Aiming by Diamonds

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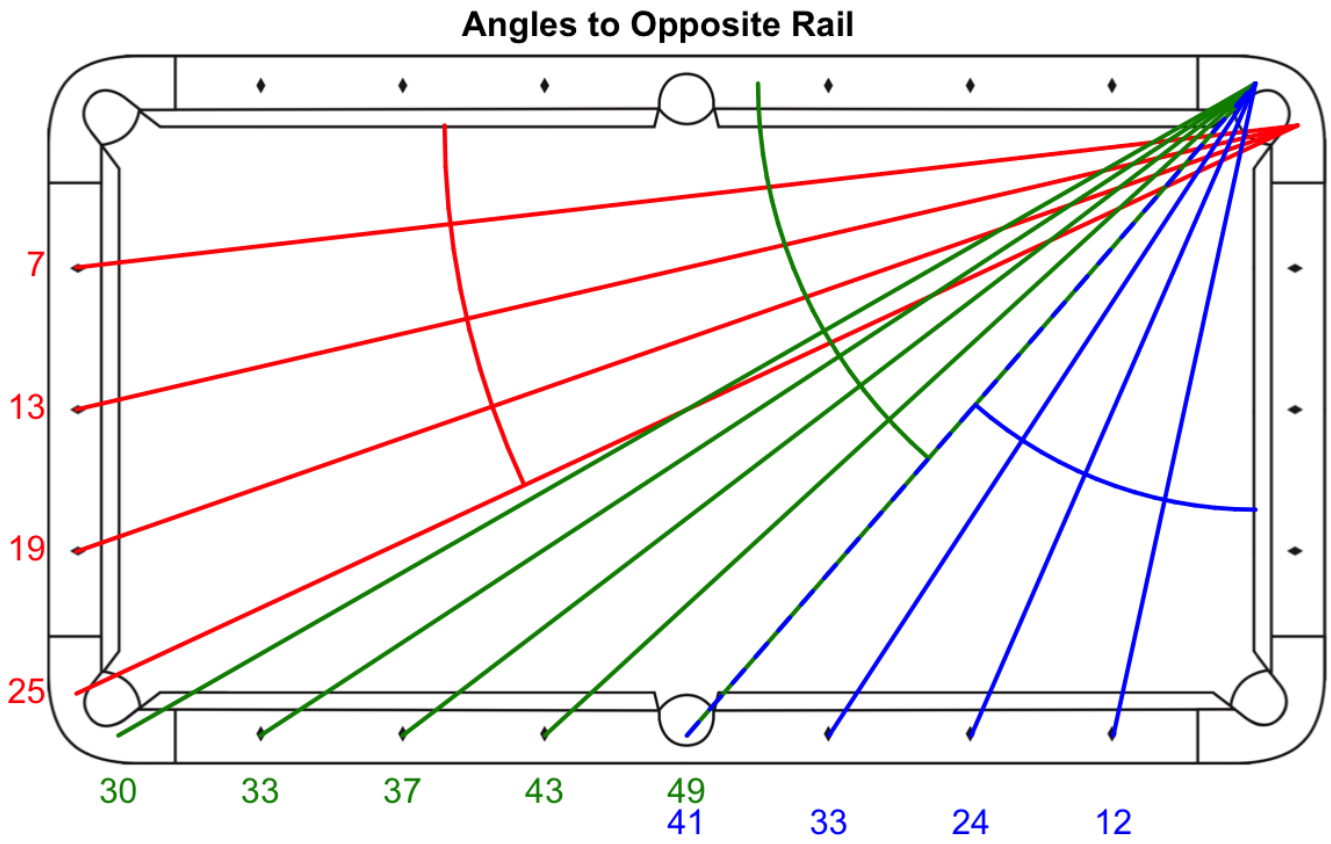
Given the cue ball (CB), object ball (OB), and the pocket (or other target), we will calculate the cut angle by estimating two other angles first: the "OB angle" between the OB-pocket line and a rail, and the "CB angle" between (an initial rough estimate of) the shot line and a rail. The cut angle will then be the difference, or for back cuts the sum, of the OB and CB angles relative to the same rail. One edge in these angles being a rail lets us take advantage of the diamond sights around the table and use a handful of reference numbers to measure any angle very accurately.

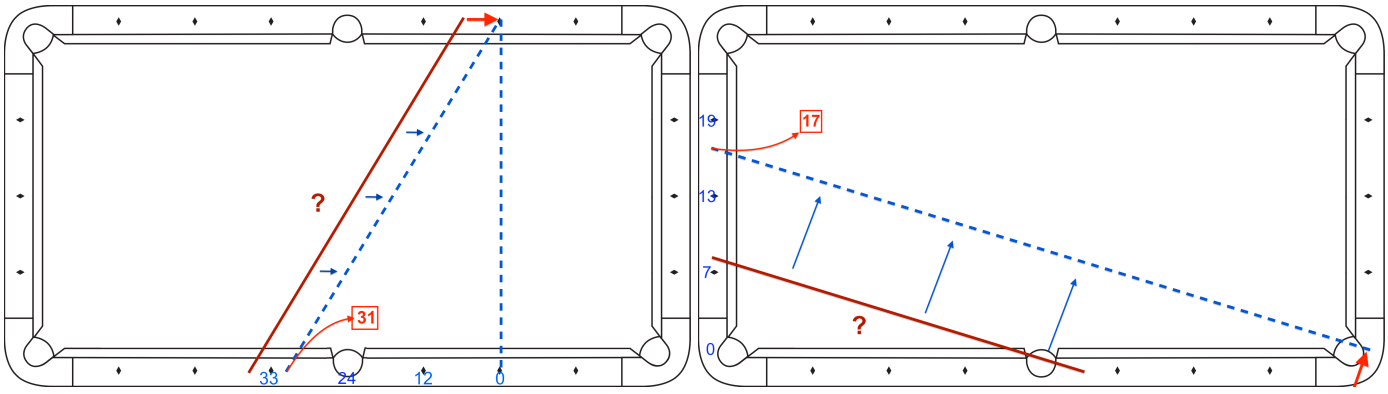
1 Basic Angles

These are the *only* angles you need to remember. Everything else is optional, for convenience only.



All angles here are given relative to the closer rail to keep them under 45º for easier mental arithmetic. Note that all lines are to the opposite rail's unmarked "corner diamond" spot on its diamonds line, in line with the adjacent rail's cushion nose.

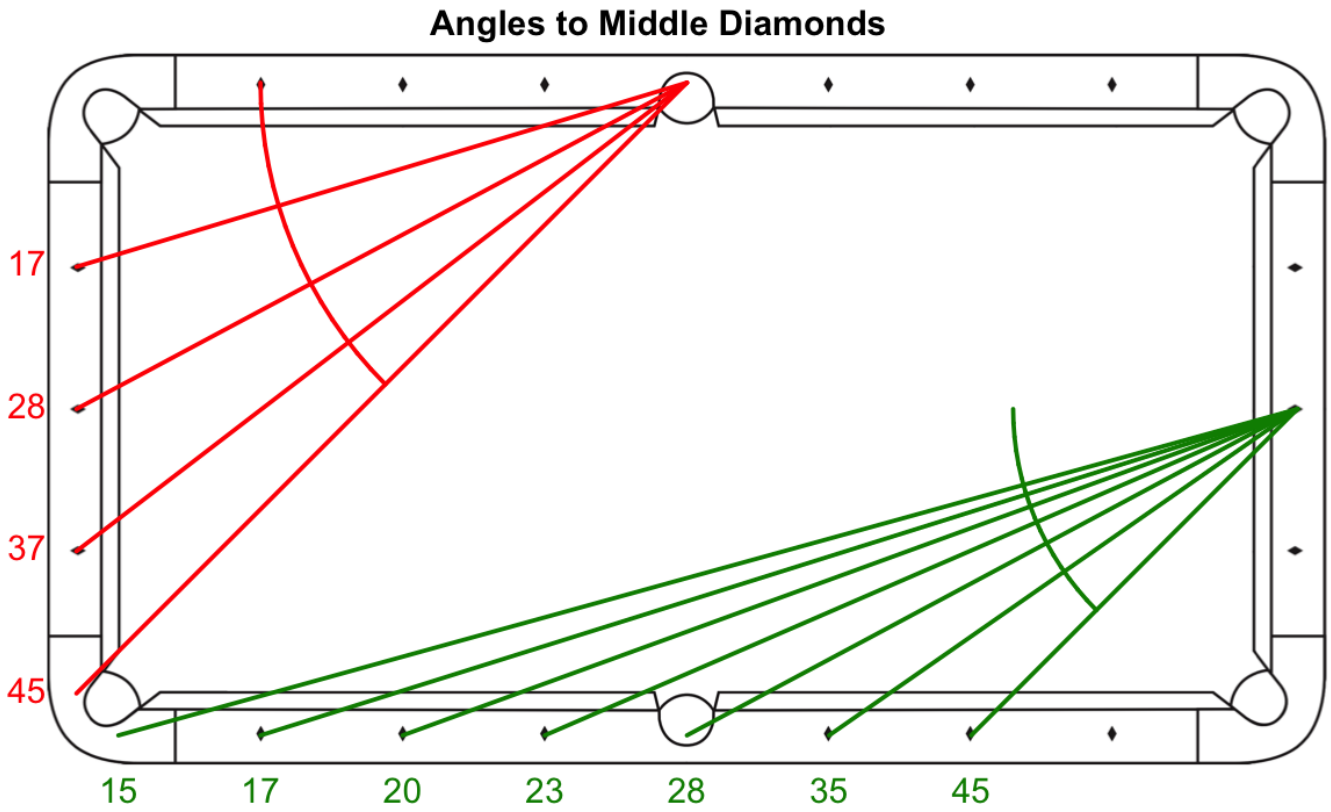
Any line on the table can be compared to these angles by holding the cue over it and shifting parallel, without any rotation, until the line is crossing two opposing rails (if not already) and goes through a diamond on one of them.



To avoid rotating the cue during larger parallel shifts, you can hold it with two hands in front of you and sidestep.

2 More Angles (optional)

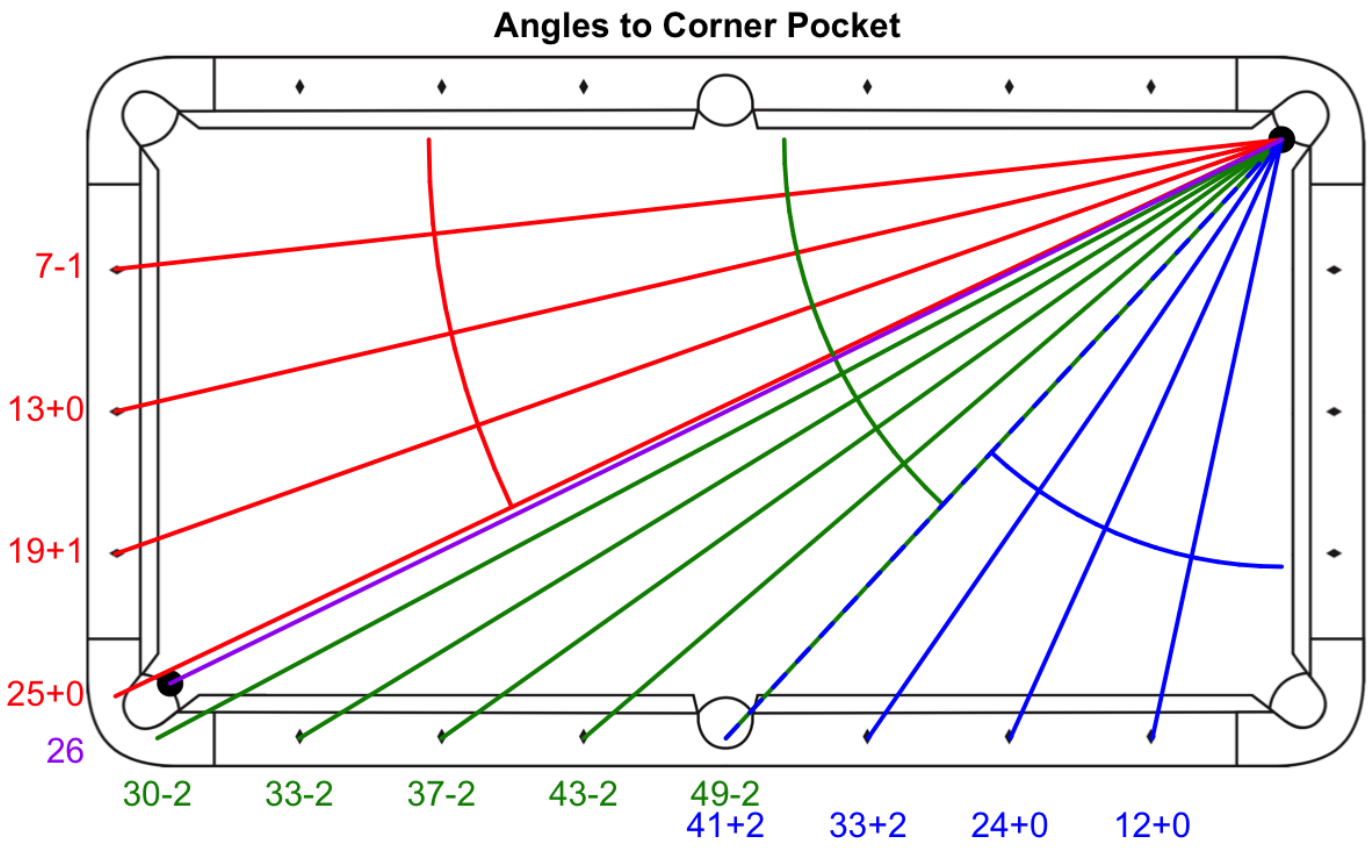
Remembering a few more angles can help avoid some large parallel shifts.



3 OB Angle

Stand behind the OB and point the cue at the pocket opening. You can then parallel shift to a diamond to get the OB angle (for a corner pocket, this will be an inch or two at the most to the "corner diamond" next to it).

Alternatively, if you don't need a more specific target within the pocket, you can remember the small "pocket adjustment" numbers below (given for 9-foot tables; slightly different on others) to account for the shift to the center of the pocket opening, and quickly read the angle off the rail under your cue without having to shift at all.



The 26º pocket-to-pocket angle shown is also handy reference.

Similar adjustments for the side pocket can be calculated, but are not as useful compared to parallel shifting to a more specific target spot.

4 CB Angle

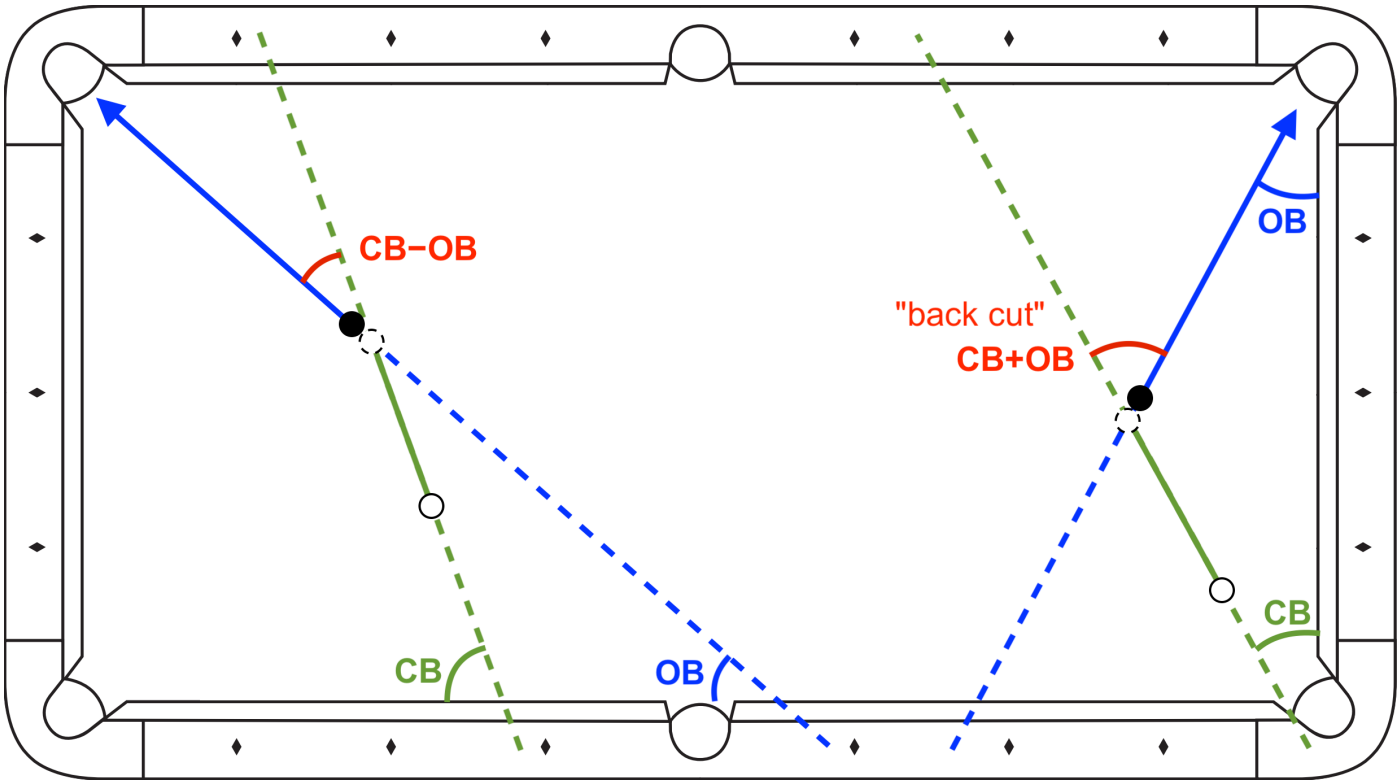
To get the CB angle, we will use (a rough guess for) the "ghost ball" (GB) center, where we expect the CB center to be at the moment of impact with the OB, which is a ball radius (1-1/8") away from the OB edge along the OB-pocket line. The line for the CB angle is then the CB-GB line.

After determining the OB angle, from behind the OB put the cue tip down at the GB center, and walk over to behind the CB, pivoting the cue at the tip so the cue now points along the CB-GB line.

- Why not just shoot at the GB center? Although that may be the first and only aiming method for most players, for all but very thick cuts it is extremely sensitive to any deviation in estimating that 1-1/8" distance from the OB edge (not to mention completely neglecting throw), whereas its use here is far more forgiving; hence the "rough guess."

5 Cut Angle

First, if the OB and CB angles were calculated relative to different rails (one long, one short), take the complement of one by subtracting it from 90º. Then, take the difference of the two if it's a regular cut, or the sum if it's a "back cut" (the OB and CB angles face in opposite directions). That's it.



6 Throw

For all but very thick cuts (small angles) or short pocket distances, we need to correct for cut-induced throw (CIT) due to CB-OB friction at contact, as well as any side-spin (english) induced throw (SIT). Cut friction and inside spin will throw the OB forward, increasing the required cut aim angle to pocket, whereas outside spin can throw the ball wider than the perceived GB cut angle, requiring a negative adjustment. See the simple approximations below for quick mental throw adjustment to the cut aim angle.

6.1 CIT (no side spin)

Choose the **speed factor s=4/2/1** for slow/medium/fast CB speed.

For a **rolling CB** (maximum forward roll or back spin at the time of OB contact) add throw proportional to **s° per 60°**. In other words, **1° per 30° at medium** speed, double for slow, halve for fast.

- **Example:** a slow (s=4) rolling 45° cut should be aimed at 45+3=48°, and a fast (s=1) rolling 15º cut would have ¼º throw, which can be ignored.

For a purely **sliding CB** (no roll by the time of OB contact) add **2 / (s+2) / (s+1)**° throw for 15/30/45º cuts, interpolating between. Sliding CIT is independent of speed up to 15º, and constant (s+1)º above 45º.

- **Example:** 7-8º stun shot will have 1º throw regardless of speed, and a medium-speed (s=2) 60º stun shot will have 3º throw. A slow (s=4) 22º stun shot will be halfway between 2º (for 15º) and 6º (for 30º) which is 4º, requiring aim at 22+4=26º.

For less than maximum forward or backward roll, you can average rolling and sliding numbers accordingly.

6.2 SIT (including CIT)

The effects of side spin on throw are complex. If you really want to aim cuts as accurately as possible using side spin (assuming you are already correcting for deflection to deliver the CB at your aim point), you can try learning the small table approximations below, though remembering the general principles alone goes a long way.

One useful set of numbers worth remembering at least is the gearing outside spin amount for a cut angle, at which throw becomes zero: **20/40/60/70%** for 15/30/45/60º cuts, *independent of speed and roll*. Less outside spin will always throw the OB forward, and more will throw it backward.

6.2.1 Rolling SIT

Medium speed numbers given. Double for slow, halve for fast.

Spin%	0°	15°	30°	45°	60°
-100	1	1	1	1	1
-75	1	1	1	1	1
-50	1	1	1	1	1
-25	0.5	1	1	1.5	1.5
0	**0**	**0.5**	**1**	**1.5**	**2**
+25	-0.5	0	0.5	1	2
+50	-1	-0.5	-0.5	0	1
+75	-1	-1	-1	-1	-1
+100	-1	-1	-1	-1.5	-2

Observations:

- Rolling inside spin throws forward ~1º at medium speed at any angle.
- Rolling outside spin >=75% throws backward ~1º at medium speed at most any angle.

6.2.2 Sliding SIT

Choose s = 4/2/1° for slow/medium/fast speed.
Max throw ("max") is always **s+2º**.
Interpolate unspecified entries between the closest given at that angle.

Spin%	0°	15°	30°	45°	60°
-100	s	s	s	s	s
-75					
-50	max				
-25	2	max			
0	**0**	**2**	**max**	**s+1**	**s+1**
+25	-2	0	2	max	
+50	-(max)	-2	-2	2	max
+75	-(max-1)	-(max)	-(max)	-2	0
+100	-(max-2)	-(max-1)	-(max-1)	-(max)	-(max)

Observations:

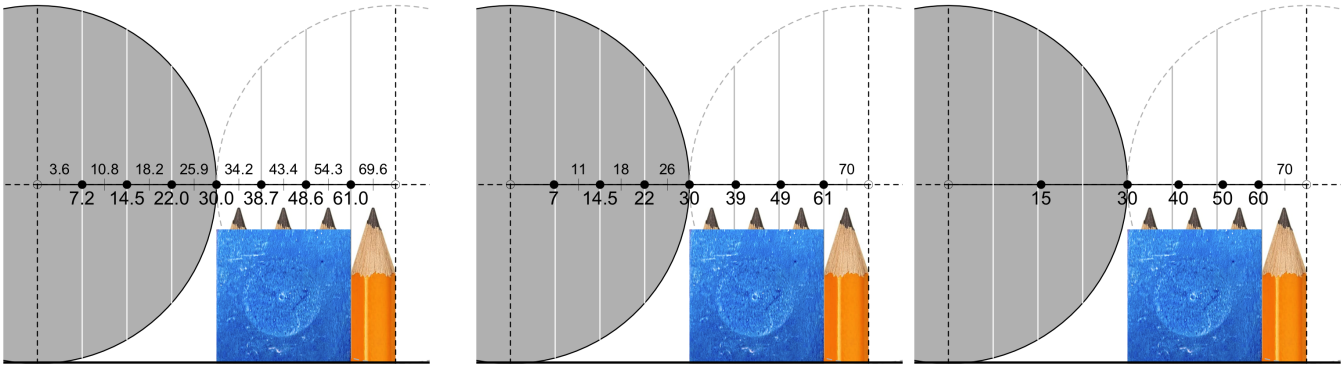
- Maximum sliding inside spin always throws sº.
- Maximum sliding SIT, which is ±(s+2)º, occurs around 30-40% away from the gearing outside spin amount in either direction.
- Sliding outside spin is shaky ground, especially for thin cuts: small changes in spin cause large swings in throw. Remembering the gearing and 100% amounts at the most, and avoiding the rest on all but pocket hangers is probably safest.

7 Angle Aim Points

Now we just need to send the center of the CB at the aim point for the final calculated cut angle. Viewing the OB from behind the CB, eighths of a ball diameter away from the OB edge provide a set of "fractional aiming" landmarks.

- 1/8-ball is about the thickness of a pencil, and 3/8 is a cube of chalk.

The angles at the exact fractional landmarks are given below for reference. In practice, we can more easily remember nearest integers, or the nearby locations of round-number angles around them, and adjust proportionally in between.



Aiming at the middle of a *segment* instead of a point can provide a visually bigger target for some angles. If an angle point proves difficult to visualize and aim at, try viewing it as the middle of a segment twice as far from the edge or center.

- **Example**: For 20º, instead of picking the point 1¼ eighths from the edge, you can aim at the 2½ eighths segment from the edge. Then for 21º, that segment shrinks twice as much as the 1¼ eighths point would move, visually amplifying the difference.

With some practice using these references, you can visually pick the aim point for most angles to a degree.

8 Accuracy of Calculations

The effective size of a pocket target for the OB center is about 3" at most angles and speeds. That is 3º from 5 feet away, so cutting an OB from the table center to a corner pocket, you can shoot 1.5º too thick or thin and still make it. For a "spot shot" (head/foot spot to a near corner, under 3 feet) you can be 2.5º off. The rounding of the angles given here to integers only adds up to a cut angle error of 1º in the worst case, and ¼º on average, so that alone is not going to make you miss. Similarly, for eyeballing OB and CB angles in between two diamond numbers, and for adding throw, you can fairly safely keep your mental math to whole numbers, or half degrees if you will.

9 Very Thick Cuts

For cut angles under 10° or so, GB radius accuracy and cut-induced throw matter much less, so for very long pocket distances, simple GB aiming may become more accurate than the rounding errors of this method. Another cut angle estimation method useful for small angles is cue arc in inches: with the tip pivoting at the GB center, the inches of butt end travel between the OB-pocket and CB-GB lines is very accurately the cut angle in degrees.

10 Developing Feel

Try to visually guess the cut angle first before every shot, and after you have the calculated angle, take another mental picture of what that number looks like before you go down. With that feedback, you will quickly get better at guessing. Even though calculation is quick and easy enough to always use for every shot, having a good guess is valuable as a sanity check alone, and once good enough, you can skip the math for casual play or faster shot clocks, falling back on it as you need.