

## TOOLS OF THE GUN PRO TRADE: WHAT TOOLS DOES A GUN PRO NEED?

## TO JUDGE A GUN

Soon you'll be learning how to create sleek custom sporters from ungainly military irons; and how to restore grime-encrusted antiques to lustrous "like-new" elegance; and you'll be learning how to perform firearms repairs and alterations with aplomb.

But everything has its beginning. In the gun field, fortunately, the jobs most commonly sold are the easiest to perform: accurizing, scope/sight installation, bolt jewelering, stock finishing, etc. These relatively simple tasks also require the least expensive tools.

The primary purpose of any rifle or pistol is to deliver a projectile where it's aimed, consistently and without malfunction. Elaborate engraving and checkering, fancy wood and expensive sighting equipment, are meaningless if that gun scatters shots into basketball-size groups.

Conversely, the ugliest, most scarred and beat-up rifle that shoots straight shot after shot is still a thing of beauty in that it admirably accomplishes its design function.

Your Unit 2 gun shop section deals with simple accurizing — the factors controlling how well a rifle fulfills its design objective and potential. With these little-known trade secrets, you can often reduce 100-yard groups from 4" or worse to 1" or 1½" with off-the-rack or used sporting rifles; gain acceptable, even astonishingly good accuracy from the most neglected or abused military smokepole.

As you'll discover, one of the most frequent requests for help (and jobs) comes in the form of: "I can't hit a bull's broadside with this thing, and I'm not that bad a shot!"; or "I'm building a bicep on my finger. This trigger pull is so heavy it's impossible to squeeze off shots." Other customers will want you to install telescopic sights on new rifles, or mount scopes and/or new iron sights on military rifles proven sufficiently accurate and in good enough condition to warrant the investment.



*FIGURE 1 — By performing relatively simple jobs requiring a minimum of tools, quite often the gun pro can reduce 100-yard groups from 4" or worse to less than 2" on abused military rifles.*

By mastering the instruction in your gun shop sections of the Course, you'll soon be able to gain the know-how to solve these common problems — profitably.

## BASIC TOOLS REQUIRED

Now let's get acquainted with the tools, equipment, and supplies most often used by professional gun repairmen. The list can be quite lengthy. Nobody, however, buys everything at once — especially when just starting. To complete the jobs described in your Unit 2 Gun Shop, you require little more than the equipment provided and included in your Course.

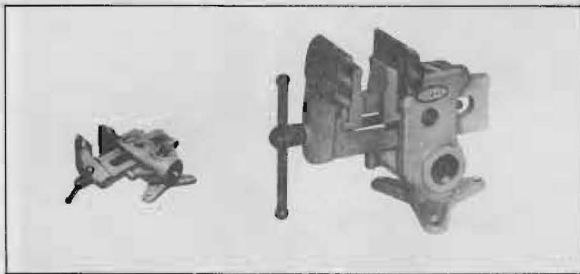
Later, as you progress in knowledge and ability, you may want to add other tools and supplies — items you can purchase out of the profits from your first simple jobs. These, in



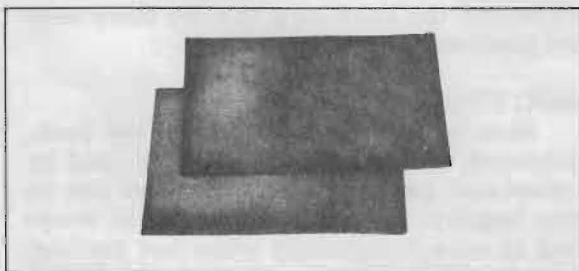
turn, should enable you to perform more detailed gun work, leading to even more profits. Sales of firearms, ammo, and accessories when you get your FFL license can also provide "expansion capital." Few new businesses provide such a splendid earn-as-you-learn and pay-as-you-go profit opportunity!

### Swivel Vise

The single most important tool in any gun shop is a good vise — preferably of swivel design and with 3" steel (not cast iron) jaws. A detachable, clamp-on vise can be used if bench space is limited, but is not recommended. A vise is something you'll use constantly, on nearly every job that comes in. Get the best heavy-duty model you can afford, and one with provisions for mounting (and dismounting) padding and lead plates. These additions or inserts prevent marring of wood and metal. Vises that will do the job are available at most hardware stores.



*FIGURE 2a — A swivel vise such as the VERSA-VISE is one item of equipment that the gun pro should have. The Versa-Vise gives both vertical and horizontal holding positions. It rotates full circle in either position. The vise automatically locks in the desired position when the jaws are clamped tight. The built-in anvil is 1-3/4" square. The jaws are 3 1/2" x 2 1/2", opening to 5". It has removable, serrated pipe jaws for rounds up to 1 1/2" diameter. (Photo courtesy Brownells, Inc.)*



*FIGURE 2b — Protective pads are a must for your gun shop vise. These are heavy 9/10 ounce (5/32" thick) top-quality cowhide leather pads, the old standby to use on vise jaws when working with gun parts or other items you don't want to mar. (Photo courtesy Brownells, Inc.)*

Your two lead inserts can be formed of common plumber's sheet lead, 1/16" or 1/8" thick, of a size to conform to the jaw areas with a 1 1/2" flange extending over the top of the vise. Sheet lead can be easily cut to size with a tin snip, and is soft enough for the flange to be bent into shape with light hammer blows. Lead inserts are used primarily for holding screws in position for dressing, and gripping-in-the-white unfinished metal. Don't use lead inserts on wood surfaces or with highly polished or blued steel as they can cause scratches and blemes.

Felt and leather inserts are easily made, cutting material to the size of the jaws and glueing it on scrap 3/4" or 5/8" plywood or hardwood. Don't use soft or thinner wood as vise pressure will quickly reduce your insert to splinters. No flanges are used here, of course. The inserts are simply dropped into place and held in position by tightening the vise.

Felt should be at least 1/4" thick (preferably 1/2"). Such padding is indicated when gripping highly polished, smooth metal surfaces. Sharp angles, under pressure, will quickly tear felt.

Leather inserts should be of soft, oil-tanned leather, and used when working with wood or heavy or sharp-angled metal components.

### Gunsmith Screwdrivers

Ordinary soft-metal drivers will "drive you screwy" if you attempt to use them for gun repairs. Invariably they are just a bit undersize for a given slot and under pressure will twist, marring the screw, or even worse, removing half of it. The screw remains seated while you rise and do outside loops over that shiny, stand-out blemish.

Finely ground and tempered gunsmith's drivers fit most standard gun screws perfectly, eliminating the ugly scratches which are the hallmark of the in-a-hurry amateur. Always take your time with any repair or alteration, especially when starting. Many deep scratches, especially the long, running variety, are impossible to cover without expensive, time-consuming grinding, polishing, and rebluing.

If a screwdriver isn't precisely the right size (as is often the case with metric or antique screws), the true gun pro will either make a driver from rod material or grind a spare or "blank" driver to perfect fit.

We have provided you with good-quality screwdrivers. Later you will undoubtedly wish to add even more to your collection.

### Metal Files and Cleaning Brush

Files are relatively inexpensive and are

used frequently for cutting and cleaning up dovetails, shortening and renotching bugged screws, removing and smoothing out burrs, etc. An assortment of various sizes and types are recommended. Always store separately or with the teeth protected, as cutting edges, with the files jumbled together, are rapidly dulled.

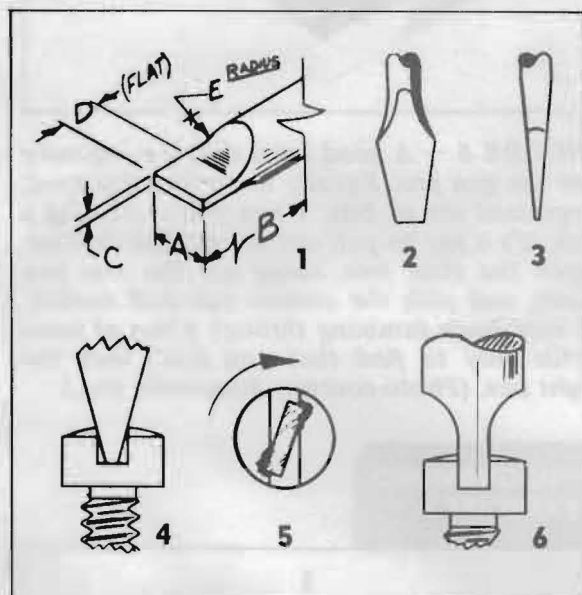


FIGURE 3a — Nothing is more disgusting than a bruised scope mount, a distorted screw, or the white metal showing through the finish of a \$150 scope mounting job. Gunsmith screwdrivers are not of the double-wedge type swaged on a punch press as shown in 2, 3, and 4 above. A design such as 2 will chamfer the work if the screw is in a deep hole. It can be seen from 4 that this double-wedge type transmits its torque to the top of the screw slot. The depth of the screw slot is thereby used as a lever with its mechanical advantage applied at the top of the screw slot. With such a small area contacting the screwdriver, the screw will be scored, or one section of the screw head will break off if heavy pressure is applied. The wedge shape also tends to back the driver out of the screw slot. In 5 we see what happens when a blade too narrow and thin is used. The gunsmith screwdriver in 6 is ideal. The torque is applied at the bottom of the slot where the screw is strongest. The blade fills the slot. The blade is the same width as the shank as shown in 1, and has the same radius so will not chamfer the work or mark the screw. The proper manner to set a scope mount screw on a gun is to tap the handle as you turn the driver. This takes the stress off the threads as the screw enters the work. You can tap the handles of these drivers without damage.

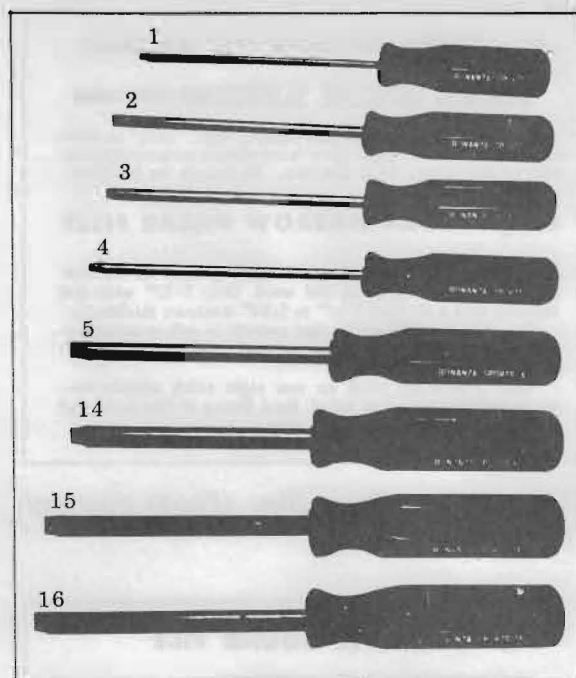


FIGURE 3b — Here is a good STARTER SET of gunsmith screwdrivers: (1) Remington, Winchester, etc., plug screws; (2) Lyman, Leupold, Redfield scope screws; (3) B&L, Weaver, Buehler scope mount screws; (4) for Williams 10-32 screws; (5) Remington, Winchester, Sako, Savage, etc. guard screws; (14) guard screws and general-purpose; (15) guard screws and general-purpose; (16) Redfield streamlined scope mount rings. (Photo courtesy Bonanza Sports Mfg. Co.)

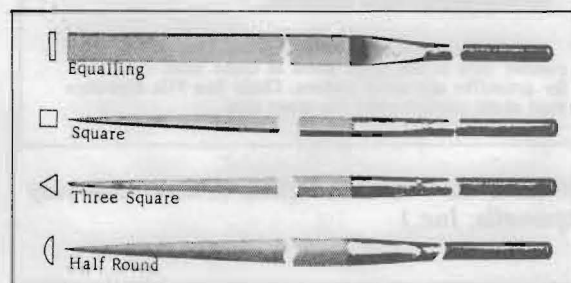


FIGURE 4a — Gunsmith needle files. The above four numbers are the needle files most commonly found on gunsmith benches throughout the world. (Photo courtesy Brownells, Inc.)

#### Electric Hand Drill and Bits

A good-quality 1/4" high-speed drill is almost indispensable for cleaning badly fouled or corroded bores (with a cleaning rod attachment), drilling scope, sight, and swivel holes, etc. An assortment of bits, preferably of the short screw-machine variety, should be kept on hand. (Long drills tend to wander and break more easily.)



### 8" - EXTRA NARROW PILLAR FILES

Considered the standard gunsmithing file. "Safe" on both edges so you can cut right up to faces without undercutting the sides of your work. #0 is Coarsest, #4 smooth for finishing.

### 4" VERY EXTRA NARROW PILLAR FILES

A file to treat with loving care. It will get you off the hook many times in both metal and wood. Only 5/32" wide and tapering from a bit over 3/64" to 5/64" maximum thickness.

Cuts No. 0 and 00 are for fast removal in soft or untempered metal. Because of their coarser cut, they work beautifully for final removal of wood.

Cuts 2 & 4 are ideal for rear sight notch adjustments, extractor/ejector groove relief, final fitting of fine parts and a multitude of other jobs in the shop.

FIGURE 4b — Pillar files. (Photo courtesy Brownells, Inc.)

### 6" PARALLEL ROUND FILE

Like Extra Narrow Pillars, these files will stand you in good stead in numerous touchy situations in the shop. Swiss pattern cut teeth.

Cuts No. 00 (very coarse) and 0 have Chisel cut teeth. For fast metal removal or can be used as rasps to slightly enlarge or adjust (fudge) accessory holes in stocks. Small diameters available will handle all common screw holes.

Cuts No. 2 & 4 are for adjusting screw and pin holes, scope mount holes, fine cuts on tightly curved parts and all types of parallel round cuts.

Diameters: 3/32"; 1/8"; 5/32"; 3/16"

### ROUND CHAIN SAW FILE

Round Chain Saw Files in medium cut. Designed to make parallel cuts in the tough metal in chain saws — so work for gunsmiths and metal workers. Chain Saw File diameters start where parallel round file sizes stop.

FIGURE 4c — Round files. (Photo courtesy Brownells, Inc.)

Specially manufactured sight slot file. True parallel 3-square file with only one side cutting - other two sides "safe". This means the file can be used to widen dove-tail slots in gun barrels without danger of deepening the slot or damaging the edge not being worked on. Being a true parallel file you have absolute control over the angle of the dove-tail - impossible with other type files.

FIGURE 4d — Sight base file. (Photo courtesy Brownells, Inc.)

Before going on, please do Programmed Exercise 1. Make sure you write your answers on a separate sheet of paper before looking at the answers on the page specified.

Unit 2, Part 1

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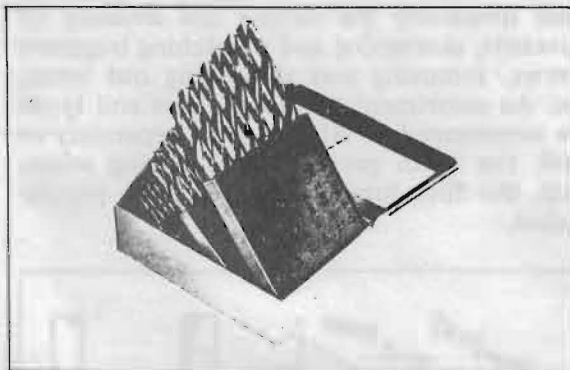


FIGURE 5 — A good hand drill is a necessity for the gun pro. Equally important is a good, organized set of bits. When you're starting a job, it's a joy to pull out an indexed drill set, open the steel box, swing out the row you want, and pick the correct size drill needed. It sure beats fumbling through a box of loose drills only to find that you don't have the right size. (Photo courtesy Brownells, Inc.)

### PROGRAMMED EXERCISE

1

1. Why is it that a screwdriver with a wedge bit is not suitable to use on gun screws?
2. What is the main reason many gun owners request the services of a gun pro?
3. Name two very important requirements that any vise used in your gun shop should meet.

Answers on Page 6

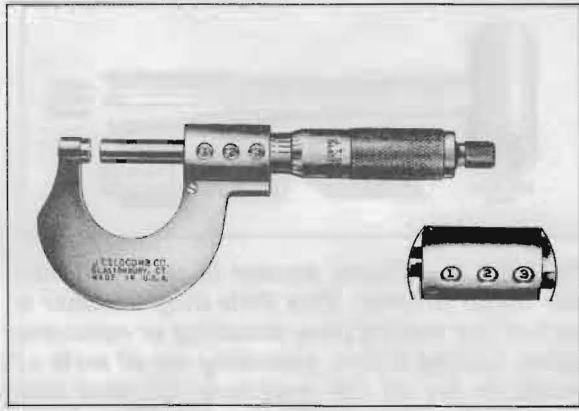
### 1" Micrometer and Vernier Calipers

Calipers are "musts" for any gun pro. In your "How to Use Your Micrometers" supplement we show you how to use and read verniers.

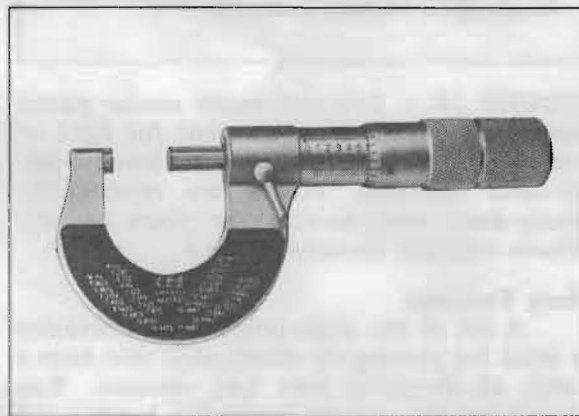
### Propane Torch

A propane torch is invaluable for soldering sights and lugs, spot annealing (removing extreme hardness from areas where scope-mount holes will be drilled), heating barrels so expansion permits removal of obstructions, and many other uses. Complete portable propane units are available in most hardware stores.

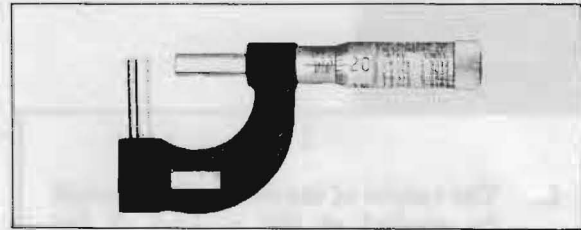




**FIGURE 6a** — Various types of micrometers are available for the gun pro. Decide very carefully what you need before you invest in one. Highly recommended by the men in numerous arms plants, the armed service, the aircraft industry, and various technical branches of the government is the Speedmike. Speedmike features include fully finished satin chrome frame, lapped anvil and spindle, unique adjusting nut assembly which provides full engagement with spindle thread, friction stop, precision balanced. Direct, easy-to-see figures read in thousandths with graduations on the thimble for simple reading of ten-thousandths. (Photo courtesy Brownells, Inc.)



**FIGURE 6b** — Above is the exceptional Swedish micrometer made by the world-famous C. E. Johansson Works, maker of the internationally standard "Jo-Blocks." Extremely accurate and beautifully precision made. Range is from 0 to 1". Readings — and accuracy — in/to .001". Slant-line sharp black graduations eliminate the possibility of reading errors. Dull chrome finish. Cut-away forged frame. Lapped tungsten carbide anvils. Hardened, ground, and lapped threads. Solid bronze inner sleeve. Insulating grip with decimal equivalents on it for fast reference. Positive one-hand locking device. Friction thimble. Wear adjustments. (Photo courtesy Brownells, Inc.)



**FIGURE 6c** — The case/tube mike is highly recommended for measuring wall thickness of case necks to check for progressive variations in wall thickness from reloading to reloading. Graduations to .001", overall capacity 1". Easy-to-read black markings on conventional thimble. Anvil diameter is .125" and will fit cases of all calibers. Also useful for finding the concentricity of holes, distance from hole to edge of work piece, and other shop jobs. (Photo courtesy Brownells, Inc.)



**FIGURE 7** — A small propane set-up is something you will want in your gun shop. These outfits are inexpensive and widely available. (Photo courtesy Brownells, Inc.)

#### Gunsmith's Pliers

The assortment of gunsmith's pliers shown in Figure 8 handles nearly all gun shop requirements; the individual types such as needle-nose and parrot-beak all have their applications. Insist on steel, not the cast-iron variety, with jaws that meet perfectly.

#### Plastic Hammer

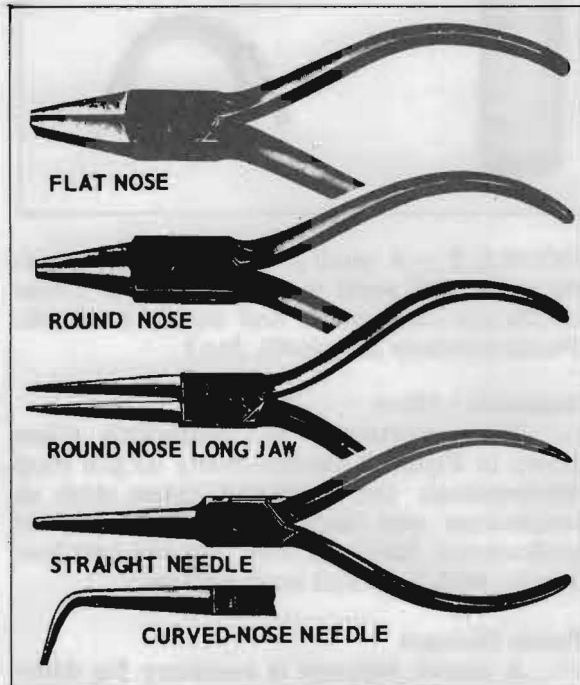
A plastic hammer is necessary for delivering maximum power on easily scratched or easily marred surfaces. Some of these have interchangeable heads and let you select the correct hardness for specific jobs.

#### Automatic Center Punch

Automatic center punches are used for marking drill hole sites in metal. The model illustrated in Figure 10 "trips" automatically and is adjustable for light or heavy impressions.

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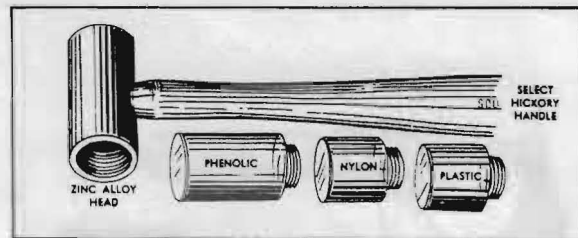
1. The torque of the screwdriver should be applied at the bottom of the screw slot where the screw is the strongest. With a small edge of the wedge contacting the screw, it is easy to score the screw or break off the head.
2. Accuracy. Their gun is not shooting accurately enough for them because of hard trigger pull or some other malfunction.
3. At least 3" steel jaws; it should have provisions for mounting and dismounting padding and lead plates and it should be of the swivel design.



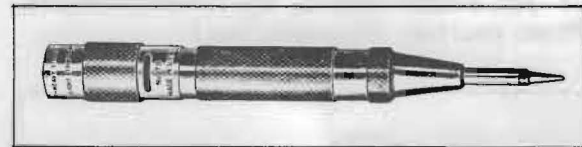
*FIGURE 8 — Perhaps no other tool on the bench is required to do more jobs than the gunsmith's pliers — everything from getting up inside a small action and inserting a spring the size of a small hair to holding red-hot rods while being formed. Because of the extremely rough to extremely delicate work done with pliers, just being tools isn't enough; they must be instruments. (Photo courtesy Brownells, Inc.)*

Unit 2, Part 1

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*FIGURE 9 — Plastic no-mar hammer will not mar metal finishes. This little shop hammer is perfect for driving pins, installing or removing sights, seating inlays, pounding on all sorts of things or for all the multitude of other jobs around the shop where you have to pound, but don't want to mar the metal or wood you are working on. Available with three types of non-sparking, non-marring tips in four sizes. Tips come in amber plastic — a tough, fairly light tip for most general work. Nylon, an extremely tough, resilient tip, very resistant to cracking, chipping, or splitting. Phenolic, a resin-impregnated, cloth-reinforced tip that is very dense, highly resistant to abrasion, splitting, or breaking to let you give the work a more resounding wallop. (Drawing courtesy Brownells, Inc.)*



*FIGURE 10 — This automatic center punch has an easy screw-in adjustment for light or heavy impressions. Best for instantaneous single-hand spotting. Points are replaceable. Heavy-duty construction for years of use. (Photo courtesy Brownells, Inc.)*

#### Shop Tweezers

A set of the angle-point model tweezers is ideal for picking up small parts that have a habit of dropping into tiny recesses. You should get the straight design for tugging and setting screws into position.

#### Set of Punches (Drifts)

A set of punches is required for removing the assembly pins used in most new guns and in many older models. The versatile unit shown in Figure 12 ends the problem of breakage as tips are replaceable and interchangeable in three diameters, two lengths.

#### Trigger Pull Gauge

How stiff (or light) is that trigger pull? The Ohaus trigger pull gauge gives the answer from 0 to 72 ounces in one-ounce increments. The gauge also reads in grams. It's great for checking progress when working on triggers.

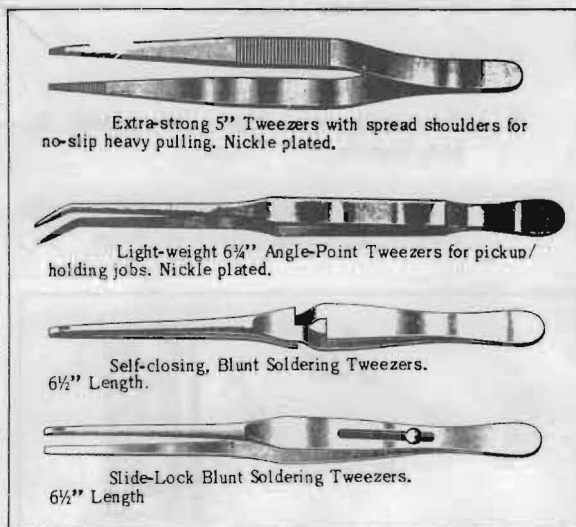


FIGURE 11 — A variety of shop tweezers are available to save many of the frustrations of fingering small parts. (Drawing courtesy Brownells, Inc.)



FIGURE 12a — No pin punch can be guaranteed against breakage. Therefore, you should get the very best available. This one is hammer-forged by hand of highest quality tool steel. Carefully hardened and tempered with points and heads highly polished, knurled body. (Drawing courtesy Brownells, Inc.)



FIGURE 12b — Always use starting punches to break loose stuck or tight pins to protect both the pin punch and the gun. These starting punches are designed to start the most rusted or frozen pins. (Drawing courtesy Brownells, Inc.)



FIGURE 12c — Center punch. (Drawing courtesy Brownells, Inc.)

#### Safety Glasses

Safety glasses are a necessity for protecting your precious vision. They are mandatory when using power equipment or reloading. Some of those available fit over regular glasses (if you wear them), and have high-impact, clear plastic lenses. A special chemical prevents fogging.

#### Magnetic Pick-Up Tool

You should have a magnetic pick-up tool. The one shown in Figure 15 telescopes

out to 27 inches and makes it easy to reach into small recesses or behind cabinets for that small part or spring you fumbled. It lifts up to 1 1/2 pounds.

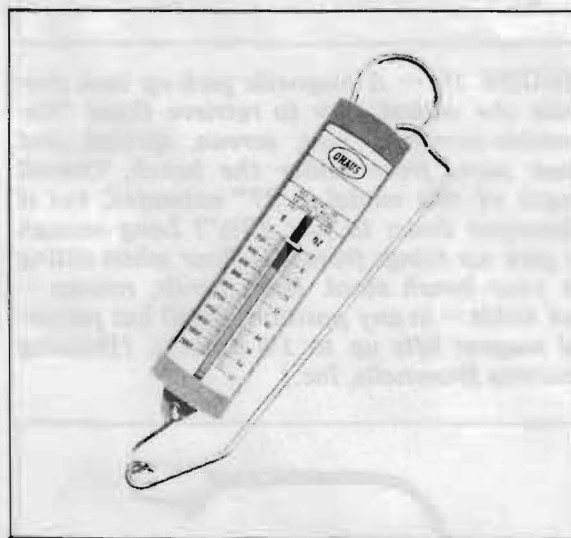


FIGURE 13a — The Ohaus trigger pull gauge has a range from 0 to 72 ounces in one-ounce increments. Reads in both ounces and grams.

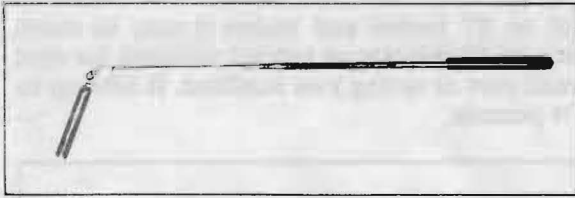


FIGURE 13b — Brownells' trigger pull gauge. Made by Schrader, this is one of the best trigger pull gauges on the market today. Calibrated from 4 to 80 ounces in 2-ounce graduations. Small in size, it is accurate and precision-made.

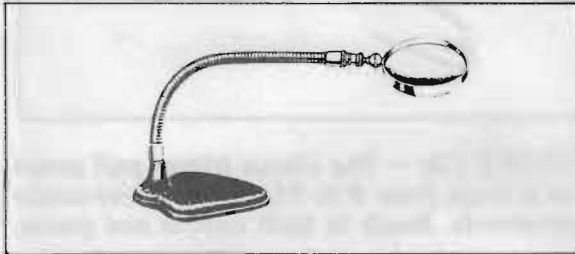


FIGURE 14 — Safety is always the first consideration in guns and gun repair. Comfort is a big consideration, too, and so it's best to have goggles that can be worn for long periods of time under the most adverse conditions, including sudden and frequent temperature changes, without fogging! Also, your goggles should be specifically designed for maximum protection from chemical splash and spatter, both of which can happen when blueing. Your goggles should also be shatterproof. (Photo courtesy Brownells, Inc.)





**FIGURE 15** — A magnetic pick-up tool provides the easiest way to retrieve those “impossible-to-reach” pins, screws, springs, and small parts from under the bench. Overall length of this model is 27” extended, but it telescopes down to just 13½”! Long enough to pick up things from the floor while sitting on your bench stool. Head bends, rotates — and holds — in any position. Small but powerful magnet lifts up to 1½ pounds. (Drawing courtesy Brownells, Inc.)



**FIGURE 16** — Features of this bench magnifier include a powerful 4” diameter ground and polished lens and chrome-plated, fully flexible gooseneck arm. Ball-joint swivel for easy positioning. The heavy cast iron base holds firmly on table or bench. Put it where you need it — on the reloading bench or where you engrave, checker, fine-fit, accurize, do pistol work, check trade-ins, or whatever. (Drawing courtesy Brownells, Inc.)

#### Bench Magnifier

A magnifier is a big help when doing small, precision work — cleaning up screws, making minute adjustments, etc. The four-inch lens swivels to desired positions.

#### Inspection Light

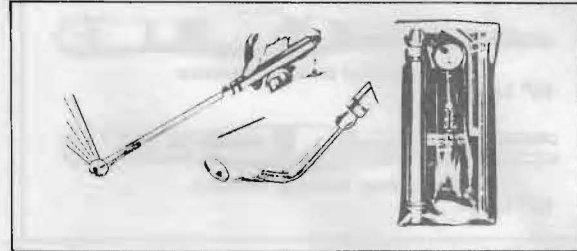
It’s good to have an inspection light. Cold light curves around corners, lets you peer into and check chambers and barrels . . . look deep into those dark nooks and crannies. It’s ideal for checking used guns.

#### Other Basic Tools

Here are some other basic tools you’ll find useful:

1. Hacksaw with assortment of metal-cutting blades.
2. 12” steel ruler.

3. 6” engineer’s square.
4. Assorted C clamps.
5. Assorted wrenches — standard, Allen, metric.
6. Assorted cleaning rods and attachments, all appropriate calibers.



**FIGURE 17a** — This inspection light uses light-carrying plastic to bend the light beam around corners into anywhere you want to see. (Photo courtesy Brownells, Inc.)



**FIGURE 17b** — This inspection light has a flexible, chrome-plated neck which bends to any angle needed to let you direct a brilliant high-intensity beam of light to any remote or concealed place. Perfect for checking chambers of shotguns or rifles, barrels, inside actions, chokes, close examination of machine work and final finish, and so on. Brings normally hidden flaws into high relief with direct or reflected light. (Photo courtesy Brownells, Inc.)

#### BASIC GUN PRO SUPPLIES

Here are some basic gun pro supplies you will want to add as you go along. We will be discussing these as we progress in the Course.

1. Drill rod, assorted sizes, for making and replacing lost pins.
2. Abrasives. Grit cloth, 240, 400, 600. Wet-or-dry carborundum papers, 220, 320, 400, 600. Silicone carbide abrasive.
3. Epoxy glue. For basic stock repairs, anchoring splinters, glueing cracks, etc.
4. Solder. Various high and low-temperature alloys.

5. Solder touch-up. Blends new soldering into overall blueing.
6. Cold blueing touch-up cream.
7. Chamber casting alloy such as Cerrosafe.
8. Kasenite hardening compound. For firing pins, hammers, triggers, etc.
9. Stock touch-up compounds. Linseed oil, Linspeed, True-Oil, epoxy types.
10. Glass barrel-bedding compound.
11. Solvents, rust inhibitors, gun cleaning and penetrating oils.
12. Trigger guard screws. Assortment for Mausers, Springfields, Enfields.
13. Gunsmith's springs, assortment.
14. Gunsmith's screws, assortment. (Including No. 9 wood screws for recoil pad installations.)
15. Steel shimstock. Purchase in various thicknesses — .003 to .010. Use for taking headspace measurements and for scope shims.
16. Precut scope mount shims. Often needed for *perfect* scope installations. Different lengths and elongated holes accommodate almost any rifle.
17. Swivel assortment. Keep a supply of standard and quick-detach styles on hand for fast and profitable swivel-sling installations.
18. Recoil pads. It pays to inventory a variety of small, medium, and large pads of both rifle and shotgun types (yes, there is a difference). Stock fitting, which you'll learn soon, provides an excellent source of income.

#### Do You Need a Metalworking Lathe?

Does a gun pro have to have a lathe? Ultimately, perhaps. Not now, certainly. A

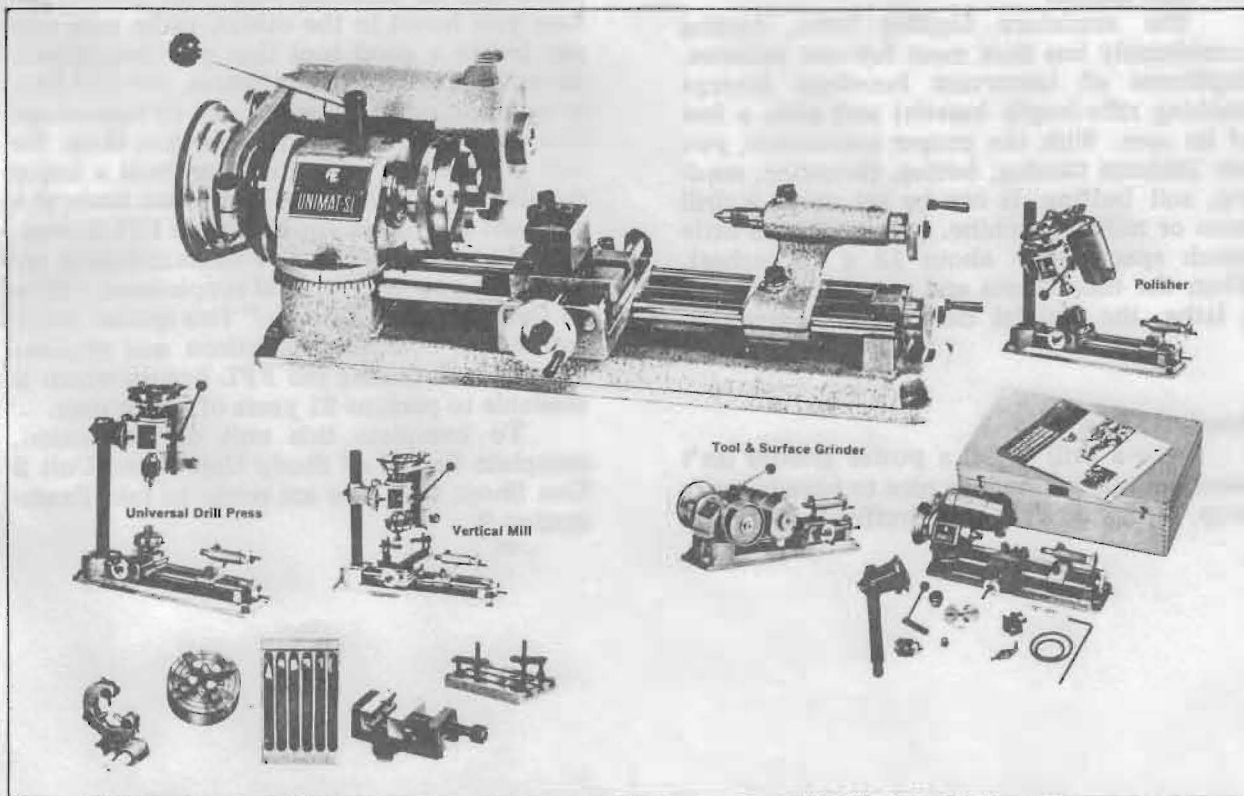


FIGURE 18 — When you get going with your gun shop, you may wish to consider adding a UniMat. The UniMat is a complete miniature machine shop for the gunsmith. Only 16" overall, but a ruggedly built, professional tool. Speeds from 900 to 7200 rpm. Many accessories available let it perform almost any machine operation for you. (Photo courtesy Brownells, Inc.)

full-size lathe costs a lot of money and requires considerable floor space and skill on the part of the operator. Its presence is justified much more in a machine shop than in the usual gunsmith's bailiwick.

Concerning guns, large lathes are used primarily for turning barrels to satin smoothness prior to blueing; and to a lesser extent for chambering barrel blanks for a specific cartridge. Chambered-in-the-white barrels cost so little more than the unchambered variety that you'd have to work an awful lot of blank barrels (and enjoy doing it) to justify the cost of a lathe. Also, chambering reamers cost money.

Most gun pros, when ordering a new barrel for a customer, usually get the chambered variety, thread it into the action, and send it out for polishing and blueing.

Later, if you decide to specialize in or include blueing among your services, you'll probably want to add a lathe. It can, of course, with the proper attachments, be used for a variety of functions: making tools, cutting threads, milling, etc., functions usually performed by the gun pro with a machinist's background.

#### Consider the Mighty But Mini UniMat

The miniature UniMat lathe, costing considerably less than most full-size varieties, duplicates all important functions (except working rifle-length barrels) and adds a few of its own. With the proper accessories, you can perform turning, boring, threading, sanding, and buffing. It can be set up as a drill press or milling machine. And it requires little bench space (only about 13 x 18 inches). When the time comes and you feel you need a lathe, the UniMat deserves consideration.

#### Bench Grinder

Like a drill press, a power grinder isn't essential, but it's mighty nice to have in one's shop. With various stones, buffers, and brush-

es, this tool finds wide use in both metal and woodworking — for polishing barrels before blueing, grinding off rough or rusted spots on some metal areas, shaping initial stock contours, etc. The bench grinder is definitely a tool you'll want to have later.



*FIGURE 19 — A bench grinder is not essential in your gun shop, but it's nice to have and useful for working on both metal and wood.*

Before going on, please do Programmed Exercise 2. Make sure you write your answers on a separate sheet of paper before looking at the answers on the page specified.

Now — don't go out and buy all of the equipment we have described. Many of these items will be provided with your course. Before you invest in the others, make sure you can locate a good tool that you can afford. As you go along in your course, you will likely be locating tools and items of equipment that you want to add to your gun shop. We will provide you with a catalog from a major supplier from which you can select items at a discount as soon as you have your FFL license.

As soon as we receive Examination 2, we will send you your special supplement, "How to Get your FFL License." This special publication has complete directions and requirements for obtaining the FFL license which is available to persons 21 years of age or over.

To complete this unit of instruction, complete Part 2 of Study Unit 2 and Unit 2 Gun Shop; then you are ready to take Examination 2.



PROGRAMMED  
EXERCISE

2

Match the function or description on the right with the tool or item of equipment on the left by placing the appropriate letters in the blanks provided.

- |                                       |   |
|---------------------------------------|---|
| _____ 1. Propane torch                | A. Clean corroded bores.                                      |
| _____ 2. Automatic punch              | B. Soldering sights.  |
| _____ 3. Set of punches               | C. Parrot-beak.   |
| _____ 4. Inspection light             | D. Marking drill hole sites.                                  |
| _____ 5. Safety goggles               | E. Setting screws into position.                              |
| _____ 6. Electric hand drill and bits | F. Removing assembly pins.                                    |
| _____ 7. Gunsmith's pliers            | G. A necessity when working any power equipment or reloading. |
| _____ 8. Shop tweezers                | H. Good for inspecting channels that are curved.              |
| _____ 9. Steel shimstock              | I. Often needed for proper scope installation.                |
| _____ 10. UniMat                      | J. Performs many of the functions of a lathe.                 |

Answers on Page 12

ANSWERS

2

- |       |      |      |
|-------|------|------|
| 1. B  | 2. D | 3. F |
| 4. H  | 5. G | 6. A |
| 7. C  | 8. E | 9. I |
| 10. J |      |      |

STUDY UNIT 2 – PART II

TOOLS OF THE GUN PRO TRADE: ACCURIZING THE MILITARY RIFLE

STUDY  
UNIT

2

PART

2

TOOLS OF THE GUN PRO TRADE: ACCURIZING THE MILITARY RIFLE

**THE VENERABLE G.I.'S**

Because of low cost and wide availability, "surplus" (meaning obsolete) military rifles often serve as the new hunter's first big game rifle. They serve as the "loaners" gun buffs reserve for use by friends, thus preserving their more valuable rifles (and the friendship in question).

There are many of these venerable "G.I.'s" around, and few come anywhere close to delivering the accuracy of which they are actually capable. Some have been resurrected after years of storage in cosmoline; others have gathered rust and dust for decades; a few have

seen frequent use and received proper cleaning and maintenance from former owners. Nearly all eventually wind up at the gun pro's for service of one kind or another.

We are talking here about accurizing military rifles per se — as-issued Springfields, Enfields, and Mausers — not the fine sporters based on these arms which have usually been thoroughly checked over and tuned by the customizer.

Quite often you'll come across so-called military "sporters" — rifles that are strictly government issue — except that someone, importer or distributor, has slapped on an inex-



*FIGURE 1 — One of the most popular G.I.'s is this Springfield .30/06 M1903 rifle, which incorporates a modified Mauser action. This Springfield is suitable for conversion to a custom sporter. (Reprinted from Small Arms of the World, courtesy Stackpole Book Co.)*



*FIGURE 2 — This .30/06 caliber Enfield was often called the "British Springfield." Originally chambered for the .303 British, it was manufactured in .30/06 caliber during World War I. The Enfield has a long action and is suitable for magnum conversions. (Reprinted from Small Arms of the World, courtesy Stackpole Book Co.)*





pensive sporter stock for "sales appeal." Such rifles also require careful checking. More often than not, the new stock has ruined what accuracy the rifle had, due to poor or indifferent barrel bedding.

In your Unit 2 gun shop section you'll learn specific methods, step by step, of vastly improving the accuracy of almost any rifle, military or otherwise. But first . . .

### Let's Talk About Headspace

There is no point in accurizing, or spending any time for that matter, on a rifle that

has excessive headspace. This problem is frequently encountered in military rifles and can be corrected only by rebarreling or "setting back the barrel" (screwing the barrel further into the action, to a precisely determined point). Later you'll learn how to do this — but such a project isn't pertinent to this discussion.

Let's explain "headspace." In a properly headspaced rifle, the cartridge fits snugly within the chamber with the bolt face flush against the head (base) of the cartridge. When a high-pressure overload or years of firing standard



FIGURE 3 — The 98K German Mauser 7.92mm incorporates the famed Mauser 98 action, which is used today with only slight modifications on many contemporary custom sporters. (Reprinted from *Small Arms of the World*, courtesy Stackpole Book Co.)

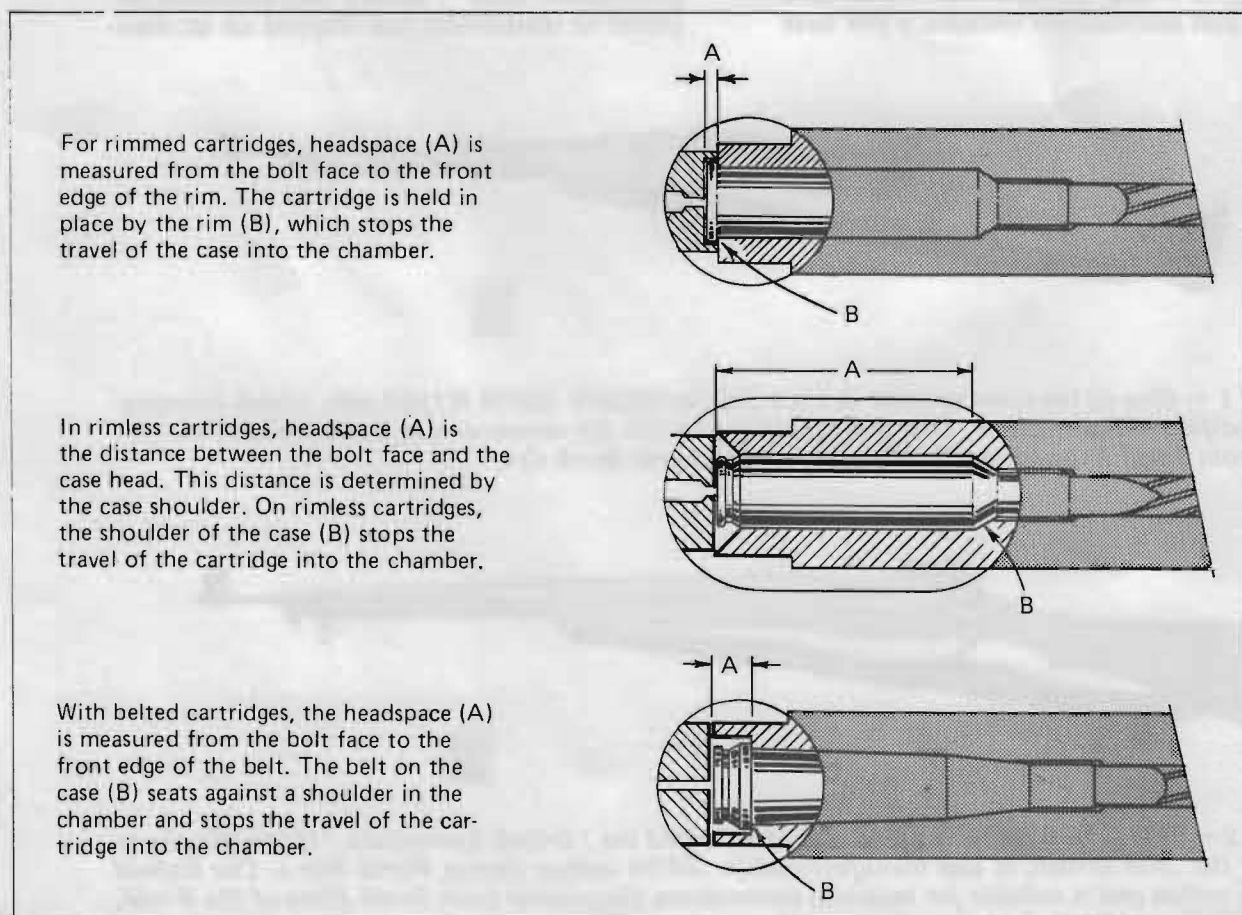


FIGURE 4 — Headspace measurements in rimmed, rimless, and belted cartridge chambers.

ammunition moves the barrel slightly forward against its locking threads, a pocket or "headspace" is created between the bolt face and the cartridge base. This empty space is small, measured in thousandths of an inch, yet it absolutely ruins accuracy and can permanently damage the rifle and the shooter.

Here is what happens when a cartridge is fired in a rifle with excessive headspace: The brass cartridge case stretches to fill this space, causing it to rupture or, at the very least, setting the stage for a future rupture if and when the case is reloaded (see Figure 5). A ring or discoloration indicating metal stress often forms around the case just ahead of the web.

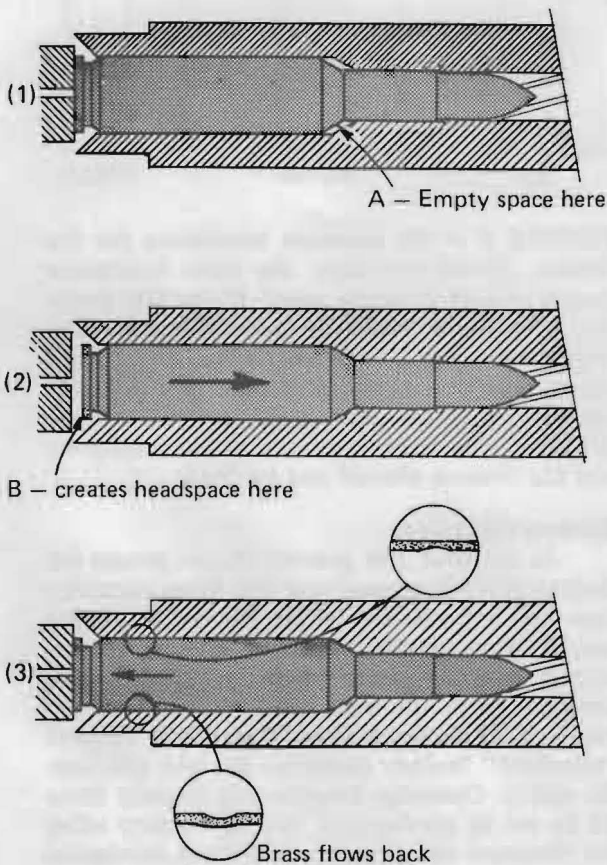


FIGURE 5 — When there is excess headspace in a rimless cartridge chamber (1), the striker forces the case forward until it bears against the front of the chamber, creating a space at the base of the cartridge (2). The brass expands, or flows back, to fill the chamber, creating stress on the web portion of the cartridge.

If the rifle is of modern design with the cartridge head completely enclosed in steel (see Figure 6), there is little initial danger to the shooter. The case swells on firing to fill

the chamber completely, blocking the escape of gases. Chamber pressure rises to 60,000 pounds per square inch (psi) or more. Modern rifles in good basic condition can withstand this pressure. For a while. Continued firing may ultimately increase headspace to the point where the case can't stretch enough to fill the empty headspace. Then primers pop and hot gases may be driven under tremendous pressure through the gas escape ports and into the shooter's hands and face. Excessive headspace doesn't go away. It gets progressively worse with each shot.

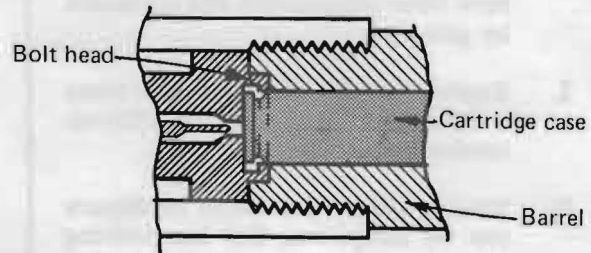


FIGURE 6 — When the cartridge is completely enclosed in steel as shown, there is little initial danger to the shooter because of cartridge expansion due to excessive headspace.

Most military rifles suffering from this malady pose a serious threat to the shooter's safety. Unlike more modern bolt-action designs, these rifles do not enclose the cartridge head in steel (see Figure 7). The web, that portion of the cartridge that usually gives way and ruptures under excessive headspace, is completely unprotected. When a case lets go, the rifleman, unless he's extraordinarily lucky, is going to be burned or worse by hot gas and tiny brass "daggers." This is why it's so important to check any military rifle that comes into your shop for proper headspace!

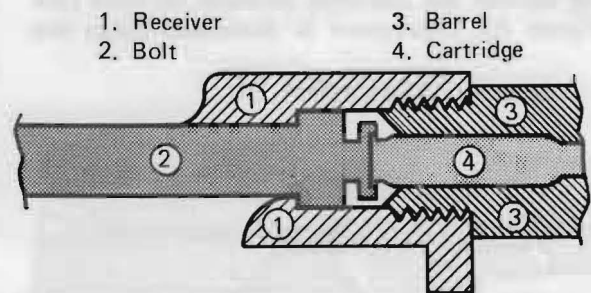


FIGURE 7 — The older military designs do not enclose cartridges in steel, and thus excessive headspace can be very dangerous. When the cartridge case "lets go," the explosive result can be disastrous to rifle and shooter. That's why it's so important to check for excessive headspace with any military rifle that comes into your shop.

Before going on, please do Programmed Exercise 1. Make sure you write your answers on a separate sheet of paper before looking at the answers on the page specified.

**PROGRAMMED EXERCISE**

1

1. True or false? All of the *military sporters* that you see are rifles that have been customized and accurized by gun pros.
2. Explain briefly what happens when a cartridge is fired in a rifle with excessive headspace.
3. True or false? Excessive headspace can be dangerous, but has nothing to do with the accuracy of the rifle.
4. True or false? Excessive headspace is more dangerous in rifles of modern design than in some of the older Springfields, Enfields, and Mausers.

Answers on Page 6

**Rimless Cartridges**

With the exception of the .303 British and a few obscure foreign cartridges, popular military rifles are usually chambered for rimless rounds — the .30/06, 7mm and 8mm Mauser. Japanese Arisakas have usually been rechambered for the .257 Roberts, which is based on the rimless 7mm Mauser cartridge.

Rimless cartridges are held in position within the chamber by the case shoulder bearing against the chamber contour or cone (see Figure 8). Headspace is measured from the

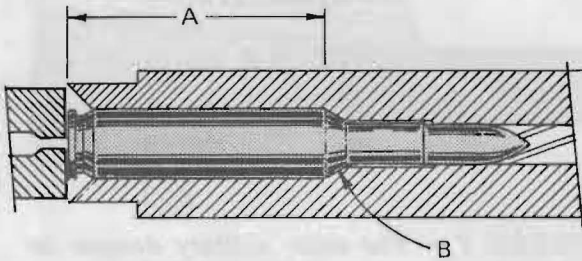


FIGURE 8 — With rimless cartridge chambers, headspace (A) is the distance between the bolt face and the case head, which is determined by the case shoulder. The shoulder of the case (B) stops travel of the cartridge into the chamber.

base (head) of the cartridge to an arbitrary point where the cartridge shoulder bears against the chamber.

**Three Types of Headspace Gauges**

The best and easiest way to check headspace is with gauges made for this purpose. Regardless of caliber or type of cartridge, three gauges are used for a given caliber. They are known as *Go*, *No Go*, and *Field* gauges.

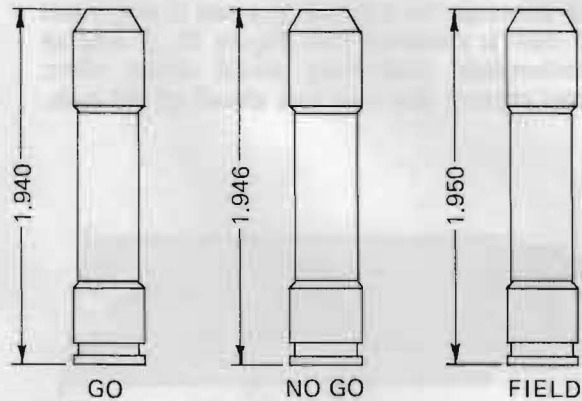


FIGURE 9 — To measure headspace for the rimless .30/06 cartridge, the three headspace gauges shown here are used. If the *GO* gauge fits, you know that you have the minimum length necessary. If the *NO GO* gauge fits, you know that you have an excess, or too much headspace. If the bolt closes on the *FIELD GAUGE*, you have much too much headspace and the firearm should not be fired.

**Rimless Cartridges**

In contour and general shape, gauges for rimless cartridges resemble the brass cartridge case for a particular rifle. The three gauges vary only in length. In .30/06 caliber, for example, the *Go* gauge measures 1.940" (the distance from the case shoulder point to the base). This dimension represents the longest "standard" factory cartridge the gun will handle safely. Cartridge lengths vary slightly from lot to lot in production, and all factory rifles are designed to accommodate both minimum and maximum-length factory ammo.

When the *Go* gauge is inserted in the chamber, the bolt should close easily, without any apparent force or pressure. It *won't* tell you if excessive headspace exists. It *will* tell you if the chamber is too short. This gauge is used primarily for checking progress and final work when chambering barrel blanks and when threading the barrel into the receiver.

The *No Go* gauge, slightly longer, is designed to reveal "mild" headspace problems. If the bolt can be closed on this gauge, easily and without pressure, it means that the rifle



is *probably* safe to fire, but that accuracy has fallen off. Rebarreling or barrel set-back is indicated now or in the near future.

The .30/06 No Go gauge measures 1.946" overall and indicates a *minimum* headspace excess of .006". The problem may be more severe.

Use of the field gauge is then indicated. (This gauge is so named because it was used during World Wars I and II to check Springfield rifles in the field.) The Field gauge measures 1.950" overall. Chambers that accept this gauge without pressure on bolt closing have a *minimum* headspace excess of .010". Such rifles are extremely hazardous and should not be fired under any circumstances! (U.S. military Springfields that flunked the Field test were always returned to the armory for rebarreling, stripping, or junking.)

HEADSPACE GAUGES FOR RIMLESS CALIBERS			
CALIBER	GO	NO GO	FIELD
22 Vaminter	1.574"	1.579"	1.583"
220 Swift	1.806"	1.810"	1.814"
222 Remington	1.294"	1.297"	1.300"
222 Rem. Mag	1.493"	1.496"	1.499"
243 Winchester	1.630"	1.634"	1.638"
308 Winchester	"	"	"
7.62mm NATO	"	"	"
358 Winchester	"	"	"
244 Remington	1.777"	1.781"	1.785"
250 Savage	1.574"	1.579"	1.583"
257 Roberts	1.794"	1.800"	1.804"
7mm Mauser	"	"	"
280 Remington	2.100"	2.1042"	2.1082"
284 Winchester	1.810"	1.815"	1.817"
30 Carbine M1	1.290"	1.296"	1.302"
M1A1, M2, M3	"	"	"
300 Savage	1.597"	1.602"	1.606"
30-06	1.940"	1.946"	1.950"
270 Winchester	"	"	"
25-06 Remington	"	"	"
8mm x 57 Mauser	1.896"	1.901"	1.905"

TABLE 1 — Length measurements for the various rimless caliber headspace gauges are shown above. Note that the same length gauge is used for different calibers in some cases.

Before going on, please do Programmed Exercise 2. Make sure you write your answers on a separate sheet of paper before looking at the answers on the page specified.

**PROGRAMMED EXERCISE**

2

1. True or false? Actually, headspace gauges measure length; that is, the only difference in the Go, No Go, and Field gauges for a .30/06 rimless would be in the length of the gauges.
2. Let's assume that you are checking four different .30/06 rimless cartridge rifles for headspace. How would you interpret the results below?
  - a. Go gauge fits comfortably  
No Go gauge does not fit  
Field gauge does not fit
  - b. Go gauge does not fit  
No Go gauge does not fit  
Field gauge does not fit
  - c. Go gauge fits comfortably  
No Go gauge fits comfortably  
Field gauge fits comfortably
  - d. Go gauge fits comfortably  
No Go gauge fits comfortably  
Field gauge does not fit

Answers on Page 7

**Rimmed Cartridges**

Few, if any, modern cartridges are of the rimmed design, although modern loadings for such oldtimers as the .303 British, .30-40 Krag, 8 x 57 JR, etc. (all rimmed) greatly exceed the original ballistics and provide near contemporary performance.

When center-fire cartridges were first developed, rims were a must. Virtually all cases, like the .45-70, were straight-walled with no shoulder to bear against the chamber and fix the positioning. Use of a case mouth abutment, employed in headspacing short, straight-walled pistol cartridges (see Figure 10), doesn't work well with long, higher-pressure rifle cartridges.

With a rimmed cartridge, the pressure of the bolt face against the head of the cartridge case holds the cartridge securely in position and the case rim prevents it from traveling forward into the chamber. During the transition period, when early center-fire cartridges "grew" shoulders, the rims were probably re-

tained to conform to existing chambering and headspacing machinery.

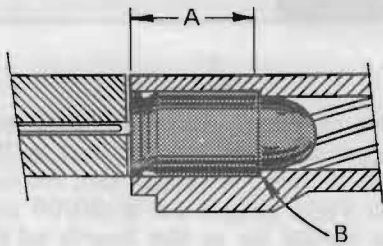


FIGURE 10 — Headspace (A) for rimless pistol cartridges is measured from the bolt face to the edge of the case mouth (B). The case mouth seats against the shoulder in the chamber and stops forward travel of the cartridge.

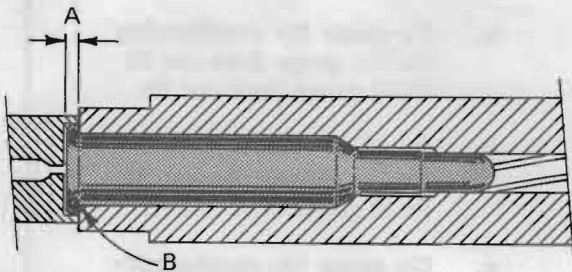


FIGURE 11 — For rimmed cartridges, headspace (A) is measured from the bolt face to the front edge of the rim. This very narrow rim measurement (B) holds the cartridge in place and stops the travel of the case into the chamber.

**ANSWERS**

1

1. False. Careful . . . in many cases an importer or distributor has slapped a sporter stock on a military arm for sales appeal — without doing anything else to it.
2. The brass cartridge case stretches to fill this space, causing it to rupture or weakening the cartridge. Stress on the metal can often be detected by a ring or discoloration on the cartridge.
3. False.
4. False.

Here, headspace is measured from the bolt face to the front edge of the rim (see Figure 11). Space in excess of the case rim thickness is excess headspace. Go, No Go, and Field gauges are also employed with rimmed cartridge rifles. Because of the short measurement length (only the thickness of the rim), short "button" gauges are used. These are carefully inserted against the chamber recess where the rim would normally bear and are held in place with a bit of grease. The bolt is then closed on the gauge.

Button gauges with pilots are also available for greater ease of handling. They eliminate the need for grease "adhesive." See Table 2.

HEADSPACE GAUGES — FOR RIMMED CALIBERS			
CALIBER	GO	NO GO	FIELD
219 Wasp & Zipper	.063"	.067"	.070"
22 Sav. H. P., 25-35,	"	"	"
30-30, 32 Win. Sp.	"	"	"
32-40, 38-55	"	"	"
22 Rimfire	.043"	.046"	.049"
275, 300, 375 Mag.	.220"	.223"	.226"
303 British	.064"	.067"	.070"
30-40 Krag	.064"	.067"	.070"

HEADSPACE GAUGES — FOR RIMMED CALIBERS			
CALIBER	GO	NO GO	FIELD
218 Bee	.065"	.069"	.072"
219 Wasp & Zipper	.063"	.067"	.070"
22 Sav. H. P., 25-35,	"	"	"
30-30, 32 Win. Sp.	"	"	"
32-40, 38-55	"	"	"
22 Hornet	.065"	.069"	.072"
22 Rimfire	.043"	.046"	.049"
275, 300, 375 Mag.	.220"	.223"	.226"
303 British	.064"	.067"	.070"
30-40 Krag	.064"	.067"	.070"

TABLE 2 — Headspace gauges for rimmed cartridge chambers are so narrow that they are frequently used with pilots for ease in handling. Because the gauges are so narrow, they are called "button" gauges.

Headspace tolerances are usually more critical for rimmed cartridges. With the .303 British, for example, only .004" indicates a "No Go" excess. (With the .30/06 rimless, it's .006".)

#### Belted Magnums

(You won't find any "as is" military rifles chambered for belted cartridges, but as long as we're on the subject of headspacing, this category should be included.)

Modern belted magnums such as the .264 and .300 Winchester mags, the 7mm Remington, etc. are somewhat paradoxical in that they incorporate a "new" but actually old device — a belt around the web of the cartridge. Like modern unbelted "standard" cartridges, the belted mags have sharp shoulders which bear against the front chamber slope and *could* provide headspacing support. In any event, the belts do increase case strength in a critical area (where separation normally occurs in a rifle with too much headspace) and strength is a must with high-pressure (up to 55,000 psi) magnum loads.

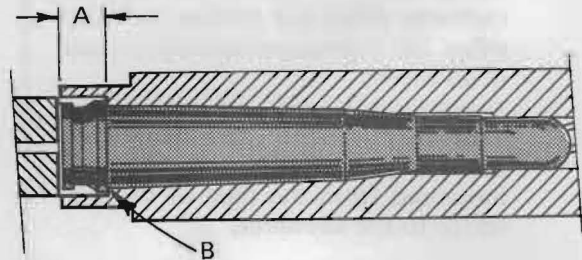


FIGURE 12 — Headspace (A) for belted cartridges is measured from the bolt face to the front edge of the belt. The belt on the case (B) seats against a shoulder in the chamber and stops the travel of the cartridge into the chamber.

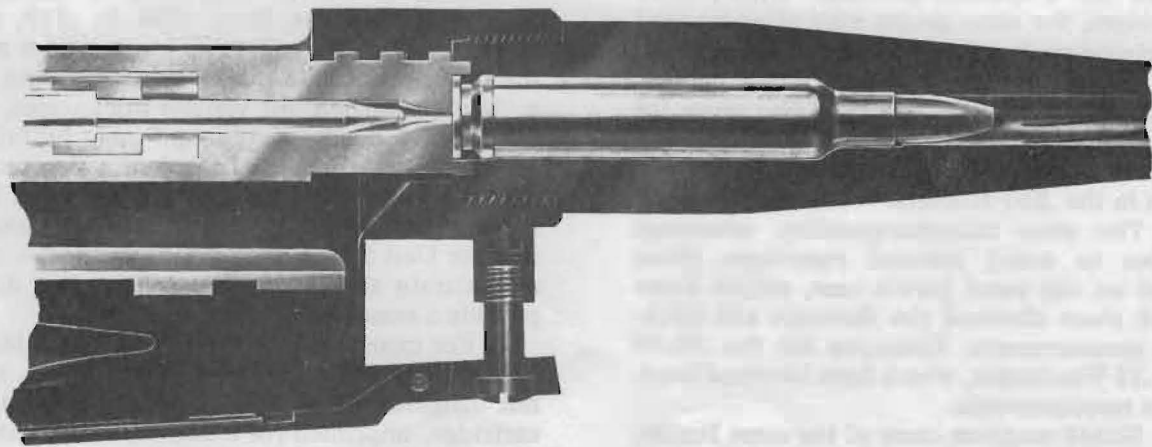


FIGURE 13 — Cutaway view of the Weatherby Mark V rifle action showing the cartridge case completely enclosed within the bolt face and the bolt enclosed within the barrel.

Belted cartridges, considered the newest, headspace like the oldest — the rimmed variety — against a recess cut in the rear of the chamber (see Figure 12). Because of the belt, the width of this inlet or recess is greater than one cut for a rim only.

The forerunner of all modern belted magnums was the English .300 Holland & Holland magnum developed in 1912. The .300 H&H, a hot performer for its day, required a belt. Aside from strength considerations, the long, sloping shoulder wasn't sharp enough for solid, front-of-chamber headspacing.

Roy Weatherby used this cartridge as the base for his first super-magnums and, while he added a comparatively sharp (actually rounded) shoulder, the belt was still there and he used it for headspacing. Thus, the highest velocities achieved at the time became synonym-

#### ANSWERS

2

1. True.
2. a. Measurement correct. Right amount of headspace.
- b. Not enough headspace.
- c. Dangerous; serious headspace excess.
- d. Excess headspace which affects accuracy; rifle probably safe to fire.



ous with belted brass "belting out" superpower. It's possible that the major arms companies, in developing their Weatherby-competitive magnums, decided to go along with or capitalize on this association rather than design belted cartridges with thicker webs.

Short (about 1" overall length) gauges of Go, No Go, and Field design are used for checking belted magnum headspace.

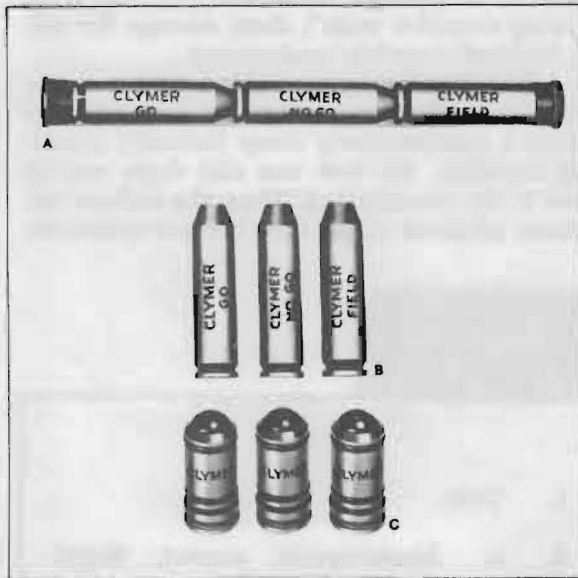


FIGURE 14 — The three varieties of rifle headspace gauges are shown above as sold by the Clymer Manufacturing Company. (A) Rimmed cartridge gauges (with pilot). (B) Rimless cartridge gauges. (C) Belted cartridge gauges (with O-rings to prevent scoring the chamber).

#### Headspace Gauge Interchangeability

Specific caliber gauges are not always required for a specific cartridge. With rimless cartridges, the same gauges may often be used for cartridges based on the same parent brass, even though they are of a different caliber. For example, you can use the same gauge for the .30/06 and the .270 Winchester, and the gauge that fits a 7mm Mauser (7 x 57) will work in the .257 Roberts.

The same interchangeability advantage applies to many rimmed cartridges, those based on the same parent case, and/or those which share identical rim diameter and thickness measurements. Examples are the .30-30 and .32 Winchester, which have identical headspace measurements.

Belted magnum cases of the same family, using the same cartridge case necked down or up to various calibers (such as the .257 and 7mm Weatherbys) may employ the same gauges.

Before going on, please do Programmed Exercise 3. Make sure you write your answers on a separate sheet of paper before looking at the answers on the page specified.

### PROGRAMMED EXERCISE

3

1. True or false? Headspace for a rimmed cartridge is actually the length measurement of the rim.
2. Button gauges are used for rifles which accommodate: (a) rimless cartridges. (b) belted cartridges. (c) rimmed cartridges. (d) all of the above.
3. Headspace tolerances are more critical for which of the following? (a) belted cartridge rifles. (b) rimmed cartridge rifles. (c) rimless cartridge rifles. (d) Tolerances are about equal in all three.
4. True or false? With rifles chambered for belted cartridges, headspace is measured from the base of the cartridge to the shoulder.

Answers on Page 10

#### An Alternate Method of Checking Headspace With All Types of Cartridges

As you can see from Table 1, excessive headspace may run from .003 to .010, depending on the cartridge. By cutting shim material of appropriate thickness, or building up a "shim sandwich" of various thicknesses, an inexpensive headspace "gauge" may be fabricated. Shimstock must be cut of a size to fit into the bolt recess, and the extractor and firing pin should first be removed (as explained in your Unit 2 Gun Shop). This method is not as accurate as using actual gauges, but does provide a reasonable safety index.

For example, let's take the .30/06. Headspace of .006" is "No Go" — excessive, but not dangerous in most instances. Insert a *new* cartridge, unprimed (or a dummy round made with new brass), in the chamber and use a dab of grease to affix a small piece of .006" shim material to the cartridge base. If the bolt can be closed with only slight resistance, the rifle

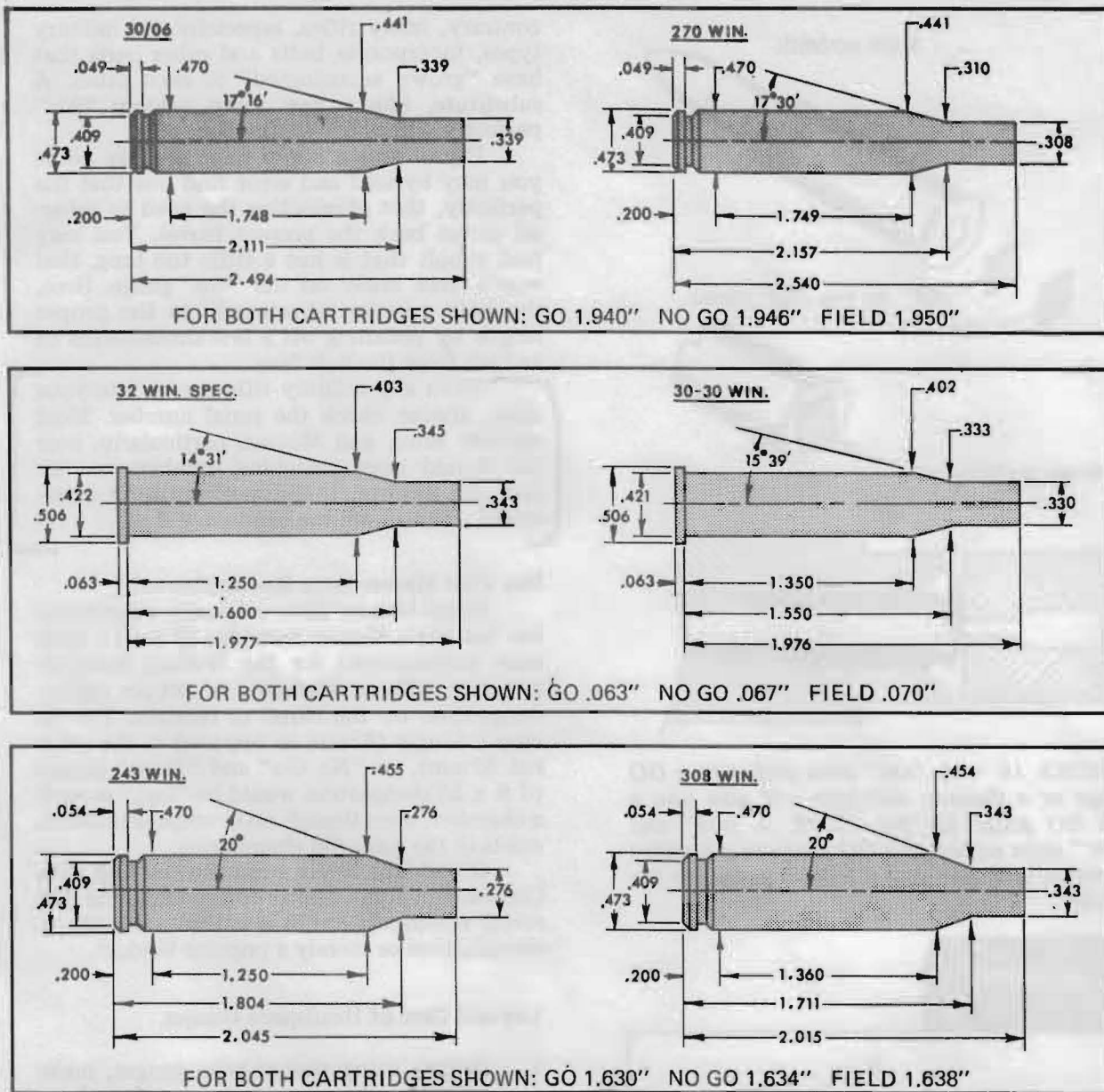


FIGURE 15 — Examples of cartridges for which headspace gauges are interchangeable. (Photos courtesy Hornady)

has at least a "No Go" headspace excess. Even though factory cartridges may vary slightly from specification, your measurement will be within the tolerance that you need.

Now add .004" shimstock (or use a piece of .10"). If the bolt closes, again with only slight pressure, you have a "Field gauge" problem or worse, and the rifle should be retired or reworked immediately.

It is important that you always use new brass when checking headspace with the shim method. A fired case from the rifle you're working on has probably stretched to fill the headspace area, thus falsely indicating "no

headspace problem." The only exception is when you have a fired case of the same caliber from a rifle you know for sure is correctly headspaced. This may be used in the suspect rifle in lieu of a new case.

By checking "No Go" and "Field" specifications for specific cartridges, and using shims of appropriate thickness, you can "build" your own gauges. Always use a micrometer to check your shimstock or "sandwich" as no one is sufficiently eagle-eyed to determine the proper thickness by "eyeballing." Also, supply houses have been known to err.

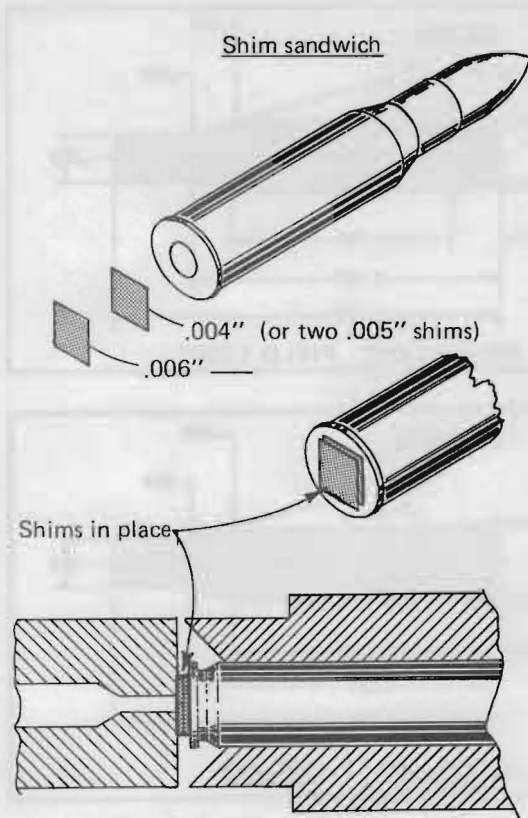


FIGURE 16 — A .006" shim added to a GO gauge or a dummy cartridge will give you a NO GO gauge for the .30/06. A .004" and .006" shim added to a GO gauge or a dummy cartridge will give you a FIELD gauge for the .30/06.

## ANSWERS

3

1. True.
2. C
3. B
4. False. It's measured from the base of the cartridge to the front edge of the bolt.

### A Word of Caution on Bolt Interchangeability

When repairing, altering, or otherwise working on military rifles (or any rifle for that matter), do not substitute a bolt of identical make without checking headspace. Mass production and parts interchangeability to the

contrary, many rifles, especially old military types, incorporate bolts and other parts that have "grown accustomed" to each other. A substitute, like a new mate, seldom "fits" perfectly without adjustment.

If you have a bin of spare military bolts, you may by trial and error find one that fits perfectly, thus eliminating the need to rebarrel or set back the present barrel. You may find a bolt that is just a trifle too long, that won't close easily on the "Go" gauge. Here, the bolt may be "shortened" to the proper length by polishing off a few thousandths of an inch from the bolt face.

When any military rifle comes into your shop, always check the serial number. Most military arms, and Mausers particularly, bear (or should bear) matching numbers on the bolt and receiver. If the numbers don't correspond, chances are the headspace is off.

### Has That Mauser Been Rechambered?

Many Mauser 98's, originally chambered for the 8mm Mauser cartridge (8 x 57), have been rechambered for the Wildcat 8mm/06 cartridge without stamping of proper caliber designation on the barrel or receiver. The 06 case is longer (63mm as opposed to the original 57mm), so "No Go" and "Field" gauges of 8 x 57 designation would be "lost" in such a chamber, even though no headspace problem exists in the 8mm/06 chambering.

If in doubt, make a chamber casting with Cerrosafe or some similar compound. This will reveal whether the rifle is indeed a headspace abomination or merely a popular Wildcat.

### Use and Care of Headspace Gauges

1. Before using rimless-type gauges, make sure the chamber is clean — free from oil, grease, and/or grit.
2. Apply grease sparingly (only a dab) to act as "adhesive" in holding button gauges without pilots in position.
3. Never use force when closing the bolt on any type headspace gauge. Only a slight "feel" of gauge is required. Aside from ruining the gauge, forcing a Go gauge merely jams it into a too-short chamber. Forcing a No Go could "indicate" a headspace problem that *doesn't* exist. Forcing a Field gauge could indicate a more serious headspacing problem than *actually* exists. **WHEN CLOSING THE BOLT, YOU SHOULD BE AWARE OF ONLY VERY SLIGHT RESISTANCE.**



4. Extreme care should be taken to make sure the gauge is seated correctly so "hang-up" of the extractor, lugs, firing pin, etc. doesn't prevent accurate measurement.
5. When possible, remove the extractor and firing pin from the bolt before using the gauges (your Gun Shop section shows how). This eliminates any possibility of the gauge hanging up.
6. The most valuable gauge is the No Go. From an economy standpoint, you are better off buying three different caliber No Go's than a complete set of three in a given caliber.
7. Headspace gauges are precision tools and should be treated accordingly. Store them in separate containers where they can't become scratched. Apply a light oil film to prevent rust. And don't drop them on cement floors!

Before going on, please do Programmed Exercise 4. Make sure you write your answers on a separate sheet of paper before looking at the answers on the page specified.

Now turn to your Unit 2 Gun Shop, where we show you, step by step, how to actually use headspace gauges, check bedding

## PROGRAMMED EXERCISE "

4

1. From Table 1, determine which of the following would take the same headspace gauges: (a) .308 Winchester and 7.62mm NATO. (b) .222 Remington and .244 Remington. (c) .250 Savage and .257 Roberts. (d) .280 Remington and .284 Winchester.
2. True or false? In the .30/06, the Field gauge is ten thousandths of an inch longer than the Go gauge and four thousandths of an inch longer than the No Go gauge.
3. True or false? To check headspace on a .30/06 rifle, if you used a spent cartridge and a .006" shim, and the bolt *did not close*, the indication would be that you had NO HEADSPACE PROBLEM.

Answers on Page 12

and correct any problems, lighten trigger pull, etc. — all of the things that add up to accurizing military and many other rifles.

1. A
2. True. .010" and .004" longer are correct.
3. False. Sorry about that, but you should not use a spent cartridge when measuring headspace. It has probably expanded to fill the chamber if it was fired from a gun that has excessive headspace.