

PACT Professional Chronograph Users Manual

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Introduction

We've been building chronographs since 1983. Our design philosophy is to build for the customer, not the engineering department. Whenever a PACT customer calls with a suggestion for improvement (or a complaint) we write it down and act on it. We incorporate these changes into our product line on a continuous bases. Your PACT Professional Chronograph incorporates every *practicable* neat idea that's been suggested to us over the last nine years.

The design of your Professional Chronograph leaves it wide open for future up grades. We have only used about one third of the available memory space. So you can count on a long and interesting string of software up grades. These will always be made available to you at a minimum cost. We also made the Professional Chronograph about 25% bigger than currently necessary in order to leave room for future hardware up grades. What form will these changes take? You tell us!

Notes on Software Revision 2.0

Your unit contains our latest software, Revision 2.0, released in October of 1992. This software incorporates several enhancements that you requested as well as some bug fixes (although we've doubtless created a few new ones):

1. Tracks multiple shot strings in memory.
2. Improved prompting in Chronograph mode.
3. John Wootters new Lethality Index added to terminal ballistics calculations.
4. Unit now turns on in "**Chronograph Running**" mode.
5. Broader range in Zero Off Set function.
6. Enhanced bullet library that now includes popular bullets from Remington and Hornady.
7. The BC Calculator can now, at Mr. Seyfrieds request, convert your measured BC back to "standard" conditions for comparison purposes.

Ballistic Calculator Operation

The most revolutionary aspect of the Professional Chronograph in the incorporation of a built in Ballistic Computer. The benefits of having easy access to trajectory information are two fold. First of all you can find an "optimized" zero for your specific gun/load combination, zero your rifle accordingly and take to the field with a

new confidence about the required hold over (or lack of it) for a given shot. The second benefit you'll enjoy (and the one you'll probably get the most use out of) is using the Professional Chronograph as a ballistics teacher. An hour or two of "what if" will destroy a lot of ballistic myths that most of us hold dear and make you a real bore at your next cocktail party.

The Ballistic Calculator is so easy to use that you can probably get it going on your own. However, it does have some trick features that may not be apparent on the first pass.

Turn your Professional Chronograph on. When the machine gets to the "FIRE WHEN READY" prompt on the screen press the "CALC TRAJ" (number 7). The first thing the Professional Chronograph needs to know is the velocity to base the calculation on. If you're shooting at the range it will pick up the current average velocity (which you can override). If none is present in memory it will default to **2500.0 FPS**. The format for entering information into the Ballistic Calculator is always the same:

1. Pushing "SET" means that you want the machine to use the data on the screen. For example when you first enter the Ballistic Calculator it will display a default velocity. If you push "SET" it will accept this and move on to the next question or calculation.

2. If you want to change the default stay away from the "SET" key and first tell the machine what it needs to know. For example if you want the machine to use 2650 FPS for its calculation just type 2650. If you make a mistake entering a number just use the back arrow key "GO" to erase it. When the number entered is OK with you hit "SET" and the Ballistic Calculator will accept the entry and move to the next screen.

3. Yes/No questions are answered with the "YES" and "NO" keys. No "SET" is required.

4. Our "rolling" menu questions (1. **MAX PB**, 2 **SPECIFIC RANGE**) are answered with the number of the option you want. The machine will briefly acknowledge your choice and then move on to the next question. No "SET" is required.

5. Any time you are messing around with the Ballistic Calculator and you realize you've painted your self into a corner hit (gently now) the "REVIEW" button. This will take you out of the Ballistic Calculator. Then hit "CALC TRAJ" again and it will let you start from the beginning with the last things you entered as the defaults.

Let's make a sample trajectory printout. If you haven't already pressed the "CALC TRAJ" do so now so that the screen shows:

ENTER VELOCITY:
2500.0

Let's change the velocity to 2650 and press "**SET**." The Ballistic Calculator will now ask you for the Ballistic Coefficient "BC." This is always a decimal number (a "." in front of the number) but the Ballistic Calculator is smart enough to add the decimal if you forget it.

Your Professional Chronograph has a built in library that contains almost all of the *popular* bullets from the major manufactures. We are somewhat memory limited so we've had to pick and choose what specific bullets to include. If you're shooting a main line rifle caliber we've probably got you covered. In order to make room for Hornady and Remington we had to kill the pistol bullets (how will you get your 32 Seecamp zeroed?) and most of the really neat Big Barnes Bullets. Please note that these Ballistic Coefficients were supplied to us, by the manufactures, on disk. We have made no attempt to verify the accuracy of these BC's.

Push RVW to activate the BC library. The first thing you'll be asked for the caliber (remember that 30 caliber is really 308, ".223's are really .224" in diameter etc.) and weight. push 284 (or .284 if you prefer) and SET to move to the next question. Lets use a weight of 160, type 160 and push SET. Now the Professional Chronograph will list every manufacture in the library that makes a bullet of the caliber and weight you specified. In this example you'll get four of them: **1 SIERRA, 2 NOSLER, 3 BARNES, 4 SPEER**. Push **3** to select BARNES. Now the Professional Chronograph will give you all of the bullet shapes available for the caliber, weight and manufacture you selected. In this case there are two: **1 SOLID SPITZER, 2 X BULLET**. Push **2**, the Professional Chronograph will display the BC (.508). Push **SET** to accept it and return to the Ballistic Calculator and **SET** again to move to the next question.

Note: The Ballistic Calculator will only produce correct results with "C1" ballistic coefficients. This is the industry standard and is what you will find in every bullet manufactures specifications (from their **current** manual) even if they don't label it as "C1." We're told that previous edition of the Hornady manual did not use C1 numbers and that this was corrected in the new manual.

Next the Ballistic Calculator asks you if you want it to use Standard (sea level, 59 degrees) or nonstandard conditions. If you tell it "**YES**" it will use standard conditions. In this case tell it "**NO**." The Professional Chronograph will now ask you for altitude and temperature information. Press **7500**, **SET** and **85**, **SET**. Based on the this data the Ballistic Calculator will correct the BC to nonstandard conditions of 7500 feet and 85 degrees.

The next question the Ballistic Calculator asks you is the sight height of your gun. Sight height if the distance from the center of the bore to the center of you sight.

Since we're just playing around we'll use the default of 1.5" (press **1.5, SET**). However if your making a "for real" field drop card do it right and measure the thing (a pain in the back side). If you're using an iron sight gun (particularly handguns) don't use the 1.5" number at all. It's so far from your gun that the resultant trajectory data will be pretty far off.

The Ballistic Calculator now has all the data it needs for the trajectory calculation. You'll now need to tell the Ballistic Calculator what sort of zero you want. Option 1, the "**MAX PB RANGE**," will calculate the maximum range at which you can fire the gun without the bullet traveling more than so many inches above or below the line of sight. This option is strongly recommended for field marksman (hunters and warriors). The default value is a six inch ``vital zone." This means that you'll end up with a zero that keeps the bullet within an imaginary six inch tube (three inches above to three inches below the line of sight) from the muzzle to the maximum ``point blank" range. The Ballistic Calculator will tell you where to zero at 100 yards for this and print a drop table according to that zero.

NOTE: A lot of folks think that a 8" (or even 12") vital zone is a great way to "stretch" the trajectory of a gun. In the field this proves to be a disaster which results in missed game and great frustration. Ross Seyfried's recent column in G&A goes into this in detail. Unless you are hunting with a charged particle weapon we strongly suggest you base your zero calculation on a vital zone of 6 inches.

The second option of "**SPECIFIC RANGE**" is of use to target shooters. If your local range only goes to 100 yards but your competition is at 500 yards you can have the Ballistic Calculator figure out where to set your gun at 100 to be dead on at 500. Again it will print you a drop table based on that zero. One **neat trick** we added to this zero option is the ability to off set the zero. Normally when the Ballistic Calculator asks you if you want an off set you'd just hit ``SET" to accept the zero default. However, if you've got a gun in the safe that you have already zeroed two inches high at 100 you can use this feature to back into a drop table that puts the bullet two inches high at 100. Note that the offset option will add about 20 seconds to the drop calculation. It is, however, quite a bit faster than rezeroing your gun.

Press **1** to accept the **MAX PB RANGE** for this example. The next three questions (starting range ending range and increment) are self explanatory. You'll probably find your self hitting the "**SET**" key three times to accept each default. If you enter a number at the ``**SET CROSS WIND**" question the Ballistic Calculator will replace the velocity column in the print out with bullet drift in inches. For now just leave that alone and press **SET**.

The final question is whether or not you want the Ballistic Calculator to print to the screen or paper. If you opt for a paper print out the Professional Chronograph will go on automatic from here giving you a print out based on your parameters. If you want to print to the screen you'll use the "**SET**" button to advance from screen to screen. If

you want to make another print out just push ``**CALC TRAJ**'' again. All of the parameters you used on the last print out will appear as defaults (assuming you did not turn the machine off) speeding data entry. Press 2 for a paper print out and lets see what you have.

Note: Be sure to tear the paper toward you to prevent jamming.

Options

We have tried to make the Ballistic Calculator as easy to use as we can with out sacrificing features. To do this we've hung the infrequently used functions on the "**Option**" and ``**CALC PWR**'' buttons. As of this writing (October '92) we have seven options listed on a rolling menu on the ``**Option**'' button.

1. **BC LIBRARY.** This allows you to access the library with out going through the Calculate Trajectory drill.

2. **THIRD COLUMN.** This lets you control the contents of the third column of the ballistic printout which is normally occupied by the down range velocities. Your options are: 1 **VELOCITY/DRIFT** (the default), 2 **POWER INDEX.** This can show 1 IPSC Power Factor, 2 Kinetic Energy (for those who still believe in the tooth ferry), 3 Taylor Knock Out (for the Torque and Recoil Club), 4 Momentum (for the silhouette shooters) and 5 John Wootters new Lethality Index (for the obsessive neat desk types).

3. **METRIC MODE.** If you turn this on the Professional Chronograph will give you velocities in MPS instead of FPS. Note that you do not change your screen separation to do this, the Professional Chronograph will do the conversion for you. We'll be adding metric mode to the Ballistic Calculator on a future up grade.

4. **FULL BC REPORT.** This changes the format of the Ballistic Calculator print out from what we call the "Brief" report to a ``Full" report. In addition to the data contained in the brief report you'll get time of flight. If a cross wind has been entered you'll get both velocity and drift.

5. **FREE RECOIL.** We'll calculate the "free recoil" of your gun/load combination. We use General Hatchers method for this calculation. In addition we calculate the ``PACT Recoil Index" (push set after the Professional Chronograph displays free recoil). This calculation is based on the velocity of recoil of the gun, again using General Hatchers formula. What we have done is to declare a 180 Gr. bullet driven to 2700 FPS with a 50 grain charge out of an 8.5 pound rifle (a 30'06) to be the standard gun. We then multiply its velocity of recoil so that it equals 100. Any time you calculate the recoil of a load we'll tell you how it compares to this standard load. For example a 300 Win. Mag. firing the same bullet at 3019 FPS with a 78 Gr. charge ends up with a PACT recoil index of 126. Which is to say that it kicks about a third more than a 30'06.

6. **COMPUTE BC.** This options allows you to enter two velocities (such as the muzzle and 100 yards) and calculate the actual BC under your actual conditions. If you select non-standard atmosphere the Professional Chronograph will give you both your measured BC and then correct it back to standard conditions for comparison purposes.

7. **PRINT CONTRAST.** This allows you to adjust the amount of time that the heaters in the print head stay on. The longer they're on (higher number) the darker the print will be and the quicker you'll be buying a new battery, vice versa. Normally you won't mess with this adjustment. However if you're trying to print in cold weather you may want to turn it up a little. Note that as the battery gets near the end the printer will finally start getting noticeably slower and fainter before it finally quits all together. Changing the print contrast here wont help you much.

The "**CALC POWER**" button currently has five options: Kinetic Energy, IPSC Power Factor, Taylor Knock, Momentum, and John Wootters new Lethality Index. You can use this feature by entering the velocity by hand or you can have it calculate for you at the range each time you fire. If you turn activate a power calculation the Professional Chronograph will automatically replace the third column of your trajectory print out with the power calculation you selected. This will automatically correct for down range velocities.

Chronograph Operation

Your Professional Chronograph uses a standard 9 volt Alkaline battery. Battery life will vary with the quality of the battery (Duracell Alkaline seem to be the best) and the light level of the sky. The brighter the sky the more current the skyscreens will draw. To get more total "on" hours out of a battery we suggest turning your chronograph off between strings.

As the battery runs down the sensitivity of the skyscreens will begin to drop, the printer will run more slowly and the display will begin to grow faint . Keep in mind that the computer in your Professional Chronograph requires far less power to run than the skyscreen/detector system. On very cold days you might consider keeping an extra battery warm in your pocket and trading them out as the battery in your machine freezes. On the other hand if it's that cold outside you might be better off staying home with your sweetheart and enjoying a hot buttered rum while you supervise her loading your ammo.

Skyscreens

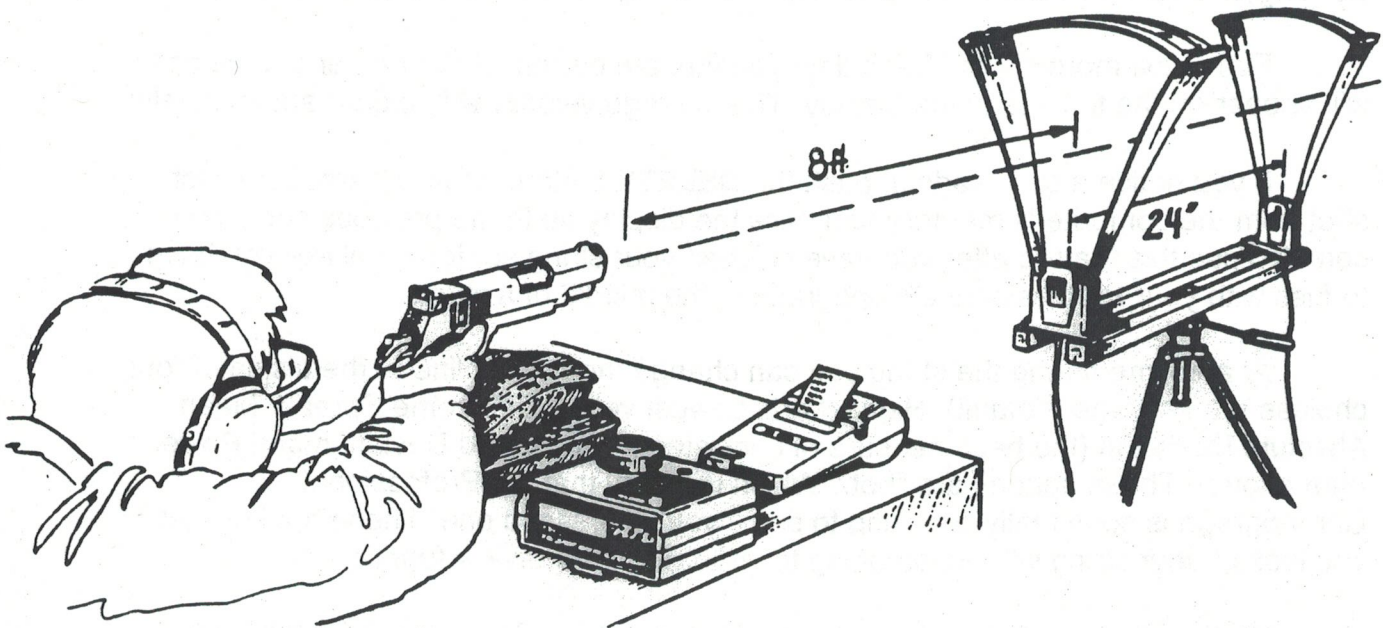
Your Professional Chronograph comes equipped with the finest Skyscreens on the market. The PACT MK5 Professional Skyscreen contains two lenses that serve to magnify the bullet and bring it into sharp focus. This provides more accurate triggering at a given range than un-lensed skyscreens. The diffuser screens provide serve as both an aiming guide and light diffuser. (On blue sky sunny days they make it easier for the chronograph to see the bullet by providing a portable cloud for the sun to illuminate.)

If you have our optional skyscreen mounting bracket just screw the skyscreens to it as shown in the illustration. The skyscreens should fit snugly against the cross pieces to insure proper screen separation. The center of the bracket is threaded for a standard camera tripod (1/4-20). If you have one this is a pretty good way to go although you can set the bracket on any flat surface.

If you are fabricating your own mounting bracket take care to insure that the screens are precisely 24 inches apart, center to center. Whatever % error you make in screen separation will result in the same % error in velocity readings.

Fit the side pieces into the cross piece and slip the unit into the skyscreen. The first skyscreen the bullet will pass over should be plugged into START, the second screen should be plugged into STOP.

When you fire you should aim in such a way that the bullet passes over the **center** of both screens at 5 to 8 inches above them. Under most light conditions you can actually shoot higher than this and still get reading but their accuracy may diminish slightly as you shoot higher. Under poor conditions, such as late afternoon or early morning in the winter or a very dark gloomy day, you may have to shoot lower in order to get readings.



Let's chronograph some loads

Set your skyscreens up making sure that they are pointed in a safe direction. Place your Professional Chronograph where you can read it at a glance and turn it on. It will display a little commercial, our copyright notice and the revision of software in your machine. Finally the chronograph will settle on the **FIRE WHEN READY**.

MAKE SURE YOU HAVE YOUR SHOOTING GLASSES ON - IF YOU HIT A SKYSCREEN OR THE BRACKET HOLDING IT, BITS OF PLASTIC, METAL AND BULLET WILL FLYING ALL DIRECTIONS AND RIP YOUR EYES OUT.

DON'T PUT METAL PLATE IN FRONT OF YOUR SKYSCREENS

Fire a round over your skyscreens. The Professional Chronograph should display something like:

**#01 (the shot number), followed by 2456.2 FPS
Avg. Vel. 2456.2 FPS**

If it does not, make sure that the first screen is plugged into **START** and the second screen is plugged into **STOP**. If this checked out you probably missed the "window". Try again, remember 5 to 8 inches over the center of the screens.

Note that you must wait about 1 second between shots, we make you do this to allow the smoke to clear. If you fire too soon you will either get no reading, an error warning or a very odd reading like 10 fps. Remember give it a second between shots.

Fire a few more shots. Each time you fire, the current shot number and velocity will appear on the top line of the display. The average velocity will update automatically.

If you notice a bad reading, push the **DELETE** button. This will erase the last shot from the computer's memory and back the display up to the previous shot. You can also use this feature after you have finished your string so don't feel like you have to fuss with your Professional Chronograph in the middle of a string.

At any time during the string you can change the bottom line of the display. Your choices are Average (default), Highest and Lowest velocity, Extreme Spread, Mean Absolute Deviation (the best measure of consistency), Standard Deviation and Power (see above). These buttons are "hot." Which is to say that the Professional Chronograph is continually checking to see if you've pressed one. These hot keys let you look at your string without stopping to go through the review function.

We feel that you normally don't want the printer on. So we leave it off till you specifically tell it to print. While you are firing you can make a hard copy of the screen at

any time by pressing the "PRINT" button. If you want the whole string with the statistical summary press "REVIEW" followed by "PRINT." If you think you might have a "bad" reading in your string you may want to review **before** printing. If you like to waste paper (once you've seen one rain forest you've seen them all) push the "MENU" button and tell the Professional Chronograph to print when you fire. Each time you fire the Professional Chronograph will print the shot number and velocity. All other functions remain intact.

Push "REVIEW"

The Professional Chronograph will ask you which string you want to review and default to the current string. If you want the last string fired just push review again. Otherwise enter the number of the string you want and press review again.

HI #003 868.2
LO #007 823.5

The highest and lowest shot velocities and their corresponding shot numbers are displayed.

Push REVIEW again:

SD: 45.8
CV: 5.99%

The Standard Deviation of your string is displayed in addition the SD is displayed as a percent of your average velocity (Coefficient of Variation).

Push REVIEW again:

MAD: 38.4
CV: 5.02%

Your PC calculates the Mean Absolute Deviation (average variation) of your string and once again displays it as a percent of your average velocity. This number is **the key** to measuring the velocity variations of your loads. The load illustrated *varies an average of 5.02%*. This is the number that should be used to compare one load to another. The smaller the better.

One more time:

ES: 105.9 FPS
AVRG: 763.8 FPS

"ES" stands for **Extreme Spread** which is the difference between the high and low shot velocities. "AVRG" is obviously the average velocity of your string. You can continue to press the review key and review each shot.

Two important points to remember when reviewing:

1. The chronograph will not record shots when it's in review mode.
2. You can start the printer at any time by pressing **GO**.

You can get a print out of your string at any time during the review by pressing the **PRINT** button.

To begin a new string press "**GO**." To add shots to the existing string push "**CST GO**"

How it works

Each skyscreen contains a photo-transistor which is constantly measuring the current light level. Because the bullet is darker than the sky, when a bullet goes over the skyscreen the light level drops a little bit. The amplifier inside your Professional Chronograph takes note of this drop in light level and amplifies it to the point that the drop is big enough for the computer to notice. The computer then times how long it took for the bullet to travel from the first screen to the second screen where the light level again drops. Accurately converting this time into a velocity is easy, provided the computer knows how far apart the screens are. The Professional Chronograph always tells you the skyscreen separation it is looking for when you turn it on.

Light Conditions

Many light sensitive chronographs have a reputation for being flaky under certain light conditions. We have gone to great lengths to minimize this problem, but you may still occasionally run into a combination of conditions that may make it hard for your chrono to read correctly. It will help if you develop an understanding of how your chronograph works.

Your PACT Professional Chronograph is looking for a decrease in light level when the bullet passes over the skyscreen. Assuming that enough light was entering the skyscreen to begin with, your Professional Chronograph will always get an accurate reading. If, on the other hand, the light level increases as the bullet crosses the skyscreen, you will probably get no reading at all.

How could the light level increase? Let's say that you are chronographing under a dark blue sky and that the sun is reflecting brightly off of the bullet. Now the bullet is

actually brighter than the sky above it. When it crosses over the skyscreen the light level goes up instead of down, thus we get no reading. Note that with a slow bullet like a 45 ACP fired under these conditions you may still get a reading. This is because the bullet may be over the screen long enough for the bullet to be considered the "normal" light condition. When the bullet leaves the light level drops and triggers the computer. This will still give you an accurate reading, but it is not "ideal".

By using the diffuser provided with your Professional Chronograph you can eliminate most of these troubles. The diffuser acts like a portable overcast day. Assuming the sun is hitting it, it will actually provide a "sky" that is 200% to 400% brighter than the blue sky above it.

If the sun is low in the sky and is illuminating the underside of the bullet your Professional Chronograph may have a hard time seeing it even when using the diffuser screens. If this happens you might try shooting lower over the skyscreens. You may also eliminate the problem by changing the light conditions. Put a shade to the **side** of your screens so that the bullet is in the shade when it crosses over the skyscreens, thus increasing the **contrast** in light level between the bullet and the sky. You might also try changing the direction of fire and/or tilting your skyscreens. Remember we are trying to get as big a contrast between the bullet and the sky as possible.

When operating on an overcast day the diffusers will not do anything for you (other than act as an aiming guide. If it's a very dark overcast day and you find yourself having trouble getting reading try removing them altogether.

Sooner or later you **will** find a light/glint combination that the Professional Chronograph can't sort out. **When** this happens stop wasting ammo. You'll either need to change the set up a little or wait a few minutes for the conditions to change.

Muzzle Blast

Most of our original customers were pistol shooters and we have gone to some lengths to filter out muzzle blast. Unfortunately if we filter it out completely your chronograph would not see bullets either. When you fire a subsonic (below around 1200 FPS) round, the sound of the gun reaches the skyscreens before the bullet does. If it shakes the screens hard enough they will trigger and give you an incorrect reading. For example, let's say that you are firing a .45 ACP at 850 FPS and find that your Professional Chronograph is telling you that your round is going 680 FPS. What's happening is that the muzzle blast is triggering the start screen before the bullet gets there, but it lacks sufficient power to trigger the stop screen by the time its traveled that far. So we have a situation where the blast started the computer and bullet stopped it, hence the low reading. If the blast is severe enough to trigger both screens, you will be measuring the speed of sound instead of your bullet velocity. In either case the solution is simple: **BACK UP!**

When you fire a supersonic round the bullet gets to the skyscreen before the blast does. Keep the muzzle a few feet back from the first skyscreen to keep from beating it up. Remember that the farther your screens are from the muzzle the lower the velocity your chronograph will read (the bullet starts slowing down as soon as it leaves the barrel). If the blast is severe enough the gas from the cartridge (which proceeds the bullet for the first few feet of travel) may trigger the start screen and cause erroneous readings. You can also trigger on the mirage caused by the shock wave. This seems to occasionally occur with the sun near directly over head and is only a problem with subsonic rounds. With supersonic rounds the bullet is gone before the mirage gets to the screens.

Another muzzle blast problem occurs when the skyscreens trigger on the **shadow of the muzzle blast**. This can happen when the sun is quartering to directly behind you and fairly low on the horizon (otherwise known as shooting north in the winter months). What happens is that you have a fairly dark blue sky, so the Glint Guard turns up its sensitivity. The sun is reflecting off the edge of the slit in your skyscreen. When you fire, your muzzle blast expands rapidly outward and as it crosses the line between the sun and your skyscreen the amount of light impacting the edge of the skyscreen slit drops producing an absurdly high reading (like 2700 FPS for your rimfire 22 pistol). Changing the direction of fire **will** solve the problem. If the fellow firing next to you causes your chronograph to trigger this is probably the culprit.

Problems

Hopefully you won't have any problems with PACT Professional Chronograph. We have busted our rears to make this thing as reliable as possible. Of course every so often a capacitor dies, a resistor breaks or an integrated circuit goes on vacation. These things don't happen very often and we go to great lengths to see to it that we only use the best possible components. If your Professional Chronograph does misbehave, here are some things to check:

Are the screens plugged in correctly?

Is the battery up to speed? When it gets low on power your Professional Chronograph will get less sensitive. For example it may have trouble seeing a bullet although it may still pick up your hand.

Is the bullet darker than the sky? If it's not, the Professional Chronograph will have a hard time seeing it. You might try shooting lower over the screens.

Water can wreak havoc inside your skyscreens. If you leave them out in the rain they will fill with water which will short out the photo transistor. If this happens, it may be necessary to take them apart to dry them out. You probably won't leave them out in the rain twice.

If you do have a problem, for goodness sake, **DON'T SUFFER IN SILENCE!** Call us at 800 PACT INC. Our success depends on your satisfaction. We have been building electronic products for shooters for years. We will get you sorted out.

Odds and ends

How do you know if your Professional Chronograph is telling you the truth? If the reading you get is close to what it should be you can count on it being within .5%. That's point five per cent **not** five percent. Normally you will find that the readings are actually better than that. If the unit prints a bad velocity it should be off by enough to be obviously wrong. Bright overcast days will produce more accurate and consistent readings than blue sky sunny days.

In ten years of chronograph building we have yet to have a unit returned for repair because it read too high. However about once a month a member of the Magnum/Weatherby club has us "check his unit out" because it reads "200 feet low." While we have seen a few bad counter chips, out of thousands of chronographs tested, it is damn near impossible for a unit to read "200 feet low" with one cartridge and correct with another.

If you want to compare two chronographs you should set them up so that a single shot registers on both units. We recommend that you compare average velocities on 10 shot strings. To compare the "Variability" of one chronograph to another compare the SD's or MAD's (if available) recorded on each string on each chronograph. If chronograph "A" has a 10% lower SD or MAD **on the same string** as chronograph "B" than you can correctly say that chronograph "A" has a slightly lower "total system error." Note that even with two chronograph set up you can get duplicate erroneous readings. Any error caused by environmental conditions will likely effect both machines.

Paper Change

Your Professional Chronograph comes with an 80 foot roll of paper. You may have a new hobby before you use it up. If you do need to put a new roll in just remove the six screws from the bottom of the unit and carefully lift the cover off. Tear the end off the new roll at a 45 degree angle to make it easier to thread through the print mechanism. Pull about six inches through so that you have enough to thread through the paper slot in the top of the case. Put the top back on and press it down tightly. While you do this pull a little paper through to make sure it comes freely. Turn the Professional Chronograph over and replace the screws.

DON'T BE A DUMB ASS!
ALWAYS WEAR EYE PROTECTION!