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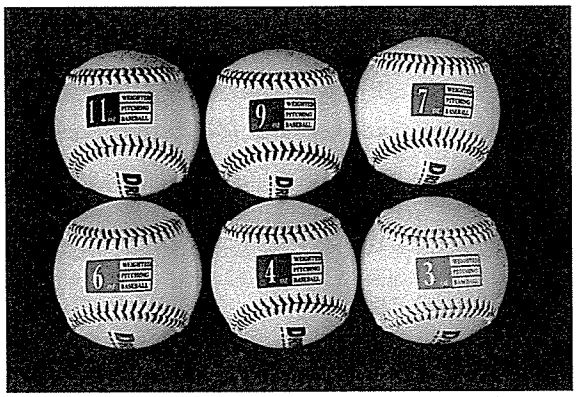
VELOCITY TESTING with Weighted Baseballs

Background on Weighted Baseballs

Training with weighted baseballs has been around for decades, and their effectiveness at developing velocity has been proven time and time again in peer-reviewed journal articles by authors like Dr. John Bagonzi, Dr. Coop DeRenne, Alan Blitzblau, and many others. Many of these articles also focus on arm health, and no research study using weighted baseballs has concluded that they were inherently more likely to cause arm injuries. Furthermore, our own study on using 3–7-oz. weighted baseballs for velocity testing in early 2017, featuring a test group of elite athletes using the motusBASEBALL sleeve, found no statistical difference in either elbow stress or shoulder rotation range of motion. While it's certainly possible that future tests with a full marker-based solution could yield different results, for the time being there is insufficient evidence that either underloaded implements or overloaded implements are more stressful on the arm compared to a baseball when thrown at max effort.



At Driveline Baseball we have continually tested and retested the use of stitched, hard-cover weighted baseballs since 2007, and we still use them with our older athletes. *For youth athletes, we suggest using PlyoCare balls only as outlined in Hacking the Kinetic Chain- Youth, our guide focusing on pre-high school pitchers.* We have cycled in mechanic-specific drills with them to gauge the effectiveness of using constraint-based methods to improve kinesthetic awareness of the pitching arm, and the success with these methods eventually caused us to develop softer- and heavier-weighted implements, which is how PlyoCare balls came into existence. After years of trial and error, we have developed a truly elite product in our Driveline Leather Weighted Balls, which are designed to have the same feel and durability as a game ball.

Velocity Testing: Pulldowns

While our weighted baseballs can be used for a variety of things, such as command work and long toss, there's no mistaking the fact that they were primarily designed for one thing: to push the body's ability to throw absolute gas!

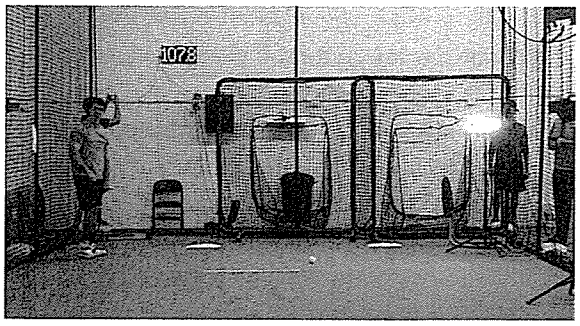
The use of overload/underload-weighted baseballs thrown at maximal RPE helps reorganize the delivery in ways that traditional instruction can never assist with. An athlete cannot consciously control the arm at high intensities due to the rapid angular velocities occurring at the shoulder, meaning that countless reps with an unloaded pitching arm are largely a waste of time. Our goal is for the athletes to use the constraint drills with PlyoCare balls to maximize the efficiency of their throwing patterns and to use the Leather Weighted Baseballs to imprint those patterns by challenging the neuromuscular systems at the highest possible intensities.

To create the greatest challenge for the body during velocity testing, we have our athletes use a technique that resembles a crow hop, run and gun, shuffle step, or whatever it takes to throw the ball as hard as possible. A general rule for technique is the best athletes at weighted-ball velocity testing (aka "Pulldowns") tend to cover around 10 yards (or sometimes a little more) of ground before throwing the ball. It's difficult to run straight on towards the target and turn 90 degrees to get sideways without killing momentum, so our athletes tend to start out on their glove side of the target, creating a banana route into the middle of the throwing lane before taking their last few steps in a sideways position before throwing the ball. It's wise to start out slow at first with the footwork and gradually work up to operational speed. Assuming all things are equal, a faster pace is better. However, we all know an infinite linear relationship between movement pace and throwing velocity is not real. The athletes' movement pace should push them to move fast enough that they push their ability to properly sequence the kinematics, but not too fast to the point where they are simply running out of control. These are running throws, not throwing runs. For a more in-depth look at Pulldown technique, go to our website to check out the video on this exercise.

Executing a Pulldown Session

The throwing programs briefly outline the progression for Pulldown sessions, but let's go ahead and discuss at length what one of these training days looks like, as well as the benefits and reasons behind the progression.

The first step to going through a Pulldown session is understanding that the approach to the warm-up process is just like a game day. That means progressing PlyoCare throws slowly from low to high RPE. For example, Reverse Throws, Pivot Pickoffs, and Roll-Ins should be started at a low intensity, with the athlete slowly increasing RPE after each throw. By the time athletes get to Rocker Throws and Walking-Windup Throws, they should begin to increase their RPE above 85%. Once PlyoCare throws have been completed, the athlete should do whatever it takes to put himself in a position to be able to throw at 100% RPE for velocity testing. This often entails some sort of combination of the Jaeger long toss extension and compression phases, but it's ultimately up to each athlete to decide on how to optimize his own readiness for 100% RPE throwing.



Casey Weathers pulling down 107.8 mph with a baseball on January 12, 2016, a facility record that has stood for 1.5 years and counting

An example Pulldown progression looks something like this:

Regulation baseball	**1 throw @ 80% RPE, 3–4 throws @ 100% RPE**
6-oz. weighted baseball	**1 throw @ 80% RPE, 3–4 throws @ 100% RPE**
7-oz. weighted baseball	**1 throw @ 80% RPE, 3–4 throws @ 100% RPE**
Regulation baseball	**3–4 throws @ 100% RPE**
4-oz. weighted baseball	**1 throw @ 80% RPE, 3–4 throws @ 100% RPE**
3-oz. weighted baseball	**1 throw @ 80% RPE, 3–4 throws @ 100% RPE**

The particular weighted baseballs thrown and the amount of reps per set varies between throwing programs, but the progression above represents a fairly standard weighted-baseball velocity testing day. It's definitely an unexpected sequence, since most people assume the order of throwing is 7, 6, 5, 4, 3 oz. Let's break down each step and explain why we have assembled the order this way.

By starting out with a regulation baseball, we present athletes with an opportunity to throw a familiar object first in order to help them gain confidence in their ability to execute a high-intent Pulldown. The first rep is done at 80% RPE to establish the footwork and timing they will use on their Pulldowns. After the 80% RPE throw is completed, the athlete will execute the prescribed number of throws on his program at 100% RPE. The prescribed number of throws will often be based on an athlete's age, overall workload, throwing fitness, and familiarity with throwing weighted balls. All things equal, athletes new to our programs will tend to have a lower vol-

ume of Pulldowns than athletes that are seasoned veterans. We mostly care about charting the highest velocity throw, but we also encourage creativity with charting velocity data as well. There's nothing wrong with charting the athlete's minimum, average, maximum, or any other statistics.

We have athletes use a 6-oz. weighted baseball right after the regulation baseball because it's the most subtle change in weight while also working the athlete towards throwing overloaded baseballs at max effort. The first throw with the 6-oz. ball is at 80% RPE to help the athlete gain familiarity with the new implement. Execute the prescribed number of throws at 100% RPE, then repeat the same exact steps with the 7-oz. ball.

As you can see, we have the athletes work up slowly in weight until they reach the 7-oz. ball. To be clear, 9- and 11-oz. weighted baseballs are meant for catch-play use and are not programmed into velocity testing days. We incorporate overloaded baseballs into Pulldown sessions because EMG studies have shown that there is increased activation of the pronator-flexor mass when using them, with pronation angular velocity of the forearm significantly higher as well. Throwing overloaded baseballs is a great method for developing speed-strength and driving physiological adaptation of the muscles responsible for protecting the UCL because the brain understands the need for the body to properly decelerate and support the elbow when they are thrown at maximal intensities. Overloaded baseballs also help maximize the efficiency of the Pickup Phase, Elbow-Spiral Phase, and Driveline Phases, optimizing ability to create ball speed.

After the athlete is done with their 7-oz. weighted-baseball throws, the next step is to transition back to the regulation baseball immediately at 100% RPE and complete the prescribed number of reps. We originally programmed this transition due to the concept of post-activation potentiation, the idea that the central nervous system (CNS) may be primed at a higher level after throwing overloaded baseballs. However, our velocity-testing data collection over the last several years points to no correlation between throwing overloaded baseballs and immediate improvement in velocity with the regulation baseball. Instead, the results have been fairly split, with some athletes improving regulation-baseball velocity right after throwing overloaded baseballs, whereas other athletes decrease in regulation-baseball velocity. The exact reasons for this are still unknown, and further research on different types of athletes is an ongoing task for us. Still, we find this progression a reasonable means to translate the more efficient throwing patterns learned with an overloaded baseball to a throw with a regulation baseball.

Once athletes finish their second round of regulation baseball throws, they moves on to throws with the 4-oz. weighted baseball, repeating the original sequence of the first throw performed at 80% RPE, with the next several throws performed at 100% RPE. To finish the velocity testing day, athletes will repeat the same exact sequence with the 3-oz. weighted baseball. These underloaded baseballs are utilized in Pulldown sessions for the following reasons:

- *The ability to move the arm at supramaximal speeds teaches the body to move quicker and to preferentially recruit even more "fast twitch" muscle fibers due to higher peak output of the ballistic profile.*
- *Doing so presents a challenge to the body to transfer the throwing patterns learned from using PlyoCare balls, overloaded baseballs, wrist weights, and long toss to lighter implements.*

As noted earlier in this chapter, our own studies using the motusBASEBALL sleeve have revealed that underloaded baseballs are *not* more stressful than a regulation baseball. The reasons why are unclear for now, but here are a few things we do know. First, due to an artificially lower inertial mass, internal rotation of the throwing arm is cued slightly earlier than it normally would be with a regulation baseball, causing the arm to accelerate faster. Continuing to push the ability to increase arm-acceleration speeds cannot be done in any other way than throwing underloaded implements.

Throwing underloaded baseballs also creates additional kinesthetic awareness of how the arm works in the high-level pitching delivery. The athlete's release point often shifts closer to the body due to the quicker unwinding of internal rotation, making it common for athletes to spike their first several underload baseballs. Athletes are challenged to transfer throwing patterns from PlyoCare drills and other modalities, because throwing underloaded baseballs is the least-constrained activity the athlete can perform, meaning there is the most room for error. For example, it's somewhat easy for an athlete to self-organize the ability to create forward shoulder rotation and drive the throwing hand over the elbow when throwing a 1-kg PlyoCare ball. What happens if that movement is immediately attempted with a 3-oz. weighted baseball? Decreased proprioception and increased arm speed make it easy for the brain to lose track of where the arm is in space, likely causing a breakdown in throwing-movement efficiency. Progressively reducing the weight over time towards underloaded implements continues to challenge the neuromuscular system to avoid the forearm's losing control of the direction of elbow extension. Purposely making the task at hand tougher on athletes' neuromuscular system helps them regain the ability to make improvements rather than go through the motions with an implement that has long been mastered.

Understanding Velocity Spreads

The actual numerical differences between each weighted-baseball velocity can tell us many things about an athlete, sometimes before even seeing them for the first time. Here are the two most common scenarios we have encountered over the last several years:

1. *Perfect positive linear slope, with the 7-oz. ball being the lowest velocity and the 3-oz. ball being the highest. For example, 7 oz. = 88 mph, 6 oz. = 90 mph, 5 oz. = 93 mph, 4 oz. = 95 mph, 3 oz. = 98 mph.*
2. *Perfect positive linear slope from the 7-oz. ball to the regulation baseball, then the underload balls taper off onto a slope of about zero. For example, 7 oz. = 88 mph, 6 oz. = 90 mph, 5 oz. = 92 mph, 4 oz. = 92 mph, 3 oz. = 93 mph.*

Scenario 1 is the ideal result to shoot for. The velocity difference between the 7-oz. and 5-oz. balls should be 5-6 mph and the velocity difference between the 5-oz. and 3-oz. balls should also be 5-6 mph. This generally tells us that the athlete is healthy and has overall good throwing patterns. Scenario 2 isn't the worst result by any means, but it does tell us that the athlete may have a few problems. These issues can range from a subpar ability to accept force, inefficient throwing patterns, or perhaps a previous injury history related to both of those, causing a breakdown when transitioning to underloaded baseballs.

While we have seen scenarios where athletes have a perfect negative linear slope (7 oz. = highest velo, 3 oz. = lowest velo) and perfect zero linear slope (all velocities are the same), they aren't particularly common. Whatever the case is, the goal is for the

athlete's velocity spreads to look similar to scenario 1 while also increasing their velocities across the board. This usually points back to the athlete seeking to improve his throwing patterns and force acceptance while pushing his intent by consistently competing against his own velocity numbers on Pulldown days.

Projecting Mound Results

"Hey look, that guy can throw really hard with a running start. What does that equal to on the mound?"

This is possibly the most common question we have received throughout the history of our company and, to be fair, it's a completely valid question. Athletes don't get to pitch with a running start, so that means there needs to be some sort of parallel between the two events, right?

In short, there is no direct translation between mound throws and Pulldowns. What we mean by that is if Athlete A's baseline numbers are 85 mph off of the mound and 89 mph on a Pulldown, then a 4-mph increase on Pulldowns doesn't necessarily guarantee a 4-mph increase on the mound as well. However, our data collection over the last several years has given us enough information to create these rules of thumb:

- *If all things are equal (total throwing movement and intent on both mound throws and Pulldowns is either good or bad) then there's usually a gap of 4-6 mph between Pulldowns and mound throws, with Pulldowns being the greater velocity. This gap can widen for elite athletes that have Pulldown velocities greater than 102 mph.*
- *If throwing patterns are good on Pulldowns, but poor on the mound, then the gap between Pulldowns and mound throws becomes larger than 7 mph.*
- *If throwing patterns are poor on Pulldowns, but good on the mound, then the gap between Pulldowns and mound throws becomes smaller than 4 mph. This means there are even cases where mound velocities can exceed Pulldown velocities.*

Our throwing programs are written with this information in mind to maximize the athletes' ability to blend the intent they learn on Pulldowns and the throwing patterns learned with PlyoCare drills to a slope, maximizing potential for their training to carry over to when it matters: game day.