

David Tubb's Competition 6mmXC die set

Engineered
by 10-time
National
High-Power
Champion
David Tubb

from **Superior Shooting Systems Inc.**

[the leader in high-performance accessories for the competitive shooter]

Information & Instructions

[SAFETY NOTE: Reloading ammunition is a potentially dangerous activity. Please take time to familiarize yourself both with this product as well as accepted safety practices. If you do not fully understand something, please call us for help at 1-806-323-9488. Play it safe!]

Origin

The "original" 6mmX (20-degree shoulder) resulted from chambering a barrel using a .243 Winchester reamer held (stopped) 0.132 inches short of its intended depth. This was done to allow use of a .22-.250 case. The 6mmX sizing die was made by shortening a .243 Winchester die (seating die also) 0.145 inches (additional length was based on varying shellholder heights; this ensured the case could be run fully into the die and attain adequate case shoulder contact). We then took a .22-.250 case and ran it fully into this sizing die and then loaded the rounds and fire-formed the case in the 6mmX chamber. The .22-.250 case neck could initially be expanded using the sizing die provided a tapered (.17 cal. to 6mm [.243 cal.]) Redding expander was installed or that the expander had been modified with a taper.

The 6mmXC (30-degree case shoulder) cartridge came about as a natural progression from shooting the original 6mmX. The 6mmXC has some features which I feel are more desirable compared to the 6mmX. —



Superior Shooting Systems Inc. custom 6mmXC die set components [left to right] Redding competition bullet seater / gauging bushing in use on case / .265 and .267 neck/shoulder sizing bushings / sizing die body / decapping stem with tapered expander installed, bushing retainer / decapping pin retainer to replace expander after initial sizing

- 1.) The cartridge case body length is 0.023 inches shorter than the 6mmX. This means that 6mmXC chamber reamer now cuts the base of the case closer to the original .22-.250 base diameter.
- 2.) Shortening the case body also allows for less longitudinal (length) stretching during fire-forming. This will result in the 6mmXC having a greater case life (more firings).
- 3.) Its 30-degree case shoulder allows less case growth (less trimming required).

I have found that velocities attainable with the 6mmXC are equivalent to those attainable using .243 Winchester. Barrel life is much better than .243 Winchester due to the fact that the XC has about 7 grains less powder capacity.

Sizing Die

This custom resizing die has some advantages over conventional neck bushing style dies.

- 1.) On our die, both the neck and shoulder are included in the bushing, not just the neck. This is a better design because it allows excess sizing lubricant a place to escape and not make a dimple on the shoulder of the case. It also allows changing the bushing to make a caliber change (say, to a 6.5mmXC) or you can make a shoulder angle change (say, to 45 degrees) and you can still use this same body die. You could effectively use this die for any caliber and any shoulder angle as long as you use the .22-.250 as the parent case.
- 2.) By having an integral neck and shoulder bushing, the entire case neck is able to be resized, unlike a neck bushing full-length sizing die in which the very bottom of the case neck is NEVER resized. Plus, having the neck and shoulder bushing consolidated is an asset to alignment and preservation of concentricity in the sizing operation.
- 3.) Since the neck and shoulder area are one piece, it is also possible to adjust the amount or extent of case body sizing and shoulder set back independently, without compromising and being unable to size the full length of the case neck to prevent having too much shoulder set back. I like to have the full length of the case body sized (die threaded fully down to shellholder) and then adjust the height of the neck/shoulder bushing independently to specify the amount of case shoulder set back (this process is explained on Page 5 in these instructions).
- 4.) This die comes with two different bushings for use in sizing, and a third bushing designed to be used to determine cartridge case headspace when used in conjunction with a set of dial or digital calipers. The use of this “gauging bushing” will be explained later. The two sizing bushings have different neck diameters and, thus, will result in different amounts of case neck tension. The bushing diameter is clearly indicated on each bushing. Keep in mind that the sized case neck will be approximately 0.001 inches larger than the actual bushing diameter; this is due to spring back in the brass.
- 5.) This die features a tapered expander plug (.17 cal. to 6mm [.243 cal.]) to neck up the parent case's .224 caliber neck diameter to .243. The taper greatly eases this operation and results in less stress being placed on the case neck.
- 6.) The die also has a separate decapping pin retainer for use without an expander plug. The expander should be unnecessary once the case has been fire-formed (this retainer won't expand the neck when you resize).

Sizing and Preparation for Fire-Forming

To prepare a .22-.250 case for use in the 6mmXC chamber, adjust the sizing die to fully engage the shellholder to ensure that the cases get maximum run up into the sizing die. Run the press ram to its fully “up” position and thread the die body downward until it is touching the shellholder. Thread the die body lock ring down until it stops against the top of the press.

The threaded portion of the die that retains the neck/shoulder bushing should be tightened down snugly against the bushing; thread down the lock nut to secure it. These die settings may need to be adjusted after this initial use but it is imperative to fully size these cases prior to fire-forming. Adjustment instructions are in this material.

When forming (running through the sizing die) the 6mmXC you will be setting and reforming the shoulder radically enough that you will get a bit of “mushrooming” at the shoulder/case body junction [see photos]. This is nothing to be concerned about. The case body will blow out circumferentially to the chamber dimensions upon fire-forming.

View of .22-.250 case after initial sizing in 6mmXC die: note the “mushrooming” evident in the case shoulder area. This is perfectly normal. Don't be concerned if this initial sizing of the .22-.250 case produces creasing or a denting in of the case body under the shoulder as evident in this example. This area of the case will expand and conform to the rifle chamber when the round is fired and make for a correctly formed 6mmXC ready for many firings.



Forming Tips

When initially working the cases I use a cotton swab and some powdered moly (graphite will work) to lubricate the inside of the .22-.250 case neck. This eases the tapered expander into and through the neck with less resistance. I also use Imperial Sizing Die Wax on the case neck and shoulder. Don't wipe it off after sizing! I leave the lubricant on the case neck and shoulder for fire-forming as I feel this will help the case fully expand to the chamber with as little resistance as possible.

Note for 6mmX Users

If you changed barrels on your rifle and went from the 20-degree shoulder 6mmX to the 6mmXC, you can use all your old 6mmX cases. Just run them through this new sizing die as was instructed for .22-.250 use and fire them in the new rifle. The overall length on all 6mmX cases (20- and 30-degree shoulders) is 1.911 inches (suggested trim length is 1.900). Since the 6mmXC sizing die will be reforming the shoulder somewhat on the old 6mmX cases, you will very likely have to do some case length trimming on the sized 6mmX cases to get them to the correct length.



[left to right] virgin .22-.250 brass / new (unfired) .22-.250 case after having been run through the 6mmXC die (note the normal shoulder mushrooming and case body creasing/denting) / a fire-formed 6mmXC case / a fire-formed 6mmX (20-degree shoulder) case / a 6mmX after having been run through the new 6mmXC die, now ready for fire-forming in the 6mmXC chamber.

Fire-Forming Load

Keep in mind that in order to properly fire-form the case with the first firing, the charge must be stiffer than what you would use for your short range load (200 and 300 yards). Your bolt will open very easily for Rapid Fire while fire-forming with the stiffer charge. [Load suggestions are found on Page 6 of this material.]

For fire-forming I use a load which is between my short range and long range load. This is because I am usually shooting this through a new barrel and know that my short range load is reasonably mild, while my long range load is definitely hotter. Since I don't know exactly what my 600 yard load will be for a new barrel, I back off of my normal 600 yard load 1 grain. This just happens to be about 1 grain more than my short range load.

I am using 107gr. moly-coated bullets for all stages or events and also for fire-forming. I would recommend that you seat your bullets (whichever bullet you might use) so that the bullet is just touching the lands (rifling) for fire-forming. This does a couple of positive things: it puts the un-fire-formed head of the case directly against the bolt face. It also assures a little more firing pressure, which enhances the fire-forming.

What you are actually doing in fire-forming a .22-.250 case into a 6mmXC is really no different than shooting a new piece of brass in any chamber. When a .308 Winchester case is fired in a .308 Winchester chamber, the case is fire-forming (though slightly) to the chamber of your particular rifle. Some rifles (particularly rear locking lug designs) shoot their best groups when fire-forming.

As said earlier, I leave residual case sizing lubricant on the case neck and shoulder during fire-forming as I feel this will help the case fully expand to the chamber with as little resistance as possible.

I would not be hesitant to shoot my fire-forming load in a match, even for a Rapid Fire event. The mushrooming of the case shoulder actually helps the case feed with more consistency (larger shoulder diameter) than the normal .22-.250 body taper. As said, even with the stiffer fire-forming charge, the bolt will still open very easily for Rapid Fire use.

Accessory Notes: If you use a Gracey or LE Wilson case trimmer (or other LE Wilson, or similar, products) get the tooling for a 6BR and it will work just fine. These particular products function either off the neck and shoulder configuration of a round and/or the body diameter and taper. Again, the 6mmXC is the same as a 6BR with respect to these dimensions.

Seating Die

The bullet seating die for the 6X is a Redding 6BR competition seater. This die features close tolerances and a spring-loaded, sliding sleeve that accepts and supports the cartridge case prior to moving it up to seat a bullet.

The dimensions are extremely close for 6mmXC and 6BR rounds (except the overall length). While the 6mmXC definitely is longer, the fact that the 6mmXC case will protrude out of the back of the 6BR seating die is of no concern. The forward portion of the case body as well as the neck and shoulder are supported adequately by this die to seat the bullet into the case with minimal runout.

To install and adjust the 6BR seater into your press for use with 6mmXC, do not follow Redding's instructions as the 6mmXC round is longer (the bottom of the die cannot be situated as near the shellholder). Instead, I suggest placing a fire-formed 6mmXC case into the shellholder with the press ram run fully "up" and then threading the die into the press until light contact is encountered, indicating that the case shoulder has contacted the corresponding portion inside the sliding sleeve on the seating die. Then turn the die farther in until stopping resistance is felt, indicating that the sleeve has compressed fully into the die body. Back the die up a turn and leave it at that. The bottom of the die will show a sizeable gap to the shellholder, but this is again due to the shorter 6BR round length and in no way compromises the function of the seating die. The case neck and shoulder area are still getting full support, as designed.



The Redding competition bullet seater.

Selecting a Sizing Bushing



Two neck/shoulder sizing bushings are included with the die set. One is .265 diameter, one is .267 diameter. Depending on the make and lot of brass you're using, there may be different neck wall thicknesses. I choose a bushing that gives me 0.003-plus case neck tension on the bullet. In other words, I measure the sized case neck inside diameter and want that to be 0.003 smaller, or slightly more, than the actual bullet diameter (0.243 inches).

Another way to do it is measure the outside diameter of the case neck of a loaded round and subtract 0.004 from that figure (accounting for spring back in the brass); use the bushing that is closest to that figure, but err on the side of the smaller bushing. My experience has been that the only real danger is having too little neck tension to hold the bullet (less than 0.002 inches difference).

Depending on the neck wall thickness of the lot of brass you're using, either of these bushings should work well. Included are a .265 and .267.

Sizing Note

Due to differences in wall thickness and brass characteristics, different brands and lots of brass may size "differently" than others. The best way to proceed might be to size a few cases using each bushing and see what the end results are by measuring outside case neck diameters before and after seating a bullet into them. That is the sure way to determine case neck tension, and, therefore, which bushing to choose for routine sizing use. Sorry, but custom size bushings are not available.]

Gauging Bushing Use

We have included a special neck/shoulder bushing that has an extra-large diameter neck area. This bushing is NOT to be used for sizing, but rather is intended as a means to gauge case shoulder set back, and, consequently, as an aid to determine the correct amount of sizing and determine correct sizing die adjustment.

After fire-forming, take a fired case and place the gauging bushing over the case neck, letting it stop on the case shoulder. Using a suitable caliper, measure from the base of the case to the top end of the gauging bushing (take several readings and average). Record this figure. This figure is a close approximation of the chamber headspace in your rifle (the figure you read from the case will be a little shorter than the actual chamber dimensions because brass contracts a small amount after expansion during firing).

Next adjust the sizing die downward, checking progress using the caliper and gauging bushing, until the sized case shows the same caliper reading as you got with the fired case. This shows that the neck/shoulder sizing bushing has contacted the case shoulder. [Note that the case body is being sized to a smaller diameter and this will, correspondingly, effectively lengthen the case compared to what it was fresh out of the rifle chamber; this will stop once the sizing bushing has made contact with the shoulder.] I recommend now adjusting the die downward a little more until the gauging bushing shows the sized case 0.003-0.004 inches shorter. This indicates that the case shoulder has been "set back" that amount. Setting the case shoulder back that 0.003-0.004 inches ensures that the rounds will function easily and reliably through the rifle. If the case shoulder is contacting the chamber, the bolt will be harder to close. It can also cause other problems, but all are avoided by setting back the case shoulder the amount recommended, and even a little more does not compromise accuracy.



Shown is the decapping stem with tapered (.17 caliber to 6mm [.243]) neck expander installed. After initial sizing of the .22-.250 cases you don't need to use the neck expander unless somehow you are really dinging the necks on your fired brass. Replace it with the knurled decapping holder [shown on right]. This part will retain the decapping pin.



Fired case in the caliper with the gauging bushing in place.

Option: Since the neck/shoulder bushing is capable of independent adjustment and not necessarily dependent on the positioning of the die body to attain the necessary degree of case shoulder contact, some people will prefer to proceed in another way. The position of the sizing die body with respect to its height above the shellholder when the press ram is run fully upward determines the extent the case is run up into the sizing die body. This, in turn, influences the amount of contact made with the die body interior nearer the base of the case. The maximum amount, of course, is limited by shellholder contact with the bottom of the sizing die body. To get maximum case body sizing (maximum length of the case body contacting the die interior), thread the die body down until it touches the shellholder, as instructed earlier for initially sizing .22-.250 cases. If the threaded retainer for the neck/shoulder bushing is also snugged down fully against the neck/shoulder bushing, this is liable to result in excessive case shoulder set back. To attain the correct amount of case shoulder set back, leave the die body touching the shellholder and instead back out the threaded retaining piece until desired contact and case shoulder set back is attained. When you're backing off the threaded retaining piece, you are allowing the neck/shoulder bushing to elevate slightly, thus controlling the degree or amount of contact it will have with the case shoulder.

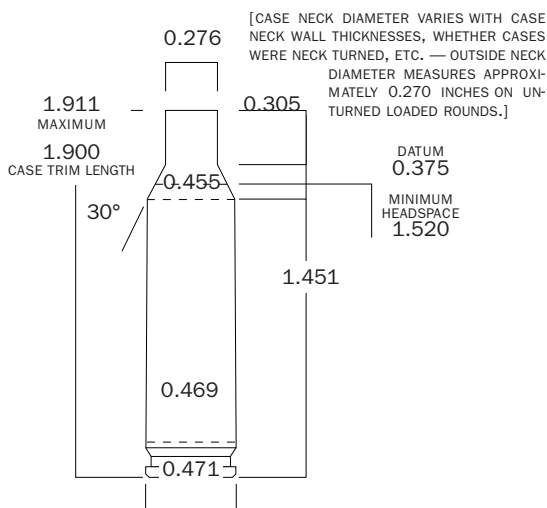
I prefer this method of die adjustment because I am a firm believer in sizing cases to minimum body diameter allowable by the sizing die. I do this for reasons of function and have yet to see more or less case body sizing affect accuracy in any of my rifles.

IMPORTANT! If you're using "Tubb" 6mmXC brass from Superior Shooting Systems Inc. reduce all charges listed on this page by 2 full grains. This brass is thicker than the Remington brass these loads were originally worked up with.

6mmXC Cartridge Specifications

[6mmX with 30° case shoulder]

[figures indicated in drawing are minimum **chamber** dimensions, unless otherwise noted]



The loading data below was attained using the following combination of components:

Remington .22-.250 parent case
Federal 201M [match] primer

I have had good success with all propellants listed in this loading table. My winning load for 2002 was with Hodgdon 4350; in 2001 I won with Viht. N150.

New cases may require a few firings to attain a length beyond 1.900. This is nothing to be concerned with as it is perfectly fine if the cases are a little bit short.



Load Suggestions

[ALL loads listed are with moly-coated bullets! Using these loads with non-coated bullets will result in higher pressures.]

[PLEASE NOTE also that ALL loads listed are with a new Gary Schneider polygon barrel. Conventionally-rifled barrels will require more propellant to attain listed velocities.]

Note: After your 6mmXC cases are fire-formed using one of the fire-forming loads listed below, I suggest starting at that listed fire-forming load when working up your 600 or 1000 yard load. Chronograph and watch for pressure signs.

Fire-Forming Loads

with Sierra 107gr. moly-coated MatchKing
VihtaVouri N150: **33.0 gr.** [approx. 2900 fps]
Hodgdon VARGET: **33.0 gr.** [approx. 2900 fps]
Hodgdon 4350: **37.0 gr.** [approx. 3000 fps]
VihtaVouri N160: **37.0 gr.** [approx. 3000 fps]

200 Yard Event Loads

with Sierra 107gr. moly-coated MatchKing
VihtaVouri N150: **32.0 gr.** [approx. 2850 fps]
Hodgdon VARGET: **32.0 gr.** [approx. 2850 fps]
Hodgdon 4350: **36.0 gr.** [approx. 2950 fps]
VihtaVouri N160: **36.0 gr.** [approx. 2950 fps]

300 Yard Rapid Fire Loads

with Sierra 107gr. moly-coated MatchKing
VihtaVouri N150: **32.0 gr.** [approx. 2850 fps]
Hodgdon VARGET: **32.0 gr.** [approx. 2850 fps]
Hodgdon 4350: **36.0 gr.** [approx. 2950 fps]
VihtaVouri N160: **36.0 gr.** [approx. 2950 fps]

600 or 1000 Yard Event Loads

with Sierra 107gr. moly-coated MatchKing
VihtaVouri N150: **34.0 gr.** [approx. 2950 fps]
Hodgdon VARGET: **34.0 gr.** [approx. 2950 fps]
Hodgdon 4350: **38.0 gr.** [approx. 3020 fps]
VihtaVouri N160: **38.0 gr.** [approx. 3020 fps]

Short Line Loads (reduced bullet weight)

I use 107gr. bullets across the course. Due to the inherently light recoil of this round and bullet weight combination, I see no need of reducing bullet weight, and it never hurts to shoot a bullet at all yard lines that offers superior wind-bucking capability. However, if someone wants to experiment with lighter bullets for 200 yard events, I would simplify matters by shooting the 600 yard load with the lighter bullet. A very light bullet, like a 70gr., might need to have the charge increased a grain or more, but the idea is to reduce recoil and also ensure flawless bolt operation, so I don't think a maximum velocity load is wise in this instance.

Check the web site for updates and loading information: www.davidtubb.com

If you'd like to learn more about all topics in these instructions (fire forming, sizing, etc.) I suggest getting a copy of *Handloading for Competition* by Zediker Publishing. The web site is www.zediker.com or call 662/473-4637.