*Supporting narrated video (NV) demonstrations, high-speed video (HSV) clips, technical proofs (TP), and all of my past articles can be accessed and viewed online at **billiards.colostate.edu**. The reference numbers used in the articles 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**.*

This is the third article in a series dealing with *"How to Aim Pool Shots (HAPS),"* a three-disc instructional-DVD collection I recently created with fellow BD columnist Bob Jewett. HAPS covers cut-shot aiming systems, how to adjust for cut-induced throw, how to aim without guessing when using sidespin (english), and how to aim specialty shots including caroms, kisses, combos, rail cut shots, and elevated-cue shots. Also included are numerous simple but effective systems for aiming kick and bank shots. An outline of the entire HAPS series along with video excerpts from each DVD can be viewed online at: **dr-dave-billiards.com/aiming**.

This month, we will look at how to deal with throw, which is motion of an object ball (OB) away from the expected "line of centers" direction when the cue ball (CB) hits the OB with a cut angle or with sidespin. If you are not very familiar with throw, watch online video **NV B.86**. It demonstrates many important throw effects. The amount of throw varies with cut angle, speed, and spin; and with certain types of shots, if you don't compensate your aim for throw, you will miss the shots. A summary of all throw effects can be found in the "squirt, swerve, and throw effects" section of the aiming FAQ page at **billiards.colostate.edu,** in items 16-37 in the numbered list beneath the videos and illustrations. One way to adjust for throw is to change your aiming line to compensate for the expected amount of throw. Disc I of HAPS shows how this is done. Another way is to use what is called "gearing" outside english (OE). The latter approach is the topic of this article.

Diagram 1 illustrates how throw varies with the amount of sidespin. The shot is a ½-ball hit, where the aiming line is through the center of the CB and the outside edge of the OB. If a small amount of (or no) sidespin is used, the OB will be undercut (see the blue arrow). In this case, the throw is called cut-induced throw (CIT) because the spin isn't enough to overcome the sliding motion between the CB and OB due to the cut angle. If a large amount of sidespin is used, the OB will be overcut (see the red arrow). In this case the throw is called spin-induced throw (SIT) because it is the excess spin that creates sliding between the balls. It turns out that there is an specific amount of spin, called gearing OE, that causes the CB to roll along the surface of the OB during contact as if the balls were meshing like gears. Under this condition there is no sliding between the balls, and therefore absolutely no throw. With gearing OE, the OB will head exactly in the expected "line of centers" direction. The english is labeled "outside" because the tip is on the outside of the direction of cut. For example, because the OB in the diagram is being cut to the right, the tip is on the left side (outside) of the ball. **HSV B.33** demonstrates each case (equal to, less than, and greater than the "gearing" amount of OE) in super slow motion if you want to see how the balls react.
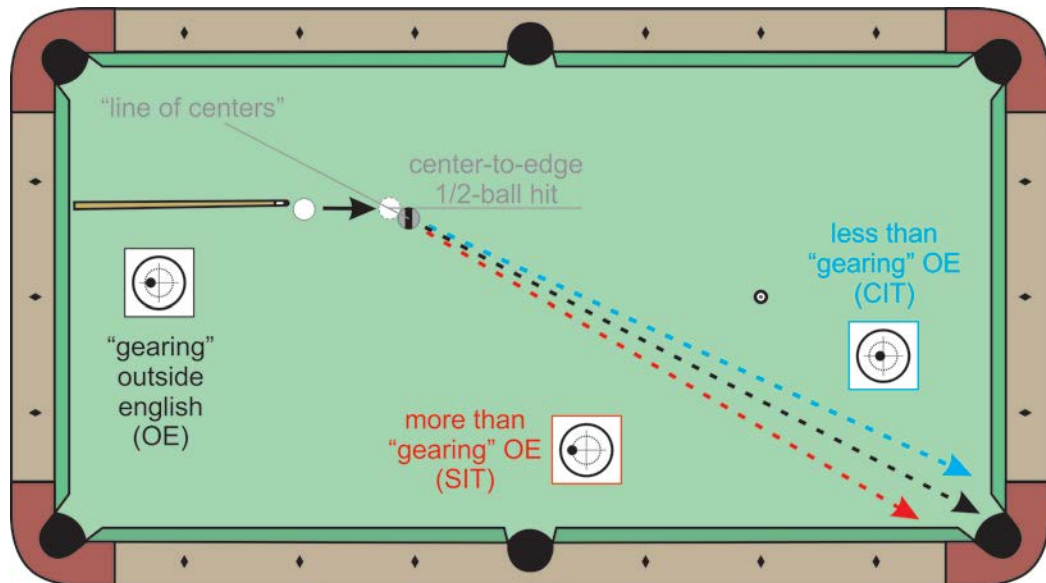
Diagram 1 "Gearing" outside english, CIT, and SIT

There is a simple rule for determining the tip position required to create gearing OE for a cut shot of any angle. It is called the 40% rule, and it is illustrated in **Diagram 2**. Here's how it works: First imagine or use your cue to visualize the line through the OB to the pocket. This direction defines the "line of centers" for the shot. If you parallel-shift this line to the CB (see the red line in the diagram), that defines the "line-of-centers" point on the CB (the red dot in the diagram). The tip contact point must be a little less than half (2/5 or 40% to be precise) of the distance from center ball to the "line-of-centers" point to create gearing OE. This procedure and visualization can be difficult at first attempt; but with practice, it will become easier. **NV E.3** demonstrates to apply the 40% rule at the table for the shot in Diagram 1. Check it out and give it a try. Much more information dealing with when and how to use gearing OE can be found under "outside english" in the english (sidespin) FAQ page at ***billiards.colostate.edu***.

As shown by a graph in **TP A.26**, every cut angle requires a different amount of sidespin to create gearing OE, resulting in no throw. Fortunately, the 40% rule works for every cut angle. For a small cut angle (a fairly full hit), the required amount of english will be small; and for a large cut angle (a fairly thin cut), the required amount of english will be large. Either way, the required tip position is determined using the same procedure and visualization techniques.
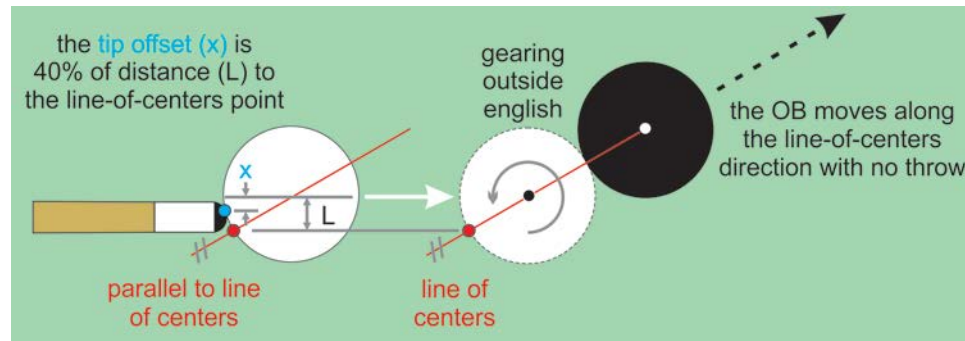

Diagram 2 "Gearing" outside english 40% rule

One thing you need to be careful with when applying the 40% rule is visualizing the contact point accurately. As illustrated in **Diagram 3**, due to the roundness of the tip, the contact point is not on the line through the center of the cue. So be careful to place the cue so the contact point, and not the center of the cue, is aligned with the

required 40% tip contact-point position. **NV E.3** and the HAPS-I DVD demonstrate how to visualize thist and how to apply the method successfully at the table.
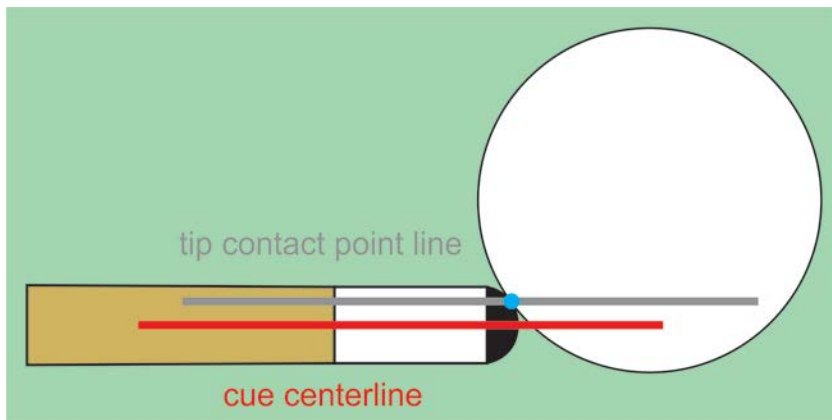
If you want more information about how to compensate your aim when using sidespin, see "aim compensation for squirt, swerve and throw" in the "aiming" FAQ page at **billiards.colostate.edu**. And if you want to learn more about how, when, and why english is used in a variety of game situations, check out Disc II of the Video Encyclopedia of Pool Shots (VEPS). VEPS-II takes a comprehensive look at this topic.

I hope you enjoy my series of articles dealing with the "How to Aim Pool Shots (HAPS)" DVD set. If you want to view video excerpts from the entire series, check out online videos **NV E.1** through **NV E.8**. Enjoy!

Good luck with your game,
Dr. Dave

normal video

NV B.86 – Cut-induced throw (CIT) and spin-induced throw (SIT), from VEPS IV
NV E.1 – Fractional-Ball Aiming, from HAPS I
NV E.2 – Back-Hand (BHE) and Front-Hand English (FHE), from HAPS I
NV E.3 – Using "Gearing" Outside English to Eliminate Throw, from HAPS I
NV E.4 – Carom-Shot Trisect-Draw System, from HAPS II
NV E.5 – Combination Shot Throw Adjustment, from HAPS II
NV E.6 – Rail Cut Shot Aiming, w/ and w/o Sidespin, from HAPS II
NV E.7 – Mirror Kick-Shot Aiming System, from HAPS III
NV E.8 – 1/3-More-Than-Twice Bank-Shot Aiming System, from HAPS III

high-speed video

HSV B.33 – Outside english gearing, and cut and spin-induced throw

technical proof

TP A.26 – The amount of sidespin required for "gearing" outside english

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 at **billiards.colostate.edu**.

Dr. Dave is author of "The Illustrated Principles of Pool and Billiards" book and DVD, and co-author of the "Video Encyclopedia of Pool Shots (VEPS)," "Video Encyclopedia of Pool Practice (VEPP)," "How to Aim Pool Shots (HAPS)," and "Billiard University (BU)" instructional DVD series.