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# The 90° rule

## Part I – the basics

***Note**: 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](www.engr.colostate.edu/pool). The reference numbers used in the article correspond to the numbers used on the website.*

**A very** important skill for aiming and planning shots is the ability to predict where the cue ball will go after impact with an object ball. **Diagram 1** and **Principle 1** summarize one of the most important principles of pool related to this – the **90° rule**. It states that when the cue ball strikes an object ball with no topspin or bottom spin, the two balls will always separate at 90°. In other words, the tangent line will be perpendicular to the impact line (see **Diagram 1b**). This is true regardless of the cut angle (see **Diagram 1** and **NV 3.4**).

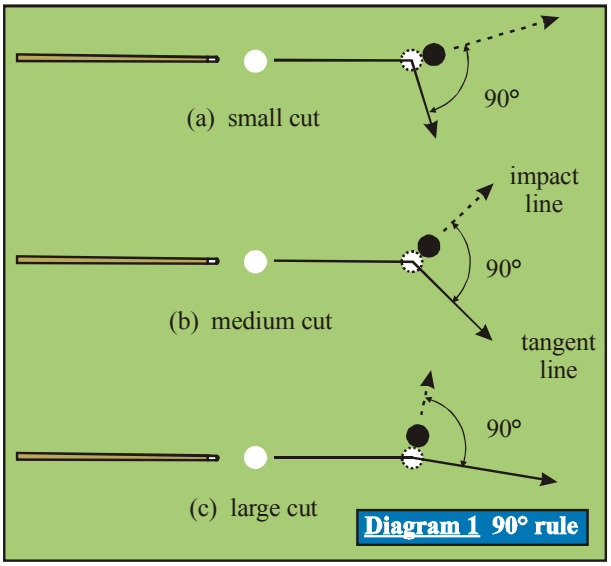


**Diagram 1** **90° rule**

normal video

**NV 3.4** **90° rule with various entering angles**
**NV 3.5** **Using your hand to visualize the 90° rule impact and tangent lines**
**NV 3.6** **Stop shot**
**NV 3.7** **Using the 90° rule to check for and prevent a scratch**

The 90° rule applies exactly only for a **stun shot**, where the cue ball is sliding without topspin or bottom spin at impact with the object ball. **Diagram 2** illustrates some of the cases where the 90° rule applies. For the shot in the top-left of the diagram, the cue ball is close to the object ball to begin with, so a center ball hit (or slightly below center) at almost any speed (except very slow) is acceptable because the cue ball will not have time or distance to develop forward roll (topspin).

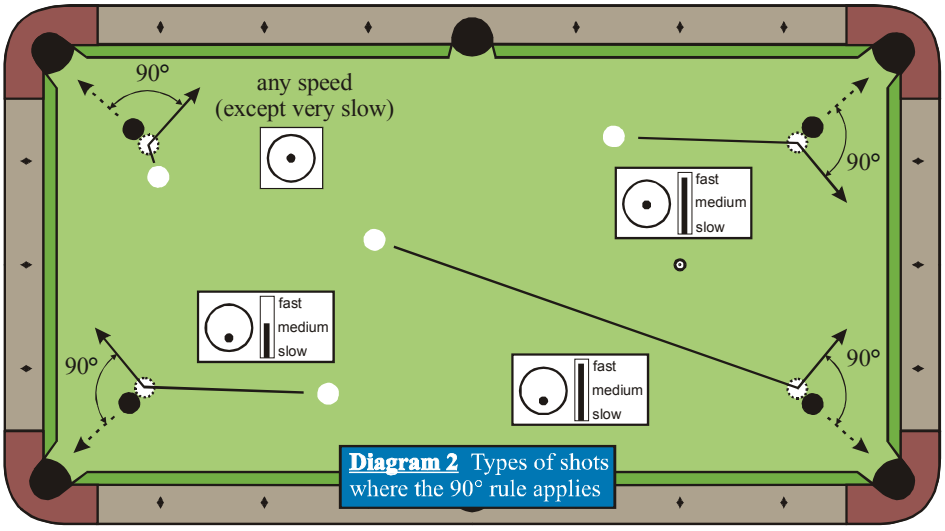


**Diagram 2** Types of shots where the 90° rule applies

For the shot in the top-right of **Diagram 2**, the cue ball is a medium distance from the object ball. In this case, faster speed is used to ensure that the cue ball does not develop forward roll. For the shot in the bottom-left of the diagram, the cue ball distance is the same as with the top-right shot; but in this case, draw (bottom spin) is used instead of speed to counteract the effects of forward roll. The bottom spin wears off by the time the cue ball reaches the object ball resulting in stun. For the shot in the bottom-right of the diagram, the cue ball is a large distance from the object ball, and both speed and draw are required to offset the forward roll that would normally develop over the larger distance.

**Principle 1** **90° rule**

***With a stun shot where there is no topspin or bottom spin, after impact the cue ball will depart along the tangent line which is perpendicular (at a right angle) to the impact line. In other words the cue ball and object ball paths, after impact, will be 90° apart (see Diagram 1 and TP 1).***

- The cue ball path will exactly coincide with the tangent line only when the cue ball hits the object ball with no topspin (follow or normal roll) or bottom spin (draw). **Diagram 2** shows the type of shots where the 90° rule applies.
- Topspin results in angles less than 90°, bottom spin results in angles more than 90° (see **Diagram 4**).
- Sidespin English has practically no effect.
- Even when the cue ball has top or bottom spin, it will still leave initially along the tangent line before curving due to the spin (see **Diagram 4**). The faster the shot, the longer the cue ball persists along the tangent line.
- If the cue ball is rolling naturally, a more useful rule is the 30° rule (to be presented in a future article).


TP 3.1 90° rule derivation


HSV 3.1 Stop shot showing loss of bottom spin over distance

HSV 3.2 Stop shot to prevent a scratch

**Diagram 3** shows a photograph of a hand shape that can be useful to help you visualize the 90° angle and the tangent line direction. The index finger points in the direction of the target, along the required impact line, and the thumb indicates the direction of the resulting 90° tangent line. **NV 3.5** shows some examples of how it can be used.

As pointed out in **Principle 1**, top and bottom spin deflect the cue ball motion away from the tangent line, and these effects must be taken into account. Even when a ball is rolling naturally, and not sliding across the felt, it has topspin that reduces the angle below 90°.

The one exception to the 90° rule is when the cue ball hits the object ball perfectly squarely, with no cut angle. In this case, the cue ball stops completely (i.e., it gets stunned into place), transferring all of its speed to the object ball. This is called a **stop shot** (see **NV 3.6**, **HSV 3.1**, and **HSV 3.2**).

The 90° rule is very useful for helping you prevent scratches, break up ball clusters, execute carom shots, and avoid obstacle balls. The scratch example is presented here and the other will be presented in future articles. The 90° rule is also invaluable for planning the path of cue ball (or any deflected ball) for position play. This topic will also be addressed in future articles.

**Diagram 4** and **NV 3.7** show how the 90° rule can be used to help you prevent a scratch. If the object ball is pocketed with a firm stroke or slightly below center, such that the cue ball is sliding (and not rolling) when it contacts the object ball, the 90° rule predicts that the shot will definitely result in a scratch. To prevent the scratch, you need to make sure the cue ball does not hit the object ball with stun. If draw is used, the cue ball path will curve and avoid the scratch. Another option is to use a slower stroke, resulting in natural ball roll, or a follow shot, which also avoids the scratch. The faster the shot, the longer the cue ball persists along the tangent line path before curving.

Look forward to the next article dealing with how you can use the 90° rule to your advantage in other common situations. Also coming soon is a series of articles on the lesser-known 30° rule, which is just as useful if not more useful.

Diagram 3 Using your hand to visualize the 90° rule impact and tangent lines

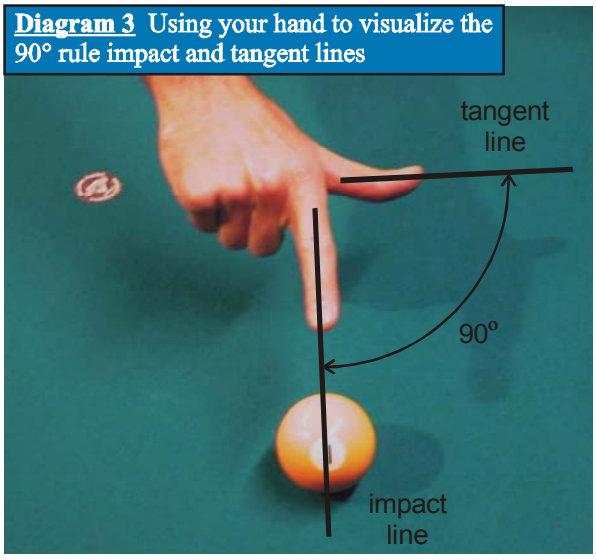


Diagram 4 Using the 90° rule to check for and prevent a scratch