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

"90/30 Degree Rule Follow-up – *Part I*"

***Note**: Supporting narrated video (NV) demonstrations, high-speed video (HSV) clips, and technical proofs (TP) can be accessed and viewed online at www.engr.colostate.edu/pool. 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.*

Since my book ("The Illustrated Principles of Pool and Billiards") came out, and since my articles started appearing in BD, I have received many supportive comments, remarks, and questions. That's one of the joys of being an author. Many of the questions have involved the 90 degree and 30 degree rules. Because of this, I have decided to write another series of articles answering these questions for the benefit of all readers. In this article, I just want to answer a few of the more basic questions and respond to some of the more general remarks. In future articles, I'll look at the important effects of English and speed on the 90 and 30 degree rules. FYI, my first set of articles dealing with the 90 and 30 degree rules appeared in the January through June, 2004 issues of BD. As with all of my past articles and resources, you can access them online at www.engr.colostate.edu/pool.

For reference, **Diagrams 1** and **2** summarize the 90 and 30 degree rules. Remember, the 90 degree rule applies only for a stun shot, where the cue ball is sliding at object ball impact, and the 30 degree rule applies only when the cue ball is rolling at object ball impact (see my July, 2004 article for more details). The 90 degree rule (see **NV 3.4**, **NV 3.5**, **NV 3.6**, and **TP 3.1**) states that the angle between the cue ball and object paths, after impact, is 90 degrees (i.e., the two paths are perpendicular). The 30 degree rule (see **NV 3.8**, **NV 3.9**, **NV 3.10**, and **TP 3.3**) states that, when the cue ball is rolling at impact, and the ball-hit fraction is between 1/4 and 3/4 (see the side view in **Diagram 2**), the cue ball's angle gets deflected by approximately 30 degrees.

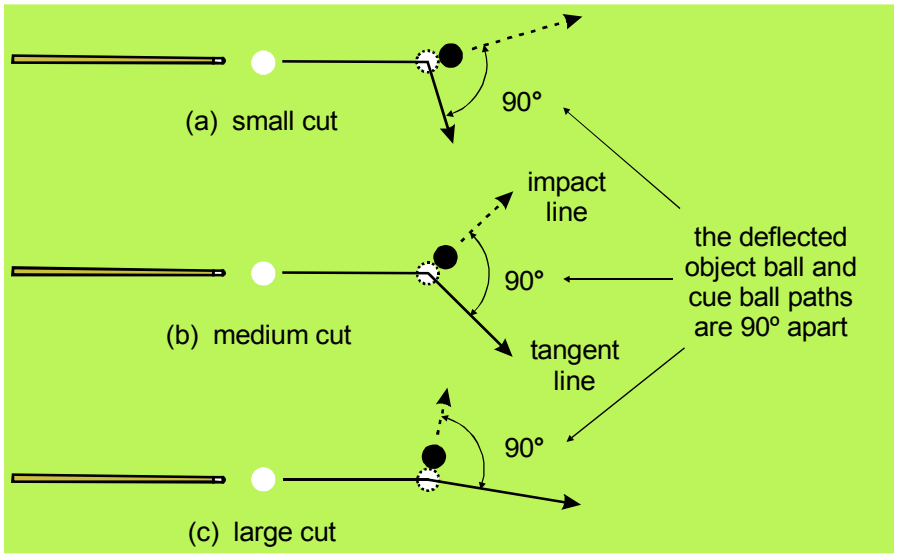

Diagram 1 The 90 degree rule

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 3.5 – Using the 90° rule to check for and prevent a scratch

technical proof

TP 3.1 – 90° rule

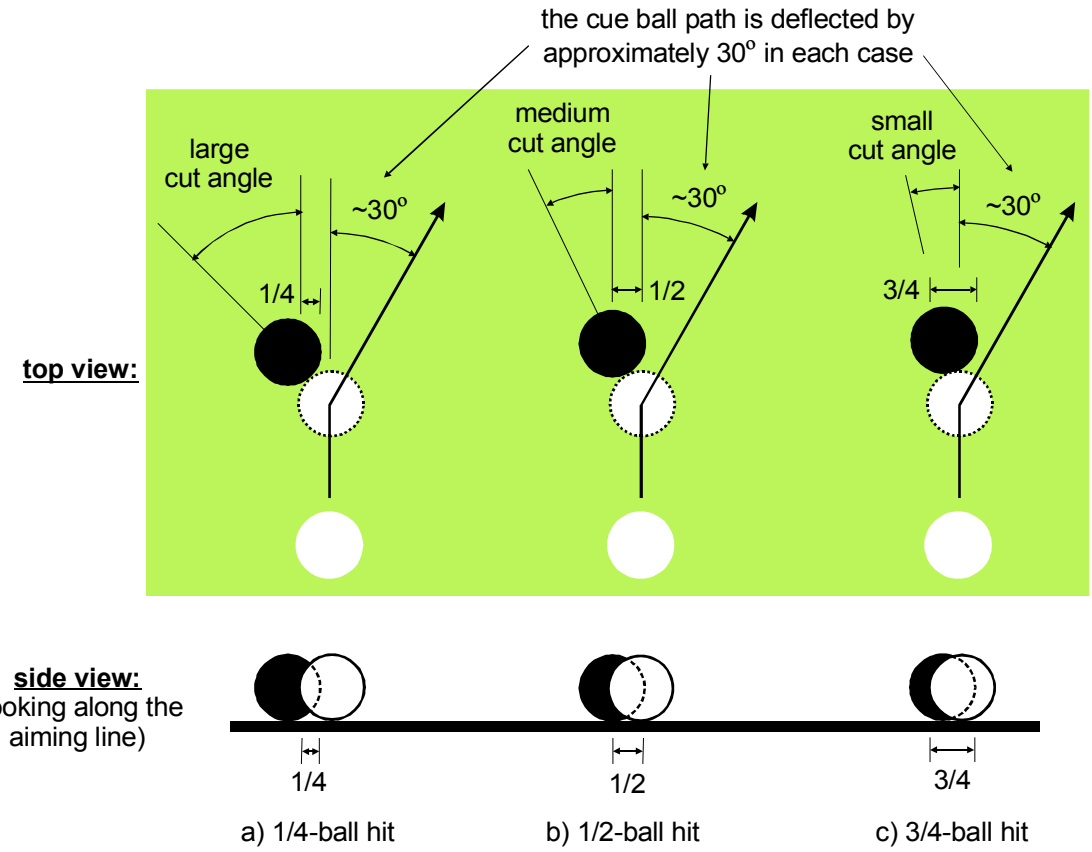

Diagram 2 The 30 degree rule

technical proof

TP 3.3 – 30° rule

normal video

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

The remainder of the article summarizes some of the more interesting and pertinent questions I have received to date concerning the 90 and 30 degree rules, along with my replies.

Question:

Is the 30-degree rule exact? In other words, does the cue ball deflect at exactly 30 degrees?

Answer:

No, the 30-degree rule is not exact. For a half-ball hit, the deflected angle is actually 33.7 degrees, and for 1/4- and 3/4-ball hits, the deflected angle is 27.3 degrees. But the reason why the rule is so useful is that the deflected angle is still very close to 30 degrees over this very large range of cut angles from a fairly thin hit to a fairly full hit (see **Diagram 2**). Because of this, the rule applies to many shots. For a good player executing good position control, leaving natural angles on each shot, the 30 degree rule applies for almost every shot! Example uses of the 30 degree rule include planning and predicting cue ball motion for:

- position play
- safeties
- carom and billiard shots
- break-up shots
- avoidance shots

I have given examples of some of these in my past articles, and others appear in my book.

Question:

Does the 30-degree rule apply only for a half-ball hit?

Answer:

No. The whole point of the 30-degree rule, and the reason why it is so useful, is that it applies over a very large range of cut angles. As long as the cue ball is rolling (i.e., not sliding) at object ball impact, the cue ball's direction will be deflected by very close to 30 degrees for cut angles ranging from a 1/4-ball hit to a 3/4 ball hit (see **Diagram 2**).

Question:

Out of curiosity, how will knowing all this stuff make me a better player? To me pool begins and ends with execution. In fact, most is played on the subconscious level. Once you start with all that messing with where to hit the ball or over thinking and conscious play you begin to dog it and your game will go into the toilet. I can appreciate what you are trying to do, but much of it is a lot of unnecessary information in my opinion.

Answer:

Your point is well taken. Many players do not benefit from knowing and trying to apply principles. Some just plain don't want to know (but I doubt they would be reading this article). Also, nothing can beat solid (and valid) intuition built from years of practice, experience, and success. However, I think the 30 degree rule can dramatically improve the games of many people. I think it can also help inexperienced players learn faster, without having to go through years of "intuition-building" trail and error. I do agree that a player must first have solid fundamentals and be able to pocket routine shots with ease. It is not worth thinking about position play and where the cue ball will go if one is going to miss easy shots. Personally, the 30 degree rule, when I began to understand how to apply it, helped bring my game to a new level. I

am a much better player with the 30 degree rule than I was without it. I think this can also be the case for others. I think knowledge and understanding of principles can be a good thing. That's the whole point of my "Illustrated Principles" articles.

Question:

The 30 degree rule: There is no such thing. What you are describing is what you think you see. Physics states that when 2 spheres collide, assuming equal mass, they will diverge or come apart at 90 degrees. Always!!!!!!!! By even mentioning this 30 degree theory goes against physics and is incorrect. You should make that clear that the spin on the ball takes effect on the 90 degree line and takes it across that line at certain increments depending on speed and spin.

Here's another:

Physicist that I have talked to say the 90 degree rule applies on every shot. In other words, the cue ball always leaves along the tangent line, perpendicular to the direction of the object ball. I think your 30 degree rule violates the laws of physics.

Answer:

Your physicist friends are partly correct. The cue ball always does start out in the tangent line direction after impact with the object ball (in the 90 degree direction). However, topspin (e.g., from forward roll or a follow shot) starts taking effect immediately. For high-speed shots, the cue ball persists along the tangent line longer before the path curves. However, for slow to medium speed shots, the cue ball curves away from the tangent line very quickly (almost immediately for many shots). Again, for a good player executing good position control, leaving natural angles on each shot, the 30 degree rule applies for almost every shot! If you are still not convinced, see the online video demonstrations (**NV 3.8**, **NV 3.9**, **NV 3.10**) of the 30 degree rule in action.

Also, regardless of how long the cue path persists along the tangent line, the final deflected angle is still very close to 30 degrees for all rolling shots. I will present more details on and examples of this in future articles.

Concerning the 30 degree rule violating the laws of physics, I know of two PhD physics professors that would take offense at that statement. They prove the basis of the rule mathematically with valid physical principles (see **TP 3.3** and the supporting paper on my website for more information). They also back up their claims with photographic evidence.

Question:

I was noticing that if you look at the 90 degree rule in the same way as the 30 degree rule -- that is, measuring from the aim line to the deflected path -- the 90 degree rule could actually be called a 45 degree rule. (I realize the traditional "tangent line" discussion is the 90 degree rule.) The 90 degree rule looks at deflection path vs. object path; but if you look at it as aim line vs. deflection, it is 45 degrees (for that 1/4 to 3/4 ball cuts range.) Just thought I would mention that. Seems to me if both rules are presented with the same "point of reference" -- the aim line -- they might be easier to remember.

Answer:

Thank you for your message and for your insights. I wish what you propose would work in every case, but unfortunately it does not. The 90 degree rule predicts a 45 degree cue ball deflection only for a cut angle close to 45 degrees (for a ball-hit fraction close to 0.3). For a very small cut-angle shot (e.g., **Diagram 1a**), the deflected angle is much larger than 45 degrees

(closer to 90 degrees). And for a thin cut (e.g., **Diagram 1c**), the deflected angle is very small (closer to zero). In fact, for every cut angle, including those in the 1/4 and 3/4 ball-hit range, the deflected cue ball angle varies quite a bit; but the angle between the deflected cue ball and object ball paths is always 90 degrees (for a stun shot). I hope that makes sense.

Question:

How can a train my hand to take the 30 degree shape you show in your videos?

Answer:

I used a plastic 30-60-90 triangle (see **NV 3.8**) to practice to the point where I can form a 30 degree "V" sign with my hand very consistently. For most people, a firm "V" ("peace") sign is very close to 30 degrees, but it is still good to practice. You can purchase a drafting triangle at any arts supplies store or college bookstore. You can also make your own by cutting one out of cardboard or paper (see the proportions shown in **Diagram 3**). To cut one out, you can use the following dimensions:

triangle width = 1 foot (30 cm)

triangle height = 7 inches (17 cm)

These dimensions result in a triangle with one angle being approximately 30 degrees ... or, at least, close enough for application of the 30 degree rule, which is not perfectly exact anyway.

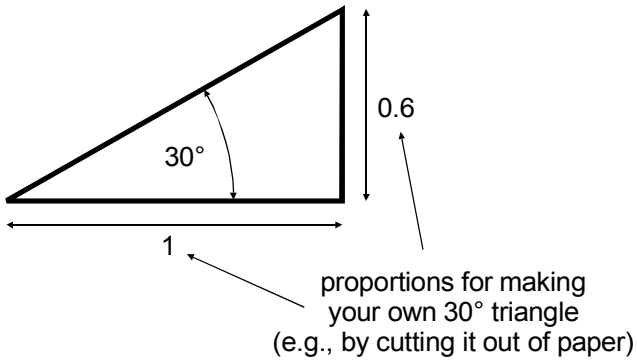

Diagram 3 30 degree angle triangle proportions

In subsequent articles, I will specifically look at the effects of speed and English on the 90 and 30 degree rules. I have received many questions and comments concerning these topics.

Good luck with your game, and practice hard,
Dr. Dave

PS:

- I recently created some discussion threads for my “Illustrated Principles” articles on the online Billiards Digest Discussion Forum. Feel free to post additional questions or comments there. To view the discussion, go to *www.billiardsdigest.com*, and click on the “Discussion Forum” button, and then click on “Cue Chalk Board.” I encourage

you to join in on the discourse; however, proceed at your own risk. I don't recommend participation unless you have thick skin. Some forum participants are quite colorful and not always polite and respectful. Regardless, I think the forum is a wonderful place for cultivating and sharing ideas and for learning. Many participants are very knowledgeable and insightful and have years of experience they are willing to share with others.

- If you want to refer back to any of my previous articles and resources, you can access them online at *www.engr.colostate.edu/pool*.
- FYI, over the next three 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 talk is geared toward a general audience (even non pool players), but it usually appeals to everyone from a geeky engineer/physicist type to a pool hall junky.

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).