David Alciatore ("Dr. Dave")

"90º and 30º Rule Review"

__Note__: Supporting narrated video (NV) demonstrations, high-speed video (HSV) clips, and technical proofs (TP), and all of my past articles, can be accessed and viewed online at __billiards.colostate.edu__. The reference numbers used in the article help you locate the resources on the website. If you have a slow or inconvenient Internet connection, you might want to view the resources from a CD-ROM or DVD. Details can be found online at: __dr-dave-billiards.com__.

Periodically, I will write an article presenting a concise summary of principles from past articles. I think it is useful to review and reflect occasionally to help keep things in perspective and to reinforce important information. I'm a teacher in my other life and I know how important repetition and reinforcement are to learning. This article summarizes my previous six articles dealing with the 90° and 30° rules. Hopefully, by seeing all of the results in one place, knowing when and how to apply each rule will become clearer.

In my January, 2004 article, I introduced the 90° rule. It states that when the cue ball strikes an object ball with no topspin or bottom spin, the two balls will separate at 90°, regardless of the cut angle. The cue ball leaves along the tangent line, which is perpendicular to the impact line (see **Diagram 1**). **Principle 1** and **NV 3.4** summarize and illustrate the important points of the rule. The 90° rule is very useful for helping to prevent scratches (see my January, 2004 article), plan break-up and avoidance shots (see my February, 2004 article), plan carom shots (see my March, 2004 article), and plan cue ball motion for position play (see my March, 2004 article).

Principle 1 90° rule

With a stun shot where there is no topspin or bottom spin, after impact the cue ball will depart along the tangent line, which is perpendicular (at a right angle) to the impact line. In other words the cue ball and object ball paths, after impact, will be 90° apart (see Diagram 1, NV 3.4 and TP 3.1).

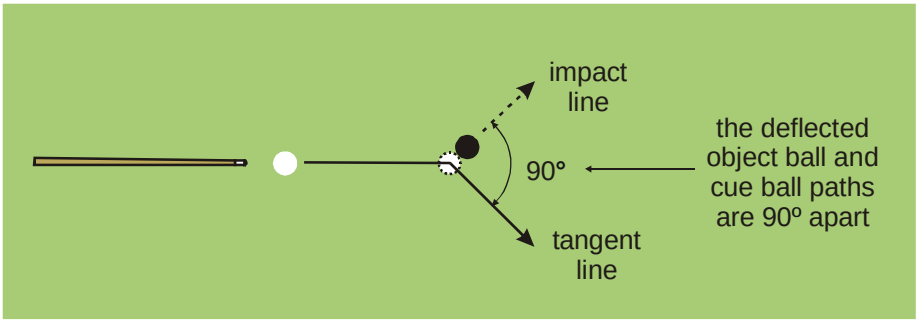

Diagram 1 The 90° rule impact and tangent lines

normal video

NV 3.4 – 90° rule with various entering angles

technical proof

TP 3.1 – 90° rule

The 90° rule applies exactly only for a stun shot, where the cue ball is sliding without topspin or bottom spin at impact with the object ball. **Diagram 2** illustrates some of the cases where the 90° rule applies. For the shot in the top-left of the diagram**,** the cue ball is close to the object ball to begin with, so a center ball hit (or slightly below center) at almost any speed (except very slow) is acceptable because the cue ball will not have time or distance to develop forward roll (topspin). For the shot in the top-right of the diagram, the cue ball is a medium distance from the object ball. In this case, faster speed is used to ensure that the cue ball does not develop forward roll. For the shot in the bottom-left of the diagram, the cue ball distance is the same as with the top-right shot; but in this case, draw (bottom spin) is used instead of speed to counteract the effects of forward roll. The bottom spin wears off by the time the cue ball reaches the object ball resulting in stun. For the shot in the bottom-right of the diagram, the cue ball is a large distance from the object ball, and both speed and draw are required to offset the forward roll that would normally develop over the larger distance.

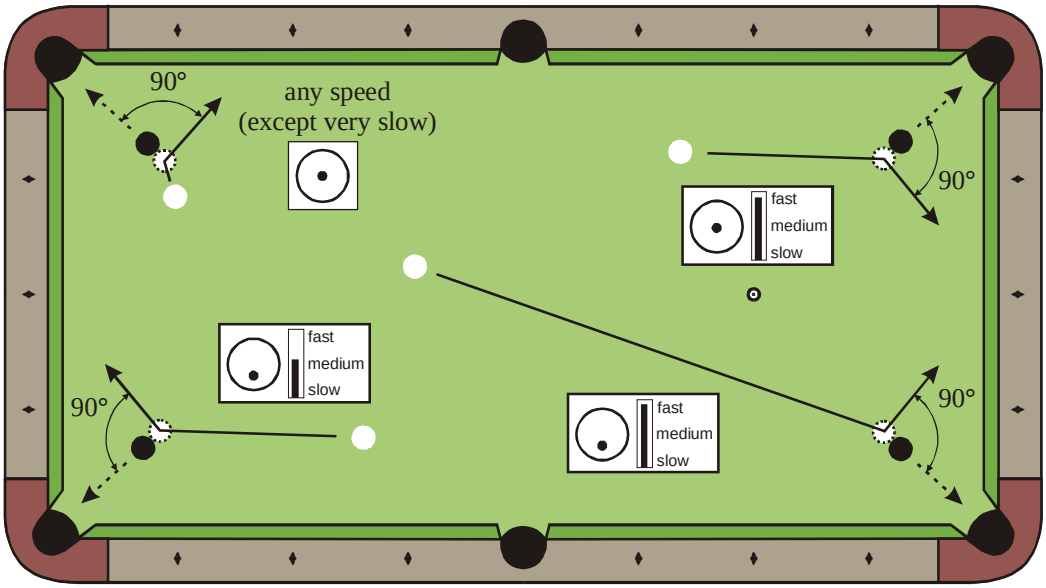

Diagram 2 Types of shots where the 90° rule applies

With many shots, the cue ball is rolling (with topspin) by the time it strikes the object ball (i.e., it won't be in stun). This is where the 30° rule comes in handy. My April, 2004 article introduced the 30º rule, when it applies, and how it is used in practice. My May, 2004 article showed some examples of how the rule can be used to help prevent scratches, plan break-up or avoidance shots, and execute carom shots. In last month's article (June, 2004), I showed how the 30º rule can be used to help you choose between a carom shot and a cut shot for a very interesting example. The key points of the 30º rule are summarized in **Principle 2** and illustrated in **Diagram 3**. The rule states that if the cue ball hits approximately half of the object ball (see **Diagram 4**), the cue ball will deflect off at very close to 30° from its original path. Note that, unlike with the 90° rule, the 30° angle is measured between the original cue ball path (the aiming line) and the deflected cue ball path (see **Diagram 3**). The deflected object ball direction is not involved. With the 90° rule, the angle is measured between the deflected cue ball and object ball paths (see **Diagram 1**). An exact half-ball hit, where the center of cue ball is aimed at the edge of the object ball, is illustrated in **Diagram 4**.

Principle 2 **30° rule**

When the cue ball hits an object ball with normal roll close to a half-ball hit (see Diagram 4), the cue ball will deflect approximately 30° away from its initial aiming line (see Diagram 3, NV 3.8, NV 3.9, and TP 3.3).

- The 30° rule applies only when the cue ball is rolling without skidding at object ball impact (see **Principle 3**).
- There is a fairly large margin of error. In other words, for a fairly large range of ball-hit fractions (i.e., cut angles), the cue ball path will still deflect by approximately 30° (see **Diagram 5**).

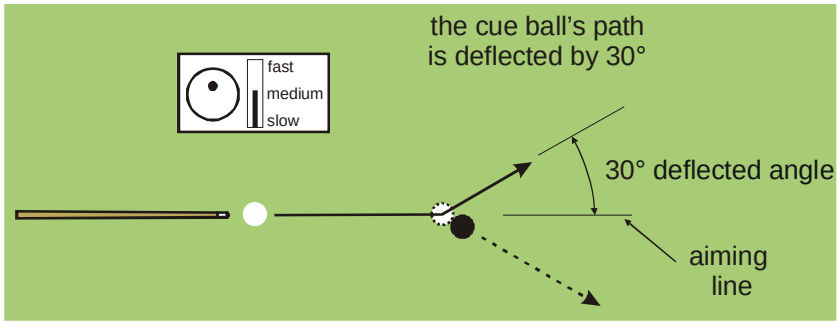

Diagram 3 **30° rule**

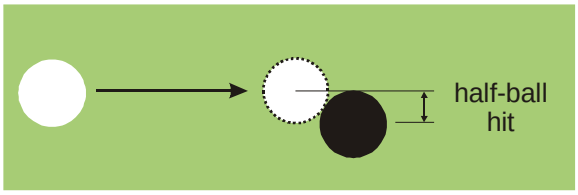

Diagram 4 **Half-ball hit**

normal video

NV 3.8 – Using your hand to visualize the 30° rule
NV 3.9 – 30° rule example

technical proof

TP 3.3 – 30° rule

Principle 3 **Normal roll**

The cue ball gradually develops normal roll as it slides along the table cloth (see my April, 2004 article and TP 4.1).

- This is true regardless of what type of vertical spin the ball has (draw, follow, or stun).
- Normal roll gives a ball the effects of a follow shot.

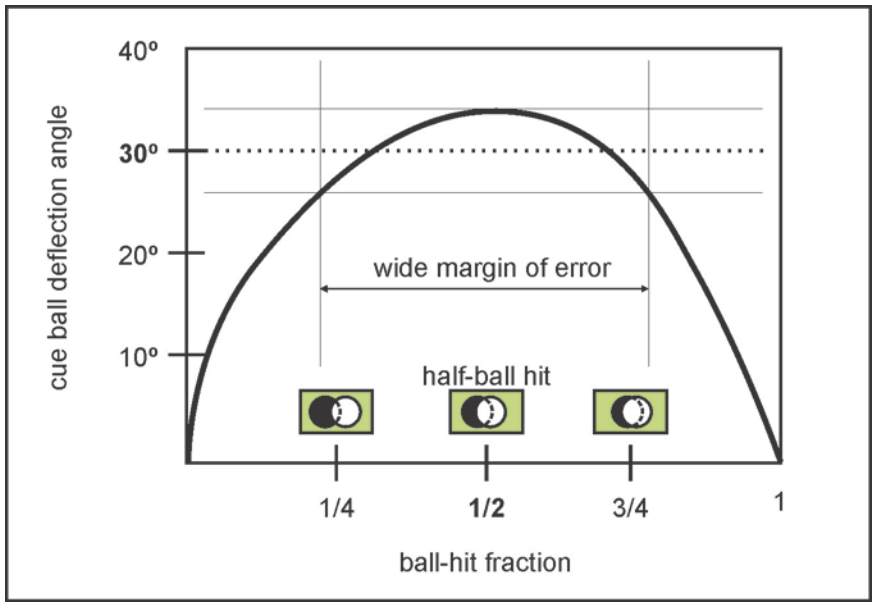

Diagram 5 **30° rule wide margin of error**

technical proof

TP 4.1 – Time and distance required to develop normal roll

Diagram 6 illustrates some of the cases where the 30° rule applies. Remember, it applies only when the cue ball has developed complete forward roll by the time it reaches the object ball, and when the ball-hit fraction is in the approximate range 1/4 to 3/4 (see my April, 2004 article). For the top-left shot in the diagram, the cue ball is close to the object ball, so follow (topspin) is required because the cue ball does not have enough distance and time to develop complete forward roll on its own. For the top-right shot, follow (topspin) is again required because the faster speed does not give the cue ball enough time to develop complete roll. In the bottom-left shot, because the cue ball is hit with slow speed, the cue ball will develop forward roll regardless of the English (except extreme draw). In the bottom-right shot, the large cue-ball distance provides enough time for roll to develop for most speeds and English (except fast draw shots).

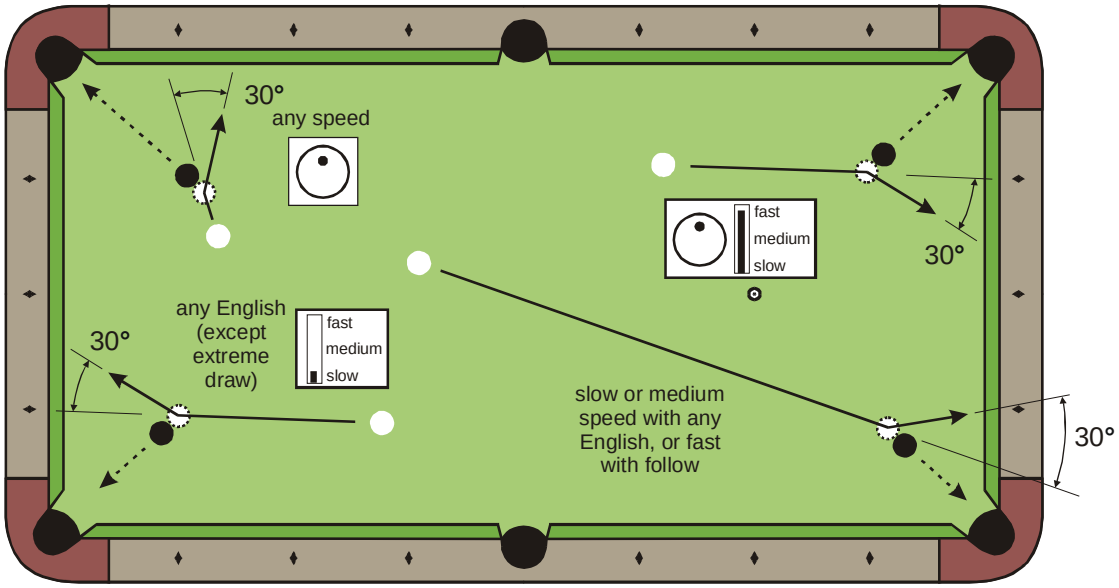

Diagram 6 Types of shots where the 30° rule applies

My June, 2004 article showed how a carom shot can be much easier to execute than a difficult cut shot. **Diagram 7** shows an example where the goal is to carom (deflect) the cue ball off the 1-ball to pocket the 9-ball (instead of trying to cut the 1-ball into the bottom-right corner pocket). The required angular deflection of the cue ball path happens to be exactly 30º. Because of this, there is an extremely large margin of error for the shot (see **Diagram 5**). You can hit as little as 1/4 and as much as 3/4 of the 1-ball and still have the deflected cue ball path be very close to 30º, and make the shot (see **NV A.1**). For even a novice player, the shot is very easy to execute. This is a great example of how a little knowledge (in this case, of the 30º rule) can help you easily win a game.

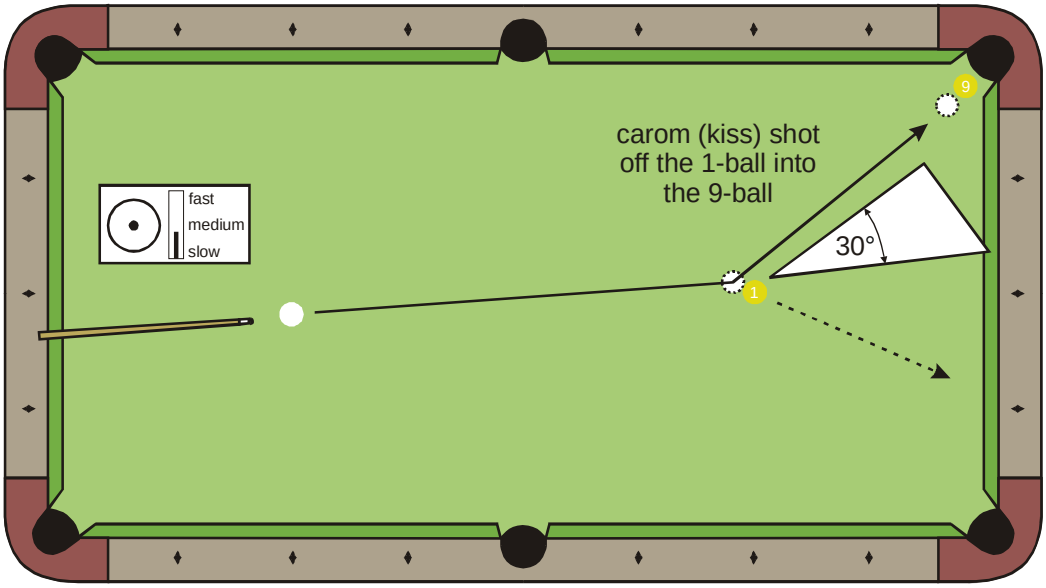

Diagram 7 Easy carom shot

Principle 4 A carom shot is sometimes better than a combo or tough cut

When available, a carom shot with normal roll is usually a better option than a difficult combination shot or an extreme cut shot.

- The margin of error for a rolling carom shot is fairly large (see **Diagram 5**), provided the speed is slow.


normal video

NV A.1 - Cut shot vs. carom shot example

I hope my last six articles have helped you appreciate the importance of the 90º and 30º rules. These principles are not new – they are presented in various forms in many pool and billiards books. However, many people still don't appreciate the value of the principles or know when and how to apply them properly (especially the 30º rule). My goal in this series of articles was to heighten awareness of these principles and help make it clear when they apply. I hope you have been or will be able to incorporate these useful tools into your game.

Have fun and practice hard,
Dr. Dave

PS:

- If you want to refer back to any of my previous articles and resources, you can access them online at ***billiards.colostate.edu***.
- If you like my HSV super-slow-motion billiards video clips online, you might also be interested in my large collection of non-billiards clips viewable at: ***high_speed_video.colostate.edu***
- I know other authors and I tend to use lots of terminology (e.g., squirt, throw, stun, impact line, etc.), and I know not all readers are totally familiar with these terms. If you ever come across a word or phrase you don't fully understand, please refer to the online glossary on my website.

Dr. Dave is a mechanical engineering professor at Colorado State University in Fort Collins, CO. He is also author of the book, DVD, and CD-ROM: "The Illustrated Principles of Pool and Billiards," and the DVD: "High-speed Video Magic."