

# How Straight Does my Pool Stroke Have to Be?

(Or... Why Beer Bottles Should Be Used for Drinking Beer)

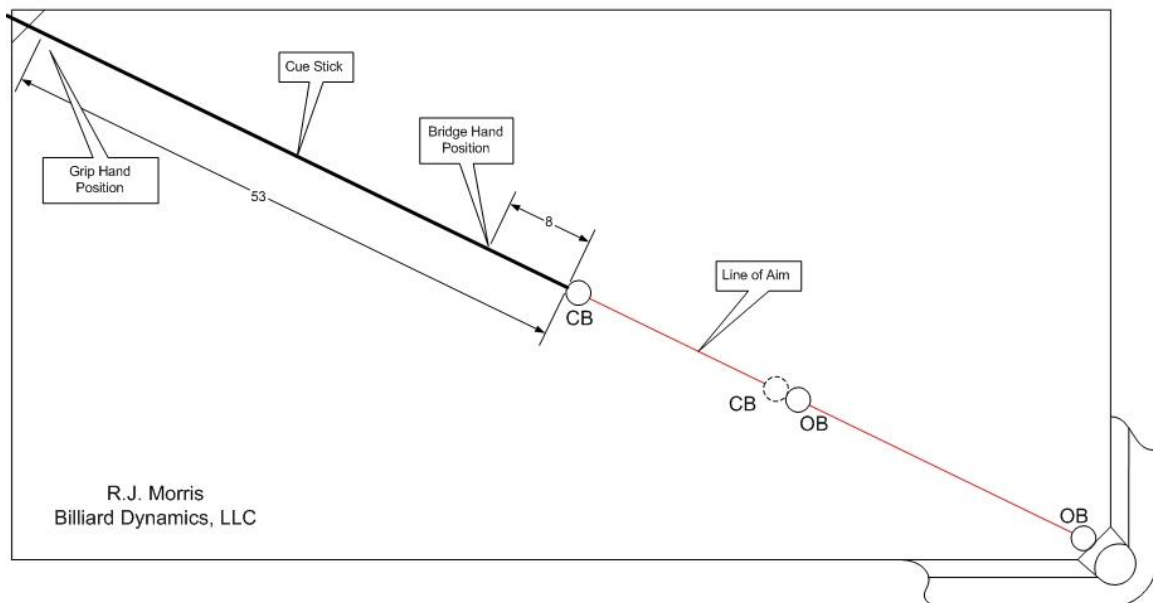
By  
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We've all heard how important a straight pool stroke is in any cueing sport. However, do you REALLY know just how straight your pool stroke has to be to make any given shot? After all, you can stroke in and out of a beer bottle 50 times in a row with your eyes shut without touching the sides. Isn't that 'good enough'?

Believe it or not, I couldn't find the answer to my specific question anywhere on the Internet. That is amazing to me in and of itself. However, I did find all of the pieces I needed to construct my analysis. And this would probably be a great time to thank Dr. David Alciatore PhD, PE at Colorado State, for publishing his technical papers on cue stick deviation, squirt, swerve, throw, and effective target sizes into the corner pocket. These papers provided all the information I needed to conduct my analysis and answer my question once and for all.

Now as you have probably already guessed, the final answer to the question is 'it depends'. If the object ball is hanging in the corner pocket and the cue ball is 6" away from that, you could make that shot with a stroke as crooked as a rolled up garden hose. However, if the object ball is in the center of the table and the cue ball is near a corner pocket and you are shooting toward the opposite corner pocket, your stroke better be laser straight. Well, in order to 'do the math', I had to pick one series of shots to analyze, so I picked the shot outlined in Figure 1. You are shooting a straight-in shot through the center of the table into the corner pocket.

Figure 1



## Basis and Assumptions:

In order to conduct the analysis, I had to make a lot of assumptions, such as bridge length, cue stick end mass, pocket width, pocket shelf depth, pocket angle, where the grip hand lies on the stick, cue tip radius, cue stick elevation, shot speed, etc, etc. So keep in mind, that the analysis I conducted is using my pool table, my cue stick, and my stance, grip, and stroke.

For comparison purposes, I have listed some of the key values that I used in my analysis:

### Pool Table Pocket

4.25" wide entrance  
1" Shelf Depth  
41° Pocket angle  
5" Pocket Hole Diameter

### Cue Stick

0.375" Cue Tip Radius  
0.243 oz Cue Stick end mass

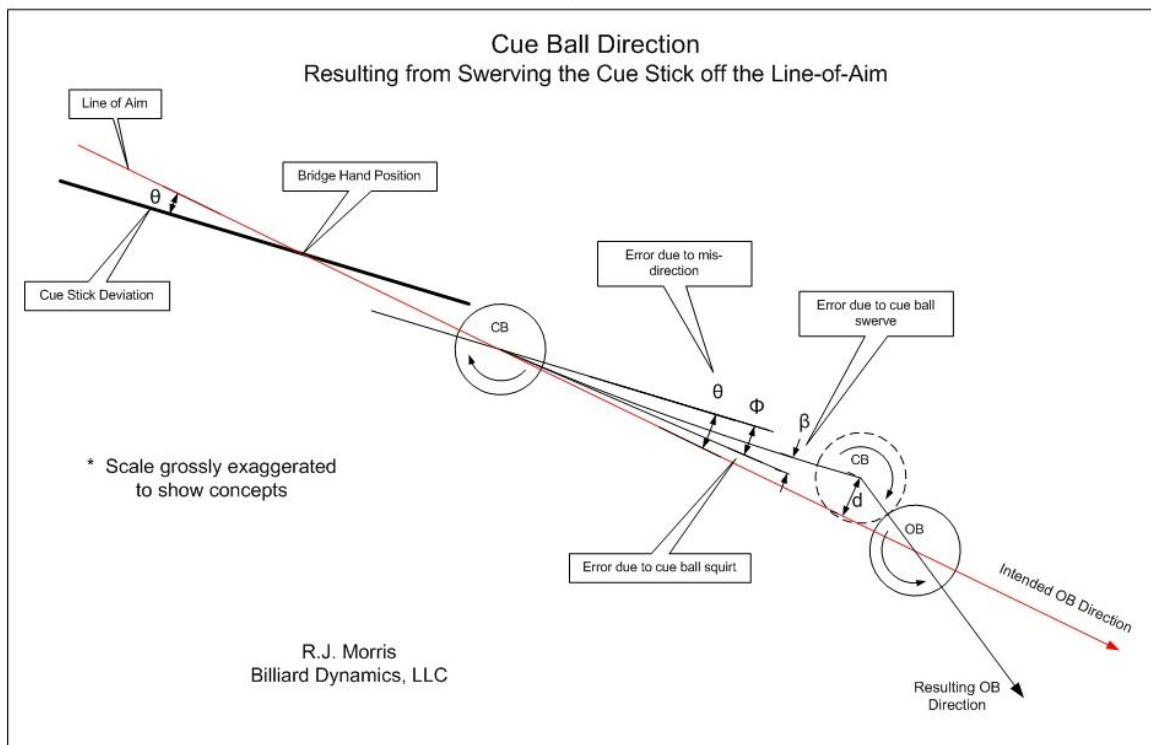
### Grip and Stroke

8" bridge length  
53" Grip Hand Position (from tip)  
2° Cue Stick Elevation (to bed of table)  
52.8 in/sec Cue Stick Velocity  
Strike the vertical center of the cue ball

## Concepts:

I broke the analysis down into three parts. The first part of the analysis centers on the cue stick veering off the line of aim and striking the cue ball. See Figure 2.

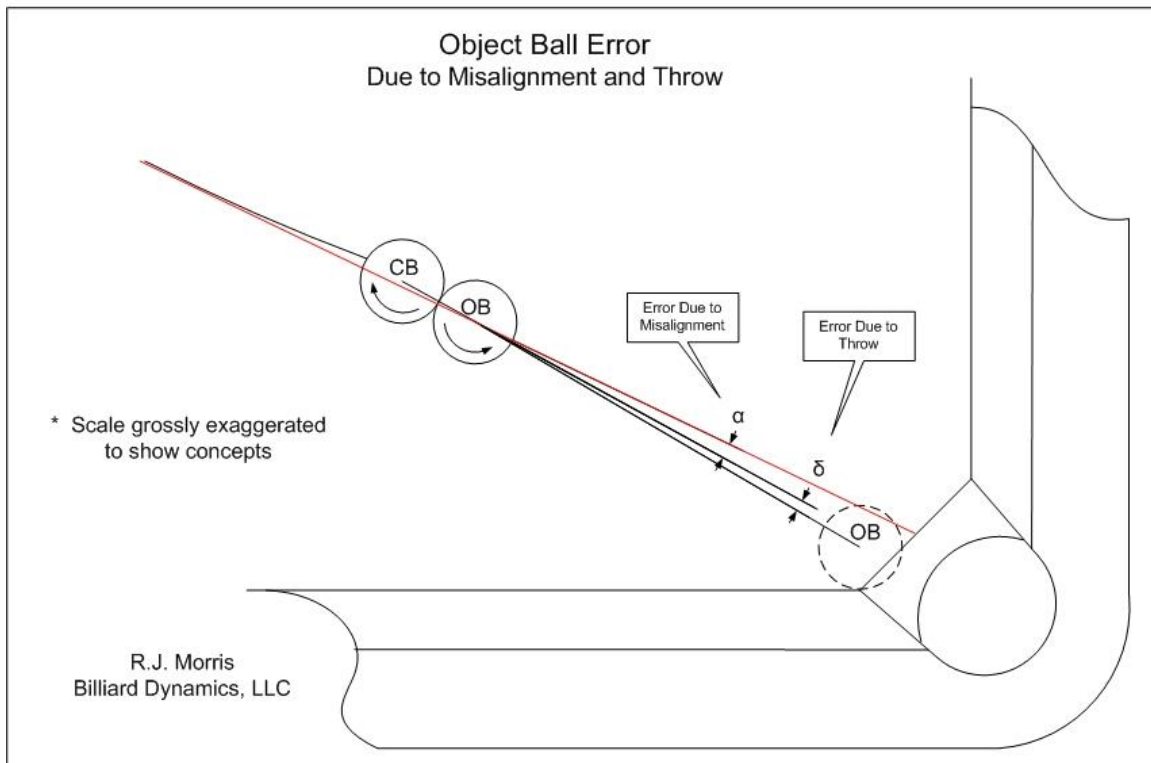
Figure 2



As my grip hand veers right of the line of aim, my cue tip veers left. (I assume my bridge hand is solid and acts like a perfect fulcrum.) Knowing how far laterally my grip hand deviates from the line of aim, I can calculate the angle of mis-alignment  $\theta$ . This is the direction that the cue stick would push the cue ball if it were simply misaligned and hitting the center of the ball. However, because my bridge is solid, the tip of my stick veers left of center and strikes the cue ball slightly off-center, it causes the cue ball to 'squirt' back toward the line of aim (angle  $\Phi$ ). Hitting the cue ball left of center not only causes the cue ball to squirt right, it also applies left hand spin to the ball. This angular velocity, in turn causes the cue ball to 'swerve' back to the left away from the line of aim (angle  $\beta$ ). The combination of  $\theta$ ,  $\Phi$ , and  $\beta$  dictate just how far off the line of aim the cue ball will be when it actually strikes the object ball.

The second part of the analysis centers on the cue ball actually striking the object ball. Here, we have two problems. We know from the first analysis that the cue ball is no longer on the line of aim when it contacts the object ball. See Figure 3.

Figure 3

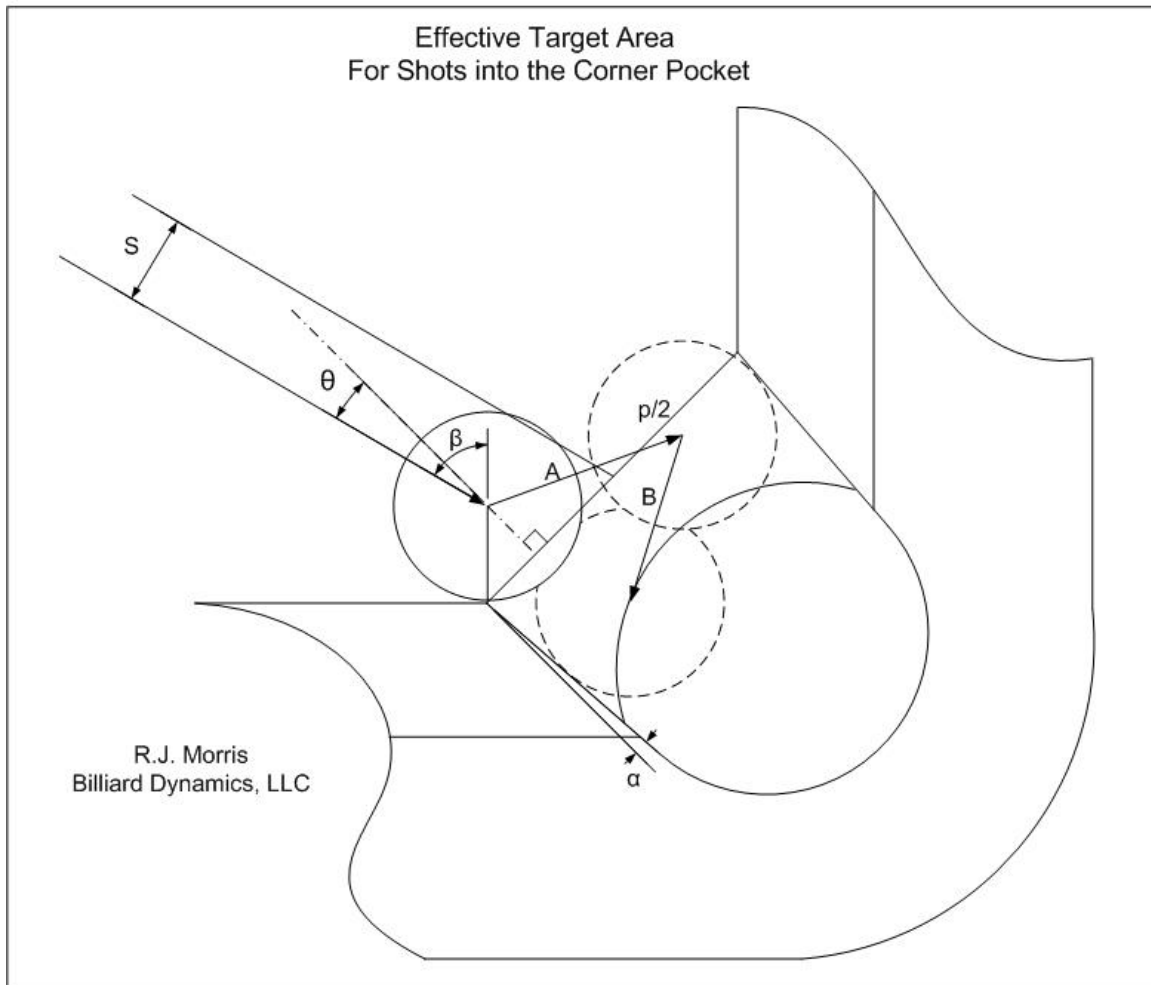


This fact actually creates a 'cut' angle  $\alpha$ . Alpha is the angle that is created if you were to hit the cue ball in the center, but simply missed your aim point. An additional angle of error  $\delta$ , is created by 'throw' induced by the English that was inadvertently applied to the cue ball. Friction between the cue ball and the object ball actually creates a 'gearing' action, which applies an opposite spin to the object ball causing it to veer even further off the intended target line. The combination of mis-alignment (angle  $\alpha$ ) and throw (angle  $\delta$ ) finally determine the final direction of the object ball.

Our final part of the analysis answers the question of 'How far off the line of aim can I be and still make the shot?' You would think that a 2.25" diameter object ball going into a

4.25" pocket could be off the line of aim 1 inch in either direction and still go in the pocket. In actuality, it can be off-line further than that. How much further, is dictated by the object ball angle of approach, and the design features of the pocket. See Figure 4.

Figure 4



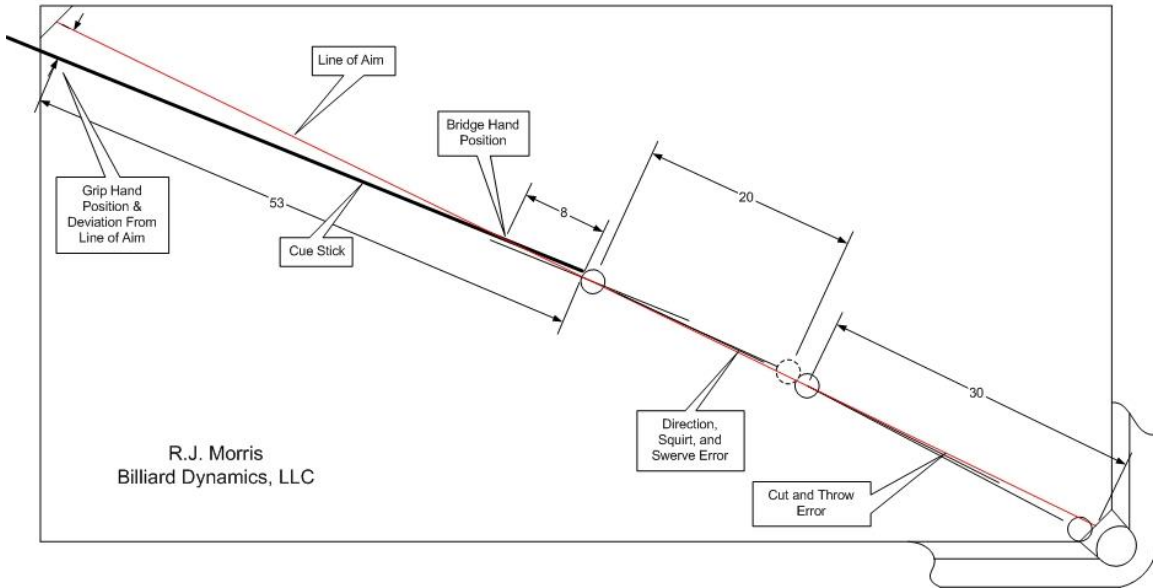
### Analysis:

Assuming you are pool players and not physicists, I won't bore you with all the math. We'll just jump ahead to the results of my pain staking work.

### Results:

Let's pick one shot along the line of aim in Figure 5. Assume the object ball is 30" from the pocket and the cue ball is 20" from the object ball, and all are along a perfectly straight line. Given the assumptions listed above, let's also assume that my grip hand swerves off the line of aim 0.300" at the point my cue contacts the cue ball. Will I make the shot?

Figure 5

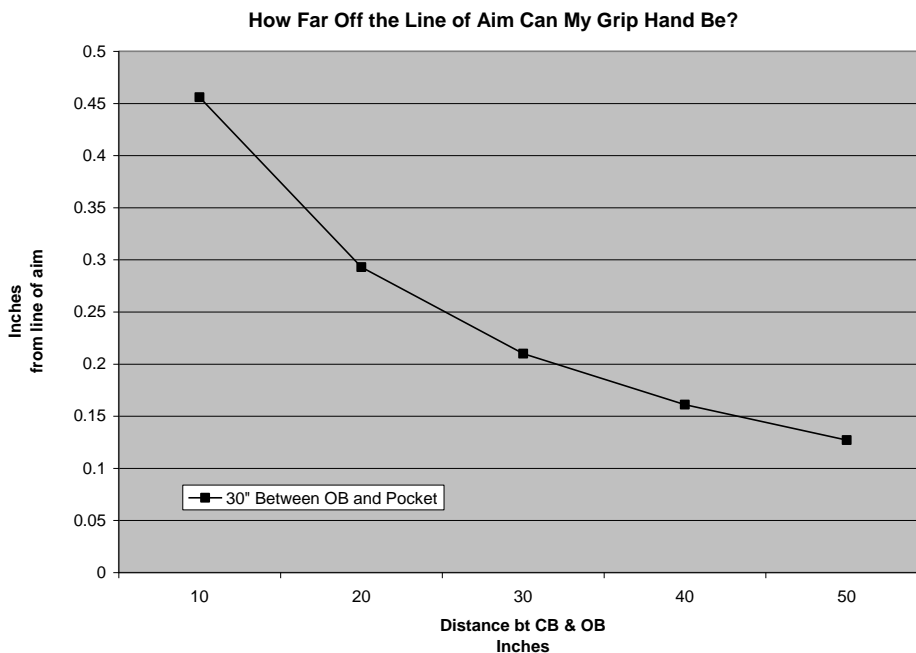


For this given shot, Analysis 1 determines that the cue ball actually ends up 'off the line of aim' by 0.066" by the time it contacts the object ball. Analysis 2 indicates that as a result, the object ball is directed off its intended target line by 1.261" by the time it reaches the pocket. Analysis 3 concludes that the object ball can be off line by 1.263" and still go into the pocket.

Therefore, I MAKE the shot.

Figure 6 shows what happens as we move the cue ball further away from the object ball. The object ball always remains 30" from the pocket.

Figure 6



As you can see, when the cue ball is 50" away from the object ball, we can only veer off the line of aim by 0.129 inches and still make the shot.

As you would expect, the most difficult shot, we can set up in Figure 1, is where the object ball is in the center of the table and the cue ball is near the corner pocket opposite of the pocket we're shooting into. In this situation, the maximum grip hand deviation we can have and still make the shot is **0.065** inches. WOW... that is laser straight!

Now, back to our beer bottle...

My cue stick has a diameter of 0.500 inches at the tip. My beer bottle has an opening diameter of 0.750 inches. That leaves me a 0.125 inch gap all the way around my tip. With a 53 inch grip hand distance and an 8 inch bridge, my grip hand can veer off the line of aim by 0.828 inches (over 7/8") before the tip will hit the side of the bottle. If I plug a 0.828" grip hand deviation from the intended line of aim into our model, it concludes that I can't make the shot in Figure 1, even with the object ball 14" away from the pocket and the cue ball 14" from the object ball. That means, if the best I can do is stroke in and out of a beer bottle 50 times with my eyes shut, I will have a hard time making even the simplest of shots. So, the next time someone tells you to hone your stroke by stroking your cue in and out of a beer bottle, just let them know that you prefer to use your bottle for drinking beer.

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