the smaller reamers and thicker on the larger reamers. You do not want to make flute walls to thin as they tend to break if the reamer gets to dull, and when this happens the barrel will more than likely be ruined. Plenty of coolant should be applied to the cutting surface during machining to eliminate heating and stress.



REAMER FLUTE SHAPE & DESIGN

DEPTH OF FLUTES

You want to use an ample supply of coolant when cutting the flutes. Depending on the reamer size you will go in about 3/4 of the depth on the first cut and then finish to the correct depth the second pass. Watch for bowing as you cut the flutes. If it is bowing, you are either taking too heavy a cut, or the cutter is dull, or you may be cutting to fast.

MAKING SHOTGUN BARRELS

Whatever the reason you do not want this to happen as it is putting internal stress in the reamer blank. When heat treating the blank, it will probably warp badly. If you fill there is stress in the reamer blank, I would suggest that when you get ready to heat-treat the reamer, that you put the reamer in the furnace when you turn it on.

Bring the temperature up to 1000 degrees, and let it set for 30 to 40 minutes. Remove and bury it in lime until cool, or turn off the furnace and let it cool over night.

MAKING SHOTGUN BARRELS

HEAT TREATING THE REAMER

Bring the temperature of the furnace up to the temperature that is recommended by the maker of the tool steel. Coat the reamer blank with some decarbonizing powder, put the reamer blanks in the furnace and let set for 10 minutes. Remove and quench in the oil tank, or what other quenching medium the manufacture recommends.

When you quench the blank make sure that you go straight in the quenching tank, if you quench the reamer at an angle, you will warp it. If you do warp a reamer you will have to bring the reamer up to 1500 degrees and let it cool in the oven, then straighten it when cool. This is based on using 01 tool steel for all your reamers and cutting tools.

When you have both reamers quenched, lay them down on something where they will not roll off. They are very hard and brittle, and if they fell on the cement floor, they would probably break.

TEMPERING THE REAMERS

Turn off the furnace, close it up and let it cool down to 350 degrees. We will then put the hardened reamers into the furnace to draw the hardness, and remove internal stress. Leave the blanks in the furnace until the furnace reaches 100 degrees, or better yet leave them in over night. The reamers will be about 61 to 62 Rc in Hardness.

The reamer blanks are now ready to be ground to size. We will grind the flutes first. Set up the tool post grinder on the lathe. Get everything lined up and put the small lathe dog on the reamer blank, on the pilot end and grind the flutes end first.

SQUARE REAMERS

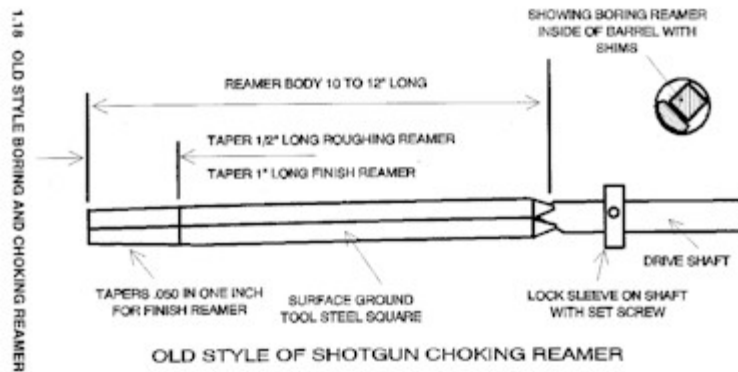
Shotgun barrels are made from steel tubes and although they may be reamed to size with a series of barrel reamers, such as those used on rifle barrels. They are usually finished bored and choked with a long, four-sided square reamer of 01 tool steel, ground to size on a surface grinder. These reamers are 10" to 12" long and have a tapered lead at the front end, about 1" long on the finishing reamer.

The driving rod for these reamers is brazed to the rear end of the reamer, the opposite end from that which has the tapered lead, and the reamer is pushed through the bore as the barrel tube revolves.

The choke boring reamer is used in shotgun barrels to cut the choke. After the finish or fine boring reamer is used the choke boring reamer that has a tapered lead an inch long which tapers about .050" in this distance is used to bore out the choke portion of the barrel that is not bored out by the finish boring reamer. A wood packing strip is used, with paper shims on the

MAKING SHOTGUN BARRELS

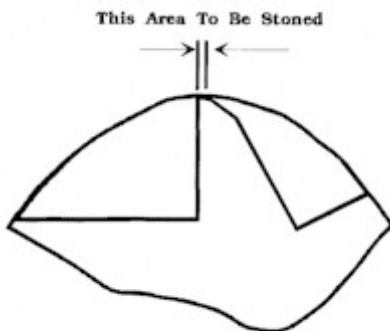
tapered portion of this choke boring reamer and this reamer cuts on two edges.



GRINDING THE REAMER

Clean out the centers on the blank, and set between the centers. Cover the bed of the lathe up to keep the grinding dust off the ways. Set the lathe in back gear drive; turn on the lathe so it will run in reverse. Then turn on the tool post grinder, and starting at the tail stock end, touch the grinder to the blank.

Move the grinder past the blank, set in about .005 and engage the feed. It will not clean up completely, but it will start to clean up any part that is warped. Make one pass and if it is cleaned up enough so you can get a measurement, check the size of both ends. There should be about .002 taper from the pilot end to the end of the blank.



The tail stock end should be the smaller end. This is very important to have or you will get a rough bore. We are grinding the rough reamer first, so you want to end up with the pilot end of the reamer .003 thousands smaller than your re boring drill. When you get this size remove the reamer blank from the lathe. While the lathe is set for the .002 taper, we will do the other blank. It is done the same way except that the final size should be .700 for the rough and .730 for the finish reamer. We will allow the .0005 to hone in to size.

Now that the second reamer blank is ground, we will grind the leading edge taper. Set the

MAKING SHOTGUN BARRELS

compound on the lathe to 1-1/2 degrees. This will be your cutting edge next to the pilot. Turn the lathe on in reverse and the grinder and start feeding the wheel by hand on the cutting edge of the reamer. Grind this angle down a few thousands into the recess. Do the other reamer also. It will take several passes to do this. Take light passes not much over .005 so you will get a good finish.

When you have completed this on both reamers, take the blank from the lathe. Turn it around, put the dog on the other end and put it back in the lathe. Before doing this, make sure you bring the tail stock back to center.

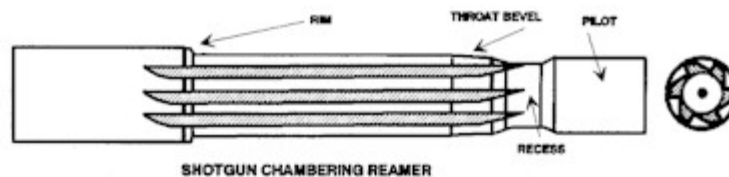
GRINDING THE PILOT

Square the grinding wheel up, and where the recess is, grind this down to about .040 to .060 smaller than the pull rod. When the recesses are completed, it is time to grind the pilots to correct size. The roughing reamer which is .699 diameter, the pilot will be ground to .003 smaller than the rebores drill.

Do not take over .003 per side, as it will heat the metal too much. Go slow and easy. The pilot on the finish reamer will be ground the same way, and the size of the pilot will be .003 smaller than the O.D. of the rough reamer, which will be .699.

When completed with the pilots there is one more operation to do. This is to grind the 4 flats length ways on the pilot for the oil to pass. These flats can be ground on the lathe if the lathe is equipped with an indexing head, or you can grind them by hand if your careful.

You should leave about .060 on each corner of the pilot. This is usually enough to give good oil flow to the reamer. If this should give trouble on chips plugging up the reamer flutes, turn up the oil pressure to get more flow. The finish reamer will give no trouble if it is sharpened well.



GRINDING THE CLEARANCE

Now comes the time to relieve or grind the clearance on the back of the flutes for clearance. If you do not have indexing on your lathe, it will have to be ground by hand. If you have indexing on the lathe, the tool post grinder will grind this clearance. To grind the relief by hand you will need a small hand grinder. Coat the reamer flutes with a lay out fluid. This will darken the metal so you can see how close you are getting to the cutting edge.

Grind the relief just back of the cutting edge, and up to within .005 to .010 of the cutting edge. It will not take much to give the necessary relief, as all you need is clearance so the reamer will not

MAKING SHOTGUN BARRELS

rub.

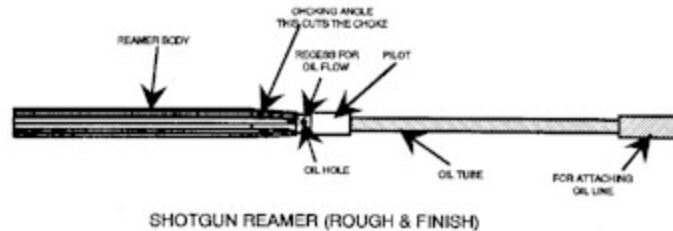
STONING THE CUTTING EDGE

Once the face has been honed, it will be necessary to hone the flutes. Hone right up to the edge watching the lay out fluid coating. This will tell when you have gotten it honed tight.

Start from the area where you ground the relief, and slowly go up to the cutting edge. It should feel sharp when completed.

ATTACHING THE PULL ROD

When you have both honed, it is time to sweat the pull rod to the reamer. It is best to use a 1/5-inch drill rod for this purpose, as it is smooth and uniform. Clean out the 1/5-inch hole in the reamer with some rolled up emery cloth, put some paste solder in the hole. Insert the drill rod into the hole, and heat the shank until the solder melts.



When it melts, rotate the drill rod in the hole to get a good tinning job. Let cool and job is completed. This is one important reason for stress relieving the reamer while heating in the furnace.

If the reamer warps then it will be crooked on the pull rod, which in turn will cause a rough and oversize bore.

Before using the reamer the first time, recoat the flutes and cutting edges with the layout fluid. The reason for this is when you use the reamer the first time. If it gives you trouble the lay out fluid will show up any rub spots, and any place you do not have enough clearance.

- The main problem that you may experience will be chatter.

A new reamer has more tendency to chatter than one that has been used for some time. Chatter may often be reduced by closer fitting pilots and guide bushings, or reducing the speed, also sometimes increasing the feed will eliminate chatter. If for some reason there should be little clearance the reamer will not cut freely, as the lands or margin will rub instead of cut against the walls of the barrel. In most cases, the reamer will either lodge or break off a flute or two, or break off. In the case of a finish, reamer the barrel will be ruined. This is why I always soft solder the pull rod on, rather than fastening it on solid.

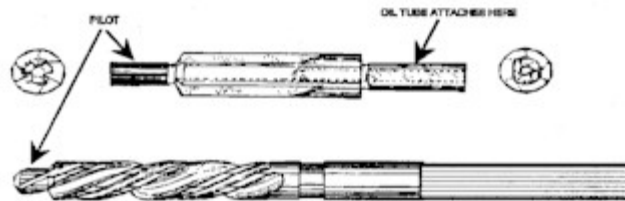
MAKING SHOTGUN BARRELS

MAKING SHOTGUN BARRELS

BORING TOOLS

After you have turned the outside of the bored blank to the contour that will match the barrel you can now bore the barrel.

The boring tool that I mostly used was the standard drill bit with a pilot ground on it that was a close fit to the bore. This was done on the lathe with a Tool Post Grinder. Chuck the back end of the drill in a collet or three jaw chuck, and use a hardened female center in the Tail Stock. Grind the pilot at least 1/2" long, but 3/4" is better. A recess is cut at the shoulder of the pilot to make sharpening the drill easier. The drill is then removed from the lathe and the shoulder is resharpener to the correct angle of the original drill. It is wise to select the drill size to about .0025 thousands smaller than the finish size of the bore. The reamer will remove the extra stock, and finish the bore to a close fit for the liner.



DIFFERENT TYPES OF BORING DRILLS

A shaft close to the size of the drill is now brazed to the end of the drill. The shaft is slightly beveled, and the drill and shaft is laid in a piece of angle iron. The shaft has to be raised slightly to be centered with the drill. After all is lined up the two are brazed together, and let cooled slowly to relieve any stress. Grind off any extra brass and drill is ready to use.

BORING THE BARREL

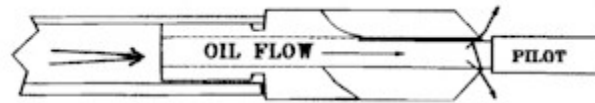
After the barrel blank is drilled to .500 size, (see book Barrel & Actions) you can drill the barrel out to the desired size for the bore that you choose. If you bore the barrel to let's say 12 gauges, you will need two boring tools to get it to the desired size fore reaming. The barrel is then centered in the lathe head stock spindle using the lath chuck and end collets to clamp it firmly. If the spindle hole is too small, the barrel will have supported with a steady rest on the chamber end, and the chuck on the muzzle end.

Insert the drill in the tail stock chuck, or in a special holder on the carriage. The carriage is the best way to re bore the barrel, as the drill has to be with drawn about every half inch to clean the drill.

Start the lathe up and lubricate the bore with a good grade of cutting oil, and adjust the speed for the drill size that you are using. Start the pilot in the chamber end, and engage the feed on the

MAKING SHOTGUN BARRELS

carriage. Have the feed set for a slow feed rate, or the drill can be fed in by hand if so desired. Feed the drill in the barrel for about a half-inch, remove from barrel and clean the chips from the drill.



1.20 OIL FED BORING DRILL

Keep repeating the process until you have rebored the barrel the full length. I have included another type of drill that I use for reboring. To use this type of drill you will need at least 500 pounds of oil pressure. This drill will flush out the chips, therefore there is no need to stop and clean out the chips.

When you have made the first reboring pass through the barrel, you can run the second rebore drill through the barrel to get the final size for reaming. If you have enough oil pressure, you can use a roughing reamer to remove the extra metal and finish the bore to within .010 to .015 of the final size.

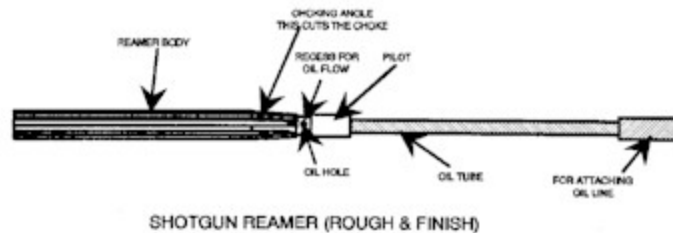
If you are planning to make only one gauge size, you can deep hole drill the blank with a deep hole drill .030 to .035 smaller than the finish size. This will save you a few hours work.

MAKING SHOTGUN BARRELS

REAMING THE BORED BARREL

Change the feed on the lathe to the proper feed. Usually start a little slow and increase it to where you are getting a good job and yet not plugging up. Sometimes if you have to fast a feed you will have trouble with the reamer plugging up.

On shotgun barrels the choke can be cut on the reamer, so when reaming, when the first part of the reamer emerges from the barrel the feed is shut off. The chamber end of the blank should be sticking out the back end of the tailstock.



Choke reaming this way will let you have almost a finished barrel when the finish reamer completes reaming. When completed all that is left is lapping and polishing.

NOTE - The reamer is made slightly different for this type of reaming than the one described on making the reamer.

Clamp the drilled and rebored barrel in the head stock and carefully center it. On your reamer pull rod unscrew the driver from the end of the rod. Now slip the rod into the barrel, all the way through the barrel, and out the bushing on the reamer adapter.

Screw the driver back on the rod and slip into the driver holder on the lathe carriage, and tighten setscrews. Clamp the oil tube to the carriage block, and connect the oil line to the fitting on the end of the reamer tube. Replace the shields on the end of the lathe. Be very sure it is on good as there will be much oil coming from the barrel in reaming.

You should now be ready to start. The first reamer is the rough reamer; its purpose is to remove the excess metal from the bore, smooth and true up the bore.

The finish reamer does not remove much; it takes the bore to size, and gives the mirror finish to the bore. Double check to see if the oil pressure valve is opened all the way.

Double check the hoses to be sure they are tight, and turn on the oil. Let it run for a few minutes and turn the pressure up to about 300 to 400 lbs. The pounds of pressure are not important as the amount of oil coming from the end of the barrel.

It has to be shooting out under enough pressure to get rid of the chips so they will not plug up the reamer. If it plugs up it could ruin the barrel, and probably break the reamer. Start up the lath in back gear. Make sure that the pilot of the reamer is inside the barrel, and engage the feed lever.

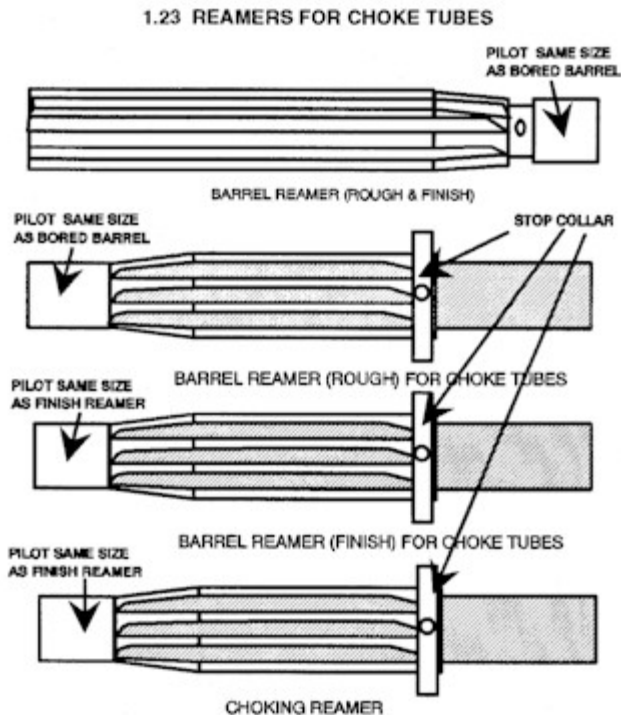
MAKING SHOTGUN BARRELS

As the reamer is starting to feed into the barrel it may cut a little rough but it should straighten out soon.

MAKING SHOTGUN BARRELS

REAMERS FOR CHOKE TUBES

It will, if sharpened right and starts cutting smooth from the start, or after it is in the barrel about 1 inch. Keep your fingers on the reamer rod as through the rod you will be able to know if everything is cutting well. If it is cutting smooth, set back and let it ream.



It is a wise practice always to keep your fingers on the reamer rod, as a flute could plug up. If the reamer plugs up, more than likely the oil pressure will go up slightly.

If for any reason, the reamer plugs up or starts to act up, disengage the feed lever and while the lathe is still running, back out the reamer. It is wise to have something lying across the ways of the lathe. As the carriage travels down the ways of the lathe, it will move it along with it. I use a wrench. This way if you have to take out the reamer you will know where to start the reamer cutting again.

STUB REAMERS

The stub reamers shown here are the reamers to use in making choke tubes. The barrel can be drilled on the lathe, and then reamed to the correct finish bore size. This size will have to be calculated from the size of the factory barrel it will be used on.

The barrel is then turned to the tube size on the OD, threaded and then finished. At this point,

MAKING SHOTGUN BARRELS

they are choked with the proper reamer.

DULL REAMERS

When you back out the reamer, do not shut off the lathe, if you do you will leave long marks in the barrel.

As you back the reamer from the barrel, you will be able to see if it was plugged or not. If it is not plugged, it is probably getting dull, and rubbing instead of cutting.

Remember when looking for trouble spots on the reamer, get it in a good light and look for bright spots.

This will usually show you where the trouble spots are. If everything is OK, as it should be, you should be about through by now. As the reamer starts to come out of the barrel, it may start to chatter slightly as the pilot is not supporting the reamer any more.

When you see the pilot emerging, be ready to shut it off as soon as it just reaches the recess. When the oil pressure drops, let it go about 1 inch and disengage the feed. Shut off the oil and slide the reamer back down the barrel to where it was sticking out. Shut the machine off now. Disconnect the driver, or if you want unscrew the reamer rod from the driver, and remove the reamer.

Put the finish reamer in the barrel, screw in the driver and repeat the process. When you finish the final step of reaming, shut everything down. Loosen the setscrew, from the reamer adapter, and remove the reamer. Do not take the chance of the reamer marking the barrel by sliding it back down the barrel.

When the last reaming operation is completed, you will remove the barrel. Let the oil drain from it for a few minutes, wipe out and inspect. Hold the barrel up to a light, a window is best and check for smoothness. Also, make up a go-no-go gauge to check for correct size.

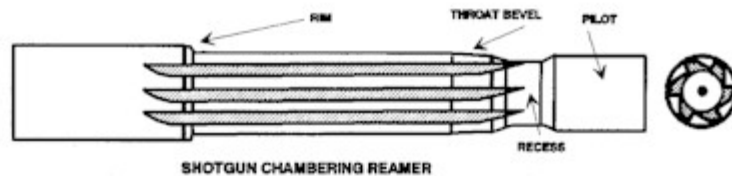
MAKING SHOTGUN BARRELS

CHAMBERING A BARREL

I will use a 12 gauge chambering (finish) reamer, and head space gauges (go and no go), and go through the process of chambering a shotgun barrel.

USING A DRILL BIT TO CLEAN CHAMBER

This information for the 12 gauges is similar for most barrels. Clamp the barrel in the lathe in the three or 4-jaw chuck, and true it up so there is no wobble.



Put a sharp tool bit in the lathe tool holder and square off the cut off end of the barrel. You will need a large enough drill bit to remove the extra metal, unless you are planning to use a roughing reamer to remove the extra metal. You will need now to chuck the barrel on the shank in front of the threads. When using a dial indicator be sure the barrel is running true on both ends. If it is not running true, you will cut an out of round chamber. Chuck the drill in the tail stock chuck, as you will have to drill out the chamber end just a little shorter than the unfired cartridge.

This will remove enough metal so the finish reamer will not have to cut much.

Now set a small lathe dog on the reamer, and with a center in the tail stock, move the tail stock up close enough to the barrel so the reamer will be in the barrel next to the shoulder of the reamer.

Have the reamer in the tail stock center. Leave the lathe in back gear setting and with the tail stock fastened down. Slowly feed the reamer into the barrel, keeping plenty of cutting oil on the reamer.

You can rest the lathe dog on the compound, while feeding in. Be sure that the reamer is on the tail stock center when you feed it in as if it is not it can grab and break the reamer.

ALWAYS HOLD THE REAMER BACK AGAINST THE TAIL STOCK CENTER.

Usually at first, you will be able to feed in for a depth of about 1/8 to 1/4 inch, before removing the reamer and blowing out the chips. As you get down to the shoulder area, the feed in is less.

NECK CHAMBERING

MAKING SHOTGUN BARRELS

On any type of shotgun, the chamber must be made longer than the shell, for the length of the shell that is used in its fired condition. The crimp has to unfold as the shell is fired, and the chamber must have sufficient length to allow the shell to open flat. If the shell does not open completely, pressure can build up and damage the shotgun.

A short chamber will permit the long shell to be chambered in the unfired condition, but after firing the forcing cone in the barrel constricts the opening of the shell causing deformed shot, blown patterns and high pressures.

Modern post war shell construction has been toward the folded crimp type style, with the result that the shells have become much shorter than they were formerly. The 2 3/4" shell now is approximately 2 3/8" overall in the unfired condition, and does not reach 23/4" even when fired.

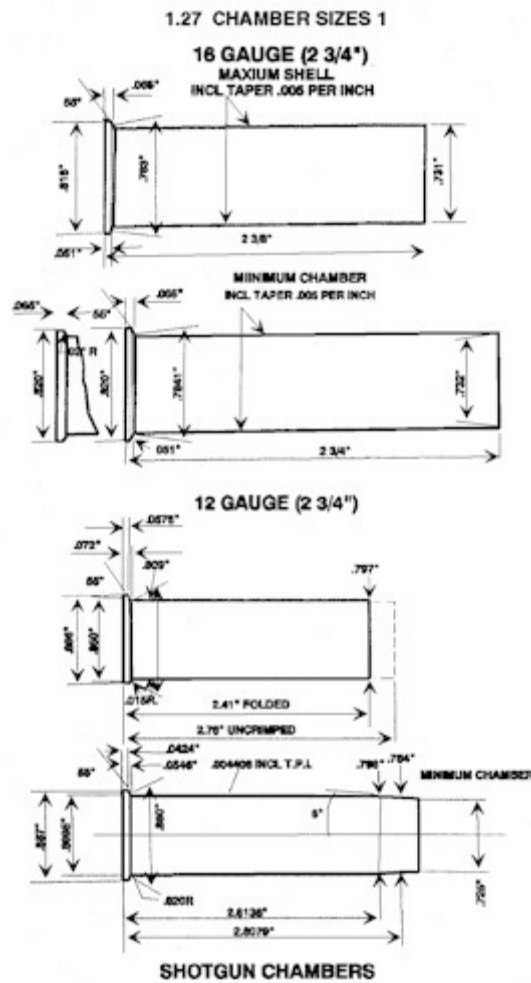
MAKING SHOTGUN BARRELS

CHECKING THE HEADSPACE

When you get close, you will have to use the headspace gauge. You will need to know what the correct headspace will be.

In most cases, the headspace gauge rim will be flush with the chamber end of the barrel.

When you get close, it would be best to use a dial indicator to go the final few thousands. This is how the 12 gauges are chambered and head space. Other types of barrels and actions are done the same, with a little variation. The head space should not be over .003 on the Go Gauge.



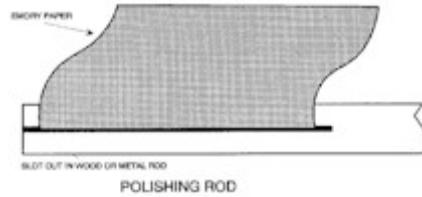
POLISHING THE CHAMBER

After the barrel is correctly headspaced, the chamber should be finely polished. This is done with the lathe running at a high RPM.

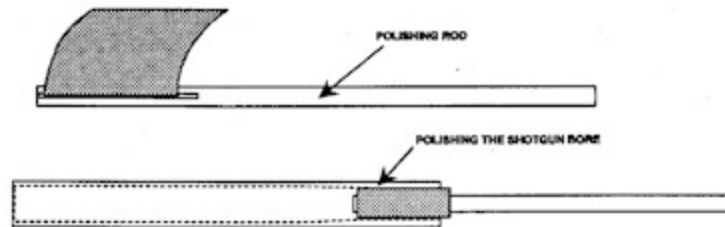
Note - The barrel that is sticking out the back of the lathe should be centered with a collar that

MAKING SHOTGUN BARRELS

has set screws to hold the barrel from starting to run out of center with the high RPM. Use a fine polishing cloth on the end of a slotted rod.



Do not over polish, as this will change the dimensions of the chamber. You will be able to see all the scratches, and will be able to measure any part of the chamber.



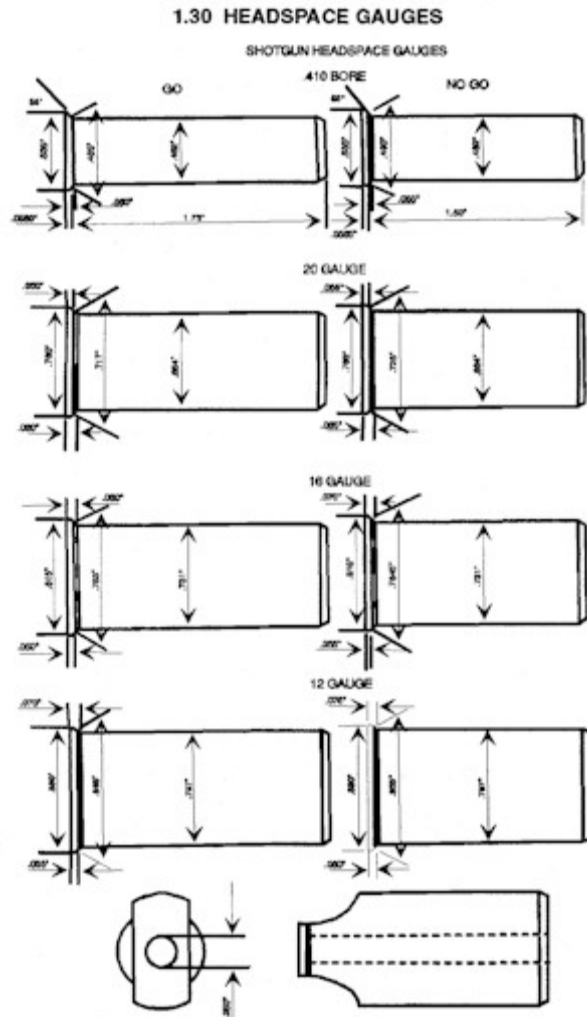
1.54 POLISHING THE BARREL

Drop a new loaded round into the chamber and it should enter freely with very little side play. Head space should be kept close, .003 Max. over go gauge.

MAKING SHOTGUN BARRELS

SHOTGUN HEAD SPACE GAGES

These may come in handy on repeating shotguns. In making the head space gauges, which is a simple machining job, start with 1" drill rod. The drill rod should be cut about 1" to 1/2" longer than necessary for the length shown as a lathe dog will be clamped to it.



Square off the ends of the drill rod and then center the drill rod blanks in the 3-jaw chuck of the lathe. Center with a 1/8" center drill on both ends of the drill rod. Clamp the lathe dog to the drill rod and turn all the dimensions to the size as shown.

If you have a tool post grinder, leave .005" to .008" of stock for grinding. When the gauge is completely turned and finished, heat treat it and then draw the hardness back to a straw color. If you are going to grind the gauge, clean out the centers and then finish grind the gauge.

MAKING SHOTGUN BARRELS

The flange angle (on the front of the rim) is slightly larger to show that it exist, and it is necessary to make the gages this way, as the front end of the countersink in a shotgun chamber can be anywhere between 55% and 90%. If the gages are made with a 90% angle at the front of the rim, they will probably not seat in all chambers and therefore give you a wrong head space reading.

The rim angles and proportions are about the same for all gages. In most cases you will have to cut the sides of the gage heads down, as shown, in order not to be affected by extractors or ejectors.

A hole should be drilled in the head so that in case a firing pin is snapped when the gage is in place, the pin will not be damaged. The hole can be filled with rubber or leather to relieve the shock of the pin fall.

MAKING SHOTGUN BARRELS

LAPPING THE BARREL

LEADING

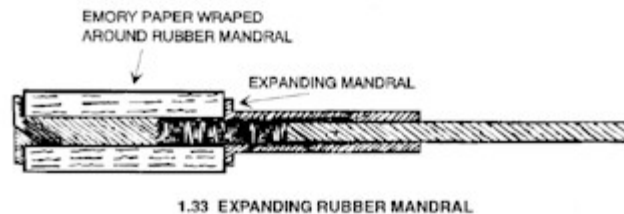
Most barrels will lead to some extent when high velocity shells are used, and while it is no big job to remove the plastic residue or lead, the job gets old fast. You can polish a barrel if you have a rough bore and remove much of its tendency to metal foul.

With a shotgun barrel, the lead lap is not practical since the shotgun barrel usually has several different diameters, shoulders and bevels in its length. A metal mandrel should be used, with crocus cloth wrapped around it, if the barrel show tool marks, or, if apparently smooth, with a plain cotton cloth saturated with oil and the finest lapping compound you have on hand.

The lap rod is inserted from the breech and marked so that the lap will not reach into the muzzle end of the choke boring. It is pulled and pushed straight back and forth and should never be turned in the barrel. If you are encountering problems with leading in the choke area, that too should be lapped. Whatever little change you make in the choke cannot be as great as that caused by lead or plastic building up in it, to deform shot and blow patterns. Besides cloth, any type of lap tip is of course usable, and the best probably is pieces of sole leather placed on a bolt or mandrel and turned to a round cylinder slightly greater than bore diameter on the lathe, or shaped on the sander.

LAPPING THE BARREL

Give the lap a coating of light oil and withdraw it to the breech end of the barrel, allowing it to extend slightly from this end, so that the string may be removed and the lap coated with a fine grade of emery available from Brownells. While the lap is at the rear end of the barrel, coat the barrel from the muzzle end with oil.



The lapping rod is equipped with a ball bearing cross-handle at the opposite end from the lap so that it can be easily grasped and worked back and forth through the barrel. Place stops at both the muzzle and breech end of the barrel so the lap will never be pushed or pulled entirely from the barrel. Lap the barrel for ten or fifteen minutes, adding fresh emery and oil frequently.

After the above amount of time, withdraw the lap from the barrel, wash the barrel out with solvent, and examine it to see that all burrs have been removed. If further lapping is necessary, an

MAKING SHOTGUN BARRELS

entirely new lap must be made if it has loosened.

If you desire an extra high polish, the barrel can be polished with rouge and light oil after the lapping operation. Leather washers about two or three thousandths of an inch larger than the groove diameter of the barrel is placed upon a polishing rod with ball bearing cross handle. The leather washers being separated from each other with small brass washers and retained in place by a brass nut on the end, which is made slightly under the bore diameter. During the polishing operation, this nut can be tightened a little from time to time, to swell the leather washers slightly. The polishing operation may be kept up for an hour or more.

MAKING SHOTGUN BARRELS

FINISHING SHOTGUN BARRELS

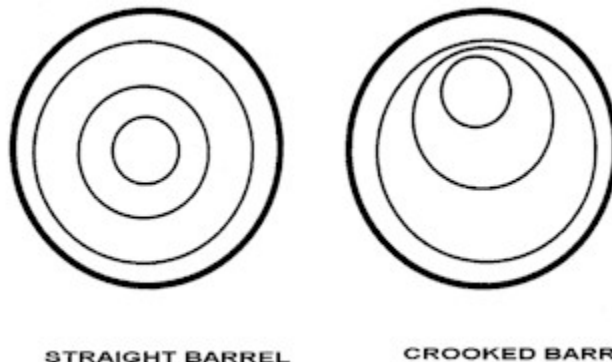
This is one phase of the gun barrel business that is gaining more interest. I have found there is a good market due to the amount of old guns around with pitted bores as well as the special shooting groups. There is also a very good market in relining of the older shotguns that are unsafe to shoot. This is one phase of the gun barrel business that is gaining more interest. I have found there is a good market due to the amount of old guns around with pitted bores as well as the special shooting groups. There is also a very good market in relining of the older shotguns that is unsafe to shoot.

The making of the shotgun barrel is really a simple operation. 1350 or Stress proof is the only steel that I use in making these barrels. It takes longer to make a shotgun barrel than a rifle barrel, but this is due to the slower speeds that must be used. The steel that is used for shotgun barrels must be very free machining steel, one that will give a very high finish from reaming alone. Stress proof or 1350 steel meets all the above requirements.

If you are going to make very many barrels you can drill this blank with a 1/2 inch deep hole drill or have a special drill made that will be .030 smaller than the roughing reamer. You normally do not want to go any bigger than 1/2" as the reason is that the barrel after drilling, can be centered, and turned to the final size. If you tried to finish the bore, then turn the outside, you would have all kind of troubles due to the thin walls. This way you can turn the barrel, keep it straight, and finish it on the outside, then finish boring, and reaming to size.

CHECK FOR STRAIGHTNESS

You have made a drill, and have the barrel drilled. Check for straightness, and if crooked straighten it. Read the chapter on turning barrels. Contour the barrel to the size that you have decided on, and finish it out.



Leave the chamber end about 6 inches long, and while turning, make a clean up pass on it to clean it up and run true. When all of this is done, the next step is to now bore the blank out to

MAKING SHOTGUN BARRELS

the desired size for reaming. There are two methods and both work about as well. The first is to make a reboring drill. The other is to braze a rod to a 21/32-drill bit that has a pilot ground on the front end. This is for a 12 gauge.

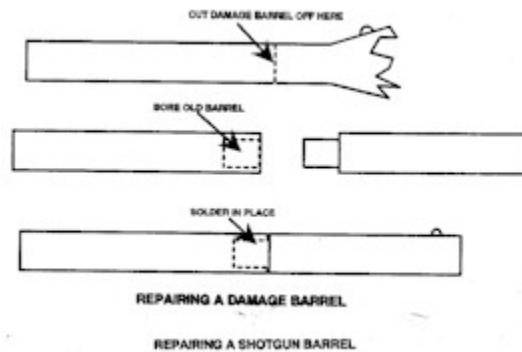
With either one, you will be able to drill the barrel out. The barrel should be chucked in the lathe, and turned at a fairly slow speed. This will have to be a trial and error test to see which works best for you. If you use the drill bit you will have to use plenty of oil, and keep the chips blown out of the barrel. Keep the drill sharp so it will cut a smooth hole. I will assume that for the first few barrels you will use the twist drill, due to the ease of getting the right size.

With the twist drill, you will be able to drill about 3/4 inch at a time before cleaning the chips out. After the barrel is bored, you will run a roughing reamer through it to clean it up, then the finish reamer. In most cases, we make the barrel full choke, as it is fairly easy to change the choke.

MAKING SHOTGUN BARRELS

DAMAGED BARRELS

If you saw 3" off the muzzle end of any shotgun barrel it will remove the entire choke and convert the gun to a true cylinder bore. When you reduce the length of a shotgun barrel by this amount such as the case of the barrel that is blown apart as a result of snow, dirt or some obstruction's being in the barrel when the gun is fired. A small amount of choke can be put back into the barrel that has been shortened by cutting a .006 to .009 deep recess, about 2" long, starting about 1 1/2" back of the muzzle.



You can cut the recess by wrapping a few thickness of NO. 2/0 emery cloth around a near bore diameter dowel rod and rotating the rod in the lathe and the rod put in the chuck. A stop must be put on the rod so that the cutting will be done the same distance from the muzzle around the bore. The actual undercutting is achieved by moving the barrel around the abrasive cloth as the rod is spinning. The amount of metal removal is checked with inside calipers each time the barrel is withdrawn to permit attachment of a new piece of emery cloth to the rod.

After the desired depth has been reached, a finer grit of abrasive should be used to bring about a scratch-free surface. The choke put into a barrel by the above method will not always produce a pattern that is too much better than that given by a cylinder bore.

The dimensions I have given here are the ones that I have used with good results. These are approximately a happy medium on chokes and bores.

For example, a full choke browning has a bore diameter of .730, and a full choke that is .699. Winchester is .730-bore diameter, and the full choke is .699. Who is to say which one is best. If you do much work on shotgun barrels you will soon find there are no two alike, and I have found that will vary as much as .042 from maximum to minimum. The old German shotguns are usually tighter yet. What this means if you have not figured it out yet is that you will probably have to make special tools for each different barrel.

The old types of barrel reamers that were used in the past are usually used in the finishing of the choke. I have found that these give a good job, but took quit a bit longer and did not give the

MAKING SHOTGUN BARRELS

results that I wanted on the bore. With the reamers described, you will usually not have to hone or polish any part of the barrel, except the choke section. I will show you how the reamers are made and the oil tube clamp for the lathe carriage. I will show you how to make a full choke barrel, but if you want to make a modified barrel, this can be made on the finish reamer.

Table 4: SHOTGUN BORE AND CHOKE SIZE

12 GAUGE

BORE DIAMETER IS

	.730		
FULL CHOKE	.694	AC	.036
MODIFIED CHOKE	.712	AC	.018
IMPROVE CYLD	.721	AC	.009
CYLINDER BORE	.665	AC	.000

Table 5: SHOTGUN BORE AND CHOKE SIZE

16 GAUGE

BORE DIAMETER IS	.673		
FULL CHOKE	.640	AC.	.033
MODIFIED CHOKE	.656	AC.	.017
IMPROVE CYL.	.665	AC.	.008

MAKING SHOTGUN BARRELS

CYLINDER	.662	AC	.000
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Table 6: SHOTGUN BORE AND CHOKE SIZE

20 GAUGE

BORE IS	.619		
FULL CHOKE	.590	AC.	.029
MODIFIED CHOKE	.604	AC.	.015
IMPROVE CYLD.	.613	AC.	.007
CYLINDER	.615	AC.	000

There are many arguments from various shooters on chokes, lengths of barrels, etc. In the old Black Powder days, a long barrel was needed for getting maximum power out of black powder. I don't know how many times I have been told about a person having a long tom shotgun that would shoot like a rifle, and out shoot other shotguns.

SHOTGUN CHOKES

To the average sportsman the term "choke bore" means that the diameter at the muzzle (bore) is less than the diameter at some point behind the muzzle. Any shotgun barrel constricted at the muzzle to the extent of .005 of an inch may be termed a cylinder bore.

After passing a certain limit in reduction, the choke always defeats its main objective by giving erratic patterns with large holes in them. The larger the bore the greater the reduction of the bore must finish close to a given length, and that should be approximately 1 3/8, or better as a standard should be about 1 inch.

There is also another great misconception on chokes, and that is measuring the choke with a dime. How often we see a person take a dime from his pocket to see if it will enter the muzzle.

MAKING SHOTGUN BARRELS

Such a test does not tell him much. If you were to measure with a dime, you will find that it measures about .705. Even on some American guns, it would go into a full choke. If you are measuring a Browning modified choke barrel, you would probably find the dime would not enter the choke, as it measures .701.

Table 7: SHOTGUN REAMERS

12 GAUGE SHOTGUN REAMERS

	Pilot	Body	Choke
ROUGH REAMER	.656	.694	
FINISH REAMER	.694	.730	.694

Table 8: SHOTGUN REAMERS

16 GAUGE SHOTGUN REAMERS

	PILOT	BODY	CHOKE
ROUGH REAMER	.562	.640	
FINISH REAMER	.640	.673	.640

If you do very many pattern testing, you may find that some modified chokes will shoot tighter than many full chokes. Once you have the reamers made, now get some fairly heavy wall tubing. This should be 1/2 inch for the 12 gauge. You will need to thread one end so you can screw a fitting to that end, so the high-pressure oil line can be attached. All you need then is a fixture to

MAKING SHOTGUN BARRELS

mount in the carriage where the tool blocks mounts.

Table 9: SHOTGUN REAMERS

SHOTGUN REAMERS

20 GAUGE

	PILOT	BODY	CHOKE
ROUGH REAMER	.531	.590	
FINISH REAMER	.590	.619	.590

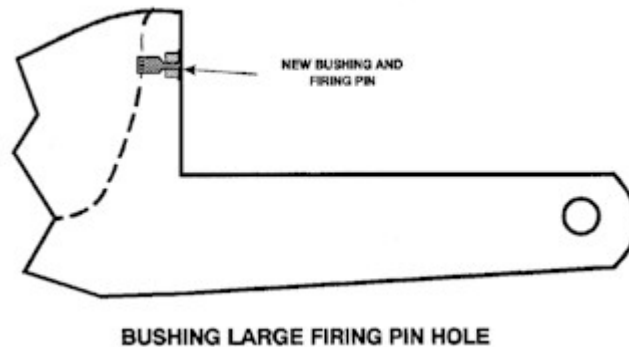
The dimensions I have given here are the ones that I have used with good results. These are approximately a happy medium on chokes and bores.

MAKING SHOTGUN BARRELS

BUSHING FIRING PIN HOLES

There are many old single shotguns around that with a little conversion would make excellent guns for modern cartridges.

Many of the firing pin holes are so enlarged that sometimes the primer flows back into the hole and makes it difficult to open the action. The other problem is that the large firing pin may allow the primer to flow back into the firing pin hole and blow the primer. If this should happen, then higher pressure of the modern shell may let gasses blow past the firing pin and tear up internal parts of the shotgun.



The worst danger is that these high-pressure gases may hit the shooter in the face, and possibly cause eye damage. To eliminate this problem, the firing pin hole needs to be bushed with a hardened block, and the firing pin, and hole reduced in size. This process is the same if you are converting a break-open shotgun to a rifle cartridge. You do need certain equipment to be able to do this properly. You will need some type of lathe, a milling machine or a sturdy drill press with a heavy machine vise to hold the block.

You will need to locate or make a 3/8 inch tap, with as fine a threads as possible to tap the hole with. This tap can be made quite easily. More on making taps in a later issue. You need to have drill rod in 1/2 & 3/8 inch size for bushings, 1/4 or 3/16-inch drill rod, depending on the size of the original firing pin. I will describe the process of converting a sliding breech block to a smaller firing pin.

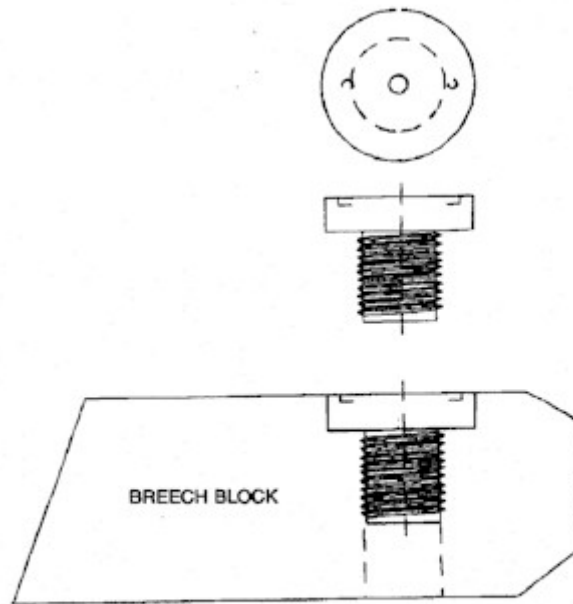
DRILLING THE BREECH BLOCK

Remove the block from the shotgun, and disassemble the parts from the block. You need to find a drill bit the size that just fits into the firing pin hole (the large size). The breech block can be drilled on a lathe after truing it in a 4-jaw chuck; the method that you use is up to you. The firing-pin hole in the bushing is first drilled with a small center-drill and then re-drilled with the correct wire gauge drill, after which it is reamed from the rear either with a firing-pin reamer or a tapered pin reamer.

I prefer the taper pin reamer for this work, so that the firing-pin hole is slightly relieved just back

MAKING SHOTGUN BARRELS

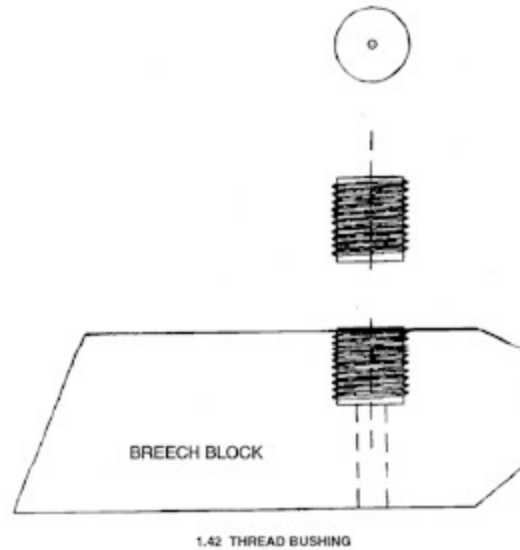
of the face of the bushing. As the firing-pin hole through the bushing may not be centered with the original firing-pin body hole in the breech block, it will be necessary to make a firing pin with an off-center nose if this is the case.



1.41 BUSHING FOR BLOCK

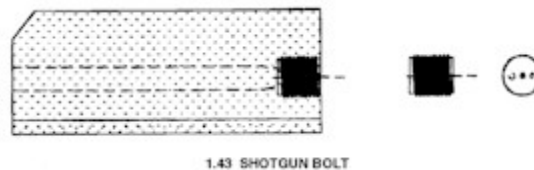
The original firing pin, if it is an odd shape, may be cut off square, after being annealed, replaced in the breech block and the location of the off-center nose located with a drill run through the firing-pin hole in the bushing. If the firing pin hole is not square to the face of the breech block, but rather on the angle, you will need a pilot ground on the drill bit to keep the bit from walking.

MAKING SHOTGUN BARRELS



This is ground on the bit that you use to first drill the hole for the 3/8-inch tap clearance drill. The pilot for this drill is ground with the drill bit in the lathe using a tool post grinder.

I have however drilled out many breech blocks without this block, by using short bits, and opening up the hole in steps. In addition, if you have an assortment of end mills, they can be used to square up the face of the hole by using them as a drill, and going just deep enough to remove the angle. Once this angle is removed, the breech block can then be drilled with the correct size drill. Drill the hole to about half the depth of the breech block, or slightly deeper with the first drill, then clean it up with the clearance drill that is the correct size or fine thread tap that you are using.



Once the hole is drilled, do not remove the breech block from the vise. You will need it clamped in the vise so that the hole can be tapped out straight. To do this the tap is centered in a center that is clamped in the chuck of the mill or drill press. Either the tap will have a male or female center cut in the end of the tap, which we will use.

Oil the tap, and with slight pressure on the tap from the drill press, turn the tap into the drilled hole of the breech block. Back out every little bit to clean the chips from the cutting edge. The old pin is then drilled and tapped for a piece of tool-steel to be screwed in and turned up for a new nose, after which it is hardened and the temper then drawn to a deep blue in oil. The bushing is removed from the breech block, and 2 small holes drilled for a spanner wrench to make it easier to screw in and out, before hardening, and the temper drawn in oil at a dark purple and the bushing replaced in the block.

MAKING SHOTGUN BARRELS

Check the surface carefully to see that it is flush with the face of the breech block, if not grind it down flush and polish it. A different method of bushing the breech block is to bore the block out to a square-bottomed bore, to a diameter to thread for 1/3 inch with a fine thread of 32 or more per inch, to a depth of 3/8 inch. A piece of 1/2 inch drill rod is then threaded to fit this bore tightly and screwed in against the bottom of the hole.

To get the right angle the old firing pin hole can be used as a guide. The firing pin hole will need to be drilled all the way through the block. Insert the drill in the back end of the block, and then clamp the other end in the chuck of the drill press. With the machine vise setting loose on the table of the drill press or milling machine, lower the spindle down so that the breech block will be inside of the jaws of vise.

This is done with the drill chucked and the cutting end of the drill in the back end of the breech block. With the breech block in between the jaws of the vise, carefully close the jaws of the vise on the sides of the breech block. Be careful that you do not spring the drill. Slide the vises lightly so that nothing will be in a bind. Once clamped, the firing pin hole can be drilled all the way through the breech block at the same angle.

This is very important or when completed, the firing pin may hit the primer off center. You will need to now drill out the breech block for the hardened bushing that will be screwed in the block.

Having the 3/8-inch tap and the correct size drill for that tap set the breech block back into the machine vise for drilling. You can use the same procedure for lining up the block as you did before, except that you will drill out the hole this from the front, or cartridge end.

With the first drill chucked in the drill press or the mill, carefully clamp the breech block in the vise using the drill bit to get the correct angle. If the firing pin hole is right angle to the breech block, it is a simple matter to just drill out the block. It is best to drill the bushing hole out with the next size smaller drill, and then clean it out with the correct size drill.

I would, once the breech block is lined up clamp the vise securely to the drill or mill table to keep the vise from moving around while drilling. If you leave it loose, there will be a certain amount of chatter while starting the drill, and once the drill bushing is inserted, these chatter marks will not look good. A drill fitting the body hole of the firing pin in the breech block is inserted from the rear and the bushing is drilled deeply enough with this to take the body length of the old firing pin.

A 1/16-inch drill is then used to drill on through the bushing for the firing-pin nose, which bore is then enlarged with the correct size wire-gauge drill and reamed out as in the previous method.

The bushing is still part of the original 1/2 inch drill rod, several inches long, and is now unscrewed from the breech-block hardened and then the temper is drawn in oil to a dark purple, to blue. The bushing, still on the several inches of rod, is then screwed tightly back into the breech-block and, using a high-speed steel hack-saw blade, is cut off just beyond the face of the breech-block, after which it is ground down flush with the breech-block face.

Go to the lathe and with some drill rod, make another firing pin the exact size of the old one, with

MAKING SHOTGUN BARRELS

the exception that the firing pin tip will just be a bit smaller. Leave the tip .050 to .070 inch longer than the original. The block rises in closing this action, so even if the firing pinhole location is marked centrally with the bore, there is no assurance that the firing pin will always strike a primer centrally.

FIRING PIN PROTRUSION

Firing pins should have a protrusion of .050 inch beyond the face of the breech block when in the fired position. The firing pins must be made with as little protrusion as possible and still fire the cartridge every time without punching a hole in the primer.

The breech block moves straight down when the action is opened but it starts to move down before the firing pin begins to retract so that the nose of the firing pin is dragged partly through the primer before being retracted mechanically. This results in a broken firing-pin if the protrusion of the pin is greater than .040 beyond the face of the breech block, and .035 is better yet, if it will fire every time.

There will be a variation in the thickness of heads of shot gun cases, so this firing-pin protrusion checked with several different makes of cases, to be sure that primers will fire every time.

MAKING SHOTGUN BARRELS

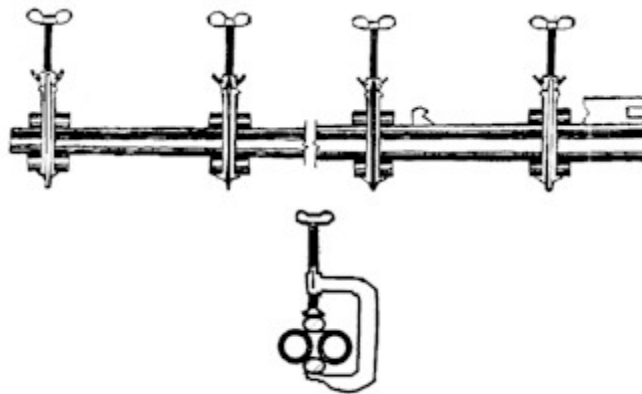
RESOLDERING RIBS

The barrel should be held by its breech lug between padded vise jaws when the top ribs to be worked on. The muzzle end of the barrels should be supported by means of a stand cut to a length that will allow one end to rest on the floor while the other rests in a "V" against the bottom of the barrel.

If the bottom rib on a double barrel is to be soldered back on, then the breech end of the barrel itself must be held in the vise and the muzzle support should be employed as an auxiliary holding medium.

Replacing a complete rib will mean refinishing the entire barrel or set of barrels. First, remove the barrels from the gun, take off the sights and any other accessories that might in any way be adversely affected by the application of heat, or interfere with the affixing of clamps to the ribs.

The top of the barrel has to be tined using a paste solder, or in the case of double barrels the "V". Welder's chalk can be used on the barrels where you do not want the solder to flow. The underside of the rib is also tined and then placed in position, supporting it with small brass wedges for doubles. Now put a small round rod about 5/16" in diameter on top the length of the rib. Tie the rod and the rib down with small copper wire, using one strand and wrapping it spirally down the barrel. Small wedges can be used to tighten the wire and force the rib closer to the barrel.



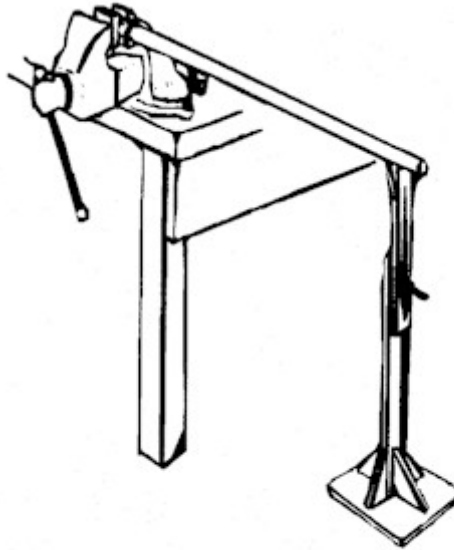
HOLDING RIBS IN PLACE FOR SOLDERING

RAISING THE RIB

With the barrels set up in the vise, the loose rib should be lifted up so that a small wooden wedge can be placed at the extreme end of the break between rib and barrel. If the rib is parted at two or three places along a given length, but holding on between these breaks, then the rib should be parted from the barrel up to the point of the last break. By doing this the sweating can be done easier and the completed job will be better. Where the rib is loose at several points

MAKING SHOTGUN BARRELS

throughout its entire length, or hanging on only at its last few inches, it is best to remove the entire section rather than try to work around a few points that are holding.



1.46 SUPPORT FOR HOLDING THE BARRELS

When the entire rib is removed from the gun, the job of scraping the all the old solder from the surfaces and the barrels can be done easily. An edged scraper made from hardened drill rod or tool steel works fine such as a discarded triangular file with the serration's ground off. This makes a good tool for not only this particular job, but also a deburrer. Scraping the solder off the barrels and rib when the latter is only partially lifted from the gun requires that you be extra careful and use a scraper form a hacksaw blade.

Ventilated ribs are easy to replace, and in most cases the rib has come loose at the muzzle, or they may have been dented enough to pull one of the holding studs away from the barrel. All the surfaces must be clean and the hardest part of the job is just cleaning the contact surfaces so they will join.

CLEANING THE RIB

When through with the scraping, the surfaces to be tinned should be cleaned with emery cloth glued to a very thin piece of wood or metal. Acetone applied by means of cotton on a stick to the scraped surface, will remove any remaining tinning-inhibiting matter.

The cleaning of metal surfaces before tinning is very important, as the sweating job depends almost entirely on how well the surfaces to be joined are tinned.

TINNING

MAKING SHOTGUN BARRELS

When an entire rib and barrels are to be tinned, butane torch can be used very efficiently. After the rib and barrels have been thoroughly tinned, flux the surface and go over the tinned surface until a thin, uniform coating is achieved. Any excess should be scraped off so that no solder will collect into little droplets and fall between the barrels when the rib is sweated on.

On most of the ribs, it is not necessary to tin the surfaces, as enough remains from the original to form a solid joint. Be very not to pull or bend the rib away from the barrel, so use very thin scrapers to clean the solder areas.



GAS BURNER FOR HEATING BARRELS & RIBS

You do not want to mar the blue, so use acid flux with great care. Use small C clamps to hold rib to the barrel, and then use the welding torch to apply the heat.

Remove any wooden wedges remaining and the rib is allowed to bear against the barrels by means of "C" clamps placed about six inches apart along the length of the entire rib. If it is the bottom rib which is being sweated in place, then a steel rod about 5/16" in diameter, and as long as the entire rib, should be placed between the clamp and the rib itself. The radius of the rod will bear more evenly on the convex surface of the rib than would the flat end of a "C" clamp.

Tighten up the clamps snugly until the rib is against the barrels and properly in the center, then with a Butane burner apply heat, but no more than is necessary to make the solder flow freely. Solder that is overheated tends to become grainy when it hardens. Work from breech towards muzzle at a length of about six inches at a time before going farther.

As the solder melts and begins to flow freely, the "C" clamp screw should be tightened until the rib is fully against the barrel. Excess solder that flows out from between the joint should be wiped off before it hardens and sets up on a portion of either the barrels or rib where it will be difficult to remove. Repeat this until the rest of the loose rib is joined to the barrels.

For a complete fitting a ventilated rib to a single barrel gun or a solid rib to a double, you will need some special equipment and several solid metal rods that will just slip through the barrels. These rods are needed to hold the barrel or barrels at proper heat and should be heated to 500° F. before insertion. If you do many, a special burner should be constructed, but the bluing tank gas burners can also be used for the heating job.

Heat the steel or copper rods and slide the hot barrel rods in place and use the burners to heat the barrels with the rib up. When the temperature gets up to around 400° F., use the welding torch and heat up the rod on top of the rib, while heating the rib at the same time. When the solder melts and bonds, you are finished. Now clean visible solder from the edges of the rib and the barrels at the joint. On doubles, it will be necessary to use two small rods, one on the bottom as well as the one on the top of the rib. When everything is cleaned up the barrels must be

MAKING SHOTGUN BARRELS

polished and blued.



On Double barrels, look at the muzzle of the barrels and see if any solder is needed to fill in an opening between the top and bottom ribs. This opening should be filled in by flowing solder into the opening and then trimming off the excess with a file.

Allow to cool normally in the air and then remove the clamps, and with a very narrow chisel scrape away any traces of solder that show between the joined surfaces. Do not cut below the solder and scratch the barrel, as the marks would be hard to remove. Clean up the barrels to remove any flux and oil with a light oil inside and out.

MAKING SHOTGUN BARRELS

REPLACING BARRELS

REPLACING BARRELS ON DOUBLE BARRELS

You will need to make quite a few different finishing reamers, as just about every barrel is different. Due to the simplicity of making the reamers after you learn how, you should be able to make several different sizes at a time. You will need to make sizes starting from .008 over the sizes we recommended for the finish reamer, and down to .030 under the finish reamer, in .002 steps.

The following is a description of the process of turning thin shotgun barrels for replacement barrels for shotguns. In most cases, the barrels should be matched exactly on the outside for ease of replacing the ribs. The following process can be used for replacing most any barrels that you might come across.

If the barrels are not sweated in to the chambered end and you need to replace the barrels, you can true up the chamber end of the original (the barrel will need to be cut off in front of the hinge) barrel and bore it out so it can be relined.

TURNING LINERS

To prepare a barrel that you drilled into a shotgun barrel for lining, it must be turned to size. The first thing to do is cut the barrel to the length that you need plus 1 inch for cleaning up. You will need the extra 1-inch in truing up each end, and the final finishing of the barrel.

You have the barrel cut to the correct length, so now chuck the barrel in the lathe and face off both ends of the barrel. If the bore has run quite a bit off center, you will need to repeat this process after a few passes on the O.D.

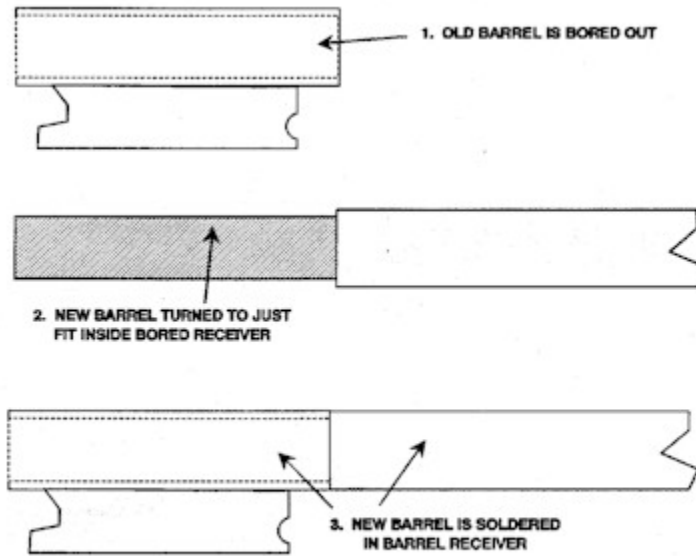
The reason for this is that if the angle on the end of the barrel is off, one side of the barrel will be thicker than the other. In turning, the barrel will probably warp. Now that the barrel is squared, put the faceplate on the lathe. Take a bar of steel that is 20 inches long that has centers in each end, and has been turned true.

You will need to set the tail stock to an exact .0000 setting so that there is no taper in the OO of the liner when finished. Set the dial indicator on the carriage of the lathe, set it to 000, and set the tail stock over a bit. Crank the carriage down towards the head stock to where the mark is on the barrel. Check the reading on the dial indicator, and if it is not right, reset the tail stock and repeat the process until you get 0.0104.

Having now completed setting the tail stock to 0000, set the barrel blank between the centers, and then clamp a lathe dog on the head stock end. The tail stock center, I have found over the years work better if it is carbide. If you are careful, you can use the standard high-speed center.

MAKING SHOTGUN BARRELS

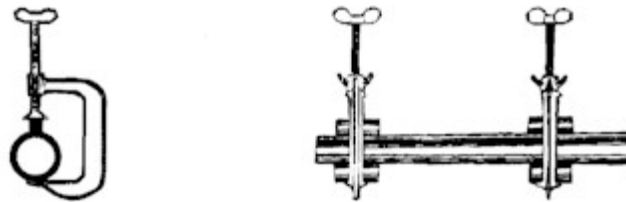
Put a little grease on it that contains MolyKote Z before setting it up.



REPLACING BARRELS

I have tried to use live centers off and on, but I have found that I get too much chatter, and that will cause stress to build in the barrel, and thus warp the barrel.

It is very important to keep any stress from building up in the barrel (Live centers, too tight centers, dull tool bit, improperly sharpened tool bit, etc.) Now for the tool bit. I have used carbide most all the time in turning barrels. I prefer a good grade of high-speed steel as they are sharper and cut better, but require sharpening every pass, to keep a good edge. I had to use carbide due to the time saved.



HOLDING RIBS IN PLACE FOR SOLDERING

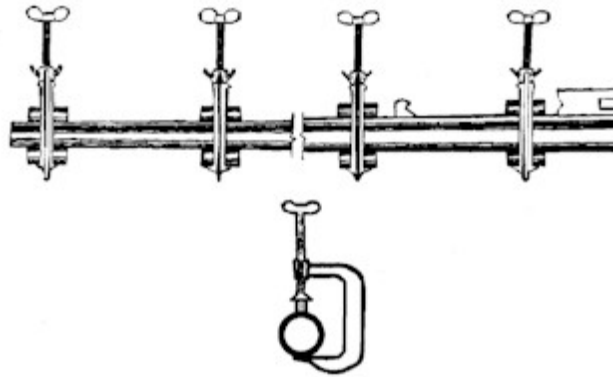
I grind all my tools to the general shape. On high speed bits I used only about .010-nose radius, stoned on by hand. Set the tool up so it is about .010 above the tail stock center.

If I have the time, I usually use a feed of .004, but you will need to experiment to see which feed works the best. Usually I do not take over .020 passes per each side on each pass.

What you have to watch for is that the cut is not heavy enough that it will cause the liner to spring,

MAKING SHOTGUN BARRELS

especially on the barrel that is half way turned down. This springing causes stress. Here is where a good steady rest or a follower rest becomes important. With a follower rest, you will be able to cut the outside of the barrel with no taper that is caused by springing.



HOLDING RIBS IN PLACE FOR SOLDERING

TOOL MUST CUT CLEAN

The tool must cut clean, for if it drags, or it is slightly dull it will cause the barrel to heat as it is turned. When the bit is sharpened right you will get some heat build up, but not much. Watch the chips, as they are coming off the barrel. If they turn a dark blue, you are taking too much a cut, or the tool is dull.

Keep close watch on the pressure on the tail stock. It must be snug on the barrel, but not tight. As the barrel heats its lengthens, and the tail stock must be loosened, if the tail stock center loosens too much, the tool bit will chatter.

After the barrel is turned to about 3/4 finished, you will need to remove the barrel. You will then check to see if the bore is straight, and straighten if necessary.

If you have kept a sharp tool and a light feed, it should be straight. You must, after ever pass from now on the barrel should be checked to see if it is straight.

If the barrel has warped, take a lighter pass after it is straighten.

When you have finish turning the barrel down to within a few thousands of the finish size, set the feed to the lightest feed. Sharpen the tool bit, hone it very good, and make a finish pass. This should finish the liner, and it will be ready for inserting into the bored out barrel.

SOLDERING THE BARRELS TOGETHER

You will be able to install new barrels on old double-barrels, just about the same way. Cut off the old barrels, first removing the ribs, in front of the hinge. Then you have to rebore the chamber ends to fit the new barrels. In some cases, this is the way they were assembled, and they can be heated and the old barrels can be removed. Many the old shotguns were made this way at the

MAKING SHOTGUN BARRELS

factory.

Take the finish barrel and turn the chamber end to the size needed to just slip in the old chamber section of the double barrel, or single shot. I might point out that the fit has to be very close, or you may get a bulged chamber. You can use a good low melting point silver solder or hard solder to solder the new barrel in place. Once soldered in place the ribs/sights can be installed back in place.

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While we are on the subject, I want to point out that replacement of barrels in double barrels and single barrels are not limited to shotgun barrels. A well made double or single barrel shotgun can be relined to a rimmed rifle cartridge just as easily. The firing pinholes and the firing pin HAVE to be bushed to handle the higher pressure.

MAKING SHOTGUN BARRELS

CHAMBER THE BARRELS

It is best to chamber the shotgun barrels to at 95 percent completed before installing, and finish after installing. If you are careful, the chamber ends can be completed and the head space finish before installing as the shoulder will regulate how far the liner can be inserted. In installing, a special fixture should be made to hold the shotgun barrel end solid while inserting the new barrels. They are heated with a gas burner such as is found on gas stoves, or hot water tanks and when hot, all the surfaces are well tinned and all are assembled.

POSITIONED THE RIB

With all setting up work done, the rib is positioned against the barrels by means of "C" clamps placed about six inches apart along the length of the entire rib. A steel rod about 1/2" in diameter, and as long as the entire rib, should be placed between the clamp and the rib itself. In this way the radius of the rod will bear more evenly on the convex surface of the rib than would the flat end of a "C" clamp. A square shaft 3/8" square is placed on the top rib the same length as the rib.

Now begin to carefully heat the work, commencing at the breech, and when sufficiently hot, don't heat too fast or too hot, apply solder, using the muriatic acid~ zinc, or a good past solder as a flux, to the joining of the ribs and barrels. Tighten up the clamps until the rib is positively against the barrels and properly in the center then with a Butane burner apply the heat, but no more than is necessary to make the solder flow freely for solder that is overheated tends to become grainy when it hardens.

I prefer paste solder for soldering as it will melt quickly by the heat of the barrels, and will be sucked in until the space between the different pieces is completely filled. Do this until the entire length of the barrels is gone over. At the muzzle fit and insert a small piece to fill the space between the barrels and the top rib.

Work from breech towards muzzle over a length of six inches at a time. As the solder melts and begins to flow freely the solder will seep out between rib and barrels, and the appropriate clamp screw should be tightened until the rib is fully against the barrel. Any excess solder that flows out from between the joint should be wiped off with a cloth before it has a chance to harden and set on a portion of either the barrels or rib where it is not wanted. Repeat this same operation all along the rib until the entire loose unit is fully and positively joined to the barrels.

Look at the muzzle of the barrels and see if any solder is needed at that point, if there is an opening between the top and bottom ribs. It is necessary that all the space between the top rib and the barrels be completely filled with solder, or rust will form there. This will cause problems later to the barrels, and in time will work under the ribs, causing the ribs to come loose from the barrels. This opening should be filled in by flowing melted solder into the opening and then trimming off the excess with a piece of emery cloth laid against a flat stick or file.

Allow for normal cooling by the surrounding air and do not pour water on the barrels to induce

MAKING SHOTGUN BARRELS

rapid cooling as it might seep into some minute crack existing between the rib and barrels and form a steam pocket. Remove the clamps, and with a very narrow chisel scrape away all traces of solder that show between the joined surfaces, being careful not to scratch the barrels.

When the work is soldered and is cool, wash it well with warm water, and using a stiff toothbrush to remove dirt and all trace of the flux that may remain on the work. With a chisel or scraper remove all surplus solder and brighten the work with emery cloth of different grades. Begin with the coarser and finishing with the fine or with flour and emery.

With a knife or scraper remove all surplus solder and brighten the work with emery cloth of different grades. Begin with the coarser and finishing with the fine or with flour and emery.

To stop any possible rusting that might occur because of using the solder or flux, the barrels should be cleaned with some good detergent, dried off, and coated with light oil. The insides of the barrels should be swabbed and a light oil applied.

MAKING SHOTGUN BARRELS

REPAIRING SHOTGUN BARRELS

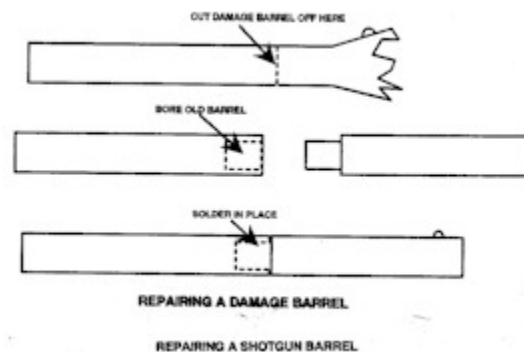
There are times when something gets into the end of the shotgun barrel. When fired there may be a bulge formed, or the end is blown off.

To repair such a barrel, there are three choices:

1. Cut off the barrel and shoot as is.
2. Install some type of adjustable choke.
3. Add an extension to the barrel that has the choke in it already.

To do the latter, you will need a barrel that is as big on the OD as the old barrel, and one that has the choke that you want.

A lathe will be necessary to do this job, with at least a 36" distance between the centers. You will need two centers that are big enough to center the bore, and one a live center.



CUTTING THE BARREL OFF

Cut off the barrel right behind the bulge, and true up the end in the lathe. A steady rest will be needed to hold the barrel unless the bore of the lathe is large enough to hold the barrel. When the barrel end is trued up, center the barrel and set up the steady rest about 2 inches from the cut off end of the barrel.

Once it is set up, you will bore the inside of the barrel 1/2 of its thickness, and 3/4" deep into the bore. Measure the ID very carefully so when you turn a shoulder on the extension barrel it will be a very close fit.

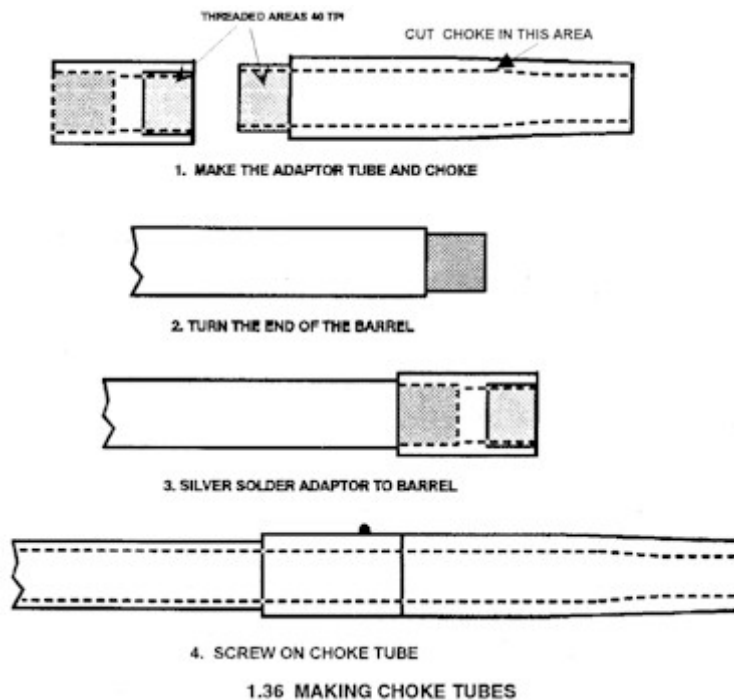
MAKING SHOTGUN BARRELS

SHOULDER ANGLE

The shoulder angle has to be very accurate, so the fit between the two barrels will be exact. The length of the shank on the extension barrel has to be exactly the right length, so it will but up on the shoulder on the inside of the barrel as well as on the outside.

When you have achieved this fit, and have the extension barrel turned so it will just fit the counter bore with no play, it can be soldered.

You can get paste, low melting temperature silver solder from most gunsmith supply business. Coat the inside of the counter bore, as well as the outside of the shoulder of the extension. If you have a slightly loose fit, you may need to make a mandrel that will just slip inside the bores of the two barrels. This will keep both in line while soldering and cooling.



Carefully heat up the outside of the barrels after they have been combined. Be sure to keep the heat uniform all around the barrels, and when the solder melts evenly, let cool. Test the barrel after it is cleaned out to make sure you have a good soldering job.

On all the different Inning jobs that are listed above, be extra careful when first testing. All of these methods have been used many times, and have been proven safe. I cannot however assume any responsibly for accidents or injuries do to using improper methods or shortcuts.

New ends for damaged barrels can be made from Stress Proof or other free machining steel. The short bars can be drilled in the lathe and then reamed and choked as per instructions in the chapter on Opening Chokes.

MAKING SHOTGUN BARRELS

Once you get the tools made, making chokes is a simple machining job, and then turning out choke tubes like those that the Cutts can be made for all the different gauges. The big problem that you will have is making all the tools for the different sizes of barrels.

Safety First.

MAKING SHOTGUN BARRELS

CROSS FIRING

Cross firing will sometimes occur with double-barrel guns. If the cross-firing occurs at over 30 yards distance, separating the barrels more at the muzzle and for a few inches back will correct it.

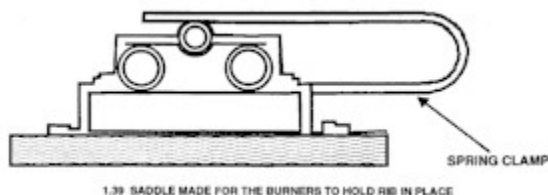
In correcting cross firing in doubles, the upper and lower ribs are both loosened with a small butane torch flame to the ribs for eight or ten inches back from the muzzle. You also have to remove the solder from the ends of the ribs at the muzzle. Measure the distance between the barrels and a piece of thin steel, thick enough to force the barrels farther apart, is pushed down between the barrels. The width should be thinned so that it will keep the top rib at the same height it was before, or the gun will not shoot at the same place.

The steel piece does not need to be more than 1 1/2" to 2" long. Solder it in place, so that it will hold the ribs at the same height as it originally was.

Calculating the amount the barrels should be separated to eliminate the cross firing is a going to be a problem. Patterning the barrels before to see where they crossfire will also show the amount of cross firing at distances within range of the gun. Remove the barrels from the gun, and lay them on a table that is pointing at a target. A wedge or shim sufficient to spread the barrels approximately .03" will correct a gun shooting about 15" off at 40 yards, using 29" barrels however, only trial can tell on each type of gun.

Place a heavy cross line that is marked off with heavy vertical lines 4" to 6" apart, and then look through the barrels at this line will show where the barrels point. This is like bore sighting in a rifle. Bore sighting does not mean too much, because the barrels are actually slightly bent apart, and sighting accurately down a curve is something that is difficult to work out.

When the ribs are loosened, lay the barrel back on the table, in the same position, and use a wedge pushed between the barrels at the muzzle to separate them until the cross pointing is corrected within range of the gun. After this point is found, the distance between, the barrels can then be measured and the flat steel piece of correct thickness to maintain this distance between the barrels is soldered in place.



MAKING SHOTGUN BARRELS

SOLDERING RIBS BACK ON

The ribs are then lowered into place and wires wrapped around the barrel with wedges beneath them on top of the ribs. The bottom rib can be placed against both barrels for resoldering but the top rib, should be the same elevation as before, will in most cases not quite touch the barrels. This gap must be filled in with new solder and the ends of the hollow beneath the ribs at the muzzle must be refilled with solder.

MAKING SHOTGUN BARRELS

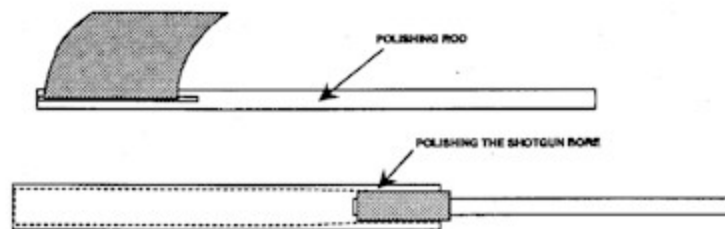
OPENING A CHOKE

Sometimes a customer wants the factory choke of a shotgun barrel opened slightly, as it may pattern too close with the loads used. The choke is enlarged by enlarging the bore at the muzzle. Usually this is done with the brake cylinder hone or expanding rubber mandrel with Carborundum cloth cemented to it. By placing the mandrel in position, back in the enlarged portion of the barrel and expanding it with the nut. It is started revolving and brought slowly out to the muzzle then run back again and repeated until the straight muzzle portion of the barrel is enlarged to give the required choke. Removing .012" to .015" inside the muzzle will reduce a choke from full to three-quarter. An automobile piston pin hones can be used if you can find one of the correct size.

POLISHING THE CHOKE

Shotgun barrels sometimes require polishing out, due to small pits or rust spots, or a new barrel may be rough enough to lead and spoil the pattern after a few shots. I usually do this polishing by mounting a steel rod in the lathe chuck with a slot about 4" long sawed down from the outer end.

Place Carborundum clothe cut 4" wide around the outer end of the rod by placing the end in the saw-slot and wrapping it around the rod in the opposite direction from that in which the rod is turned. The grain of the Carborundum to be used will depend upon what condition the barrel is in as to pits or rust. If little rust and only small pits appear, a fine grit followed by gradually finer through the polishing stage will take care of the problem and a dull polish.



1.54 POLISHING THE BARREL

The final polishing should be done with oiled Carborundum cloth of 000 grit, followed by crocus cloth used with no oil on it. These final polishing operations are done with the barrel held solid in a vise or lathe chuck and the polishing rod operated by hand, lengthwise of the barrel. The polishing rod is turned a little from time to time during the polishing operation, so that all parts of the barrel are polished evenly. The barrel should show no scratches and should have a mirror polish if you have removed all marks and pits.

MAKING SHOTGUN BARRELS

CHOKING BARRELS

SHOTGUN CHOKES

To the average person the term "choke bore" means that the diameter at the muzzle (bore) is less than the diameter at some point behind the muzzle. Any shotgun barrel constricted at the muzzle to the extent of .005 of an inch may be termed a cylinder bore.

After passing a certain limit in reduction, the choke always defeats its main objective by giving erratic patterns with large holes in them. The larger the bore the greater the reduction of the bore must finish close to a given length, and that should be approximately $1 \frac{3}{8}$, or better as a standard should be about 1 inch.

There is also another great misconception on chokes, and that is measuring the choke with a dime. How often we see a person take a dime from his pocket to see if it will enter the muzzle? Such a test does not tell him much. If you were to measure a dime, you will find that it measures about .705. Even on some American guns, it would go into a full choke. If you were measuring a Browning modified choke barrel, you would probably find the dime would not enter the choke, as it measures .701.

The best way to determine the amount of choke in your barrel is to measure the amount of constriction in the end of the barrel; skeet boring excepted, and then subtract this figure from the actual bore diameter of the barrel. This will give you the number of thousandths of actual choke in the barrel.

The bore diameters of Browning 12 gauge guns run about .725 but those of Winchester and Remington run .730 and their bores are about the same, or .729. The 12 gauge bore diameters run from .717 inch up to .760, and obviously a tube or a choke setting that might give a good full choke pattern with a .717 bore would over choke a gun with a .750 bore. The sizes of the 16 gauges, Browning bore diameters run .665, Remington's .673, and Winchester .664. The 20 gauge runs .611 for the Browning, .619 for the Remington, and .614 for the Winchester.

The full choke standard used to be .040 or 40/1000 inch, or 40 "points" of constriction the barrel makers terminology, but with modern ammunition, a gun with that much constriction is over choked. The full choke barrels today that I have seen have from 28 to 37 points of constriction. It used to be, 30 points of constriction normally gave improved modified patterns, 20 points (half choke) modified or 60 per cent patterns and 10 points (quarter choke or strong improved cylinder) about 50 percent.

DIFFERENT PATTERNS

The different patterns of the various chokes are supposed to deliver the following in a 30-inch circle at 40 yards:

Full Choke	70 to 80 per cent
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MAKING SHOTGUN BARRELS

Improved Modified	65 to 70 per cent
Modified	55 to 65 percent
Quarter Choke	50 to 55 per cent
Improved Cylinder	45 to 50 per cent.
Skeet No. 2	(Usually delivers modified patterns)
Skeet No. 1	Cylinder About 35 to 40 per cent

Table 10: SPREAD OF SHOT PATTERN IN INCHES AT BORING

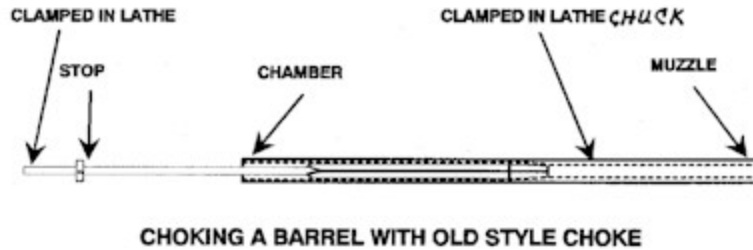
VARIOUS RANGES IN YARDS:

	10	15	20	25	30	35	40
CYLINDER	19	26	32	38	44	51	61
IMPROVE CYLINDER	15	20	26	32	38	44	51
MODIFIED	12	16	20	26	32	38	46
FULL	9	12	16	21	26	32	40

If you do very many pattern testing, you may find that some modified chokes will shoot tighter than many full chokes. Once you have the reamers made, now get some heavy wall tubing. This should be 1/2 inch for the 12 gauges. You will need to thread one end so you can screw a fitting to that end, so the high-pressure oil line can be attached. All you need then is a fixture to mount in the carriage where the tool blocks mounts.

This fixture clamps the tube to keep it from turning. The reamer you make it can be counter bored to a depth of 3/4 inch to accept the 1/2 inch oil line tube.

MAKING SHOTGUN BARRELS



This should be sweated together with soft solder. This is done by cleaning up the 1/2 inch counter bore.

Then tinning it and the 1/2 tube, heating the tube and reamer shank together, slipping it into the counter bored hole rotating it a few times and letting the solder cool.

You put the barrel in the lathe with the muzzle end in the chuck. The reamer will be started at the chamber end, and pulled towards the muzzle. On the roughing and finishing, the reamer will not come out all the way out of the barrel. The finish reamer will be stopped with the choke about 1 inch from the muzzle. You must hand feed the finish reamer for a few thousands out the choke. When having reached the desired length, disengage the feed and while the machine is still running back out the reamer.

In reaming the barrel, the lathe should be in the slowest back gear position. You will have to find the best-feed rate. On the roughing reamer, you will have to use the slowest feed as you are removing a greater amount of material.

WATCH FOR REAMER PLUGGING

One thing that is necessary is that on all tools, is that they must be attached absolutely solid and straight to the reamer oil tube. If not, this can cause you much grief in the form of ringed and rough barrels.

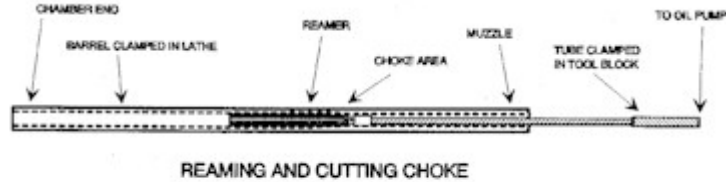
CUTTING THE CHOKE

Shotgun barrels are made from the bored steel tubes and although they may be reamed to size with a series of barrel reamers, such as those used on rifle barrels. They are usually finished bored and choked with a long, four-sided square reamer of O1 tool steel, ground to size on a surface grinder.

These reamers are 10" to 12" long and have a tapered lead at the front end, about 1" long on the finishing reamer.

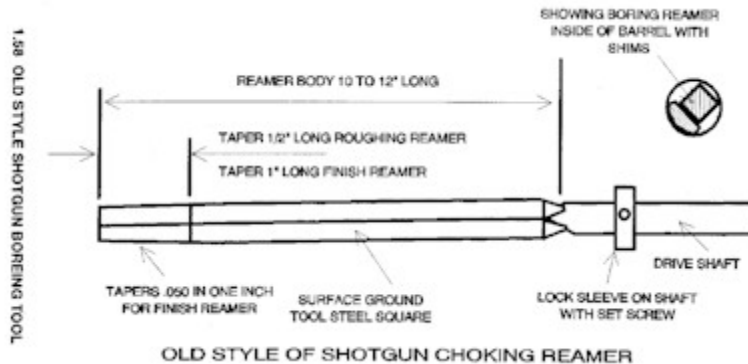
The driving rod for these reamers is brazed to the rear end of the reamer, the opposite end from that which has the tapered lead, and the reamer is pushed through the bore as the barrel tube revolves.

MAKING SHOTGUN BARRELS



1.56 REAMING AND CHOKING A BARREL WITH MODERN REAMER

A floating connection at the end of the oil tube should be used, so that the reamers are entirely guided by the bore of the blank. The end of the oil tube may be plugged for 2" and a simple universal joint used, attached to this plugged portion, or a floating drive of the type described on chambering reamers may be used. The flexible oil line from the pump is led into the side of the hollow portion of the oil tube ahead of the plugged end through a screw connection like a nipple. This connection must be removed to pass the oil tube through the barrel blank, as the oil tube is brazed to the reamer, and then put in place and the oil line connected to it before starting the lathe.



OLD STYLE OF SHOTGUN CHOKING REAMER

A wood packing strip, turned on one side to the contour of the barrel bore, is placed against one side of this reamer, its full length. Strips of paper are placed between the wood strip and the boring reamer to cause it to cut larger after each trip through the barrel.

A wood strip of the same type is used on one side of the finish or fine boring reamer but the leading edge of the opposite side has a small radius stoned upon it so that it does no cutting. The cutting is all done with the trailing edge of this side opposite to that on which the wood strip is placed.

The choke boring reamer is used in shotgun barrels to cut the choke. After the finish or fine boring reamer is used the choke boring reamer that has a tapered lead an inch long which tapers about .050" in this distance is used to bore out the choke portion of the barrel that is not bored out by the finish boring reamer. A wood packing strip is used, with paper shims on the tapered portion of this choke boring reamer and this reamer cuts on two edges.

Table 11: SHOTGUN BORE AND CHOKE SIZE

MAKING SHOTGUN BARRELS

12 GAUGE

BORE DIAMETER IS	.730		
FULL CHOKE	.694	AC	.036
MODIFIED CHOKE	.712	AC	.018
IMPROVE CYLD	.721	AC	.009
CYLINDER BORE	.665	AC	.000

SHOTGUN BORING REAMER

The shotgun boring reamer is run at a low speed and plenty of cutting oil is supplied by a low-pressure pump. In making the reamers, they are hand honed after being ground to shape by a surface grinder. They must be carefully checked for straightness. In doing the grinding, if much stock is to be removed, do not grind a lot off one side and then off the opposite side but take a small amount off the first side. Then take a like amount from the opposite side, then take the same from an adjacent side and the same from the last side and repeat this until the reamer is ground to size, as this method of grinding will prevent warping the reamer.

A third square bit, the choke-boring bit, is used in shotgun barrels. After the finish or fine boring bit is used this choke boring bit which has a tapered lead an inch long which tapers about .050" in this distance is used to bore out the choke portion of the barrel which is not bored out by the finish boring bit, but only by the roughing bit. A wood packing strip is used, with paper shims on the tapered portion of this choke boring bit and this bit cuts upon two edges, as does the roughing bit.

These shotgun-boring bits are run at a low speed and plenty of cutting oil is used. In making the bits, they are hand honed after being ground to shape by a surface grinder. They must be carefully checked for straightness. In doing the grinding, if much stock is to be removed, do not grind a lot off of one side and then off the opposite side but take a small amount off of the first side, then a like amount from the opposite side. Then take the same from an adjacent side and the same from the last side and repeat this until the bit is ground to size, as this method of grinding will prevent warping the bit.

Table 12: SHOTGUN BORE AND CHOKE SIZE

MAKING SHOTGUN BARRELS

16 GAUGE

BORE DIAMETER IS	.673		
FULL CHOKE	.640	AC.	.033
MODIFIED CHOKE	.656	AC.	.017
IMPROVE CYL.	.665	AC.	.008
CYLINDER	.662	AC	.000

Table 13: SHOTGUN BORE AND CHOKE SIZE

20 GAUGE

BORE IS	.619		
FULL CHOKE	.590	AC.	.029
MODIFIED CHOKE	.604	AC.	.015
IMPROVE CYLD.	.613	AC.	.007
CYLINDER	.615	AC.	000

Table 14: SHOTGUN REAMERS

12 GAUGE

MAKING SHOTGUN BARRELS

SHOTGUN REAMERS

	Pilot	Body	Choke
ROUGH REAMER	.656	.694	
FINISH REAMER	.694	.730	.694

Table 15: SHOTGUN REAMERS

SHOTGUN REAMERS

16 GAUGE

	PILOT	BODY	CHOKE
ROUGH REAMER	.562	.640	
FINISH REAMER	.640	.673	.640

Choke boring is similar to quick-boring, except the cutting end of the rod does not go quite through the barrel, being withdrawn and again inserted with a slip of paper placed between the slip of wood and the cutter. This is worked not quite as far as the previous boring, being withdrawn and another slip of paper placed between the wood and the chatter, and this is worked in as far as desired. Care must be taken that the choke be gradual and even. A finish can be given by folding a piece of fine emery cloth or emery paper around a rod, and by turning this in the barrel, equalize any unevenness that may occur.

Table 16: SHOTGUN REAMERS

MAKING SHOTGUN BARRELS

SHOTGUN REAMERS

20 GAUGE

	PILOT	BODY	CHOKE
ROUGH REAMER	.531	.590	
FINISH REAMER	.590	.619	.590

ENLARGING THE BORE

To enlarge the interior of a barrel, boring it choked at both breech and muzzle, push the rod to the distance from the breech the enlarging is to start, and then start boring, leaving off where the muzzle choke is to start. If the bore of a barrel is to taper from muzzle to breech, it will scatter. If made to taper too much from breech to muzzle, it will compress the shot, and cause a very scattered pattern.

A very slight variation in the size of the bore of a gun-barrel at one of its ends often has a marked effect on its shooting. If the shotgun tends to scatter the shot too much, it can usually be corrected by enlarging the bore at the breech. Choke boring is another is another type of finishing the choke.

You will have to, or more than likely need to polish the choke area. This consists in dressing out the breech with fine emery paper or cloth, wrapped upon a round wooden rod. A little oil should be used in finishing the dressing, which will not extend above half the length from the breech to the muzzle.

No attention is needed to the slope of the choke, as the size of the bore, during this operation, is usually largest at the breech. To do this get a break cylinder hone will work very well with the finest grit stones you can get. It is usually necessary to hone the slope of the choke area, as the reamer will usually not do that well there. This is where the old style square shotgun reamers work well as they will do a better finish job there. You will need to braze a 1/4 inch rod to the hone so it can reach down the barrel to the choke area. Then finish with a fine lapping compound. With the hone, you will be able to do quite a bit of alterations on the choke area. Be careful that you do not change the shape of the cone area as this will throw off the pattern.

The final polish in the bore should be a mirror like finish, instead of the finish, we see in the bore of almost all guns completed with the finishing tools and never lapped. You should lap the barrel

MAKING SHOTGUN BARRELS

with 800 or 900 carbide powder. A barrel highly finish will be known by the remarkable closeness of its pattern. The only way to achieve this is with a lead lap. Along lead lap coated with fine carbide flower, and paraffin oil as a lubricant. This process is also done in the lathe, or it can be done with an electric drill. If used in the lathe, the lap should be held in the same holder as the reamer coolant tube, and is directly in line with the bore.

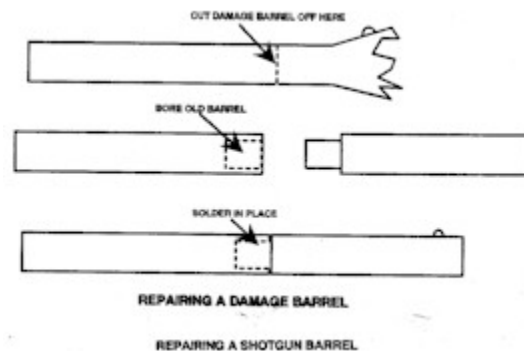
DIFFERENT SIZES OF SHOTGUN REAMERS

You will also be able to add short extensions to a shotgun barrel to replace the damage end that has a bulge or burst in it. There are many choke adapters made today that will mount to the finished reamed barrel, and making and testing a choke is eliminated. This will cut many hours from making the finish barrel, and I would recommend going this route.

MAKING SHOTGUN BARRELS

INSTALLING EXTENSIONS TO BARRELS

The barrel must be shortened enough to eliminate all of the original choke, and then you clamp the barrel in the shop vise, muzzle up. Now screw the choke body on the sleeve as tight as you can by hand, and then slip the sleeve on the barrel. Line up the assembled sleeve and body until the front sight (on the choke body) is approximately 1/10 of one turn from lining up with the top of the barrel or the rib.



Mark the sleeve and the barrel with a pencil, parallel with the barrel axis, so you can have an index line to line up the barrel and adaptor. Remove the sleeve without wiping off the pencil mark, and unscrew the body. With a good silver solder paste flux that can be purchased from Brownells, coat the inside of the sleeve and pass it down over the barrel section to coat it also. Be sure the flux covers all the surfaces, and then place the sleeve back in position on the muzzle of the barrel, and carefully lining up the penciled index marks.

After in correct position, carefully wipe away any flux, which has squeezed out on the bottom of the sleeve at the barrel shoulder. Wipe any flux off the top and the inner edge of the muzzle, being careful not to turn the sleeve on the barrel. Now light up the welding torch, using around a No. 26 or 27 size tip and with only about five pounds pressure on both acetylene and oxygen. Now give the sleeve a fast heating, and concentrating most of the flame on the heavier bottom section first and working around the whole sleeve and do not get the heat on the barrel.

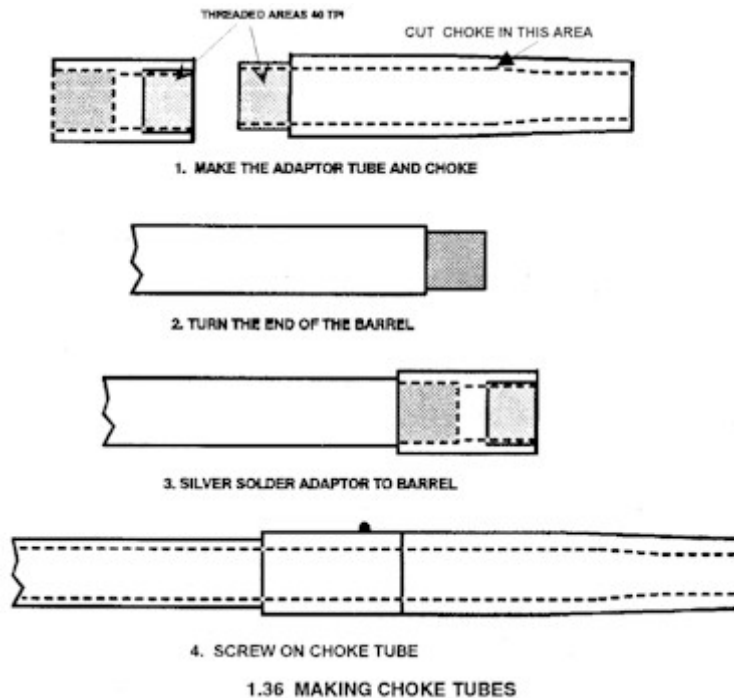
Depending on the type of silver solder, the sleeve is usually a dull red when the silver solder begins to melt and flows downward to form the sweat joint. I prefer using a low melting point paste Silver Solder as there is less heat applied to the barrel, and less chance of oxidation. Heat is applied only for about 30 seconds but experience may make it more or less.

After the solder starts to flow into position, turn off the torch and take the barrel from the vise. Wait about ten to fifteen seconds more, and then quench the hot muzzle with attached choke sleeve into a can of oil, to heat blue the sleeve.

When the barrel and choke tube is cool, clean the barrel thoroughly, using a wad of steel wool to

MAKING SHOTGUN BARRELS

clean any scale from the muzzle under the sleeve. Use a wire brush to clean the threads on the sleeve, protecting the blued shoulder section with tape.



When you clamp the barrel in the vise, I use soft wooden blocks that are hollowed to fit the barrel to prevent deformation, and then screw on the choke body. Using a strip of 1/8" flat drill rod with rounded edges passed through the slots in body for a wrench, tighten the body enough to bring the front sight into proper alignment. If for some reason you cannot screw it on enough to line up, remove the body and clean off the rear face with a file.

This will usually remove enough metal to fit the choke but if the choke turns past the sight alignment, you will then have to use the lathe to remove sufficient metal from the shoulder of the sleeve or the back end of the choke body to allow screwing the body another full turn, align the front sight. Finish up as per the instructions furnished with choke by using a setscrew is set to hold it in place.

A recess for the point of the screw must be drilled in the sleeve, using the drilled and tapped hole in the body as a guide. The screws furnished are a trifle long, and should be shortened to obtain a flush fitting.

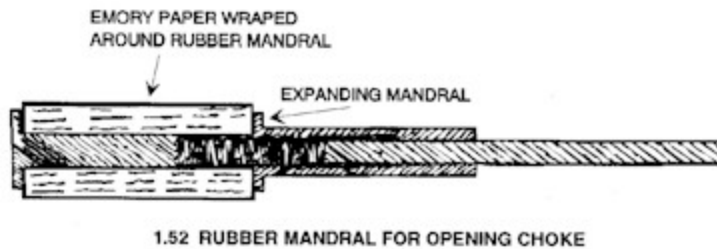
Should the shotgun pattern high, low, or to one side, correction must be made by alteration of the front sight or bending the barrel.

CUTTING A NEW CHOKE

Due to varying circumstances, you may have to cut off the muzzle of a shotgun barrel. Usually the choke is removed from the barrel, as it is in the last two or three inches at the muzzle. The full

MAKING SHOTGUN BARRELS

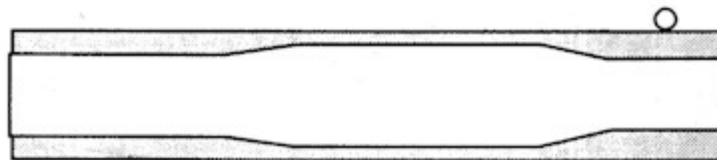
amount of choke cannot be replaced when it is removed, some choke can be put in the barrel unless you have a foreign made shotgun and it is extremely thin.



If the gun is a single barrel gun it can be chucked in the lathe and a new choke bored from the muzzle end. This choke should start 1 1/2" to 2" back from the muzzle, and leaving this length of barrel at the muzzle straight. The barrel should be bored out about 2" in length and to a diameter .007" or .008" larger than it was, with both ends of this recess bored on a taper of about 2 degrees and with no sharp shoulder at the ends. The boring tool will not leave a smooth enough finish in the recess, so it will have to be polished after being bored.

RUBBER EXPANDING MANDREL

A rubber expanding mandrel is the about the best thing to use to polish a recess choke. The rubber mandrel can be made to a diameter so that after Carborundum cloth has been cemented on it in short sections around its circumference, so it will just pass into the muzzle of the barrel. Start the polishing with 000 grit Carborundum cloth followed by crocus cloth. A steel mandrel about 6" to 8" long with a solid head upon it is used to mount the rubber upon. The rubber can be about 1 1/2" long and is slipped onto the steel arbor and pushed up against the head.



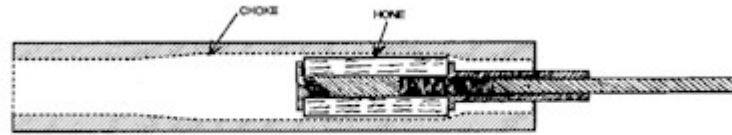
RECESS OR JUG CHOKE

Now thread the shank of the arbor, starting about 1" below the head, and it is threaded for the nut that screws onto it to expand the rubber. When you make the nut, make the nut quite long, so that when the rubber mandrel is clear at the rear end of the choke, the nut is even with or only slightly inside the muzzle. The reason for the long nut is to allow the rubber mandrel to be inserted into the choke portion unexpanded, and then it is expanded while in the recessed portion of the barrel by tightening up the nut.

POLISHING THE CHOKE

MAKING SHOTGUN BARRELS

The end of the steel arbor is held in a drill chuck in the tail stock of the lathe while the barrel is revolved in the lathe spindle. The rubber mandrel, with the Carborundum cloth cemented on it, is moved back and forth from one end of the choke to the other, while the barrel is revolving, by the tail stock. The recess should be polished out to .010" to .012". You will have to replace the Carborundum cloth several times with new pieces while polishing out the choke, as it wears out.



1.64 HONING IN A CHOKE

If the barrel cannot be chucked in the lathe to have the recess choke bored in it, you must do it solely with the rubber mandrel and Carborundum cloth. The recess is started and carried practically to finish dimensions with coarse Carborundum cloth, after which the polishing is done with the 000, followed by crocus cloth.

The arbor of the rubber mandrel is mounted in a chuck in the live spindle of the lathe and revolved while the barrel is held in the hands, and I have done many such jobs with the mandrel chucked in the drill press. When done, unscrew the expanding nut of the rubber mandrel before drawing it out of the muzzle and never tighten the nut up until the mandrel is replaced in the recess choke, or the bore at the muzzle will not be enlarged.

ADJUSTABLE CHOKE

One of the easiest ways to change the choke on a shotgun is to cut off the barrel to remove the choke plus the extra amount of barrel to get the desired length of barrel with the choke installed.

There are many advantages of the adjustable choke on shotguns. With a twist of the wrist, you can change the choke to fit the type of shooting that you are doing. The adjustable choke eliminates the need to own two or more barrels of different chokes.

The three most commonly used are: Cult's Compensator, Poly Choke and Weaver Choke, any one of which very successfully take care of choke alterations. Guns equipped with these variable choke devices are very close to being a perfect general purpose guns, especially in 12 or 16 gauge.

The Poly Choke is the easiest to use of the three makes of chokes for variable pattern control. To change the amount of choke no extra tubes or wrenches are required. All that is needed is to merely to turn a sleeve, to open or reduce the degree of choke. The amount of constriction can be so regulated as to give patterns from cylinder to an extra full choke, making the gun to which it is attached a all-around weapon.

POLY CHOKES

MAKING SHOTGUN BARRELS

Poly Chokes do not reduce recoil; neither do they affect the normal muzzle blast of the gun. While the size of the adjustment sleeve makes the muzzle of the gun appear oversize, the length of the Poly Choke is quite a bit shorter than the other two.

There are several choke-control devices for use on single barrel shotguns, and most have muzzle brake or recoil compensating features built into them. Installation is about the same for all of them, either the end of gun barrel is threaded to receive a fitting, or a similar fitting or sleeve is silver-soldered to the muzzle. The threaded types require that the proper size of sleeve or choke be chosen for the size barrel involved. There are considerable differences between diameters of shotgun barrels, even if they are the same gauges. One size of choke that will fit one make will not fit another brand of gun. You can buy different sizes to fit other barrels.

WEAVER CHOKE-POLYCHOKE.

The Weaver choke also reduces recoil, and this is needed when using heavy bird loads.

All variable chokes detract from the gun's appearance to a certain extent. The slim, racy appearing barrel must be sacrificed to allow for the necessary mechanical features in a variable choke's makeup. The Weaver Choke appears less unsightly than any of the others as they are nearer the size of the barrel itself.

Both the Cutts and the Weaver chokes are noisy, as the muzzle blast comes back towards the shooter and is more pronounced.

To install these chokes the muzzle of the gun must be trued on the lathe, and the outside turned to a specific size for a short distance, and then threaded. The thread is 40 per inch, V type. As there is quite a difference in barrel diameters, make each barrel and order the proper size for each gauge. The factories have enough different sizes to take care of practically all barrels. When using the Weaver, the body of the choke screws directly on the barrel, and the front sight is installed after the job is completed, by drilling for it in the top of the choke. When you use the Poly Choke, you must line up the front sight in mounting.

CUTTS AND PACHMAYR POWERPAC

The Cutts Compensator is very easy to install, as a sleeve is furnished, threaded on the outside, and of proper diameter for the barrel involved, which is to be silver soldered on the barrel at the muzzle.

The compensator is threaded, and a wrench is required to change tubes. Many hunters find this objectionable as it means carrying the wrench and extra choke tubes when going on a hunting trip where changing of choke may be needed.

As in the other chokes, you have to turn the barrel down to receive this sleeve. When turning, you will need a shoulder far enough back so that the muzzle will be flush with the end of the sleeve when in place. The sleeve should be a close slide fit. As with all chokes the barrel is cut

MAKING SHOTGUN BARRELS

to the length needed before turning, and the barrel should not be shorter than 22", for best performance. I make a set of mandrels to fit all the standard 12, 16 and 20 gauge chambers so I can turn the barrels on your lathe.

Cutts are made in two different weights so that when the barrel length is considerably reduced before the Cutts is installed, the heavier steel type will offset muzzle lightness. For a fast handling, muzzle light gun, select the Cutts in an aluminum alloy.

The pattern shot from the Cutts compensator are uniform and tests made with the long-range tube that there is little question but what a 12 gauge shooting a heavy load will kill with certainty up to and slightly beyond 60 yards. When the distance is less than 40 yards, the general-purpose tube on a 12 gauge, shooting the heavy 1-1/4 ounce load, is a hard combination to beat.

The barrel must be shortened enough to eliminate the entire original choke, and then you clamp the barrel in the shop vise, muzzle up. Now screw the compensator body on the sleeve as tight as you can by hand, and then slip the sleeve on the barrel. Line up the assembled sleeve and body until the front sight (on the compensator body) is approximately 1/10 of one turn from lining up with the top of the barrel or the rib.

Mark the sleeve and the barrel with a pencil, parallel with the barrel axis, so you can have an index line. Remove the sleeve without wiping off the pencil mark, and unscrew the body. With a good silver solder paste flux that can be purchased from Brownells, coat the inside of the sleeve and pass it down over the barrel section to coat it also. Be sure the flux covers all the surfaces, and then place the sleeve back in position on the muzzle of the barrel, and carefully lining up the penciled index marks.

After in correct position, carefully wipe away any flux, which has squeezed out on the bottom of the sleeve at the barrel shoulder. Wipe any flux off the top and the inner edge of the muzzle, being careful not to turn the sleeve on the barrel. Now light up the welding torch, using around a No. 26 or 27 size tip and with only about five pounds pressure on both acetylene and oxygen.

Now give the sleeve a fast heating, and concentrating most of the flame on the heavier bottom section first and working around the whole sleeve and do not get the heat on the barrel.

Depending on the type of silver solder, the sleeve is usually a dull red when the silver solder begins to melt and flows downward to form the sweat joint. Heat is applied only for about 30 seconds but experience may make it more or less.

After the solder starts to flow into position, turn off the torch and take the barrel from the vise. Wait about ten to fifteen seconds more, and then quench the hot muzzle with attached compensator sleeve into a can of oil, to heat blue the sleeve.

When the barrel and choke tube is cool, clean the barrel thoroughly, using a wad of steel wool to clean any scale from the muzzle under the sleeve. Use a wire brush to clean the threads on the sleeve, protecting the blued shoulder section with tape.

MAKING SHOTGUN BARRELS

When you clamp the barrel in the vise, use soft wooden blocks that is hollowed to fit the barrel to prevent deformation, and then screw on the compensator body. Using a strip of 1/8" flat drill rod with rounded edges passed through the slots in body for a wrench, tighten the body enough to bring the front sight into proper alignment. If for some reason you cannot screw it on enough to line up, remove the body and clean off the rear face with a file.

This will remove enough metal to fit the compensator but if the compensator turns past the sight alignment, you will then have to use the lathe to remove sufficient metal from the shoulder of the sleeve or the back end of the compensator body to allow screwing the body another full turn, align the front sight. Finish up as per the instructions furnished with choke by using a setscrew is set to hold it in place.

A recess for the point of the screw must be drilled in the sleeve, using the drilled and tapped hole in the body as a guide. The screws furnished are a trifle long, and should be shortened to obtain a flush fitting.

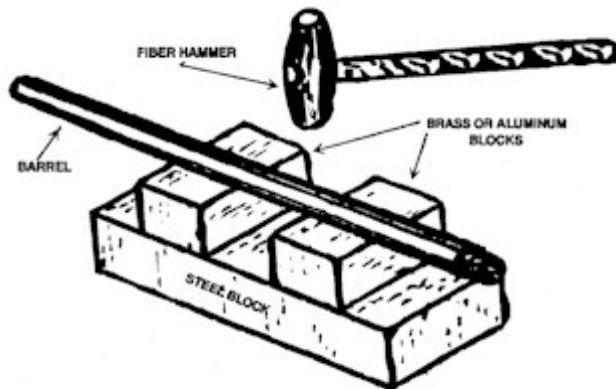
The Cutts Compensatory should be mounted exactly parallel with the bore axis. Should the shotgun pattern high, low, or to one side, correction must be made by alteration of the front sight or bending the barrel.

MAKING SHOTGUN BARRELS

OFF SHOOTING

When a shotgun shoots high, low or to one side after installation a choke attachment is installed usually receives adverse comment regarding the choke and the gunsmith. Most owners have never patterned the gun until after the choke was installed, and do not realize that if it patterns off center, it may have done the same before the choke was installed.

Through mounting many chokes, I find it difficult to mount a choke device improperly, and any shooting off is do to the gun itself. Shotgun barrels are easily bent, and any gunsmith who has mounted very many chokes comes across many sprung barrels. The barrel usually looks okay, but if it is put it in the lathe between centers, you can see it wobble. The barrel may have been bent at the factory in order to make it pattern correctly and in most cases it will be okay after the choke installed. The only way I know to tell if the barrel is okay is to mount the choke and try out the gun.



1.65 STRAIGHTENING A SHOTGUN BARREL

The rear sight on a shotgun is actually the position of the shooter's cheek on the stock, and very seldom will two men will shoot the gun the same way. The customer should pattern his gun himself, and at a fixed aiming point on the target paper and shoot at it just as he would use the gun in the field. A gun can be overshooting, yet pattern perfectly to point of aim yet could center his pattern target, but miss his birds.

Most of the cures to off patterns, besides stock alteration, is a simple process, the only two methods to correct the problem is bending the barrel or altering the muzzle of the barrel.

BENDING THE BARREL

The barrel needs some protection against making it out of round, and one method is to fill it full of fine sand. The ends are of course plugged tightly. The actual bending of the barrel, which is of course very little almost imperceptible to the naked eye, any method that will not mar the finish

MAKING SHOTGUN BARRELS

of the barrel is OK.

Barrels can be sprung by clamping the breech section in a barrel vise with long supporting protecting jaws and using a long copper rod of approximately bore diameter inserted from the muzzle and forced in the direction of the desired bend. The barrel is bent in the direction that you want to move the pattern.

STRAIGHTENING A BENT BARREL

Sometimes you will get a gun that has had the barrel bent by accident. To straighten a barrel bent accidentally the above method works just about as good as any. After straightening, the bore is sized by use of dent removing plugs, and if has a ventilated rib it is soldered back if it has broken free of the barrel. It would be impossible to straighten a badly bent barrel cold without producing a slight bulge on the outside of the bend. The stretched metal at that point would be forced upon itself and the barrel would be weakened and possibly cracked at the inside of the bend.

High and low, front sights give a small amount of pattern correction. The shotgun back sights, or the small beads placed in the middle of the barrel, has no real effect on pattern placement, but they help the shooter to pay more attention to his front sight alignment on the target.

ALTERATION OF EXISTING CHOKE

There are few calls to change the choke in a barrel, and the method of changing chokes by rolling a choke in the barrel is only used for a quickie job. You can seldom increase the choke, but to decrease it is fairly simple as all that is required is at the choke at the muzzle of the gun is reamed or polished to greater diameter.

The front edge of the choke bevel can be located anywhere from the edge of the muzzle to a point 1" back. To open up a choke an expansion reamer, very sharp, is best for the job, but to decrease the choke slightly you can use a mandrel wrapped with fine abrasive cloth, turned in the lathe or the drill press.

You will find it very difficult to obtain an exact degree of choke that the customer wants. In my years of changing patterns, the only test that can be made is by patterning the gun, of course. When polishing out a choke you will find that even the smallest amount of metal removed can make quite a difference. Most shotguns that were made a few years ago usually show reamer marks at the choke, as the makers of the guns start their checking with considerably more choke than needed. Then by reaming, firing and testing the patterns make alternations until they get the best pattern with the specified size of shot. When achieving the correct choke they did not polish out the reamer marks, as it would change the pattern.

If you want a tighter pattern usually the only means available of achieving tighter choke on a good gun is to equip it with a choke device, such as the Poly Choke, or in the case of an over/under or double, a new set of barrels!

MAKING SHOTGUN BARRELS

You can do a quickie job of choking the barrel by having the choke swaged into the muzzle end of the barrel. To do this, the barrel is cut off to remove the entire choke and the front end forced into a pipe roller or die to reduce it down to full or modified choke. A pipe cutter is used, first removing the cutting wheel and replacing it with a hardened steel roller, as wide as possible and then it is used to roll in a choke. Starting at the muzzle and increasing the pressure as it is revolved around the barrel, the latter can be decreased in diameter sufficiently to gain any desired degree of choke.

A pipe cutter can also be used for removing dents, as a finish tool to iron the outside of barrel perfectly smooth, after the dent is removed from the inside, and while the plug is in the barrel.

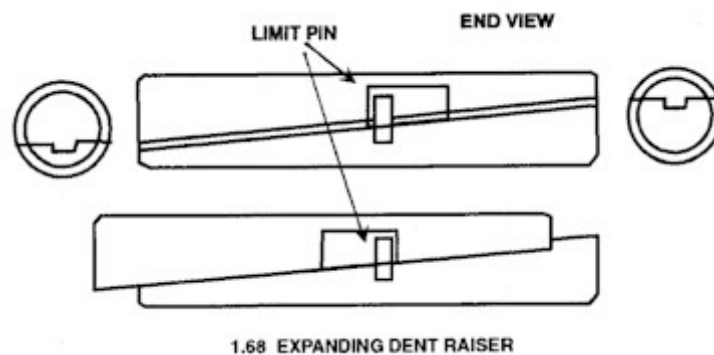
Most factories use small shot in determining pattern and choke figures, and many shotguns that give full choke patterns with such small shot will give patterns with large holes with 4's or 5's. Many times a modified choke barrel will give full choke patterns with these larger shot sizes.

MAKING SHOTGUN BARRELS

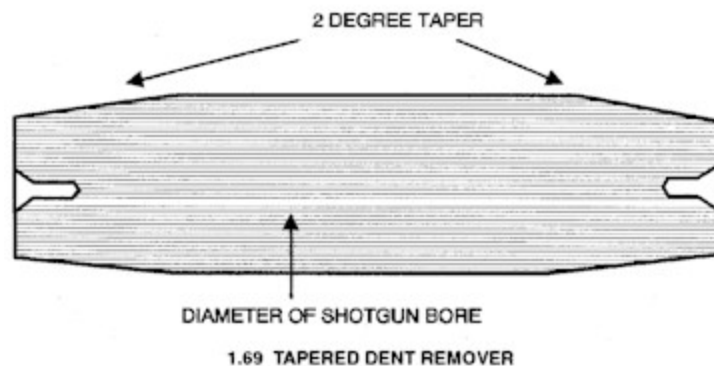
DENT REMOVAL

Dents and bulges in shotgun barrels are very common problems in shotguns. To remove dents, the dent must be forced out from the inside by means of steel drive or expanding plugs. Dents are removed from shotgun barrels either with solid steel plugs, graduated in size about .002" apart, or with expanding plugs.

If the gunsmith has in his shop a lathe and tool post grinder, he can make his own dent removers. To handle most types of dent removal work, you should have at least one remover of each type for the 12, 16, 20, 28, and 410-gauge shotgun.



Before the dent remover is inserted in the bore, it should be wiped free of any foreign matter clinging to it, similarly, the bore of the gun should be cleaned. The chances of either the bore or tool getting scratched, as a result of some fine abrasive particles being interposed between them, is reduced.

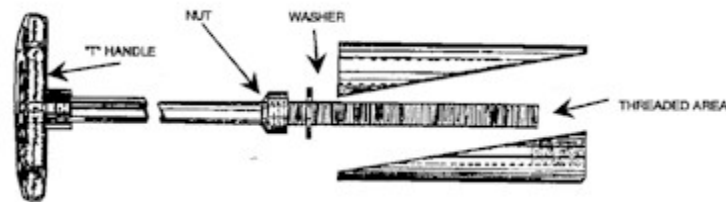


After removing the barrels from the receiver and removing any parts that might interfere with holding the barrel between padded vise jaws. The dent remover should be wiped over with an oil-dampened cloth, and then inserted into the gun tube from the breech end, and pushed forward by means of a steel rod until the dent halts it. The steel rod should be drill rod, about 24"

MAKING SHOTGUN BARRELS

long, 1/32" less than bore diameter, and have a pronounced chamfer at both ends.

Tap the rod with light blows until the dent remover body is under the dent. This action should raise the dent. If it not level with the surrounding surface of the exterior of the barrel, then knock out the dent re mover by inserting the rod from the muzzle and tapping on it. Run a clean patch through the bore and look for the dent in the barrel. If a very slight shadow appears where the dent was, then reinsert the dent remover until it is again under the dent, and gently tap around the dent with a fiber hammer.



1.70 EXPANDING DENT RAISER

This will generally fully raise and round out the indentation to conform to the normal internal and external of the barrel.

The solid steel plugs are expensive, as each barrel, size requires several of them and they must be made of tool-steel, hardened, ground and polished. A solid plug will be necessary to start bad dents up so that the expanding plug can be inserted, as its shrink and expansion is limited. In removing the dent a hammer with a composition face, is used to hammer the outside of the barrel lightly around the dent. This is done as the expanding plug is tightened against the dent on the inside, as this helps in the removal of the dent and takes off some of the strain on the barrel set up by the expanding plug.

Money wise, it is much better to either make or buy the expanding type dent raiser for at least 12, 16 and 20 gauges. Solid drive plugs are fairly easy to make, one that is made to close tolerance to fit one particular barrel probably will not fit any others you get in.

DEEP DENTS

Deep dents will require a long tapered solid plug for partial raising, so that the expanding plug can be inserted using the rawhide or fiber mallet for driving the plug through the dented area.

The ends of these solid steel dent-raisers are tapered off at 15 to 20 degrees, so they will start a dent up easily without tearing the inner barrel surface. Three inches is a good length to make them, and a heavy hardwood dowel rod or a steel rod is used to force them beneath the dent, with taps from a hammer. The barrel and the dent raisers are both oiled with light oil like sperm oil.

Expanding dent-removing plugs, assemblies are available, through Brownells. An expanding plug depending upon a turn screw for expansion a tendency to turn in the barrel, so you need a

MAKING SHOTGUN BARRELS

holding rod on the far end that can be clamped in a vise if you make your own.

The adjustable or expansion dent-raiser is made of two flat pieces of tool-steel sweated together. This type is also best made about three inches long, but in making them leave an additional inch of length, so that a lathe dog may be clamped on them. To make your own expanding dent raiser you need two pieces of good steel that are machined with angle faces, and one with tongue, or rib and the other piece with matching groove, and fitted together, off center longitudinally.

After sweating the two pieces together, cut the ends off at an angle of about 80 degrees to the sweated splice, the ends being parallel to each other. Center the ends and, placing the lathe dog on the pieces, place them between centers on the lathe and turn them to bore diameter, plus .012 or .015" and taper off the ends at fifteen or twenty degrees for a short distance, usually 1/8 or 1/4" will be enough.

Drill the pieces with a 17/64 " hole from end to end. Drill out this hole from one end to the sweated seam with a 5/16" drill and then tap the remaining portion of the hole with a 5/16" 24-thread tap.

Next on the lathe, cut a groove three inches from one end, almost cutting the piece off, so that after it is hardened it can be broken off at this point.

After this is done, heat the two pieces until the solder melts and they can be separated. Clean the soldered faces and harden both pieces, drawing them slightly at pale straw to relieve strains afterwards. After hardening and drawing, resolder the two pieces together and grind them to just under standard bore size. After finishing, all the outside surfaces should be polished and buffed to remove all the grinding marks so they do not mark the inside of the barrel. Break off the one-inch of extra length and remove the solder from the pieces.

Get a piece of 5/16" drill-rod and thread the rod for 3" with a 24-thread die and a nut is screwed up very tightly to the end of the thread. Now turn this down nut on the outside diameter so that it clears the thin end of the expansion plug. A washer of the same diameter is placed against the nut and it is turned down if necessary. A "T" handle or some type of wheel is placed upon the opposite end of the rod and then pinned in place.

When the threaded end of the rod is placed through the drilled out portion of the plug, screwed into the threaded portion, and tightened up, the plug expands in one direction. The barrel and plug should be oiled with light oil while removing dents.

Shotgun barrels are soft, and your plugs should be hardened tool steel if possible, but if this is not available, almost any type of steel that can be case hardening will work fine.

DENTED OR BENT MUZZLES

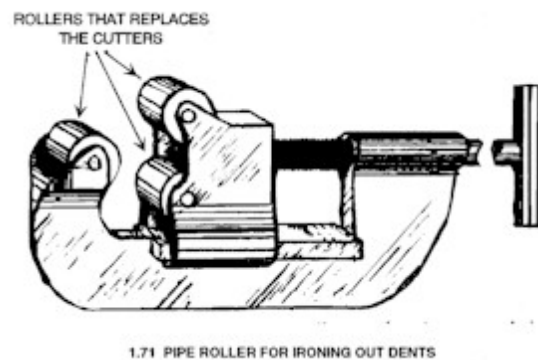
I have found the dented muzzles are usually found on double barrel shotguns, because of the thin barrel walls of such guns. Muzzles may be bent out of round or deeply dented inward from the

MAKING SHOTGUN BARRELS

gun falling or being struck against some hard surface. As a rule, these can be fixed fast and painlessly. To repair the dents use the nearest piece of round steel stock, or even brass just small enough to enter the barrel with close clearance. Remove any sharp edges and clamp it horizontally in the vise with about an inch protruding, and slip the end of the barrel over it, dent up, and work out the dent with a rawhide mallet.

BULGED BARRELS

When you have a shotgun barrel that has a bulged area in the barrel, the bulge usually occurs just at the rear end of the choke, and sometimes going as far forward as the front sight. These bulges at the rear end of the choked portion of a shotgun barrel are usually caused by obstructions in the barrel when the gun is fired.



The bulge may be removed by turning up a steel plug in the lathe, very close to the size of the ID of the bore and a few inches longer than the bulged portion of the barrel. The plug should fit closely enough so that it requires a heavy rod to push it to place in the barrel when the bore and plug is oiled.

A roller type pipe cutter is used which is a large three-wheel pipe cutter with the cutters removed and replaced with three rollers. After the steel plug is placed inside the barrel, under the bulge, the barrel is oiled on the outside and the pipe cutter with three rollers is used to iron out the bulge.