SECTION 6

Adjusting Velocity

- Checking your fps
- Adjusting Velocity

In this section you will learn how to measure the velocity of your paintball marker using a chronograph. You will also be provided with details on how to adjust the velocity and troubleshoot velocity related problems of your Warsensor WS-66 Tactical Marker using various different methods.

CHRONOGRAPHING

INTRODUCTION

This not only addresses some of the questions about chronographs and their proper use, but also to inform players how "less than ethical players" purposely circumvent safety rules. I realize that it may give people "ideas" on how to cheat, but if everyone knows about these nasty techniques, maybe more people will pick up on them.

A CHRONOGRAPH

A chronograph is a device which is designed to measure the velocity of a moving object. The first type of chronographs were the "sensor type". The chrono had two light-sensitive sensors which marked the passing of a projectile as a change in light levels. The computer chip in the chrony uses the simple Velocity- Equals- Distance-Divided-By-Time equation, to determine the speed of the paintball. The first chronographs probably wouldn't fit in an average size garage and tipped the scales at a couple of tons. They were designed to aid in the research and development of firearms and ammunition.

The second type of chrono is the "radar type". A radar chronograph uses "Doppler effect" radar which detects, and measures the speed of, a moving object. It's the same technology used for police "speed guns" and military target tracking systems.

THE IMPORTANCE OF CHRONOGRAPHING

Paintball goggles are stress tested to absorb an impact of around 320 fps. Velocities over 300 fps tend to break skin and cause severe bruising. Higher velocity paintballs have been known to cause concussions (when impacting on the temple). We don't want people to get hurt, so the limit was set at 300 fps.

You can't "guess" a paintball's velocity by the sound of the Warsensor WS-66 Tactical Marker. (Although more experienced payers have been known to approximate velocities for the sounds of paintmarkers familiar to them--this doesn't replace chronographing). You can't tell its velocity by the size of the splat it makes. The chronograph, when used properly, is the safest, most accurate way to determine the Warsensor WS-66 Tactical Marker's velocity.

NOTE: Warsensor WS-66 Tactical Markers which are at velocities of over 300 fps are said to be "hot" or "shooting hot".

THE PROPER WAY TO CHRONOGRAPH

1.Sensor Type - The ideal position is as follows.
-The end of the barrel should be at least one foot away from the front of the chronograph and at least six inches above it.
-The barrel should be parallel to the plane of the sensors.

2.Radar Type - Rest the end of the barrel on the mount provided.
There should be a clear space of at least five feet so the radar beam is not interrupted by bushes, walls, tress and other obstacles.

Always remember, the chronograph is NOT and impact sensor, so don't shoot it.

IF THE MAXIMUM LIMIT IS 300 FEET PER SECOND (FPS) IS IT OKAY TO SET MY PAINTMARKER TO 300 FPS?

ABSOLUTELY NOT! Due to ambient air temperature changes throughout the day, the effect of rapid firing on pressure and temperature of the CO2, along with a dozen other things, will effect the velocity by up to 15 fps. Set your Warsensor WS-66 Tactical Marker at 300 fps first thing in the morning and you'll be shooting at least 315 fps by noon, or sooner! Even stable systems like high pressure air and nitrogen have had velocity spikes.

THE MOST COMMON MISTAKES THAT RESULT IN INCORRECT READINGS

LIGHT. The sensor-type chronographs rely on ambient light. If it is too bright, or too dark, the chronograph will give erroneous readings, or none at all. Because it detects changes in ambient light, if the muzzle of the Warsensor WS-66 Tactical Marker is too close to the chrony, the expelled CO2 will also cause confusion in the reading.

SPACE. Radar chronographs don't suffer from any of these frailties. However, the radar chrono needs space in front of it so the beam can be projected from the chrono uninterrupted by obstacles such as trees, buildings and walls. They operate on any light (or in complete darkness) and because the beam is projected out away from the shooter, the ball naturally travels right into it. Don't worry about being irradiated. The beam is projected away from you.

Besides, if you're standing in the beam, I'm sure the paintballs hitting you will give you a subtle hint to move.

DIRTY BARRELS. Paint and shell fragments in the barrel will slow the ball down to bring the velocity down as much as 10 feet per second (fps). Watch the balls as they travel; if they're corkscrewing and hooking, you know the person chronographing has a slimed barrel.

HOLD THE PUMP. With pump action paintmarkers, if you do not hold the pump forward when you fire, the bolt usually blows back. This results in lowering CO2 pressure in the barrel and lowering velocities as much as 10 fps.

AIR SOURCE SHUT OFF. If the tank is shut off, unscrewed (to close the pin valve) or low on gas, the pressure is lower. This results in VERY low chrono readings. Players can purposely cause this to happen. They charge the paintmarker and then turn off the power source. There is still CO2 in the valve of the paintmarker, allowing them at least one shot. To thwart this type of "mistake", it's best to take several shots over the chronograph. Ensure remote systems are turned on, you can still fire the paintmarker with a hose full of CO2. If a player seems to be satisfied (or even happy) with a velocity of 220 fps on their semi, you might want to keep an eye on them.

DIFFERENT BARRELS. Different barrel lengths and interior finishes will give different readings on the same paintmarker. Shorter barrels give lower readings than longer ones. Players could switch barrels after chronographing and change their velocities, this can happen intentionally or out of ignorance. Also if the interior, or bore, of the barrel is smaller than your paint, it will slow the velocity as well (because of increased friction between the barrel and the moving ball). Switching to a barrel which is of a larger bore (but similar outward appearance) will result in a drastic raising of velocity. Sometimes as much as 25 fps.

PAINT. Old paint, which has swollen slightly, will give slower velocities. (Again, because of increased friction.) Load fresh paint and velocities start to climb. Due to the fact that different brands (and even different lots of the same brand) vary in diameter, always chrono with the paint you're going to be using that day.

LIQUID OR GAS. Some paintmarkers run on liquid CO2; check to see if the paintmarker has a siphon bottle. Those other CO2 systems that rely on gas have to be checked too. Any paintmarker running on gas will have significantly higher velocities if they manage to pull liquid. When you chronograph, you want the worst-case scenario. Force the paintmarker to draw liquid (by tipping it so liquid from the tank will flow into the valve and then firing a few shots) and chronograph. A paintmarker chronoed a 260 fps on gas will go over 300 fps on liquid. Paintmarkers with regulators and expansion chambers usually won't go liquid, as long as you're not pounding the paint down- range like you're trying to put out a forest fire. (More on that later.) Don't make markers like the Automag take liquid, however, they could get damaged internally.

DISCONNECTED REMOTES. Disconnecting the hose from your remote set-up will cause a drop in pressure in your paintmarker, resulting in lower velocities. This is why in most tournaments you are not allowed to fire/disconnect after you have been eliminated or the game has ended.

FRESH FILLS. A freshly filled CO2 tank will yield very low velocities. I've seen velocities climb 100 fps as tanks warmed up! If the tank is frosty, tell them to go get a warmer one. (Usually the field will lend you a tank, if you don't have another one.)

WHAT TO LOOK FOR DURING A GAME

Listen to the paintmarker as it fires. If you hear a pop, pop, pop, KAPOW! it's a good chance that last shot was hot (over 300 fps). Watch for players with incredibly unbelievable range. If your paintballs are dropping at their feet (and you're at 280 fps) and your opponent's are zipping straight past your head, chances are he's hot. If the paintball REALLY hurts when it hits you at longer ranges, ask the shooter to re-chrono.

"CHEATING" THE CHRONOGRAPH

All of the above mentioned mistakes can be done intentionally. Also there are other deliberate methods.

1. A string of rapidly fired shots tends to cool the CO2 down. This results in lower velocities. Watch for players shooting lots of paint just before they chrony. Or especially if they seem to be shooting a lot of just air.

2. This is pretty much reserved for Autocockers, but other compatible operating systems can be similarly modified. Basically, there is a hole about halfway down the bolt that allows air to come up from the valve and then out the front of the bolt. Some players have TWO holes, one on either side, of different diameters. One hole will give low velocities, and the other will bring the paintmarker over 300 fps. You chrono safely with one hole, and turn the bolt (easy to do with a 'Cocker) and you've changed your velocity from 280 to 310 fps! This is not something that happens by mistake.

WHAT WE DID BEFORE CHRONOGRAPHS WERE INTRODUCED TO THE SPORT

Well, we just listened. Some fields had you shoot at a tree at a certain distance, if the splat was bigger than your hand, you paintmarker was shooting hot. Luckily we discovered chronographs a few years after the sport's inception.

WHEN TO CHRONOGRAPH

Here is a quick reference list of when you should chronograph your marker.

MANDATORY

1. First thing in the morning, before play.

2. Just before lunch.

3. After lunch.

4. After adjusting, replacing or repairing internal components.

5. After changing barrels.

6. After changing your air source (putting on a new tank)

7. When requested by field staff.

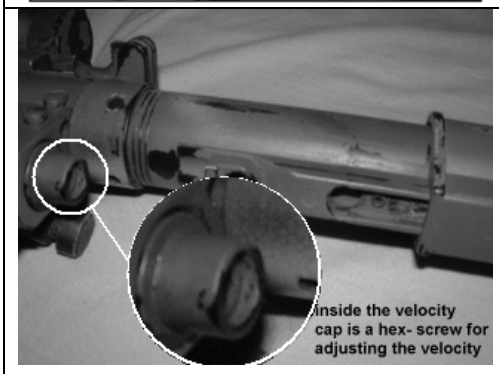
8. When requested by another player.

9. Any time you feel you should, just in case.

FOR EXTRA SAFETY

1. After disconnecting, and subsequently reconnecting, your remote hose.

2. When the weather changes (cloudy to sunny, warm to hot, rainy to clear -- I'm sure you get the point).

	Please ensure that the marker trigger is set to SAFETY ON before moving on to any further work on the marker – this is particularly important if you have the air source attached and the marker pressurized as outlined in Section 4 of the user manual.	**NEVER PERFORM MAINTENANCE ON THE MARKER UNLESS THE TRIGGER IS SET TO SAFETY ON.** **EVEN FOR SEASONED USERS SAFETY SHOULD NEVER BE COMPROMISED. MISTAKES OR ACCIDENTS CAN CAUSE SERIOUS INJURY.**
	Looking at the back end of the WS-66 Tactical marker you will see the velocity cap just under the stock. Inside the velocity cap is a hexagonal screw. The large hex wrench fits inside this screw, and can be turned either clockwise (increases the velocity), or counter-clockwise (decreasing the velocity. Adjust your velocity to adhere to the safety limits permitted by the field operators where you are playing. NEVER operate your marker at fps settings over 300fps. This can be dangerous and cause harm to others players when marked.	**Most paintball fields have limits to the feet per second (FPS) which a marker is allowed to operate at. Most fields limit this to any fps within 280-300.** **Your WS-66 can be adjusted to operate within this range. A chronograph is required to accurately determine the fps setting when making changes to the velocity.** **Chronographing requires marker to be live with compressed power source and paintball ammunition. PLEASE WEAR SAFETY GOGGLES!**
	There are other ways to adjust the velocity with more precision on your WS-66 Tactical Marker, these include but are not limited to: (a) adjusting length of the main tension spring by cutting loops off of the spring in small sections (this decreases fps and should only be done if needing to LOWER the velocity- it is an irreversible option. (b) add a stiffer spring or spring tension device depending on what's needed (more or less). Stiffer springs may be shorter than original and still provide more fps readings.	**Check on the armotech forums http://www.armotech.us/forum for tips and information on how to do spring modifications and adjustments to obtain desired results in terms of velocity adjustment on your warsensor marker.**
	After cocking the marker, and successfully loading your first paintball round into the breach – set your trigger safety switch to OFF. The marker is now LIVE and ready to fire the chambered paintball. TAKE AIM------GENTLY SQUEEZE THE TRIGGER…..You have successfully fired your first paintball. Repeat as desired.	**NEVER FIRE LIVE PAINTBALL ROUNDS AT ANOTHER PERSON UNLESS THEY ARE WEARING PROPER PROTECTIVE CLOTHING AND PAINTBALL APPROVED EYE/FACE PROTECTION (GOGGLE/MASK)**

If you have a chronograph, check the fps of the paintballs as they are fired. Optimally the marker should fire between 280 and 330 fps. Although the marker can exceed 300fps it is not recommended. Most paintball fields require the marker to be set between 290 and 300fps and no more.