"Draw Shot Cue Ball Directions"

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*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 my articles will 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**.*

Last month, we looked at several systems useful for predicting the direction the cue ball (CB) heads after striking the object ball (OB). These systems apply only for follow shots, where the CB is rolling into the OB. This begs an obvious question: Do such systems exist for draw shots also? The answer is yes, and that's the topic of this article.

In my March '06 article, I presented the trisect (3X) system, which is very useful for predicting CB direction with "good-action" draw shots. As illustrated in **Diagram 1**, the trisect system predicts that the final CB direction angle, relative to the original CB direction, will be three-times the cut angle. **NV B.67** illustrates how you can use your hand to visualize both the cut angle (A) and 3-times the angle (3A). Alternatively, as illustrated by the small cues and blue arcs in Diagram 1, you can use your cue to estimate the angle by rotating it from the line of aim to the line-of-centers, and then rotating it the same amount two more times to find the predicted CB direction. For more info and demonstrations of the trisect system, see "draw" in the FAQ section of my website.

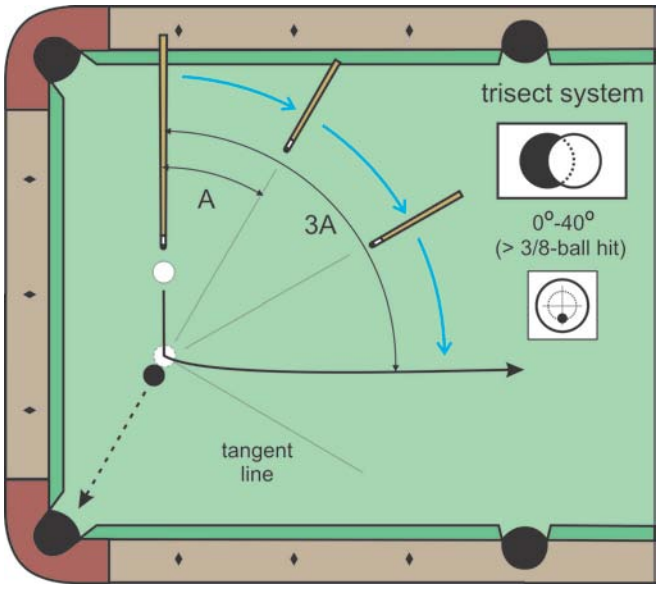

Diagram 1 trisect (3X) system

As indicated in Diagram 1, the trisect system applies only for cut angles in the 0˚-40˚ range. This corresponds to ball-hit fractions greater than about 3/8. **NV B.67** demonstrates how you can use your hand to estimate the maximum cut angle for which the trisect system applies. For most people, if you stretch your peace sign fairly hard, the angle will be very close to 40˚. Another requirement of the trisect system is that the CB must have a typical "good action" amount of backspin, which is illustrated in **Diagram 2**. If you aim the center of the CB through the edge of the OB, a "good action" amount of backspin will send the CB perpendicular to (90˚ from) its original direction. Reflecting back on Diagram 1, the trisect system predicts this

because aiming center to edge creates a ½-ball hit, which is a 30˚ cut angle, and 3 × 30˚ = 90˚. As shown in Diagram 2, it is possible to get slightly more draw than this if you really push the miscue limit. It is also easy to get less draw if you hit the CB too high or don't use enough speed. Before applying any of the systems in this article, you first need to practice this shot to develop a feel for "good action" draw. The systems in this article apply on for "good action" draw shots. If you have too much backspin, the CB will draw back at a tighter angle than predicted; and if you too little, the CB will draw back at a wider angle (closer to the tangent line). Note also that the required tip offset on the CB will vary some with shot speed and distance, and with table conditions. With more distance between the CB and OB, you will need to hit lower on the CB; and if the shot is too long, it might not be difficult to achieve a "good-action" amount of draw (especially on a "sticky" cloth).

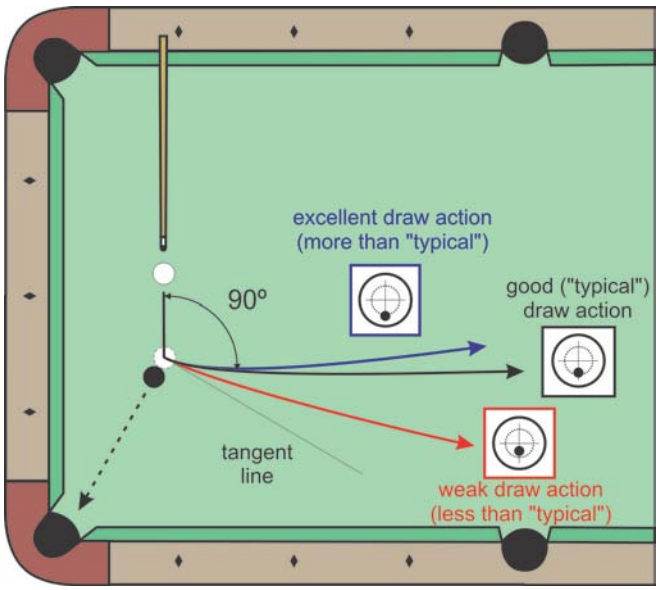

Diagram 2 Typical "good action" draw

The trisect system isn't perfect over its entire range. Recently, I did an analysis to try to find alternative systems that work better over different cut-angle ranges, including thin hits beyond the trisect system range. If you like math and physics, check out **TP B.14** on my website. If you don't, you still might benefit from the useful results summarized below.

Diagram 3 illustrates a system that works better for full-hit draw shots, in the 0˚-10˚ range (i.e., greater than about a 7/8-ball hit). This system is called the double-bisect or 4X system. It works just like the trisect (3X) system, but the predicted angle to the final CB direction is four-times the cut angle from the original direction instead of three. With full hits, the trisect system predicts a tighter angle than is typical with a "good action" draw shot (see the red path in the diagram). The trisect system works better for larger angles, up to 40˚, and is most accurate closer to a 30˚ cut. The double-bisect system doesn't work very well beyond about 10˚.

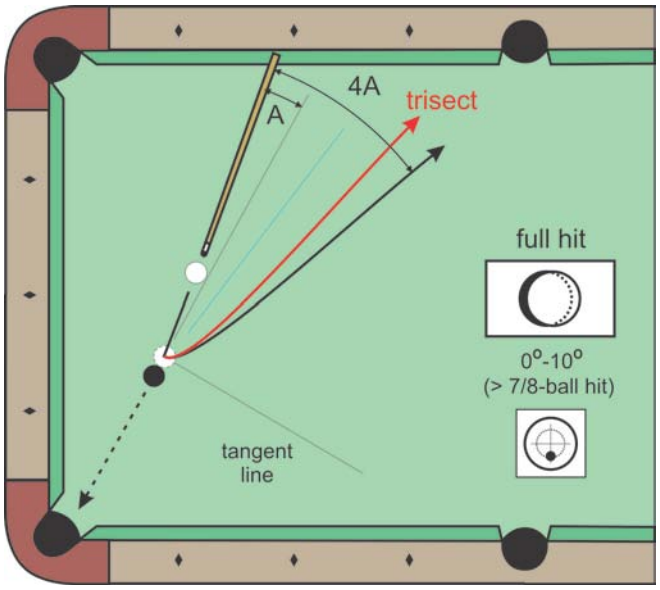

Diagram 3 full-hit double-bisect (4X) system

Diagram 4 illustrates a system that works for thin-hit draw shots, in the 40˚-90˚ range (i.e., less than about a 3/8-ball hit). This system is called the 30-minus-1/3 system. It is a little more complicated than the other two systems, but it works quite well. With really thin hits (close to a 90˚ cut), the CB does not draw back from the tangent line very much, regardless of the amount of backspin. As the ball-hit fraction increases, the amount the CB draws back from the tangent line also increases. To find the exact amount, first visualize a line 30˚ above the tangent line. As illustrated by the hand in the diagram, you can use your 30-degree-rule peace sign to find this line. Then visualize 1/3 of the cut angle (A/3) and subtract this from the 30 degree direction, bringing the line closer to the tangent line. This direction will fairly accurately predict the final CB angle for cuts in the 40˚-90˚ range. Note that for a really thin hit close to a 90˚ cut angle, the system correctly predicts that the CB would head straight down the tangent line [30˚ – 1/3(90˚) = 0˚].

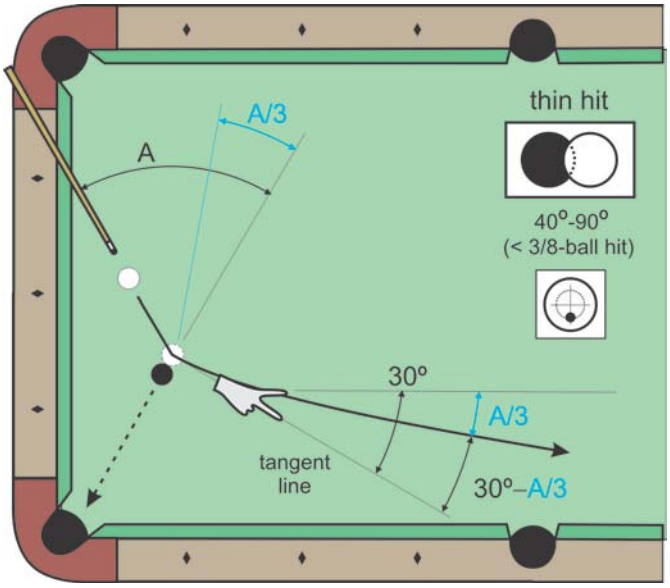

Diagram 4 thin-hit 30-minus-1/3 system

There is another system to very accurately predict final CB direction for cut angles between 20˚ and 40˚, but since the trisect system does reasonably well over this range, the additional system really isn't necessary. But if you're curious, see the details in **TP B.14**.

Don't forget that with both follow and draw shots, the CB persists along the tangent line longer at higher speeds before curving to the final direction, as demonstrated in **NV B.45** and **HSV B.23**. For more information, see "CB path speed effects" under "position control" in the FAQ section of my website. To use the systems in this article (and last month's article) effectively, you need to know how to make adjustments for speed.


normal video

NV B.45 – Cue ball path speed effects
NV B.67 – The trisect system for draw shots, from VEPS I


high-speed video

HSV B.23 – Cue ball path speed, spin, and cue elevation effects


technical proof

TP B.14 - Draw shot cue ball angle approximations

I hope you find the draw-shot CB-direction systems useful in your game. Be sure to try them out the next time you play. Remember, the trisect (3X) system works well over a fairly wide range (0˚-40˚ cuts), the double-bisect (4X) system works better for thick hits, and the 30-minus-1/3 system works for thin hits. Most cut shots in pool are in the 0˚-40˚ range (when you are playing well), making the trisect system very useful, so be sure to dedicate some practice time to learning how to use it effectively.

Good luck with your game,
Dr. Dave

PS:

- I know other authors and I tend to use lots of terminology, 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 author of the book, DVD, and CD-ROM: "The Illustrated Principles of Pool and Billiards," the DVD Series: "The Video Encyclopedia of Pool Shots," and the DVD: "High-speed Video Magic."