



## BALL SPEED SLOW-DOWN

When a ball leaves the thrower's hand, it is travelling at its' maximum velocity. Air resistance (drag) causes the ball to decrease in velocity as it travels away from the thrower. The rate, at which the ball slows-down, is dependent upon many factors. Robert K. Adair, Sterling Professor of Physics, Yale University, describes in great detail the flight of a thrown (and batted) baseball in his outstanding book, [The Physics of Baseball](#)". Written for the layman, but appropriately supported with theory, the book summarizes the Professor's conclusion (page 33) that a typical (Major League) fastball slows down at a rate of about one mile per hour for every seven feet of travel. Thus, a ball thrown by a pitcher will reach home plate, sixty feet-six inches away, at a speed about eight miles per hour slower than when it left the pitcher's hand.

Many variables which effect the air resistance "drag" on the ball, and associated air turbulence, enter into this conclusion, including air density, temperature, altitude, barometric pressure, wind velocity and direction, etc.; as well as the ball cross-section area, surface roughness, stitch height and stitch orientation relative to spin axis; and ball velocity. However, for the purposes of this discussion, and the applicability to the use of radar ball speed measuring devices, it is sufficient to apply the Professor's generalization of 1 MPH for each 7 feet of travel from the thrower's hand. When asked the specific question about the deceleration of a softball, Professor Adair offered the opinion, interpreted by this writer, that the increased drag, relative to a baseball, would be offset by the momentum of the heavier softball, resulting in approximately the same rate of slow-down as the baseball.

## RADAR SPEED VARIABLES

Several different "Radar Speed Guns" are used to measure the speed of a thrown ball. Some radars, referred to as "fast guns", measure the speed of the ball within a few feet after it leaves the thrower's/pitcher's hand. Since the speed at "release" is the pitcher's maximum, it is often the speed that most players use as a reference, since everyone is generally interested in quoting their "fastest" speed. Although these "fast guns" are excellent instruments, they can occasionally present an erroneous speed indication due to the pitcher's motion, leg kick, arm swing, or other false target anomalies often referred to as "ghost" readings for all radars. These readings are generally infrequent and in no way demean the integrity of these precision instruments for practical ball speed measurement applications.

Some "Radar Speed Guns" measure the speed of the ball after it has travelled 20-25 feet from the thrower. Anomalous readings due to the pitcher's motion are less likely, and the signal processing of numerous "Doppler cycles" can result in an accurate measurement less influenced by false target "ghosts". However, the travel distance results in a speed-reading about three MPH less than that of the guns which measure ball release speed. Thus, these devices are often referred to as "slow guns", and their speed-readings are closer to the average speed of the ball travelling between the pitcher and the batter.

The Glove Radar® works on the same Doppler principles as the conventional "Radar Speed Guns" but transmits much less power, due to its' smaller single-cell battery power supply. It also has a much broader antenna pattern to accommodate use with the variety of glove sizes and configurations, to which it is designed to be attached. Thus, the Glove Radar® illuminates the approaching ball with a much lower "microwave energy density" than the conventional

guns. The speed of the approaching ball is typically measured within a few feet of receipt of the ball into the glove to which it is attached. This is the ball velocity as it essentially reaches the batter after slowing-down at approximately 1 MPH per 7 feet of travel. At the 60 feet 6 inch baseball pitching distance, the resulting velocity measurement will be about 8 MPH lower than the "fast guns" and about 5 MPH slower than the "slow guns".

For a youth pitching distance of 46 feet, and slower ball speeds, the difference between the "fast gun" and the Glove Radar™ readings will be about 5-6 MPH. A softball pitched from 40-43 feet will be about 4-6 MPH lower at the catcher, depending upon the variables cited above.

The accuracy of the Glove Radar® device compares closely with that of the more expensive radar guns when positioned to measure ball speed in the same location. Comparisons can be made by facing the ball receiver, who is wearing the glove-attached Glove Radar®, and pointing the radar gun toward the receiving glove. The separation distance should be the minimum practical at which the radar gun will measure the ball speed.

It is of interest to note that the ball speed measured by any radar is that of the ball velocity vector directly toward the radar. If the radar is not aligned with the actual flight path of the ball from thrower to receiver, the radar speed-reading will be reduced by the cosine of the angle by which the radar is displaced from the ball travel path. This difference is insignificant when the radar is located essentially in-line, or near alignment, with the ball flight path. However, if any radar is positioned on the ground, or on a tripod, such that it is appreciably away from the ball flight path, speed inaccuracies can occur.

#### **GLOVE RADAR® VARIABLES**

The broad antenna pattern and unique signal processing of the Glove Radar® facilitate speed measurements of virtually any ball which is caught in the glove. However, if the glove is held such that the Glove Radar® is facing downward, "looking" toward the ground without facing at least somewhat in the direction of the ball, some balls can be "missed" by the radar. No radar gun can see the ball when looking away from its flight path. Since the Glove Radar® is measuring and calculating the speed as the ball is approaching the glove, the flight path vector created by any "break" on the ball is inherent in the measurement. This feature is unique to the Glove Radar®, unlike that of radar guns reading the ball velocity at a greater distance from the catcher, before the break.

Doppler radar speed measurements indicate the relative closing, or departure, velocity between the object being illuminated by the radar and the radar itself. If, in the act of catching a ball, the glove is moved vigorously toward the ball, a slightly higher speed-reading will occur. If the receiver "gives" with the ball, moving the glove away as the ball is caught, then a slightly lower velocity will be indicated. The normal movements in catching most balls is not a serious factor in measurement accuracy, but lunging for wild throws, and scooping low throws near or hitting the ground can produce anomalous speed readings. As you use your Glove Radar® you will become acquainted with its "personality", recognizing good readings and ignoring anomalies. Don't be misled by an unusually high reading as an indication of a sudden improvement, or a low reading as a loss of strength or technique. Averaging several readings, and/or discarding the high and low extremes is a good technique for assessing progress.

The Glove Radar® is an excellent training device to provide RELATIVE SPEED READINGS by which throwing improvement and progress can be measured.