THE LINEAR AND ROTATIONAL TIP VELOCITY OF A THROWN KNIFE

Facts / Conditions:
A digital movie camera filmed the event at 60 frames/second.
Distance lines perpendicular to the ground were drawn at 3 inch intervals.
The thrower stood at an 11’ toe line, left foot forward, throwing with the right arm.
The thrower threw a 14” knife weighing 12 ounces.
A single spin was thrown, i.e., 1 ¼ spins as the knife must go from perpendicular at the moment of release to point first horizontal before traveling 1 full rotation to the board.
The thrower threw at a normal/comfortable speed, i.e., not soft (a lob) and not hard (maximal strength), one typically used during competition or performing in which accuracy is a consideration.
Inches/second multiplied by a constant of 0.0568 will result in miles/hour.

Results / Conclusions:
The resulting digital movie was analyzed, frame by frame, at 60 frames/second to capture the knife in two identical positions, e.g. consecutively point forward or upward.
The knife was captured in identical positions approximately 20° above horizontal.
The knife moved 90 inches in 11 frames — from and to identical positions.
The knife moved 30 inches during its first ¼ turn.
The knife moved 120” (10’) from vertical release to a horizontal stick in the target, i.e., moving 1 ¼ turns.
Subtracting 10’ from an 11’ toe line identifies a 1’ (12") overreach to release.

**Linear Velocity**, i.e., the speed at which the knife is moving from the hand to the target was calculated at 28 miles/hour. To wit:
Distance. 90 inches from identical points within free flight.
Time. 11 frames ÷ (60 frames/sec) = 0.1833 seconds.
Rate. The result of Distance ÷ Time = (90 inches ÷ 0.1833 sec) = 491 inches/sec.
491 inches/sec X 0.0568 = 27.9 or **28 miles/hour**.

**Rotational Tip Speed**, i.e., the speed at which the tip or point of the knife is rotating about the circumference of the circle created by the knife spinning in a pin-wheel fashion as it rotates toward the target was calculated at 13.6 miles/hour. To wit:
Circumference. The result of Pi X diameter = 3.14159 X 14 inches = 44 inches.
Angular velocity.
Distance. 44 inches.
Time. 11 frames ÷ (60 frames/sec) = 0.1833.
Rate. The result of Distance ÷ Time = (44 inches ÷ 0.1833 sec) = 240 inches/sec.
240 inches/sec X 0.0568 = 13.6 or **14 miles/hour**.

Thus the tip of the knife will have a relative ground speed that ranges between 42 miles/hour (28 mph + 14 mph) as the tip rotates forward/toward the target and 14 miles/hour (28 mph – 14 mph) as the tip rotates backward/away from the target.

**Revolutions/second**, i.e., the # of revolutions the tip makes during one second of flight is 5.46. To wit:
Time to rotate one revolution. 11 frames ÷ (60 frames/sec) = 0.1833 seconds/revolution
Revolutions/sec. 1 ÷ (0.1833 sec/rev) = 5.46 rev/sec.

In the authors opinion this explains why a radar gun clocked a thrown knife at “50 miles/hour.” (Said individual was previously recorded at 35 miles/hour using the digital video technique described herein.) A radar gun detects the fastest motion. Thus, a linear velocity of 35 miles/hour PLUS the advancing rotational tip speed of 14 miles/hour = 49 mph; falsely interpreted as the “speed of the knife.” Voila! Myth busted.

Caution and note to the reader - This analysis was done using a 14 inch 12 ounce knife thrown by The Great Throwdini under “normal” conditions and for which the question was asked, “How fast is a thrown knife?” Others claim to throw a knife at 90 miles/hour, akin to the speed of a professionally pitched baseball. Clearly we recognize the difference between “normal” tournament/accuracy style throwing and a super human effort to press the limits of how far and/or how fast a knife can be thrown. None-the-less, I invite those who make such claims to stand the scrutiny of this analysis. I’m not saying it can’t be done. I’m saying, SHOW ME.

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