# Shotgun Chambers, Chokes and Ribs Lesson: 2181


OBJECTIVES 3

INTRODUCTION 3

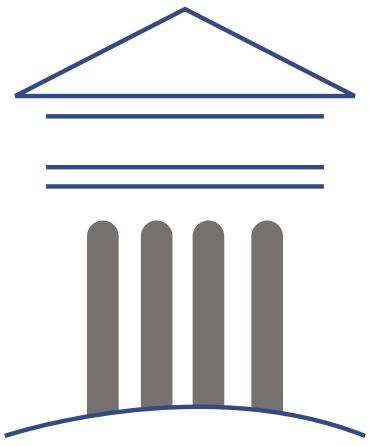
SHOTGUN CHOKES 4
- Screw-In Shotgun Chokes 5
- Precautionary Measures 7
- Adjusting Existing Chokes 7
- Choke Reamers 8
- Bore And Choke Dimensions 8
- Performing Choke Adjustment 9
- Chrome-Lined Barrels 10
- Reverse, Or Jug, Chokes 10
- Tightening Chokes 10
- Back-Boring 11
- Sleeving 11
- Self-Test Questions 11

SHOTGUN CHAMBERS 12
- Shotgun Chamber Lengths 12
- Shotgun Shell In Relation To Chamber Length 13
- Measuring Shotgun Chambers 13
- Short Chambers 14
- Notes On Conversion 15
- The Long Forcing Zone 15
- Converting Old Forcing Cones 16
- Rechambering 17
- Self-Test Questions 18

SHOTGUN RIBS 19
- Resoldering Ribs 19
- Self-Test Questions 19

ANSWERS TO SELF-TEST QUESTIONS 20

LESSON QUESTIONS 21



## Objectives

After completing this lesson, you should

1. Know what a shotgun choke is designed to do.
2. Understand how a choke reamer is used.
3. Be familiar with the effect of a short chamber.
4. Know the length of a standard 12-gauge chamber.
5. Be familiar with the term "back-bore."

## Introduction

Gunsmithing work on shotguns is big business. Besides correcting common malfunctions found in shotguns of all types, the gunsmith will be called upon to "choke" shotguns, to lengthen chambers on older shotguns, and also to install various types of ribs. Skeet or trap shooters may also want a muzzle brake installed on their guns to lessen felt recoil.

Let us take the shotgun's choke first. There are many reasons why shooters may want to have a new choke installed, or have the existing choke modified. For example, some shooters may want a shorter barrel on their shotgun for easier pointing while hunting upland game. You can shorten the barrel by merely taking a hacksaw and cutting off the required amount from the muzzle. However, in doing so, you will also remove the shotgun's choke, resulting in a cylinder bore. The owner will get fairly good results at close range, but chances are the shot pattern beyond 20 yards will leave a lot to be desired.

Perhaps the shotgun's muzzle became damaged. Again, in repairing the damage, the choke will also be altered. Here is where the gunsmith with the right knowledge can cash in on the market. There are literally thousands of shotguns waiting for an experienced gunsmith to repair them. Those gunsmiths who currently "know the ropes" are usually backlogged for a year or more. There is room for many more experienced gunsmiths — especially those who know how to properly choke shotguns.

Shotgun work does not end here. During the early part of this century, thousands of shotguns were made with shorter chambers than are currently used with modern ammunition. Shotshells of recent manufacture will fit in these old chambers, but upon firing, there is not enough room for the shell's crimp to open properly. This results in erratic shot patterns and higher-than-normal chamber pressures. For an investment of less than $100, you can start lengthening these chambers almost immediately and charge from $65 or more per barrel for your work. Once you gain experience, you should be able to complete a double-barrel shotgun in a little over an hour and get up to $150 or more for your time.

Most work on shotgun ribs will consist of repairing damaged existing ribs. You probably will not have quite as many calls for this type of work as you will for choking and lengthening shotgun chambers, but when that job does come in for repair, you will know how to do it, and you can make good money in a short time.

# Shotgun Chokes

A choke is a constriction at the muzzle of a shotgun barrel that causes the charge of shot to hold together in a dense string. Most shotgun barrels are constricted to some degree. True cylinder bores (no choke) are confined to riot or "deer" shotguns which have barrels made especially for shooting rifled slugs and buckshot.

The shotgun choke was invented by Frenchman Henri Pellet in the city of Liege, Belgium in 1861. His original choked barrel was almost identical to the Belgium choke, which is used by most of the better shotgun makers today— including Fabrique Nationale, the plant that made Browning shotguns in Liege, Belgium.

An American named Fred Kimble is sometimes credited with the invention of the shotgun choke, but this is disputed among experts. Regardless of who invented the choke, it was a good idea and made shotguns much more effective than they were previously.

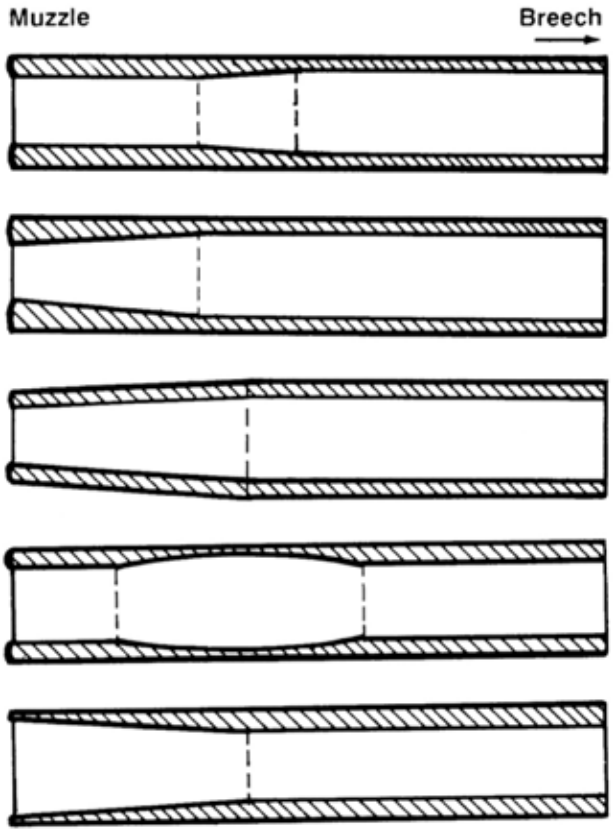



***Figure 1:*** *Several types of chokes may be found on both American and foreign shotguns. From top to bottom: Belgium, or English-style, choke; German, or straight-taper, choke; swaged choke; convex choke; and the reversed, or bell, choke.*

The Belgium choke is also known as the *English-style choke* because the English were quick to adapt the choke. With this choking system, the bore tapers to a parallel section known as the "Resserre" or "lede." However, the choke itself is the cone behind the parallel lede.

The *straight taper choke* is said to have originated in Germany and is the type used on better-grade U.S. shotguns. A special choking reamer is used with the required taper to produce this choke.

The *swaged choke* is used on most inexpensive single- barrel shotguns. A long taper is normally used to prevent the metal from crimping in the forming die.

A *bulged, convex,* or *"jug" choke* is still utilized to some degree, especially in rechoking operations where integral choke tubes are not wanted.

The *reverse,* or *bell, choke* (sometimes called a *"skeet" choke*) is used for making a very wide pattern. It is good for short-range shooting only.

All of the choke types described above are shown in Figure 1.

Any modification of existing chokes should be done with care. This is normally a trial-and-error practice in which you pattern the gun after each trial until the desired choke pattern is obtained. Shotguns are patterned by shooting at a large square of paper. The standard distance is 40 yards from the muzzle. A black bull's-eye or square is used as an aiming point.

After shooting, the target is inspected, and a circle with a 30" diameter is then drawn to take in the greatest number of shot holes. This is done without reference to the bull's-eye, which may or may not be in the center of the resulting circle. The shot holes in the circle are then counted and compared to the number of shots known to be in identical shotshells having the same shot size and weight of shot.

Chokes are made to certain restrictions to produce the following results:

- Full Choke: 65% minimum of charge in a 30" circle at 40 yards
- Improved Modified Choke: 60%-70% of shot charge in a 30" circle at 40 yards
- Modified Choke: 50%-60% of shot charge in a 30" circle at 40 yards
- Improved Cylinder Choke: 35%-50% of shot charge in a 30" circle at 40 yards
- Cylinder Bore: 25%-35% of shot charge in a 30" circle at 40 yards

## SCREW-IN SHOTGUN CHOKES

The screw-in shotgun choke tube are the standard for shotgun manufacturers all over the world. It allows the industry to inventory fewer barrels and shotguns, while providing the consumer with a practical, more versatile shotgun at a very low cost. However, most gun manufacturers will not refit the guns that are already in the field. Many gun owners would like to convert their favorite shotgun into a more modern, versatile choking system. Choke tube installation is in demand all over the country, and the return on your investment in tooling will be great.

The installation of choke tubes can be done with minimal equipment. In fact, if you do any gun work at all, you probably already have most of the necessary tools. In addition to the installation tool kit, you will need the following:

- A bench vise with rotating base and padded vise jaws
- A 1" micrometer, vernier caliper, or barrel gauge
- A method of turning the tooling (bit and brace or power tools)
- Cutting oil
- Honing oil and a barrel hone
- A shotgun cleaning kit

**STEP 1: CLEANING**. Open the action and make sure the gun is unloaded. Remove the barrel from the action and clean and deburr it thoroughly. Be sure to remove any leading and plastic from the bore.

**STEP 2: OUTSIDE BARREL DIAMETER.** Measure the outside diameter of the barrel at the muzzle to determine if the barrel meets the minimum outside dimensions for the size tube to be installed. Refer to the specification chart in Figure 2. The abbreviation "O.D." stands for "outside diameter," and "I.D." stands for "inside diameter." Figure 3 shows where to take these measurements.

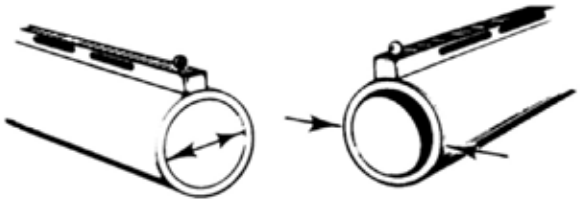


***Figure 3:*** *Areas for measuring the dimensions of shotgun barrels. The drawing on the left is where the inside diameter is measured; the drawing on the right is where the outside diameter is measured.*

**STEP 3: BORE DIAMETER.** Measure the inside of the bore behind the existing choke to be sure that the bore is not oversized. This can be accomplished by starting with a blank, unsized pilot and inserting it from the breech end of the barrel. If it drops through the barrel easily, the bore is oversized and the barrel cannot be fitted with choke tubes. This problem is most likely to arise with the so-called slug and riot gun barrels.

**STEP 4: CONCENTRICITY.** This area of installation is where you can get into the most trouble. A lot of older gun barrels have bores that are not concentric with the outside of the barrels. Avoid attempting this work on guns that are close to the minimum diameter and have had their barrels shortened to install Cutts Compensators. A lot of the older Model 12 Winchesters and Model 37 Ithacas, made before World War II, are not as concentric as later, more modern barrels.

***Example 1:*** A 12-gauge barrel has a 0.834" outside diameter; wall thickness varies 0.004" divided by 2 equals 0.002 inch. When this amount is subtracted from the original dimension, the adjusted outside diameter becomes 0.832 inch. This dimension is larger than the minimum of 0.825", so an internal choke tube can be safely installed on this barrel.

**BARREL SPECIFICATION CHART**

| Gauge | Thread Size | Min. O.D. | Max. I.D. |
|---|---|---|---|
| 10 ga. | 0.865 x 44 DL | 0.900 | 0.781 |
| 12 ga. | 0.795 x 44 DL | 0.825 | 0.746 |
| 12 ga., thin | 0.774 x 44 DL | 0.805 | 0.730 |
| 20 ga. | 0.675 x 44 DL | 0.700 | 0.626 |

***Figure 2:*** *Specification chart showing the various dimensions of shotgun barrels for integral choke installations.*

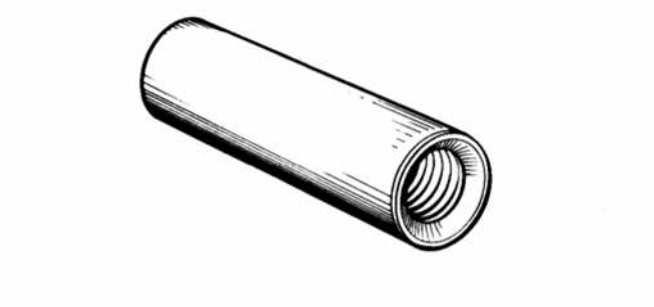


***Figure 4:*** *Typical solid pilot with threaded pilot seat.*



***Figure 5:*** *Barrel-seating spacer. Slide this over the reamer until it stops on the largest diameter of the reamer.*

***Example 2***: A 20-gauge barrel has a 0.701" outside diameter; wall thickness varies 0.006" divided by 2 equals 0.003 inch. This amount subtracted from 0.701" becomes 0.698 inch. Since this dimension is 0.002" smaller than the minimum of 0.700", this barrel cannot be fitted with an internal choke tube.

Chrome-lined barrels require special attention. The first step is to remove the chrome from the front edge of the barrel. This is accomplished by placing a piece of 240-grit emery cloth on a flat piece of steel and sanding off the chrome, taking care not to round the corners. A good method to check for any remaining chrome is to use instant cold blue. This will blue the exposed steel and show any remaining chrome. The next step is to remove any remaining chrome from the bore. This can be done with a barrel hone. Insert the hone to a depth of about 3" and hone back and forth to the muzzle until all chrome is removed. Repeat step one, since any remaining grit from he hone will dull the choke reamer rapidly.

**STEP 5:** Select a tight-fitting pilot from the kit. Pilots are graduated in 0.002" increments. The pilot selected should fit snugly in the bore with no wobble, yet turn freely. The next largest pilot should not fit into the bore. It is important that the proper size pilot is selected, since one too small will allow the reamer to cut out of line with the bore, causing the point of impact to change. Push the pilot from the chamber end of the barrel towards the muzzle with the threaded seating end of the pilot, shown in Figure 4, facing the muzzle. The pilot will stop when it reaches the existing choke.

**STEP 6:** Slide the barrel seating spacer, shown in Figure 5, over the reamer until it stops on the largest diameter of the reamer. Carefully screw the end of the reamer into the pilot through the existing choke. Be sure to keep the seating surfaces of the pilot and reamer clean and free of chips, burrs, etc. You are now ready to attach the reamer to its drive source. Many installers use hand tools such as a bit brace of the B- Square Choke Tool installing jig (adapter available from Colonial Arms), while larger, well-equipped shops may choose to do the reaming operation with power tools. Whichever method you choose to use, the reamer must be kept clear of chips and well-lubricated with a good cutting oil at all times.

**STEP 7:** You are now ready to start the reaming operation. With the barrel secured to prevent slippage and damage to the rib, brush a little cutting oil on the reamer (Figure 6) and squirt a little cutting oil into the bore. Start turning the reamer in a clockwise direction. Never reverse a reamer; this may permanently damage the tool. Cut the barrel about 1/8" deep and withdraw the reamer while still turning. Remove chips and lubricate again. Continue this until the reamer stops cutting and rubs on the barrel seating spacer. You can now remove the reamer and pilot from the muzzle end of the barrel and clean the bore to prepare for the next step.



***Figure 6:*** *Typical choke-tube reamer.*

**STEP 8**: This step involves threading the barrel to accept the choke tube. Remove the bore pilot and barrel seating spacer from the reamer and install the pilot on the tap. Slide the assembly into the bore, lubricate, and slowly start the tap, taking care to keep the tap well lubricated at all times. The tap will cut fairly easily until it bottoms out on the seating surface (approximately 17 complete turns). ***Do not force the tap beyond this point.*** The tap is capable of removing the seating surface if enough pressure is applied. After tapping, reverse the tap and carefully remove the tap and pilot from the barrel.

**STEP 9**: Remove the tap from the pilot. Clean and attach the pilot to the reamer. With the barrel seating spacer now removed from the reamer and the barrel cleaned, you now can make the final reaming cut. To clean up the seating surface, lubricate the reamer and cut until the reamer stops cutting and rubs on the largest diameter of the reamer.

**STEP 10:** Clean out all chips, oil, etc. with a bore brush and a good-quality solvent. Or, you may choose to use a thread-cleaning tool (Figure 7). When using the thread-cleaning tool, apply a little petroleum jelly to the grooved section of the tool and screw it into the barrel until it stops. Remove the tool from the barrel and wash off the petroleum jelly (which now contains the trapped chips, dirt, etc.) in hot water or shop solvent. Now that the barrel is clean, install an improved cylinder tube. The tube should screw in smoothly and fit flush with the end of the barrel when the tube stops turning. With the tube properly seated, visually check the seating surface with a flashlight. You should see the seating edge of the tube resting squarely against the slightly smaller bore size. If the area directly in front of the tube is roughly finished, you will now have to hone this area. This can be accomplished with a barrel hone and a small electric hand drill. After honing, remove the tube and clean the barrel thoroughly. Select the choke tubes to be supplied to the customer; install every one and visually check the seating. Test fire the gun.

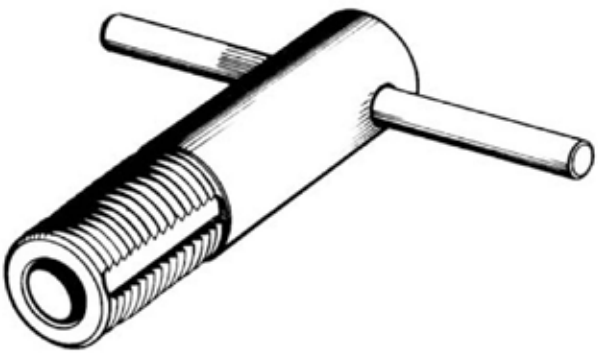


***Figure 7:*** *Barrel thread-cleaning tool.*

## PRECAUTIONARY MEASURES

- Never turn the reamer in reverse direction.
- Use shop tags that have warnings for choke use and can be left on the barrel for the consumer.
- Never ship a barrel that has been machined for choke tubes without a choke tube being in place to support the thin section.
- Be cautious when working with Belgium Browning over/under shotguns; there may not be enough metal between the barrels, even though the measurements indicate otherwise.
- Choke tube lube is not only a grease, but also it has metal particles to support threads. This is good when using tight chokes such as an extra-full one. It prevents the tubes from becoming stuck in the barrel.

## ADJUSTING EXISTING CHOKES

Most shotguns made in the last 90 years could use some choke work. Many of these are inexpensive single-shot, break-open type shotguns where the cost of installing an integral choke tube is not warranted; few people want to invest $150 for an integral choke installation on a $100 gun. You will have two basic adjustments to make. One is to open up the choke from full to improved modified. The other is to put some choke in a barrel that has been cut off, leaving it with a cylinder bore.

The majority of single-shot shotguns manufactured in the United States contain full chokes. A full choke is fine for certain shooting beyond 30 yards, but for closer shots — for example, 15-25 yards — the shooter might as well use a rifle; the shot pattern is just too tight for consistent hits. Therefore, owners of these single-shot guns can improve their shooting by opening up the choke a little bit.

Actually, the opening up of a shotgun choke to a slightly larger diameter is a relatively simple matter if you have the proper tools. The procedure requires nothing more than the controlled removal of a bit of metal from the forward bore of the shotgun barrel. However, to obtain a good shot pattern at a given yardage requires a number of additional considerations, all of them equally important to the end result and the customer's satisfaction with your workmanship.

## CHOKE REAMERS

The bore hone and four adjustable reamers shown in Figure 8 will cover most choking requirements for any shotgun from a cylinder bore in 12 gauge to a full choke in 28 gauge. Each reamer is equipped with angle blades to provide a perfectly flat slicing cut at all diameters to eliminate chatter. The blades remain absolutely true at all size adjustments and do not bulge or curve, thus assuring proper bore configuration. The factory maximum/minimum specifications of each reamer are shown in Figure 9.

As with all reamers, the cutting edge of an angle-blade expanding reamer should be honed lightly before each choking operation for best performance. Arkansas stones and thin India stones should be used for sharpening. Reamers are fine service tools and should not be abused. Never throw them in with other tools. Keep them oiled and individually wrapped when not in use. If metal chips accumulate between the cutting blades, never try to knock them out by hitting the tool against the edge of a bench or on a block of wood. The correct way to remove these chips is to brush them out carefully. Also, always release the tension on your angle-blade reamers when they are not being used.

When using a reamer, never back it off the job. Always keep it turning in the same direction until the reamer is removed from the barrel. Most beginners try to get the job done quickly; taking big cuts at one time. Never take more than a 0.003" cut at one time—preferably less. In cold weather, angle-blade reamers should be slightly warmed before exerting extreme setting pressure to prevent possible fracture of the blades.

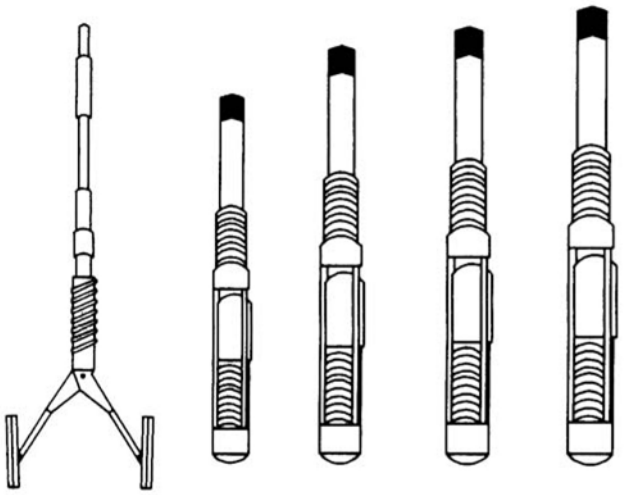


***Figure 8:*** *The bore hone and four angle-blade expanding reamers shown above will handle any choke requirements that you may encounter.*

| Shotgun Gauge | Fractional Dimensions | Decimal Dimensions |
|---|---|---|
| 12 gauge | 23/32 - 25/32 | 0.71875-0.78125 |
| 16 gauge | 21/32 - 23/32 | 0.65625-0.71875 |
| 20 gauge | 19/32 - 21/32 | 0.59375- 0.65625 |
| 28 gauge | 17/32 - 19/32 | 0.53125- 0.59375 |

***Figure 9:*** *Maximum/minimum dimensions of angle-blade expansion reamers.*

## BORE AND CHOKE DIMENSIONS

Actual bore and choke dimensions vary from one manufacturer to another and sometimes even from barrel to barrel of the same model. Measurements of each barrel should be made with a bore micrometer or choke calipers. The bore diameters and amount of constriction for each choke listed in the chart in Figure 10 is an average, using the American Standard, but should be used as a guide only.

When referring to the chart in Figure 10, remember that the differences between the various choke diameters is overall diameter difference. For example, if a customer wants a 12-gauge full choke opened up to a modified choke, the difference in constriction between the two chokes is 0.016", obtained by subtracting the modified choke dimension (0.019") from the full choke dimension (0.035"); that is, 0.035–0.019 = 0.016 inch. This is the difference in diameter, but the actual amount of metal to be removed at the circumference is half this amount, or only 0.008 inch. Always remember this, because if you were to make the full 0.016" cut (or a series of cuts totaling 0.016"), you would increase the inside diameter by double, or by 0.032 inch. Use the following equation to calculate the amount of metal to remove:

$$\text{Amount of metal to be removed} = \frac{\text{Larger diameter} - \text{smaller diameter}}{2}$$

Since bore diameters vary so much, measuring instruments within a plus-minus of 0.002" is sufficient for choke work. The Brownells choke calipers, shown in Figure 11, used in conjunction with an accurate micrometer, are ideal for measuring the amount of choke change during choke modifications. To use the calipers, secure the barrel in a bench vise and insert one end of the calipers into the shotgun bore. Loosen the T-handle

| Gauge | Bore Diameter | Amount of Constriction | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Full | Imp. Mod. | Mod. | Skt-2 | Imp.Cyl. | Skt-1 | Cyl |
| 12 | 0.729 | 0.035 | 0.025 | 0.019 | 0.012 | 0.009 | 0.005 | 0.000 |
| 16 | 0.667 | 0.028 | 0.020 | 0.015 | 0.010 | 0.007 | 0.004 | 0.000 |
| 20 | 0.617 | 0.025 | 0.019 | 0.014 | 0.009 | 0.006 | 0.004 | 0.000 |
| 28 | 0.550 | 0.022 | 0.016 | 0.012 | 0.007 | 0.005 | 0.003 | 0.000 |

***Figure 10:*** *Bore and choke dimensions.*

screw and expand the calipers to a "touch fit" and locate the maximum choke dimension. Then lock the T-handle and carefully measure the protruding comparison end of the calipers with a micrometer. Next, measure the cylinder bore of the gun. Subtract the two measurements and refer to the chart in Figure 10. This will give you the approximate choke of the gun for a certain gauge.

## PERFORMING CHOKE ADJUSTMENT

Before altering a shotgun choke, the barrel should be removed from the action. However, if this is not possible, remove all the action parts. Another alternative is to plug the chamber adequately so that metal shavings do not fall into the action during the choking process. Then, thoroughly clean out the bore before removing the chamber plug.

Assuming that you have already taken measurements of the shotgun bore and existing choke as discussed previously, secure the barrel in a padded vise in a vertical position with the muzzle pointing upward and approximately waist-high, as shown in Figure 12. You do not want to cut the choke with the barrel in a horizontal position because more metal will be removed from the bottom of the barrel due to the weight of the reamer.



***Figure 11:*** *Brownells choke comparison calipers.*

In addition to the angle-blade expanding reamer you will need the following:

- Large tap wrench to hold the reamer
- Dark cutting oil
- Cleaning rod
- Cleaning patches

A small can or bucket on the floor under the barrel will catch the excess oil and used patches.

Select the appropriate reamer, adjusted to its minimum diameter, and try it in the muzzle of the shotgun barrel. If it goes all the way in without touching the sides, remove it and adjust for a larger diameter. This adjustment is made by backing off the rear adjusting nut a half-turn maximum and tightening the front adjusting nut. The operation pushes the blades to the rear and up the inclined cuts to enlarge the overall diameter of the reamer. The reamer is tapered with the small end at the front to guide the reamer for correct alignment with the bore and choke.

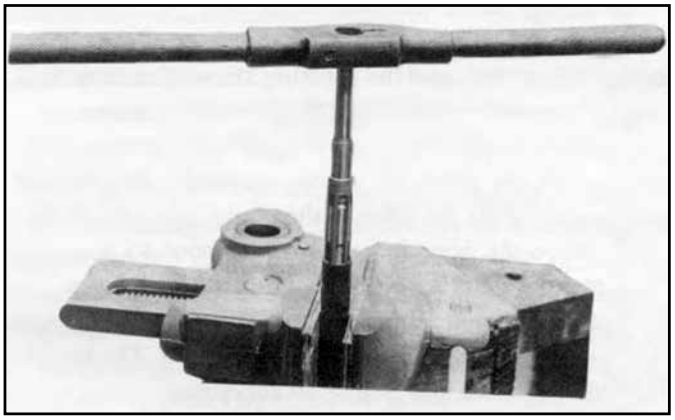


***Figure 12:*** *The barrel is secured in a bench vise in a vertical position before cutting the choke by hand.*

Continue adjusting the reamer a small amount at a time until it just touches the sides of the choke. Apply the cutting oil and make the first cut by rotating the reamer in a clockwise direction, allowing the weight of the reamer and wrench to apply the pressure. When the reamer has cut its full length, continue rotating it in the same direction and withdraw it from the barrel. Do not reverse the direction of rotation or withdraw the reamer without the clockwise rotation or the choke will be scored. Once you remove the reamer, brush the chips from the reamer and clean the barrel with a tight patch. Measure the choke and repeat the procedure if additional metal must be removed. Test fire for shot patterns, especially if your customer has specified a particular percentage at a given yardage.

There is a flat on the adjusting nuts that can be used as a scale during the choking operation. Position this flat between two of the blades and make a cut. Now remove the reamer and rotate the nut to a position between the next two blades. The second cut will remove 0.002" from the choke diameter.

The final 0.001 "of metal should be removed with the barrel hone. This is nothing more than a cylinder hone which has been used in the automotive trade for years. The honing stones are attached to flexible "fingers" which should be pressed against the sides of the choke by the coil spring, and the pressure should be firm at all times to prevent chatter. The flexible shaft assures correct alignment with the bore. The hone can be rotated in several ways, but a conventional, electric hand drill will work well. Insert the hone in the choke and turn on the drill. Move the hone in and out for about 15 seconds with plenty of cutting oil in the barrel. Always turn the drill off before removing the hone from the barrel. Once removed, wipe the bore clean and inspect it. The barrel should be smooth and free of all scratches.

## CHROME-LINED BARRELS

Angle-blade expanding reamers will not cut chrome lining, and any attempt to do so will ruin the reamer and void the guarantee. To determine if a barrel is chrome-lined, touch a drop of instant cold blue to the inside of the muzzle. If the metal blues or stains, it is not chrome-lined, and you may proceed as usual.

In some cases, the chrome lining can be removed by careful honing and flooding with cutting oil prior to the normal choke adjustment. However, this can be a tricky operation, depending upon the thickness, uniformity, and hardness of the chrome, and should be undertaken with caution.

## REVERSE, OR JUG, CHOKES

*Reverse*, or "jug," chokes, shown in Figure 13, are found in some shotguns. The choke effect is obtained in reverse choking by the removal of metal from the bore starting a short distance behind the muzzle and extending down the barrel towards the breech. On a 12-gauge shotgun, for example, the recess may be from 10" to 12" long and about 0.015" deep for modified choke and 0.021" deep for full choke. You cannot open up a choke such as this by making the recess deeper. Doing so would tighten the choke. Opening the pattern on such a gun can only be achieved by very carefully honing the short stretch of barrel between the muzzle and the choke recess.

Know how a reverse choke operates, as you may be called upon to tighten the shot pattern on such a choke. Then, removing metal will do the job for you.

In either case, repeated test firings should be made during this type of adjustment to be sure too much metal is not removed and the pattern is not opened or closed too much.

## TIGHTENING CHOKES

We have talked much about opening chokes in shotguns, but what about tightening them, obtaining a closer shot pattern for those long shots?

There are many reasons why you may be called upon as a gunsmith to tighten shotgun chokes. There are thousands of shotgun barrels with split or otherwise damaged muzzles. The only way to correct these defects is to cut the barrel back a few inches at the muzzle. However, in doing so, all choke is removed, leaving a cylinder bore. Perhaps the owner of an older shotgun has had an adjustable choke attachment installed sometime in the past and now finds the bulky attachment undesirable. He or she wants the attachment removed and a conventional choke installed in the plain barrel. Another reason may be to gain shot range. The average full-choked shotgun will hold a

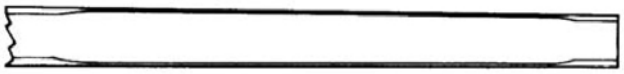


***Figure 13:*** *A jug choke consists of a recessed area within the shotgun bore.*

killing pattern to about 40-50 yards. But in some areas, shots at waterfowl — particularly wild geese — extend out to 60 or 70 yards. To obtain a suitable shot pattern at these ranges requires a tighter choke than is normally found on factory shotguns. Here's where a tighter choke comes in handy.

In some areas of the United States, shotgun shooting matches are big business. Competitors try to knock the center out of a cardboard target marked with an X. These shots are fired at ranges from 27 to 31 yards, depending upon the match. In these matches, shooters want the absolute tightest shot pattern possible.

There are several ways to make a shotgun shoot tighter patterns. Substituting copper-plated shot instead of the conventional lead shot will usually tighten the shot pattern from ½ to 1 choke degree. The plastic wad columns in shotshells will do the same thing. However, the other methods involve some type of choke adjustment to the shotgun barrel.

## BACK-BORING

*Back-boring* is the process of removing metal from the bore of a shotgun barrel from directly in front of the chamber, the full length of the barrel, to about 1" behind the muzzle. The process increases the bore diameter to a size larger than the muzzle diameter; thus, a choke to some degree is installed in the barrel by the process. The last inch of the barrel tapers down to the original size of the muzzle.

Back-boring is done with a special reamer, with the reamer's end tapered to cut the desired choke in the barrel. Such reamers are available from various manufacturers. However, the process is very slow with just one reamer. It is best to have several reamers in 0.002" increments. For example, if you wish to remove 0.006"metal from the bore of the barrel, you would use three different sizes of reamers, starting with the smallest diameter and ending with the largest diameter.

Back-boring reamers are also a good way to restore the bore of a pitted shotgun barrel. This will be described in a later lesson.



***Figure 14:*** *Back-boring bar.*

## SLEEVING

*Sleeving* shotgun barrels is another way to obtain a tighter choke. In general, sleeving involves installing a piece of barrel onto the original barrel. The operation requires the use of a metal-turning lathe.

A choked sleeve is about 6" long. One end of this sleeve must exactly match the bore diameter of the original barrel; the bore in the sleeve will then be tapered down to a smaller diameter at the muzzle (opposite end) to obtain the desired choke.

First, about an inch of the original barrel is turned down on the lathe a few thousandths of an inch to accept the sleeve. This same distance is then turned on the inside of the sleeve to obtain a perfect fit and to ensure that the bores of each piece align perfectly. The sleeve is then silver soldered onto the original barrel. Many shooting-match guns have been sleeved this way to obtain very tight shot patterns at 30 yards.

## SELF-TEST QUESTIONS

Please check your answers on page 20.

1. ***True or False.*** **In most cases, the tighter the choke in a shotgun barrel, the longer the gun's range.**
2. **What Frenchman is credited with inventing the shotgun choke?**
3. **What is the minimum percentage of a shot charge that must fall within a 30" circle at 40 yards to be classified as a full choke?**
4. **When 35% - 50% of the shot charge falls within a 30" circle at 40 yards, what type of choke does this represent?**
5. **When an integral choke is to be installed on a 10-gauge shotgun barrel, what is the minimum recommended outside diameter of the barrel to make the installation safe?**
6. ***True or False*****. When removing any reamer, it should be turned in the opposite direction from cutting.**
7. **What is the average bore diameter of a 12-gauge shotgun?**
8. **What is the average bore diameter of a 28-gauge shotgun?**

# Shotgun Chambers

Over the years, shotguns have had a variety of chamber lengths for the shells that were manufactured when the gun was originally built. Most shotguns manufactured before approximately 1930 had chambers less than 2.760" overall — the length now required to handle the overall length of modern shotshells. Because of these obsolete chambers, the already-weak chamber takes an extra beating due to the higher pressures caused by firing the longer, modern shells in these short chambers. To function properly, the shell's crimp must have room to unfold completely flat when the shot and wads go from the case to the bore. Any small amount of case forced into their path because of a short chamber will deform the shot, tear hulls, cause excessive kicking, and raise chamber pressures above normal.

Short shotgun chambers can be reamed out by hand using a special chamber reamer sold by both Clymer Manufacturing Co. and Brownells, Inc. Such reamers rechamber short shotgun chambers to modern length and cut a new long forcing cone at the same time without lengthening the chamber longer than it should be. Chamber reamers are available for 12,16,20, and .410 shotgun gauges.

Detecting and lengthening short shotgun chambers is a service that you should offer all shotgun owners. You can purchase all the equipment necessary for around $300 and then charge from $50 or more per bore. Once you have gained some experience, you should be able to measure a shotgun bore and cut the new chamber in less than one hour. You can do all this without purchasing expensive power tools.

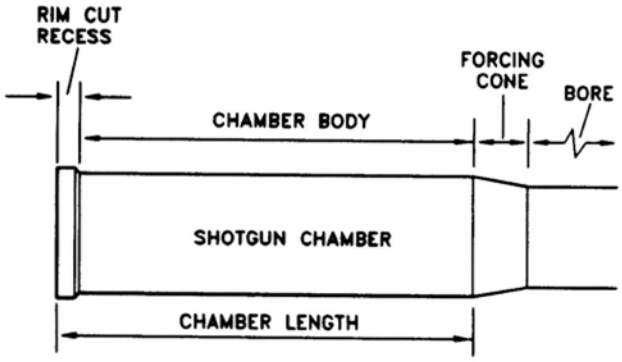



***Figure 15:*** *Sectional view of standard shotgun chamber with standard forcing cone.*

## SHOTGUN CHAMBER LENGTHS

The shotgun chamber consists of three sections, as shown in Figure 15. From left to right, first there is the recess cut for the rim of the shotshell. Next is the chamber body, which is cut with a slight taper to assist in the insertion of the shotshell and provide for easy extraction after firing. The last portion of the chamber is the forcing cone; this begins where the chamber body ends and tapers down to the bore section of the shotgun barrel.

When measuring shotgun chamber lengths, keep in mind that the thickness of the rim cut and the length of the chamber body are combined into one dimension. However, the length of the forcing cone is not included in the specified chamber length.

Prior to 1900, shotgun chamber lengths varied considerably among manufacturers, often resulting in odd fractions as shown in Figure 16. After 1900, shotguns were produced in more standard chamber lengths.

From about 1920 to the mid-1930s, the gauges were standardized to the current chamber lengths that are listed in the table in Figure 17. All modern American shotguns are made in these lengths.

You will also run across metric chamber lengths and chamber diameter specifications on shotguns made in foreign countries. These chambers will differ slightly from the current American specifications, since the accepted procedure with foreign manufacturers is to carry the dimension to the nearest millimeter. The dimensions are usually stamped on the bottom of the barrel under the chamber. For example, in the marking "12-70," the 12 designates the gauge and the 70 designates the length of the chamber in millimeters. In this case, the 70mm is the equivalent of the American 2¾" chamber. Actually, 2¾" is exactly 69.85mm, but this small difference can be ignored for all practical purposes. The accepted conversion of metric chamber lengths to American standard chamber lengths is shown in Figure 18.

| Gauge | Chamber Length in Inches |
|---|---|
| 10 gauge | 2 7/8; 3 1/2 |
| 12 gauge | 2; 2 1/2; 2 5/8; 2 3/4; 3 |
| 16 gauge | 2 9/16; 2 3/4 |
| 20 gauge | 2 1/2; 2 7/8 |
| 28 gauge | 2 3/4; 2 7/8 |
| .410 gauge | 2; 2 1/2; 3 |

***Figure 16:*** *Some of the various shotgun chamber lengths used prior to 1900.*

## SHOTGUN SHELL IN RELATION TO CHAMBER LENGTH

The unfired shotgun shell is considerably shorter than the chamber length. For example, the modern star-crimped 20-gauge 2¾" shell is 2.43" in length when loaded. When fired, the crimped end unfolds and the shell is then 2.75" in length. This matches the chamber length of 2.75 inches. Therefore, the end of the fired shell case stops exactly where the forcing cone begins tapering the chamber diameter down to the smaller bore diameter.

An unfired 20-gauge 3" shell measures 2.68" in length, which allows it to enter the 20-gauge 2¾" chamber easily (2.75 inches).

However, when the 3" shell is fired, the case unfolds to its full 3" length. The extra 0.25" of case body enters the forcing cone, creating a bottleneck effect through which the shot and wads must pass (Figure 19, on next page).

The amount and type of powder loaded in a shell is carefully selected to provide the correct rate of burning which provides the pressure necessary to overcome the inertia of the shot, and push it and the wads through the forcing cone, up the bore, and through the choke. This balance is absolutely essential for good patterns and the overall correct function of the shotgun. Anytime part of the fired shotgun case enters the forcing cone and creates the bottleneck effect, the balance is changed and several detrimental effects occur.

First, the momentary slowing of the shot charge by the bottleneck increases the rate of burning of the powder, which results in increased chamber pressure. This excess pressure not only puts a strain on the gun's mechanism and barrel, but also increases the amount of recoil. Provided the mechanism is capable of safely withstanding the 10% – 25% increase in chamber pressure, the gun will slowly but surely be battered to pieces.

The second effect is that as the shot is forced through the bottleneck, individual pellets become deformed and out of round. When the deformed pellets leave the barrel they will not stay with the main charge, since air pressure against the deformed pellets cause them to deflect in all directions. The end result is a poorer pattern both in percent and distribution of the pellets in the pattern circle.

While this has been an extreme example, it illustrates the necessity of the chamber length correctly matching the length of the fired shotgun shell. Anytime a portion of the fired shell case enters the forcing cone, it decreases the efficiency of the barrel and, consequently, the efficiency of the shotgun's performance.

## MEASURING SHOTGUN CHAMBERS

Brownells, Inc. offers a set of shotgun chamber gauges that were developed by the late Ralph Walker. These gauges are simple to use and allow you to determine the chamber length of any shotgun in short order.

To use, the shotgun chamber must be clean for accurate gauging. If normal cleaning procedures fail, make a special tool by using a brass bore brush and the forward section of a shotgun cleaning rod inserted in a ¼" electric hand drill. The rapid rotation of the bore brush will usually get the job done. If this fails, wrap a small amount of 0000 steel wool around the bore brush and allow the drill to run for about a minute. Use both of these systems dry. They will remove the caked rust, powder residue, etc., and not damage the chamber. Wipe the chamber with a clean patch and use a strong light directed into the chamber to assure cleanliness before gauging.

The Walker shotgun chamber gauges are precision-ground to specifications of each shotgun gauge chamber dimension as established by the Sporting Arms and Ammunition Manufacturers' Institute (S.A.A.M.I.). The diameter of the front end is that of the chamber body where it meets the forcing cone. While a small bevel is cut on the front end to protect it, care should be exercised to prevent the edge from becoming nicked, which will produce false gauging.

| Gauge | Chamber Length in Inches |
|---|---|
| 10 gauge | 3 1/2 |
| 12 gauge | 2 3/4; 3 |
| 16 gauge | 2 3/4 |
| 20 gauge | 2 3/4; 3 |
| 28 gauge | 2 3/4 |
| .410 gauge | 2 1/2; 3 |

***Figure 17:*** *Current chamber length.*

| Metric | Inches |
|---|---|
| 50 | 1 |
| 63-64 | 2 1/2 |
| 65 | 2 9/16 |
| 70 | 2 3/4 |
| 73 | 2 7/8 |
| 76 | 3 |
| 89 | 3 1/2 |

***Figure 18:*** *Conversion of metric chamber lengths to American standard chamber lengths.*

The forward edge of the circular cut around the gauge body is the exact point of chamber length (Figure 20). This index edge should exactly align with the rear of the chamber rim recess cut in the barrel if the chamber length is correct. Visual observation is easy but can be made more pronounced by filling the groove with a contrasting color. A simple method is to wipe the cut clean, then with a small brush fill the groove with lacquer or shellac. Regular chalk dust sprinkled into the groove will be held in place when the lacquer or shellac dries. Another method is to use common fingernail polish.

The gauge body is not tapered to avoid false gauging on the side of the chamber. The rear end of the gauge is threaded ¼–20 TPI to accept an extension. A common ¼–20 bolt or threaded rod extension will allow easy insertion and extraction of the gauge in a chamber. After use, wipe the gauge clean and lightly oil it. Store the gauges separately. Figure 21 shows the Walker chamber gauge in use.

## SHORT CHAMBERS

Starting around 1930, it became standard practice to stamp both the gauge and the chamber length on the barrel, such as "12-Gauge 2¾" or an abbreviation. While there are exceptions to the rule, a barrel stamped only with the gauge specifications should be checked with the chamber length gauge. Chances are that the chamber length is shorter than the current standard. It is also good practice to check metric chambers to assure correct function with American shells.

**.410-GAUGE**. The majority of pumps and semi-automatics will be chambered for the 3" shell, since Winchester pioneered this field in the 1930s with their Model 42 pump. Prior to that time the .410 was chambered in the 2½" length or the earlier 2" length. The designation .410 is somewhat misleading because it is the bore diameter expressed in hundredths of an inch and not the gauge, as measured for other shotguns. Some early single and double barrels were marked either 12mm or 67 gauge.

**28-GAUGE**. The original 1903 version of this shell was in $2^{7}/_{8}$" chamber length but was standardized in the 1920s to the current 2¾" chamber length. The longer $2^{7}/_{8}$" chamber will present no problems with the current 2¾" shell, but the condition of the gun should be carefully considered in shooting the 2¾" magnum shell with 1 oz. of shot, since the earlier guns were designed for light load and ¾ oz. of shot. A few European doubles, although stamped for the 2¾" shell, will give extraction problems with American shells, because the chambers are extremely tight, especially in the ultra-light version guns. Any that do not fully gauge 2¾" can be rechambered to eliminate the problem. There were a few guns chambered for a special 2½" 28-gauge shell, but these guns are extremely rare.

**20-GAUGE**. Until 1926, the standard chamber length was 2½", and you will see a considerable number of guns with this chamber length. Provided the barrel and the gun mechanism are in good condition, these guns can be rechambered to the current 2¾" length. Single and double barrels require only rechambering, but the pumps and semi-automatics will usually require alterations of the feed mechanism and ejection ports in the receiver. Prior to World War I, a few double-barrels and one pump were chambered for the 3" shell loaded with $1^{1}/_{8}$ oz. of shot. It was not popular, but after World War II the 3" shell was increased to 1¼ oz. of shot and has rapidly gained in popularity. Conversion from the 2¾" chamber to the 3" chamber is usually safe in well-built guns but under no circumstance should a 2½" chamber be converted to the 3" chamber.

**16-GAUGE.** The $2^{9}/_{16}$" chamber length was both the American and the European standard until 1929, when the American standard was changed to the current 2¾" length, the European standard did not change until after World War II, and even today the $2^{9}/_{16}$" (65mm) is still popular in some sections of Europe. The popularity of the gauge, the large number of guns manufactured in the United States prior to 1929, and the vast imports both before and after World War II has resulted in literally thousands of 16-gauge $2^{9}/_{16}$" shells. Conversion of single and double barrels to the 2¾" chamber seldom requires more than rechambering. Pumps and semi-automatics will require alterations of the action mechanism. While any sound gun will accept the conversion, the use of short magnum shells should be avoided.

**12-GAUGE.** This is without a doubt the most popular gauge in shotguns, and it also has been produced in the widest variety of chamber lengths. The British still make an ultra light upland game gun in the 2" chamber length and prefer the 2½" shell and chamber length for general use. The 2¾" chamber and shell is considered for heavy-duty use. A considerable number of the 2½" chambered guns have been imported, and the length was popular in the early 1930, when some American

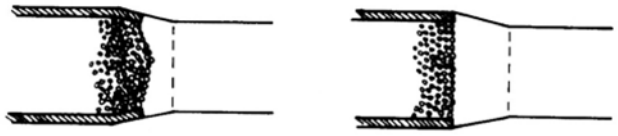


***Figure 19:*** *"Bottleneck" effect when the end of the fired shell case enters the forcing cone, thus squeezing and deforming the shot (left), as opposed to a correct length chamber (right) in which the fired case does not enter the forcing cone.*

doubles were produced in this length. Refer to Figures 22, 23, and 24, on pages 16-17.

Rechambering of the 2" and 2½" chambers to the current 2¾" chamber length should be approached with caution due to the light weight of the guns.

The 2⅝" chamber length is more commonly encountered than realized, since many manufacturers did not make the change when the 2¾" chamber length was adopted. Any barrel that is not stamped "2¾" should be gauged. The conversion to approximately 2" diameter will present no problems if the gun is in good condition, and will definitely increase the performance of the gun.

The rechambering of a current 2¾" chamber or the older 2⅝" chamber length to the 3" chamber length is of questionable safety regardless of the condition of the barrel or gun mechanism. Even if successful, the heavy loaded 3" shell with 1⅞ oz. of shot will generally render a gun mechanism useless.

**10-GAUGE.** This has been made in two chamber lengths, 2⅞" and the current 3½ inch. Under no circumstances should a 2⅞" chamber be converted to the 3½" chamber length.

## NOTES ON CONVERSION

As stated, single-and double-barrel guns can be converted to the longer chambers with little effort other than rechambering. Some of the double-barrel guns with automatic ejectors may require retiming of the ejectors, but generally no special technique is required. The Browning five-shot semi-automatic shotgun in 16-gauge, 2⁹⁄₁₆" chamber length is quite common, but requires the alteration of parts internally for proper operation with the 2¾" length shell. Malfunctions are usually the result of not making the full conversion as recommended by Browning. Follow the directions carefully and the gun will function perfectly. It is recommended that the short, magnum 16-gauge shells not be used in converted Brownings, since the gun was not designed for this heavy load. The conversion of pumps such as the Winchester Model 1912 in short chambers follows the same basic procedure. This procedure is covered in a later lesson.

## THE LONG FORCING ZONE

The example of firing a 3" 20-gauge shell in a 2¾" length chamber and the resulting effects are, in varying degrees, true with all short chambers. It is also true to a lesser degree with chambers that are the correct length but with the forcing cone of the chamber cut to accommodate the old roll-type crimped shells. These forcing cones are short and abrupt with an average length of approximately ½".

The old, roll-type, crimped-paper shotgun shells had a heavy piece of cardboard, commonly called the nitro wad, directly over the powder charge in the shell. Next came the felt filler wads, then the shot charge, and finally the over-shot wad with the shotgun case end rolled over to hold the wad in place.

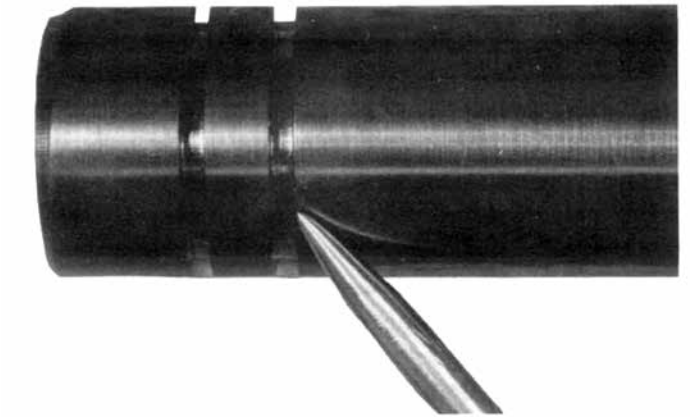


***Figure 20:*** *Lathe-cut grooves accurately indicate chamber length when placed in a clean chamber. Forward groove measures 2¾" chambers; the other groove measures 3" chambers.*

When fired, the pressure from the powder pushed the roll crimp straight as the wad and shot column moved out of the shell. It was important that the powder gas not be allowed to pass around the wads and disrupt the shot. For this reason, the forcing cone was short and abrupt to engage the over powder nitro wad immediately as it left the shell. It was compressed by the forcing cone and held the gas pressure behind the wad.

The invention of plastic cup-shaped, over powder wad was a giant step forward. As gas pressure increased, it automatically pressed the cup edge firmly outward for a perfect gas seal. Its superiority over the paper nitro wad can best be judged by the fact that reloading manuals recommended decreasing the powder charge 10% when the plastic cup wad was used instead of the nitro paper wad.

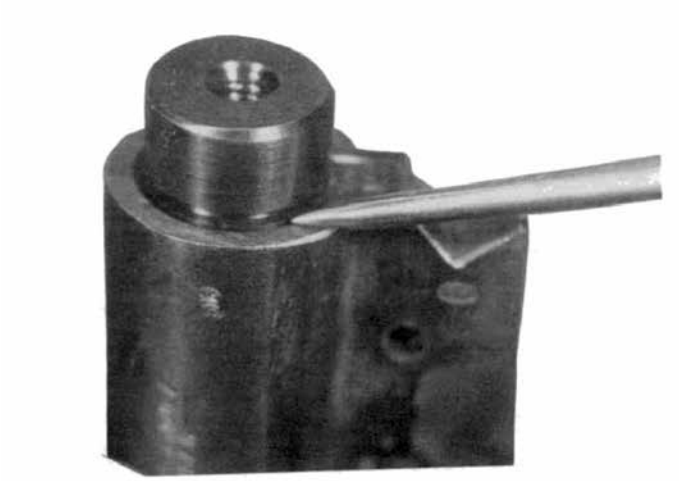


***Figure 21:*** *Walker chamber gauge inserted into a 12-gauge 3" chamber, with pointer indicating that the gauge shows proper chamber depth, or length, for a 3" chamber.*

The plastic cup powder wad completely replaced the nitro wad. Next came the plastic shot protector and then the plastic filler wads. The final step was the joining of all three components into one unit. This unit perfectly seals the gas pressure, cushions the impact of getting the shot moving, and protects the shot from being rubbed against the sides of the bore and deformed. Replacement of the old, waxed paper shell with its wads, nitro cards, and rolled crimp by the plastic shell and one-piece wad has resulted in a shotgun shell far superior in every way to the old shell.

## CONVERTING OLD FORCING CONES

Fired in a barrel from which all choke has been removed, the modern plastic shell will generally produce a 5% - 10% better pattern at a given distance than a similarly loaded shell using the old wads, no shot protector, over-shot wad, etc. In a choked barrel, the new shell has the effect of increasing pattern performance approximately a half to a full degree of choke. In other words, a barrel— choke-modified and intended for the old-type shells— will produce either an improved, modified, or full-choke pattern with the new shell.

The 30" circle at 40 yards has always been the method of determining the efficiency of a full-choked barrel. With a barrel chambered and choked for the old type shell, 70% is considered a good pattern. Yet, 30% of the shot is not in the circle and consequently has been lost for practical purposes. The new type shell will increase the percent to 75% - 80%, thus utilizing more of the shot that was in the shell before it was fired. This is accomplished primarily by reducing pellet deformation as the pellets travel through the forcing cone and barrel.

Patterning a shotgun at the range it will be used will tell you much more about the performance your customer wants than sticking to the standard 40-yard system. The performance of an improved cylinder barrel at 40 yards is not a guarantee of performance at the shorter ranges for which the improved cylinder is intended. The ultimate barrel will produce the desired pattern, completely without open spaces or "free holes," at the distance for which the degree of choke was intended.

The short and abrupt forcing cone always deformed some of the shot as it was pushed through the short cone, but this was a necessity with the old-type shell. It is not a necessity with the modern wad unit and folded crimp plastic shell. In fact, it actually decreases the efficiency of the new shell. With modern shells, a longer forcing cone allows the shot to pass from the chamber to the smaller bore diameter with less shot being deformed and without the gas leak problem (Figure 25).

Forcing cones from 1" to 3" in length have been tested, and the results indicate that generally a forcing cone of approximately

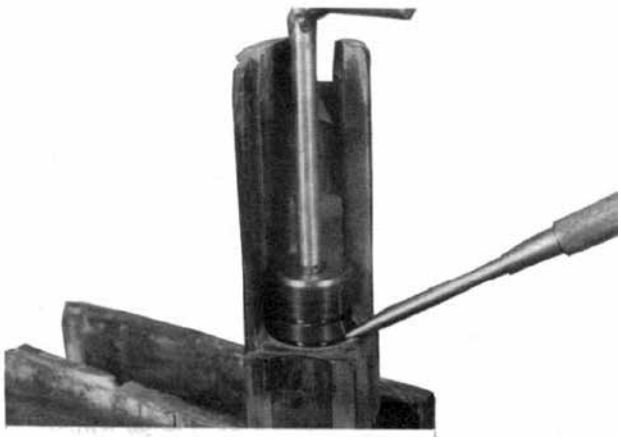


***Figure 22:*** *The chamber gauge verifies that the chamber in the 12-gauge shotgun barrel is 2¾"; as gauge seats to the forward ring. Note the extension handle screwed into the top of the gauge.*

1½" in length will provide the best results with the widest variety of loads. A short forcing cone barrel (shown in Figure 25) rechambered to the long forcing cone will give a 5% -10% pattern increase both in density and pellet distribution. The actual pattern percent gain will vary with individual barrels, gauges, pellet sizes, and shell loads used. However, the combination of the long forcing cone and the modern shell will invariably produce a more efficient pattern.

An additional advantage of the long forcing cone is that the plastic shell body sometimes unfolds and stretches to a length longer than specified. In a 2¾" diameter chamber the length can be as much as 2.90" instead of the correct 2.75 inches.



***Figure 23:*** *Classic example of a short chamber in a double-barrel shotgun. The chamber will not accept the gauge to a full 2¾" depth. This particular chamber measured 2 5/8"*

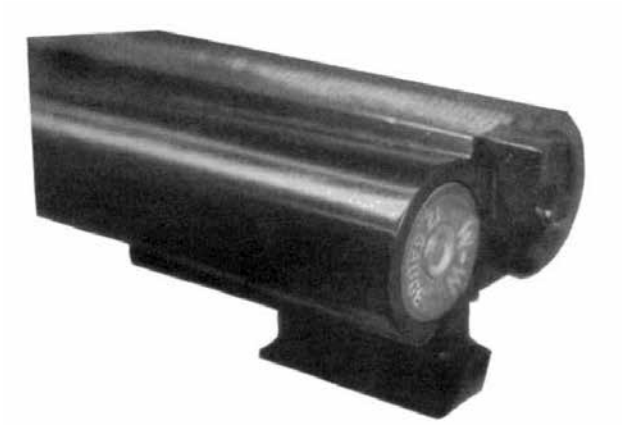


***Figure 24:*** *The same chamber as shown in Figure 23 easily accepts an unfired 2¾" shell. However, when fired, this shell will protrude into the forcing cone area, causing excessive pressures, recoil, and damage to the gun.*

The stretching varies with the quality of the shell and the load. Cheap, short magnum shells will stretch more than a quality skeet or trap load shell. In the short and abrupt forcing cone, this stretching allows the end of the shell to enter the forcing cone and create the bottleneck effect similar to a short chamber and with similar results.

## RECHAMBERING

As with the rechambering of any firearm, safety should always be given first priority. The conversions should never be attempted without a thorough examination of the condition of the gun and its components. A gun in good condition with all components locking and functioning correctly can be safely converted. Yet, a similar model in poor condition with parts and components worn and loose should not be converted. Always remember that with an older-model gun, the magnum load of its day is probably the accepted field load of today. For this reason, you should be careful to select only field or target loads and avoid the current heavy-shot, magnum shell loads.

The flute and cutter design of the reamers is such that with proper cutting procedures, the finished chamber will be remarkably smooth and chatter mark-free. Be sure the reamer cutting edges are kept sharp by careful honing with a hard Arkansas stone. When in use, the metal chips from the removed metal should be equal in front of every cutting edge to assure that the reamer is cutting evenly on all sides. If the chip buildup is in front of only one or two flutes, the other flutes are not cutting. Hone these flutes lightly until the metal removal is equalized.

Place the barrel in a padded vise, chamber toward the ceiling, with the chamber rear as low as possible for observation and ease of cutting. Squirt cutting oil into the chamber and onto the flutes of the reamer; the oil will help achieve a smooth cut. While the wrench used to turn the reamer should be secure to the reamer, it is necessary to exert pressure equally, allowing the tapered reamer to "feel" its own way and keep centered. Side pressure on the handle can result in a chamber wall being cut off-center (Figure 26, on page 18).

After about two or three complete revolutions of the reamer, remove it straight up and out of the chamber. Wipe away all metal chips and cutting oil from the reamer. An old toothbrush and mineral spirits work fine for this job. Next, run a dry patch through the bore to remove any lingering chips and cutting oil. Check with your chamber depth gauge. Normally this procedure will have to be repeated a half dozen times or more to achieve the desired chamber depth. Regardless of the number of times, it is important that the rechambering be done

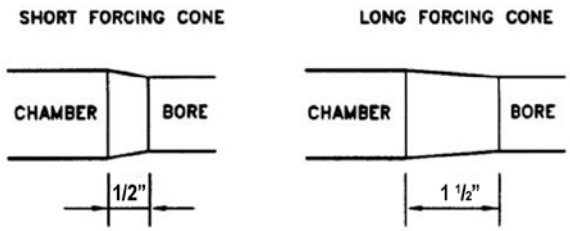



***Figure 25:*** *The difference between a short and long forcing cone.*

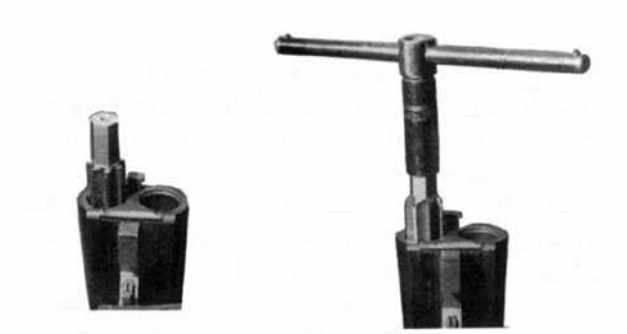


***Figure 26:*** *Left: Barrel in vise, chamber end up, with chamber reamer in position to begin cutting new chamber. Right: T-handle wrench gives control for accurate reaming.*

slowly, the reamer and barrel cleaned each time, and the depth constantly checked with the gauge. A strong light directed into the chamber will help you see the progress of the rechambering, and you can quickly note if you are not turning the reamer with even strokes.

If initial gauging has indicated correct chamber length but the chamber has the short abrupt forcing cone and you want to rechamber for the long forcing cone, the procedure is identical with two exceptions. First, all traces of the old forcing cone must be removed. Second, to achieve this the chamber must be cut slightly longer than standard, since many of the old forcing cones are pitted. The front edge of the circular-cut grooves around the gauge body is the index point for correct chamber length. However, it will generally be necessary to use the rear edge of the circular cut on the gauge as the index point for chamber depth in order to remove all of the old forcing cone. This extra length will not affect the barrel performance, since 2¾" shells are commonly fired in 3" chamber length 20- and 12-gauge shotguns.

Finish the rechambering job by polishing the chamber and new forcing cone with 500-grit aluminum oxide cloth. The Brownells choke hone tool will do the job faster and with more even results. Use this rotating tool dry for about one minute of revolution in an electric hand drill to remove any roughness, then squirt cutting oil up into the chamber and use the tool for about two minutes. The result will be a highly polished forcing cone.

The ultimate goal is to achieve as close to 100% of the pellets as possible in the shell striking within the 30" pattern circle with the pellets evenly distributed. The ammunition manufacturers have provided one giant step forward toward this goal with the modern shotgun shell. Using these shells in chambers of correct depth is another step forward. The long forcing cone is still another step toward that goal. There is a fourth step available; reworking the choke to achieve the maximum percentage of pellets evenly distributed in the 30" circle at the desired range.

## SELF-TEST QUESTIONS

Please check your answers on page 20.

9. **Name the three basic sections of a shotgun chamber.**
10. ***True or False.*** **If a shotshell easily fits into a shotgun chamber, it is safe to fire the shell.**
11. **What is the standard length of modern 12-gauge shotgun chambers?**
12. **What length were 16-gauge shotgun chambers before 1929?**

# Shotgun Ribs

A beautiful, well-designed, professionally installed ventilated rib is greatly appreciated by guns owners. It gives distinction and class to a gun as does few other single accessories. The words "with ventilated rib" automatically add prestige and value to a shotgun.

A solid or ventilated rib can be placed on any gun barrel, but the ventilated rib, in particular, has the easiest barrel to work on and gives the most pleasing appearance. Barrel ribs are made between ¼" and ½" in width, and the material used most is cold-drawn steel, machined to fit over the top of the barrel.

Until recently, most shotgun ribs were soft-soldered onto the shotgun barrel. To soft solder a rib, first the radius of the rib is polished bright and smooth and then the area on the gun barrel, where the rib will make contact, is polished in the same way. This is necessary when soldering ribs, since solder will not adhere to blued surfaces. Each leg of the rib is then heated with a torch so that solder will run freely, and by wetting the surface with soldering acid, together with the solder, a perfectly soldered surface is obtained. This operation is called *tinning*.

The rib is then placed in position on the barrel and each location where the brackets are to be placed is marked. These areas are then polished to remove all bluing and are finally tinned like the rib brackets.

When all spots on the barrel have been tinned and the barrel is cool, place the rib in position, securing it with C-clamps over each rib bracket. In doing so, make certain that the rib is held firmly and that it is centered on top of the barrel. Beginning at the breech, heat both the barrel and the rib carefully with a torch at the point of contact. Be extremely careful not to overheat either the barrel or rib; heat just enough so that the solder will run. To control this heat, hold a piece of soft solder in your hand and constantly use this to test the heated surfaces. When it just begins to melt on the surface of the steel, withdraw and continue to the next bracket, and so on until the rib is soldered the entire length of the barrel. When cool, remove the clamps and wash them thoroughly with hot water. This will remove the acid which would otherwise rust the bright surface of the steel. Wipe dry and if the work is to stand for any length of time before bluing, oil it lightly with gun oil. A shotgun barrel with ventilated rib is shown in Figure 27.

## RESOLDERING RIBS

Double-barrel shotguns frequently have the rib loosened from the barrels at the fore-end lug. To reunite the rib, carefully raise the loose rib as far as possible without bending it, and hold it in this position by inserting a small wooden wedge. Then, with a thin scraper, scrape both barrels and rib where they come into contact with each other. Wrap the barrels well in different locations with soft iron wire; four to six strands to each wrapping, with the ends twisted together, are sufficient. Place the wedges between the wire and rib. Any small, round, cold-drawn steel may be used, as long as the pressure can be placed between the wire and ribs. With the ribs in place, use a torch to heat the raised section of loose rib and barrels; tin these parts as discussed previously with rosin and small soldering wire. When both rib and barrel are tinned, put the rib in place by wrapping wire over this section, and hold it in place with a wedge. It may require two or three wrappings of wire in the location to hold a rib in place before a perfect job of sweating is achieved. Complete the sweating operation with the torch.

## SELF-TEST QUESTIONS

Please check your answers on page 20.

13. **Until recently, what was the accepted way to install ribs on shotgun barrels?**
14. ***True or False.*** **Ribs for double-barrel shotguns cannot be repaired.**
15. **Name the two types of basic ribs for shotguns.**
16. ***True or False.*** **Only a solid rib can be placed on a gun barrel.**

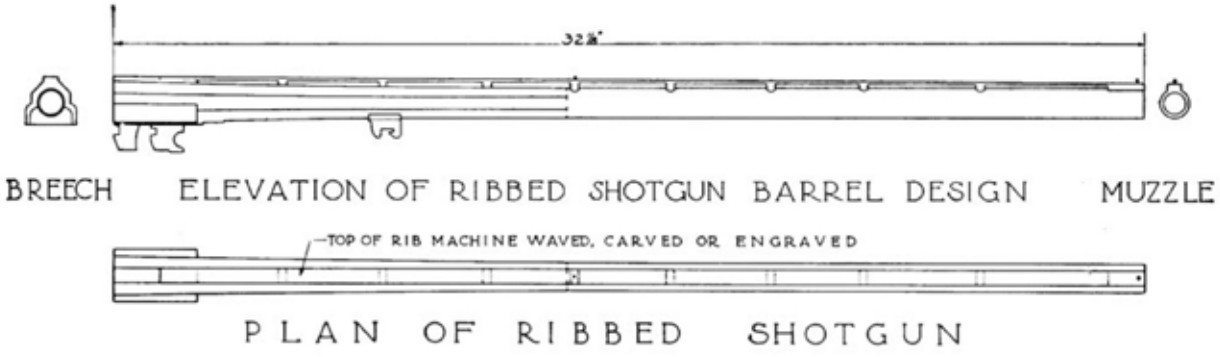



***Figure 27****: Elevation view of a shotgun barrel with ventilated rib.*

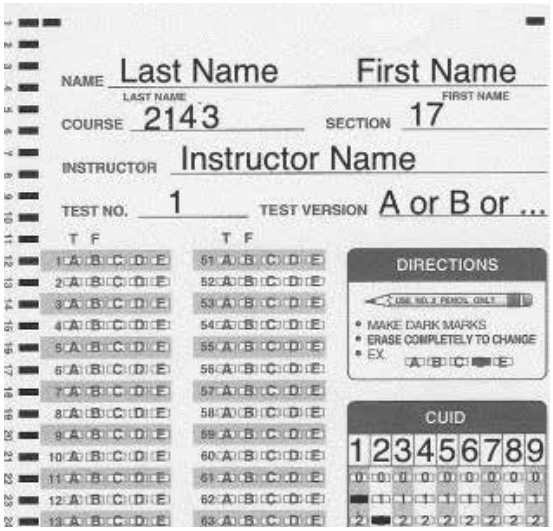
# Answers to Self-Test Questions

1. True.
2. Henri Pellet.
3. 65 percent.
4. Improved cylinder.
5. 0.900 inch.
6. False.
7. 0.729 inch.
8. 0.550 inch.
9. Rim cut recess, chamber body, and forcing cone.
10. False.
11. 3 inches.
12. $^{9}/_{16}$ inches.
13. Soft soldering.
14. False.
15. Solid and ventilated.
16. False

# Lesson Questions

**THIS IS LESSON NUMBER 2181.**

Make sure you print your name, student number, and lesson number in the space provided on the Lesson Answer Form. Be sure to fill in the circles beneath your student number and lesson number.




**REMINDER**: A properly completed Lesson Answer Form allows us to evaluate your answers and send the results and additional study material to you. Do not hold your Lesson Answer Forms to send several at one time. You may run out of study material if you do not send your answers for evaluation promptly.

You may also complete your exam online at www.sdi.edu, click on the *online exams* tab.

1. **What is the name given to the constriction at the muzzle of a shotgun that causes the charge of shot to hold together in a dense string?**
   a. Brake.
   b. Leade.
   c. Choke.
   d. Recoil reducer.

2. **What percentage of the shot charge will fill a 30" circle at 40 yards when a cylinder bore shotgun is used?**
   a. 65 percent.
   b. 60-70 percent.
   c. 50-60 percent.
   d. 25-35 percent.

3. **When using choke reamers, which of the following should you never do?**
   a. Turn the reamer in the reverse direction.
   b. Use it to choke double-barrel shotguns.
   c. Use it to choke break-open, single-barrel shotguns.
   d. Use cutting oil on the reamer when in operation.

4. **What must be used with Brownells choke-comparison calipers to be able to read the measurement?**
   a. Electronic calculator.
   b. Micrometer.
   c. Expandable choke reamer.
   d. Chamber reamer.

5. **Which of the following barrels should the angle blade expanding reamers not be used on?**
   a. Damascus steel.
   b. Cold rolled steel barrels.
   c. Stainless steel barrels.
   d. Chrome-lined barrels.

6. **What is the term used to describe a slight enlarging of the entire shotgun bore?**
   a. Chambering.
   b. Reaming.
   c. Back-boring.
   d. Choking.

7. **Most shotguns manufactured before 1930 had chamber lengths less than what dimension?**
   a. 2.76 inches.
   b. 2.60 inches.
   c. 2.67 inches.
   d. 2.57 inches.

8. **Which of the following is the standard (non- magnum) chamber length for 12- through 28-gauge shotguns?**
   a. 2¼ inches.
   b. 2½ inches.
   c. $2^{5}/_{8}$ inches.
   d. 2¾ inches.

**9. In which of the following conditions does the bottleneck effect take place when a shotgun is fired?**

a. Correct length chamber.

b. Short chamber.

c. Long forcing cone.

d. Cylinder bores.

**10. What are the two standard types of shotgun ribs?**

a. Solid and ventilated.

b. Full and improved.

c. Vertical and horizontal.

d. Tapered and straight.