HUTTON RIFLE RANCH

RIFLE POWDER SELECTION

	Burning Rate Order	Powley Computer and DuPont (IMR)	Hercules	Hodgdon	Norma	Herter	Winchester-Western	Nobel (Ely-Kynech)
1.	(Slow)	A.		6915				
				X283				
				H-202				
2.		5010		H-5010				
3.		B.		H-570				
				H-870				
4.		C(7828)						
5.				H-4831	205,MRP		785	
		IMR 4831		H-450				
6.		IMR 4350			204			
7.		D.	Rx21	H-414				
				H-380		100		0
8.		IMR 4320					760	
9.		IMR 4895		H-4895		101		1
10.		IMR 4064		H-375				
11.		E.			203			
				H-B1.C2				
12.		IMR 3031	Rx11	H-335	201	102	748	2
13.		F.	HiVel 2					
14.		IMR 4198	Rx7		200	103		3
15.		IMR 4227					680	
16.	(Fast)	G.	2400					

Use Magnum Primers with 4350 and slower powders.

This table is intended to show as closely as possible how powders are related. The Powley Computer is based upon single-base DuPont powders, the powders whereby others are judged; but the other powders relate to the computer only when they are compared to a computed load, not as calculated percentage-wise. This is not a loading table but it shows how the burning rate of powders compare, at about 45,000 psi.

Because of the precise instructions requested by Winchester-Western we urge you to consult the 1975 BALL POWDER LOADING DATA available free at most gun stores or from Winchester, 275 Winchester Ave., New Haven, Ct. 06504. Since we have no control over conditions of use we assume no liability for the results obtained.

EXAMPLES

	.30-30-170 gr.	Speer	20" Bbl.
Capacity	37	Drop 5%	
Load	32.5	31.3	
Ratio of charge to bullet Wt.	.19		
Sec. Den.	.257		
IMR	3031	3031	
Expansion Ratio	10		
Muzzle Velocity	2240 fps	2128	
Pressure	46,000 psi	41.M psi	

Dupont load: 32 gr. 3031 gives 2120 fps and 37,000 psi

	.25-06 Rem.	120 gr.	24" Bbl.
Capacity	62.2		
Load	50.6	50.6	
Ratio of charge to bullet Wt.	.45		
Sec. Den.	.259		
IMR	H4831	4350	
Expansion Ratio	5.4		
Muzzle Velocity	2970	3118	
Pressure	46 M psi	51 M psi	

Dupont: 48 grs. 4350 = 51,500 psi.

THE POWLEY psi CALCULATOR:

How to use the PSI Calculator to increase or decrease pressure;

How to adapt loads to other pressures — the sophisticated steps..........

The Powley Computer for Handloaders generally gives a loading combination producing pressures of approximately 45,000 to 46,000 psi. For pressure or powder changing purposes, the powders shown to the right of the "correct" powder will produce higher pressures for the same charge of powder and those to the left lower pressures.

The amount of pressure increase or decrease depends on how far from the "correct" powder you move. For instance, if a "correct" load is 60 grains of 4831 (at 45,000 psi), then 60 grains of 4350 will produce about 50,000 psi and 60 grains of "D" about 55,000 psi. It follows that 60 grains of 4320 would produce pressures near 60,000 psi and would not be recommended for any sporting rifle with the cartridge case the size of our hypothetical one with which we started.

Going in the other direction, that is to the left, lowers the pressure approximately the same 10% per powder step. These pressure ratios can be combined with changes in the charge. In the pressure ranges for sporting ammunition, a 5% increase or decrease in powder charge will produce a 10% increase or decrease in pressure. For example, if 60 grains of 4831 produces 45,000 psi, 63 grains will produce about 50,000 psi. Obviously, the case volume will become the limiting factor fairly soon.

On the other hand, you can get back to the same pressure when switching to a faster powder by reducing the charge. Again, using 60 grains of 4831 to give 45,000 psi, moving to 60 grains of 4350 will give 50,000 but reducing the charge to 57 grains of 4350 will get you back to 45,000 psi again.

These percentage changes work pretty well for a change of not more than ±3 powder burning rate classes. Naturally, any new load should be approached from the mild side and abandoned immediately if pressure signs appear.

	.270 WCF –	150 gr.	Sierra B.T.	24" Bbl.
Capacity	64.4	up 5%		
Load	56	58.5	56	
Ratio of charge to bullet Wt.	.37			
Sec. Den.	.279			
IMR	H4831	H4831	4350	
Expansion Ratio	6.			
Muzzle Velocity	2770	2845	2845	
Pressure	46 M	Up 10%	51 M psi	

Dupont: 54 grs. 4350 = 2930 @ 53,400 psi.

POWLEY COMPUTER

FOR

HANDLOADERS

INSTRUCTION MANUAL

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POWLEY COMPUTER
for
HANDLOADERS

INSTRUCTION MANUAL

PART I

EFFICIENT POWDER SELECTION

You are to be congratulated on having an advanced type of computing device which makes it very easy for you to find the best load for your rifle. This comes about as the result of extensive design studies for High Velocity rifles which had not been previously undertaken.

ACCURACY

Your computer will always specify a nearly full case of powder, but not packed. There are two reasons for this. First, to be discussed later, is for you to get highest possible velocity. The second is for you to obtain the most uniform ignition. This is very important for uniformity of pressure from shot to shot so that uniform velocities result. You hardly need be told how important this is for accuracy.

General Hatcher in HATCHER'S NOTEBOOK on p. 398 shows that with 49 grs. of a powder in the .30-06, the average velocity was 2611 f/s with the primer down and 2567 with the primer up; the pressure difference was 3500 psi. This is because the case was not even nearly full.

Density of loading is the ratio of the weight of powder used to the weight of water which will fill the powder space.

Your computer will start with a loading density of 0.80 for 4198 and 4227; for all other powders it is 0.86.

VELOCITY

Your computer lists by Powder Number DuPont's IMR powders. These are all straight nitrocellulose powders with some chemical modifications. For all practical purposes, a given weight of one will develop the same total energy as any of the others. Therefore, the more powder we burn, the greater the energy and the higher the velocity we can expect to obtain. The computer, as already described, will nearly fill the case without overdoing it. We can then expect to get maximum velocity.

There is an IF here, however. The amount of energy delivered to the bullet is very highly dependent upon the maximum pressure developed. We have to say that we will get greater velocity from one of the IMR powders the more we use, IF the maximum pressure remains the same.

All loads directly indicated by your computer will result in approximately the same maximum pressure. This preserves one of the central features of the computer and that is to give you maximum velocity with good working pressure. In other words, you will obtain maximum performance from the selected combination.

IMR POWDERS

As indicated earlier, all these powders have substantially the same composition and energy. They are extruded tubes of varying sizes which are chopped to short lengths before coating. On your computer they are arranged so that, moving to your left the powders increase in size and, moving to your right the powders decrease in size. A small size powder of given weight will have a total surface greater than the same weight of large powder. This means that, when ignited the gas evolution is faster for the small powders than the larger powders. Thus we can say that 4227 is smaller and faster than 5010 which is larger and slower than the others.

DuPont has standardized the performance of powders supplied to handloaders in canisters; 5010 and 4831 are not presently supplied in canisters.

The rate of burning is governed by the pressure. The pressure is governed by a complex combination of factors with the result that slow powders can sometimes be made to burn faster than fast powders and vice versa. This is mentioned to give you a little better picture of the process and particularly to emphasize that a particular powder will NOT AUTOMATICALLY have some BURNING RATE but rather that this will depend upon HOW YOU USE THE POWDER.

In general small powders work best in small volume guns and large powders work best in large guns. Recall that you have seen cannon powders which are much larger than rifle powders. Another way to get this picture is to say that fast powders are made for small cartridges with small calibers. Slow powders are made for large cases with large calibers.

This is illustrated in .30 caliber with a 150 gr. bullet. Your computer will select the following powders on the basis that the case is nearly full and good working pressure will develop:

CARTRIDGE	POWDER NUMBER
.30-30 Winchester	3031
.300 Savage	4064
.30-06	4320
.300 H. & H.	4350
.300 Weatherby	4831

Furthermore, within one particular gun, the smaller powders are best for light bullets and larger powders best for heavy bullets. This can be illustrated in .30 caliber with the 06 case:

BULLET WEIGHT	POWDER NUMBER
110	4064
150	4320
220	4350

Still the above is with a nearly full case and good working pressure.

Burning powders inside pressure bombs and measuring the heat evolved enables us to tell how much energy is contained in them. This is an experimental figure and converts so that we can say 50 grs. of an IMR powder develop about 8900 ft. lbs. of energy.

Let us take the 50 grs. of various IMR powders and use them in a .30 caliber gun with a 180 gr. bullet. If this total energy of 8900 could be converted to bullet motion via muzzle velocity it would be 4725 f/s! This would be 100% efficiency. However, let's put the powders in a .30-06 cartridge and see what results we get:

Powder Number	Maximum Pressure	Velocity f/s	Bullet Energy	Percent Efficiency	Flame Temp. ° F.
5010	27,400	1950	1520	17	2200
4350	39,800	2360	2230	25	3200
4320	47,000	2580	2660	30	3800
4064	51,500	2705	2930	33	4100

Your computer will not select any of the above loads because the case will not be nearly full. The 5010 load is distinctly not practical because you will find that the powder has not completely burned under these conditions.

You will notice on the computer slide some vacant spaces for powder numbers filled in by letters of the alphabet. This means that no exactly suitable powder is available. However, we can still secure good loads at good working pressures by changing the indicated powder charge and moving to a powder number to the left or right of one of the lettered spaces. Specific instructions for doing this will be given in Part II.

BALLISTIC EFFICIENCY

In the above tabulation 50 grs. of powder will develop a total energy of 8900 ft. lbs. The various bullet energies developed compared to this give the percent efficiency. Notice that we nearly doubled the pressure and nearly doubled the efficiency at the same time. The efficency inside a gun is determined by the pressure. Therefore, we can say that efficiency in any gun is necessarily going to be limited by the limit of pressure which can be used.

Let us compare various guns all at the same pressure limit, whatever it is. Let's take the same 50 grs. of IMR powder with the .30 caliber 180 gr. bullet. The ratio of charge to bullet weight is, therefore, 0.28. Refer to the Expansion Ratio—Velocity Tables on your computer. At an expansion ratio of 4, the velocity is 2200 with an energy of 1935. This is an efficiency of 22%. The same combination used in a gun with an expansion ratio of 12 produces a velocity of 2770 and energy of 3070. Here the percent efficiency is 34. All of the 50 grs. of powder are converted to gas. In the one case this gas can expand to 4 times its original volume while the bullet is being accelerated to the muzzle. With an expansion ratio of 12 the gas can expand 12 times while the same bullet is going to the muzzle. The result is that the velocity is greater, the energy is greater and, therefore, the efficiency is improved greatly. In a similar way you can increase the horsepower of an automobile engine by increasing the compression ratio.

Going back to our first tabulation, it should now be quite evident that, at the same pressure, the .30-30 Winchester rifle with an expansion ratio of about 12 will be much more efficient in handling a 180 gr. bullet than will the .300 Weatherby with an expansion ratio of about 5.5. However, the .300 Weatherby will produce much higher velocity in spite of its greatly reduced efficiency. This is still a desirable thing to accomplish.

Since the dimensions of your gun will determine the expansion ratio, your computer can only make a selection on the basis of good working pressure and thereby give you the best efficiency obtain-able.

BARREL LIFE

Notice the flame temperature in the above tabulation; it is also exactly following the pressure. This is the maximum temperature which occurs for the short period of maximum pressure.

Above 40,000 psi the flame temperature is always in excess of the melting points of all of the ingredients of alloy steels (except carbon) and is the reason for erosion in guns. High pressure is high temperature and, therefore, fast erosion. It is as simple as that. BARREL LIFE DEPENDS UPON THE PRESSURE.

Barrel life does not depend upon the velocity of the loads as such. If high velocity has been obtained by running high pressures then the cause is still the high pressure and not the velocity. Velocity is always higher near the muzzle where erosion is least.

Because larger guns burn more powder more heat is evolved per round so large guns at a given pressure will erode or have barrels burn out faster than small volume guns.

BORE CAPACITY

The Expansion Ratio—Velocity Tables automatically assign relative numerical values for bore capacity. The Expansion Ratio is simply the ratio of the total volume of the gun to the case capacity. It is the number of times the gas will expand by the time the base of the bullet reaches the muzzle. Inspection of the tables shows that it has a profound effect upon the highest velocity obtainable. Lower Expansion Ratio guns are lower in efficiency than higher Expansion Ratio guns.

Paradoxically, actual low Expansion Ratio guns are used to produce higher velocity than with high Expansion Ratio guns. This is because our rifles are all about the same length. For a given barrel length, reducing the Expansion Ratio increases the chamber size. A large chamber will hold and burn more powder. More powder is more energy and, therefore, more velocity.

Please notice that every time you change seating depth or bullets in a case the case capacity value changes and there is also a small change in the Expansion Ratio.

Since the initial conditions permit the development of a good working pressure, all the powders selected by the computer will have completely burned by the time the gas expansion has reached a value of 2, or at most, 4. Thus, there is no cause to worry about loss of velocity due to incomplete powder burning.

MUZZLE PRESSURE

We can give you only reasonably good ESTIMATES for muzzle pressures. They are highly dependent upon the Expansion Ratio and to a lesser degree on the Ratio of Charge to Bullet Weight. For an Expansion Ratio of 6 you can expect a muzzle pressure of about 29,000 psi for a Charge to Bullet Weight Ratio of 0.2 and about 40,000 psi when the ratio is 0.6. When the Expansion Ratio is 10 the muzzle pressure is about 5,600 psi for a Charge to Bullet Weight Ratio of 0.2 and is 7,300 psi when the Charge to Bullet Weight Ratio is 0.6. Also at an Expansion Ratio of 10 and with Charge to Bullet Weight Ratio of 1.0. the muzzle pressure is 9.800 psi. These figures apply only to loads selected by your computer.

PRIMERS

The maximum pressure developed is dependent upon the type of primer used. For Small Rifle Primers Remington 6½, Federal 200 and Peters 65 produce the least pressure. Herter 6½ and CCI 400 are intermediate; Winchester 116 and Western 6½ produce the highest pressures. Unfortunately, we do not presently have numerical values to assign but the magnitude of the difference is not enough to call for adjustment of loads on this account.

The Large Rifle Primers in 1961 were classed as follows:

A	B	C
Federal 210	CCI 200	CCI 250
Remington 9½	Herter 120	Federal 215
		W. W. 120

Class A Primers will in general give about 6% less pressure than Class B and Class C Primers will give about 6% higher pressure than Class B when the Ratio of Charge to Bullet Weight is about 0.2. When the Ratio of Charge to Bullet Weight is 0.5 then Class A Primers are 3% less hot so far as pressure is concerned than Class B and Class C are 3% hotter. With a Ratio of Charge to Bullet Weight of 1.0 the difference among the classes of primers, so far as pressure is concerned, disappears.

Since individual rifles due to other mechanical considerations will show differences in performance by about these percentage amounts, no adjustment of powder charge will be usually required.

As a refinement intended for best uniformity of ignition. we suggest that you use a Class A Primer for 3031, a Class B Primer for 4320, and Class C Primers for 4350 and larger powders. The large powders are a little more difficult to ignite and are usually used in large cases so maximum igniting conditions are required.

Furthermore, we can suggest that you yourself standardize on a particular primer for a particular load. You will then be in the best position to obtain over-all uniformity.

OTHER POWDERS

Hercules HiVel No. 2 is a higher energy powder than IMR powders. It can be used interchangeably on an equal weight basis with 3031 when it will produce approximately the same velocity as 3031 but with slightly lower pressure. This powder has been on the market for many years and has an excellent reputation for reliability.

During the past war Western made a wide variety of nitrocellulose powders in ball shape. Some of the powders, according to Western, were adjusted in energy content. The Ball Powders have a deterrent coating to make them burn like extruded powders.

Your computer is built around a mathematical description of the way actual powders perform in guns. Unfortunately, we do not have adequate information to enable us to include Ball Powders on your computer. Currently these powders, in standardized canister lots, are not on the market.

Salvaged ball powders as well as some IMR powders not listed on your computer are available to handloaders, chiefly from B. E Hodgdon of Shawnee-Mission, Kansas. Here again we do not have adequate technical information concerning them. You will find loading recommendations for these powders in many of the loading handbooks and manuals.

IDEAL POWDER

An ideal powder could be specified to work at a maximum pressure limit and energy content balanced so that reasonable barrel life would be expected. The burning would be regulated so that maximum velocity would occur without too high muzzle pressure. When this is done, a given gun would handle at a stated velocity a certain bullet weight. 100% ballistic efficiency could not be expected because the powder has to move some of itself inside the gun, we could not expect the gun to do anything but absorb some of the heat energy and a practical Expansion Ratio would always permit unused gases escaping wastefully at the muzzle.

On such a practical basis, it turns out that IMR powders actually can be made to develop about 93% as much efficiency as would an ideal powder. Velocity difference amounts to about 3%.

DUPLEX LOADS

There has always been the temptation for experimenters to attempt to improve gun performance by mixing different powders, sometimes called making Duplex Loads. However, we have just seen that present powders are so close to what could be expected of an ideal powder that any supposed benefits of mixing powders would be relatively insignificant. Even though your computer indication might be for a non-existent powder in one of the lettered areas for Powder Number, Part II will instruct how to obtain a good load.

Rumor has it that gun accidents have occurred as a result of mixing powders. We do not have adequate information for evaluating this so can give you no definite information except to advise against mixing powders because there is very little, if anything, to be gained in the first place.

MAXIMUM VELOCITY

For our conventional types of guns there are only three ways by which higher than ordinary velocities may be obtained.

1. Increasing pressure. This is usually unsatisfactory because a 10% increase in pressure increases the velocity by only half such a percentage increase, namely 5%. A pressure increase rapidly cuts down on barrel life without immediately noticeable signs. Next, the gun commences to leak, case extraction becomes difficult, case life is shortened and high temperatures sometimes start melting parts of the bullet. Still higher pressures will start melting brass at the leakage points making for a large escape of hot gas and a damaged gun.
2. For a given bullet weight, increasing the total volume of the gun by increasing the Expansion Ratio. This is a practical method which works, without going above good working pressures. You rapidly run into limitations because this means that for a given cartridge you have to increase the barrel length. Sometimes the gun becomes unwieldy or too heavy. Our muzzle loading ancestors stop-

ped when their barrels became more than about 4 feet long.

3. For a given bullet weight, increasing the total volume of the gun by decreasing the Expansion Ratio. This is the method most usually used successfully. For a given gun length the chamber is increased in size. This causes more powder to be burned with more energy and increased velocity. However, the lower limit for Expansion Ratio is usually about 5. Some anti-aircraft guns have been made with a ratio as low as 4. For those who don't expect it, it is a big disappointment to find that the case capacity has to be doubled in order to effect a 1000 f/s increase in velocity. This doesn't seem to "stand to reason" but experience bears it out. As previously indicated, going from a high to a low Expansion Ratio decreases the efficiency, so those who are disappointed sometimes incorrectly question the conditions of burning inside a large cartridge case. Your computer will find the Expansion Ratio of your gun. If it is below 4 you will probably not realize satisfactory performance. You may try but the remedy is usually another gun.

If higher velocities are desired than can be obtained by the above methods, then something other than conventional guns have to be used.

GOOD WORKING PRESSURE

Your computer is suitable only for modern arms in first class condition. When this is the case, it has been arranged so that the pressures you obtain as measured by copper crusher gauges will be well within the middle of the 40,000 to 50,000 psi range. This has been arranged with the idea that you will be able to have a barrel life of several thousands of rounds and you can anticipate no difficulties from sticking cases, leaking primers, short case life and other similar headaches and intermittent troubles resulting from higher pressures. We are not attempting to work in the vicinity of maximum loads because experience indicates that many of the troubles just enumerated are likely to occur.

Since errors in gun measurements and slide settings are possible, we suggest that you check the computer selections against recommendations in any of the several loading handbooks and manuals available to you. Should you not be able to find the particular load in question, we suggest that you follow the standard handloading procedure of approaching an untried load by starting upwards from 10% less powder charge.

There are instances where you, on your own, may consider it desirable to increase powder charges above the levels indicated by your computer. If you have a gun which has extra strength built into it and you are willing to sacrifice some barrel life, you can find loads in the handbooks and manuals which will be suitable for such situations.

Each gun has its own peculiarities so that with a given set of components you may obtain a different pressure and, therefore, velocity than another similar gun. For this reason, the Expansion Ratio—Velocity Tables on your computer can be regarded as giving you only a close estimate of the velocity to be expected. However, they have been included for your use because when you are making changes in loads, the DIFFERENCES indicated in the velocity table are quite accurate. Furthermore, they enable you to evaluate the performance of many guns whch may not be available to you and you wish to know more about them.

PART II

USING YOUR COMPUTER

Please pay particular attention to all directions and especially the Important Definitions appearing on the computer itself. It is very important that you make your own measurements of barrel

length and water capacity of your cases. Case capacity will vary with seating depth which is probably not the same as for published loads with which you may be familiar. Case capacity varies with the brand of case being used; 3 to 5 percent variations have been seen. Your computer then will use your own measurement and allow for such variation. Use the average of several readings because case capacity will also vary among the ones you are using.

You will find it very helpful if you write down on a piece of paper the result at each step as you calculate.

TYPICAL EXAMPLE

You have a .308 Winchester. The case capacity is 51.5 grs. with a 150 gr. bullet. The powder charge is then 44.3 grs. from the slide. You also find the Ratio of Charge to Bullet Weight is 0.295. Reading from the Sectional Density table you find the value of 0.227 for the 150 gr. bullet in .30 caliber. 4064 is the selected powder. You have a 24-in. barrel but this is not the number to use with the computer; you need the distance the bullet travels which is the effective barrel length for your seating depth. From tip of seated bullet to muzzle measures 21-5/16 on your cleaning rod. The bullet is 1-1/16 long to make the effective barrel length 22-3/8. This is close enough to 22.4 in. for the computer to tell you the Expansion Ratio is 9.0. The Expansion Ratio—Velocity Tables with a Ratio value of 0.30 predict a velocity of 2730 f/s from using 44.3 grs. of 4064. Before using this load in your gun, be sure to check in one of the Handloading Manuals to see that this is a load which has been used before. Errors in measurements and slide settings are always possible, so ALWAYS take the precaution of running a check on your figures whenever you can.

SPECIAL CONDITIONS

We have tried to make your computer for any caliber, bullet, gun or case combination you may wish to use. However, it may happen that you will use a caliber, for instance, which is not on the Caliber Slide. If this is the case, you will have to figure your own Expansion Ratio, taking careful note of the Definition. It is not difficult. You will use the average between bore and groove diameter, in inches. The case capacity in grains of water can be converted to cubic inches by remembering that one cubic inch of water contains 253 grs.

If we haven't anticipated a future bullet weight in your caliber, you will have to figure Sectional Density. Square the diameter, in inches, of the bullet and then multiply by 7,000; the bullet weight, in grains, can then be divided by this product to give the Sectional Density.

If your case capacity is greater than 140 grs., your powder charge is figured at 86% of the case capacity. You must then figure your own Ratio of Charge to Bullet Weight by dividing the weight of powder by the weight of the bullet. Also figure Expansion Ratio, then use your computer as usual.

If the Expansion Ratio of your gun comes to a value less than 4.0, your gun will not perform properly with loads selected by your computer. Special purpose guns have been made for military uses in this area but pressures are extremely high, barrel life is very short, muzzle blast is quite severe and accuracy is not good.

POWDER NUMBERS

As you can see, Powder Numbers do not fill the slide and we have used letters of the alphabet to fill in the vacancies. Wherever a letter appears it means that there is no exact powder currently available for the combination you wish to use. This does not mean that we cannot come up with a very satisfactory load, however.

In the first place, any powder appearing to the LEFT of Arrow 2 will produce less pressure and velocity than we want. Any powder on the RIGHT of the arrow will produce HIGHER pressure than we want.

Remember this on those very few occasions when Arrow 2 happens to fall exactly on the dividing line between two powders, as between 4198 and 4227, for instance. When this does happen, which way you go does not matter from the pressure standpoint because the change in pressure will not cause trouble. Therefore, the general rule when this happens is to use the powder on the LEFT of Arrow 2. If your Expansion Ratio is less than 5.5, then use the powder on the RIGHT of Arrow 2. For a 180 gr. bullet in .308 Winchester Arrow 2 is between 4320 and 4064. The Expansion Ratio is 9.1, so use the indicated amount of 4320.

What do you do when the first powder selection is a letter and not a number? We will take up each case in reverse order:

"G" POWDER IS THE FIRST SELECTION. This is "off scale" for your computer, so consult the Handloading Handbooks.

"F" POWDER IS THE FIRST SELECTION. Take the Grains of Powder indicated by Arrow 1 and ADD to it 5% of this weight. Reset Arrow 1 to this increased amount. Use this weight of 3031. You will next find a new Ratio of Charge to Bullet Weight on the basis of this new weight of 3031. Use the new ratio for finding velocity. See under D POWDER for a similar numerical example.

"D" POWDER IS THE FIRST SELECTION. This will be handled nearly the same as F, above. Take Grains of Powder indicated by Arrow 1 and ADD to it 5% of this weight. Reset Arrow 1 to this increased amount. Use this weight of 4350. Next find a new Ratio of Charge to Bullet Weight on the basis of this new weight of 4350. Use the new Ratio for finding velocity. Example: You are going to use a 180 gr. bullet in .30-06. The case capacity is 61.5 grs. so Arrow 1 indicates the powder charge to be 52.9 grs. Arrow 2 shows D powder. 52.9 x .05 is 2.7 grs. 52.9 plus 2.7 is 55.6 grs. of 4350 which you will use. Set Arrow 1 on 55.6 and find the new Ratio of Charge to Bullet Weight is .308. A Ratio of .31 with an Expansion Ratio of 7.5 gives a velocity of 2680 f/s.

"B" POWDER IS THE FIRST SELECTION. There is no choice here but to go to the left of Arrow 2, regardless of the Expansion Ratio. Take Grains of Powder indicated by Arrow 1 and ADD to it 5% of this weight. Reset Arrow 1 to this increased amount. Use this weight of 5010. Next find a new Ratio of Charge to Bullet Weight on the basis of this new weight of 5010. Use the new Ratio for determining velocity. Example: You want to use a 140 grs. bullet in the .264 Winchester. The case capacity is 79 grs. so

Arrow 1 shows 68 grs. of powder and Arrow 2 is at B powder. 5% of 68 is 3.4 grs. to be added to 68.0 so you will use 71.4 grs. of 5010. Resetting Arrow 1 at 71.4 now shows a new Ratio of Charge to Bullet Weight of .510. With an Expansion Ratio of 5.1 and the other ratio of .51 the velocity is indicated to be about 3080. Here again you have to read between the lines in the table.

"A" POWDER IS THE FIRST SELECTION. This is "off scale" for your computer and there is no data available. In this region DuPont made a powder with number 7013 but we have no data.

5010 powder is quite similar to another which has been made with the number 7005. Evidently these were made during the past war primarily for .50 caliber machine guns. There are few rifle cartridges where this would be selected but we can give one example which has been successful. This was a 6.5 mm. 139 grs. bullet in a case necked down from the .300 Weatherby with an Expansion Ratio of 5.0 due to a barrel of overall length of 30-in. The case capacity is 95 grs. and the indicated powder charge is 81.7 grs. of 5010. Velocity is shown on your computer as about 3220 f/s. This gun was designed by Lt. Col. Paul Wright of Silver City, New Mexico.

There are applications for your computer which come up occasionally and are regarded as "rough". Yet your computer will handle these just as easily as though it were a problem pertaining to cartridges which have been standard for fifty or more years. Robert Hutton had a .378 Weatherby necked down to .30 caliber and wanted to check a 77 grs. bullet. The overall barrel was only 26-in. so the Expansion Ratio was only 4.5. The Sectional Density of this bullet is low, only .106. Your computer would have selected "D" powder at a weight of 107 grs. Ordinarily with such a low Expansion Ratio we would want to decrease this charge and use 4320 powder on the right of Arrow 2. However, Robert Hutton did use 4350 on the left. Therefore, let us increase 107 grs. by 5% which makes a charge of 112 grs. This gives a Ratio of Powder Charge to Bullet Weight of 1.45; more powder than bullet weight. Your computer gives a velocity of 4480 f/s for this combination. Robert Hutton actually fired 115 grs. of 4350 and the chronographed velocity was 4615; not a bad check for such unusually extreme conditions.

CHANGING POWDER CHARGES

By now it has probably occurred to you that, for most cases, your computer will develop relatively "mild loads". For various reasons, the question always comes up as to what happens when you change the amount of powder. If you change the weight by a given percentage, inside the same case, the velocity changes by the SAME GIVEN PERCENTAGE. However, at the same time, the pressure changes by TWICE THE GIVEN PERCENTAGE. That is to say, if you reduce the powder weight by 10%, the velocity goes down by 10% and the pressure goes down by 20%. If you raise the powder charge by 3½% the velocity goes up 3½% but the pressure goes up by 7%. And so on.

For the most part, your computer still gives you a little leeway in going up on powder charges and more leeway in going down. Suppose that, for some mechanical reason, your cases are sticking so you want to cut down the pressure by, say, 10%. Then cut the powder charge by 5% and you can expect the velocity will go down only 5%. All of these figures apply to small changes in loading only. Furthermore, if you are otherwise working at maximum loads, do not use these figures.

As an example of loading changes, Lt. Col. Wright was willing to sacrifice some barrel life in order to match the velocity of another load which gave a velocity of 3400 on an Avtron Chronograph for Robert Hutton. The computer indicated 81.7 grs. of 5010, as you just read. The load was increased to 85 grs., an increase of 3.3 or 4.0%. The computer velocity indication was 3220 so a 4% increase, as above, brings this up to 3360 f/s. This is close enough to the requirement, unless we want to split hairs. The pressure, on the basis of 3400 f/s velocity, is indicated to be 51,500 psi.

The new load showed the same drop over 500 yds. as the load to be matched.

BARREL LENGTH AND VELOCITY

You can use your computer to solve a problem which very frequently comes up. You want to know what the velocity change would be if you had the barrel shortened. You have already found the Expansion Ratio for your gun as well as the Ratio of Powder Charge to Bullet Weight. For a good working pressure these are the only two factors involved. You will not change the powder charge, so all you have to do is figure a new Expansion Ratio with the proposed shorter Barrel Length. As you look over the Expansion Ratio—Velocity Tables you can see that a gun with low Expansion Ratio and high Ratio of Powder Charge to Bullet Weight will be affected much more by barrel shortening than will a gun with both high Expansion Ratio and low Ratio of Powder Charge to Bullet Weight. This is the reason that you cannot specify a certain percentage change of muzzle velocity per inch of barrel unless you refer to only one particular gun in the first place. You can use the Speer Ballistic Calculator to see what effect a new velocity would have on the trajectory and Remaining Velocities and Striking Energies.

CONCLUSION

It has been a pleasure to prepare this computer for your use. I certainly hope that you find it useful for many years to come and that your shooting will improve and your enjoyment of the sport will increase.

Homer S. Powley
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