David Alciatore, PhD ("Dr. Dave") **ILLUSTRATED PRINCIPLES**

"90° and 30° Rule Follow-up – *Part V: The Final Chapter*"

Note*: Supporting narrated video (NV) demonstrations, high-speed video (HSV) clips, and technical proofs (TP) can be accessed and viewed online at* [***billiards.colostate.edu***](http://billiards.colostate.edu)*. The reference numbers used in the article (e.g.,* ***NV 3.4****) help you locate the resources on the website. You might also want to view the resources from a CD-ROM. See the website for more details.*

Last month, I lied! I wrote that I was done with my series of articles on the 90° and 30° rules, and I would move on. Well ... I couldn't! These rules are so important and so often misunderstood (or even often unknown, as is often the case with the 30° rule), I felt like I needed wrap up with one last article on the topic. I wanted to bring together the two rules and show where they overlap. I promise that this REALLY is the last article ("The Final Chapter") in the series.

If you don't remember what the 90° and 30° rules are and when they apply, see **NV 3.4-3.5** and **NV 3.7-3.10**. Readers with engineering or physics backgrounds might also find **TP 3.1** and **TP 3.3** interesting. Remember, the 90° rule states that for a stun shot, where the cue ball is sliding at object ball impact, the cue ball and object ball paths separate at 90° (i.e., the separating paths are perpendicular). The 30° rule states that when the cue ball is rolling when it hits the object ball, and when the cut angle is between a 1/4-ball and 3/4-ball hit, the cue ball's path will be deflected by approximately 30°. If these previous two sentences are not clear, you might want to look at the online videos and past articles on my website.


normal video

NV 3.4 – 90° rule with various cut angles
NV 3.5 – Using your hand to visualize the 90° rule impact and tangent lines
NV 3.7 – Using the 90° rule to check for and prevent a scratch
NV 3.8 – Using your hand to visualize the 30° rule
NV 3.9 – 30° rule example
NV 3.10 – Using the 30° rule to check for and prevent a scratch


technical proof

TP 3.1 – 90° rule
TP 3.3 – 30° rule

As I showed in my March ' 05 article, the path predicted by the 30° rule varies with speed, as illustrated in **Diagram 1**. The harder you hit a normal roll shot, the longer the cue ball persists along the tangent line (i.e., the 90° direction) before curving to the 30° heading (see **NV 4.24** and **TP A.4**). For slow to medium speed shots, the cue ball deflects away from the tangent line, in the 30° direction, almost immediately (see **NV 3.8**, **NV 3.9**, and **TP A.4**); but for faster shots, there is a delay before the cue ball curves and then heads in the 30° direction.

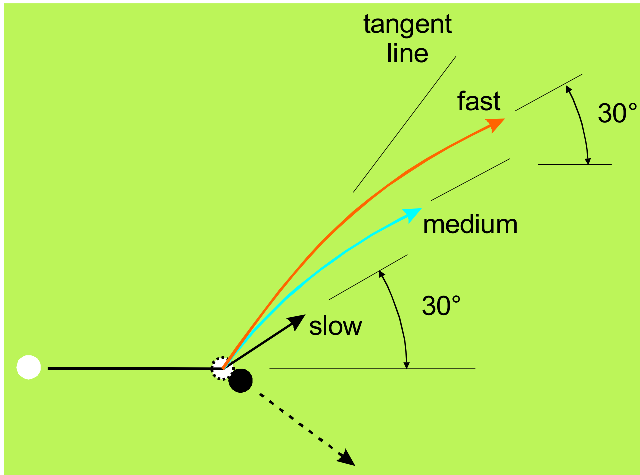


Diagram 1 Effect of speed on the 30° rule

NV 4.24 – 30° rule speed effects

TP A.4 – Post-impact cue ball trajectory for any cut angle, speed, and spin

In my April '04 article, I showed how you can use your hand to help visualize the 30° cue ball direction (see **NV 3.8**). As I have demonstrated in previous articles, this technique is very useful to help accurately plan the path of the cue ball for scratch avoidance, position play, carom shots, break-up shots, and more. **Diagram 2** shows how you need to offset your hand down the tangent line direction a little, based on shot speed, to visualize the final cue ball path accurately. **Principle 22** summarizes this useful technique. The faster the shot is, the more you shift your hand along the tangent line. Knowing how much to shift can only come with practice. The amount also depends on ball and table conditions. Notice how the middle finger in **Diagram 2** remains pointed in a direction parallel to the original cue ball direction (i.e., in the aiming line direction). In both the slow shot and the fast shot, the index finger points in the direction of the final cue ball motion. I want to thank Allison Fisher for giving me the idea to add the cute little hand to my 30° rule diagrams. That was a great idea.

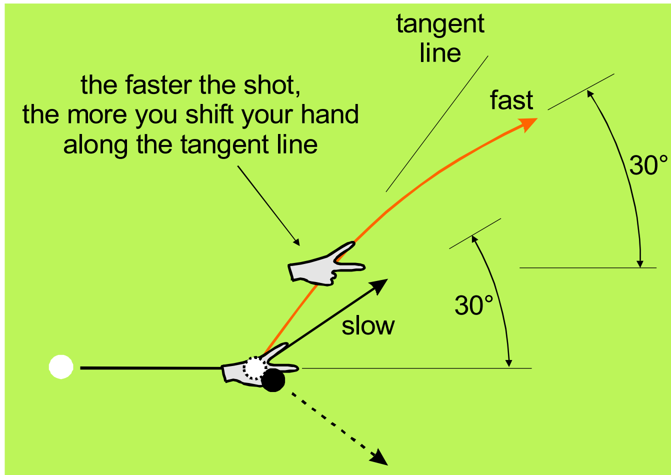


Diagram 2 Shifting your hand down the tangent line to account for shot speed

Principle 22 30° rule speed adjustment

When using the 30° rule, to adjust for speed, shift your V-sign hand along the tangent line, keeping one finger parallel to the cue ball direction. The other finger will then point in the direction of the final cue ball path (see Diagram 2).

- Shift the hand more for faster shots.
- For slow shots, the hand is not shifted at all (i.e., it is centered on the ghost ball target).

Knowing that the 90° rule applies only for a stun shot and the 30° rule applies only when the cue ball is rolling at impact, you might be asking yourself: What about shots in between, where the cue ball is rolling some but not completely. **Diagram 3** shows the answer. With the draw shot, the cue ball actually has bottom spin (i.e., the opposite of roll), so the cue ball draws back from the tangent line. With the stun shot, the cue ball has no roll and it heads directly down the tangent line. With the 30% and 70% roll shots, the cue ball does not have complete roll when it reaches the object ball (e.g., because of too much speed or not enough follow). In these cases, the cue ball path and final direction fall in between those predicted by the 90° and 30° rules, and the final cue ball angle will be greater than 30°. With the slow roll shot, the cue ball immediately deflects to the 30° direction. Note that if a shot is hit soft enough and the cue ball is sufficiently far from the object ball, the cue ball is guaranteed to be rolling when it hits the object ball. This is true even if the cue ball is hit below center, because any bottom spin or slide (i.e. stun) is eventually transformed to 100% forward roll by sliding friction between the cue ball and the table cloth (see **HSV 3.1** for an illustration of the loss of bottom spin for a draw/stop shot).

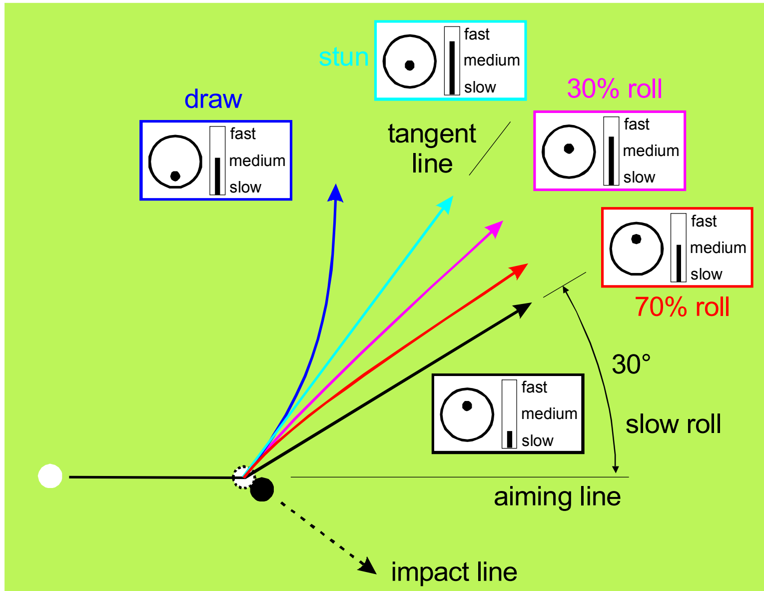
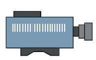


Diagram 3 The effects of vertical plane spin on the 90° and 30° rules.



HSV 3.1 – Stop-shot showing loss of bottom spin over distance

Here's a question you might have at this point: How can one predict how much roll the cue ball will have for different types of shots, and how can one know how much this affects the cue ball path? Like many things in pool, the only way to be able to answer this question is to build intuition through lots of practice. So what are you waiting for? Get to the table and start building more intuition.

I hope you have enjoyed my series of follow-up articles on the 90° and 30° rules. Now that I have written a total of twelve articles (a year's worth!) on these very important rules, I think it's time to move on. Look forward to some new stuff starting next month. For more discussion on the 90° and 30° rules, visit the many links under the appropriate headings in the "Online Discussion Threads" area of my website (***billiards.colostate.edu***). Please feel free to participate in the online discussions.

Good luck with your game, 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***.
- FYI, over the next two years I will be presenting a multimedia seminar across the country, sponsored by the *American Society of Mechanical Engineers*. The title is "The Illustrated Principles of Pool and Billiards." The talks are usually open to the public, so periodically check out the dates and locations on my website. It would be fun to have some BD readers (and not just engineers) in the audience. The seminar is geared toward a general audience (even non pool players), but it is usually well received by both engineers and seasoned pool players.

Dr. Dave is a mechanical engineering professor at Colorado State University in Fort Collins, CO. He is also author of the book: "The Illustrated Principles of Pool and Billiards" (2004, Sterling Publishing).