

THE LETTER OF THE LAW

In our sport, rules are made to be refined and reworded.



IN MY February 2002 column, I did a brief history of the rule changes in 8-ball. I was surprised by how many there had been. The Billiard Congress of America (BCA) had published annual rule books, sometimes with significantly different interpretations of the same rule from year to year. Three fouls for loss of game was in very briefly; and there have been perhaps six different sets of rules for what happens on the break. Of course, this proliferation is dwarfed by the variety of rules that you will find in your local taverns, but more than once I was startled by changes the BCA made for no apparent reason.

The global rules situation for pool is somewhat different now. The BCA is a member of the World Pool-Billiard Association (WPA), which has been the world governing body of pool since about 1990. (The BCA follows WPA rules, while the BCA Pool League, now a private organization, prints their own rules, separate from the WPA.) One of the most important policies of the WPA is enforcing a five-year period between rule changes. While there may be some wording adjustments between the revisions, you can expect few surprises most years.

About two years ago, I was asked to begin editing a new revision of the rules for possible adoption in January 2008. A first revision was put on the Web, and a lot of players provided feedback on both the wording and intent. In September 2006, about 15 delegates from around the world met for three

days near Chicago to work out the remaining details. The rules drafted from that meeting were distributed to the national federations for further feedback, and a *final* final version was finished in November.

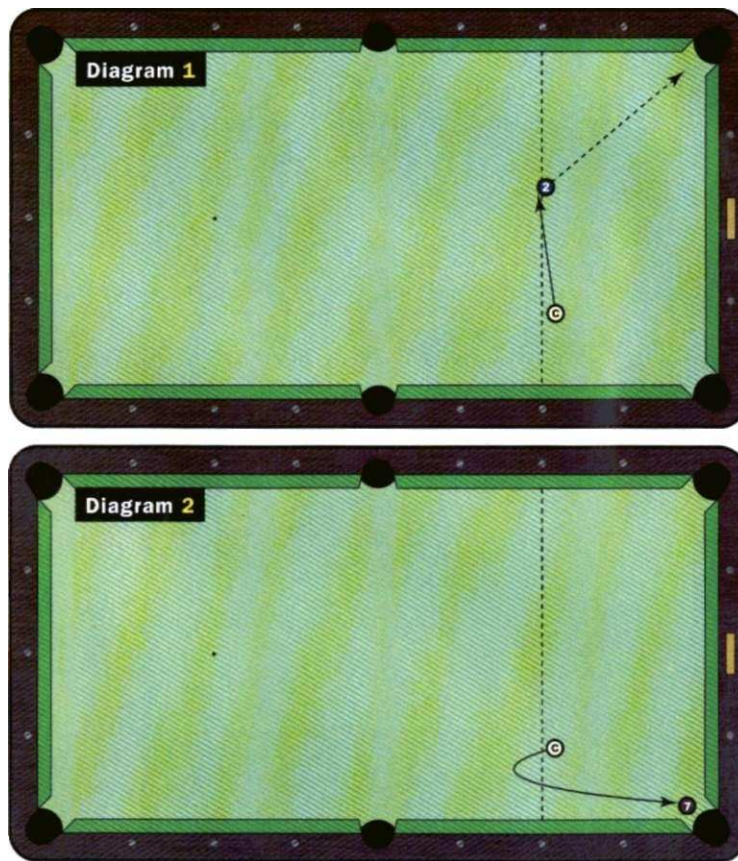
The WPA's World Standardized Rules differentiates between Rules, concerning game play, and Regulations, the peripheral issues like dress code, referee behav-

The WPA General Assembly will be meeting as this column is going to press, and will be voting on whether to adopt the new proposed Rules and Regulations. If they are adopted, you will notice a few minor changes, which we'll cover here.

The major change for U.S. players will be the disappearance of the old Rule 1.16, which suggested "cue-ball fouls only." This pertained to non-refereed matches: If the shooter accidentally move an object ball, it is not a foul. The non-shooter has the option of leaving the moved ball in position or moving it back to its original position. Basically, by discarding the option of cue-ball fouls only, all rules are to be applied in all matches. The Regulations suggest how to handle the situation where a referee cannot be continuously at the table.

The meeting in 2006 was a real eye-opener to me on this rule. It seems that the whole world — except the U.S. — is happy to apply all the rules all the time. If you brush a ball with your sleeve, it's a foul. While your local leagues may decide to play with the old rule (meaning cue-ball fouls only) since "all fouls" requires a level of sportsmanship that is too rare these days, I think they would be doing their players and the game a favor if they would try to implement this change.

Also under the proposed changes, a late lag is no longer penalized as a loss of lag. Instead, the lag will be replayed. Maybe you were unaware of this rule. Some players wait until their opponent's lag is nearly done before they



ior and shot-clock operation. While the Rules are intended to be changed only as absolutely necessary, the Regulations are considerably more flexible and had to be rewritten to match the new wording of the Rules. Together, the two documents amount to about 30 pages of text and diagrams. A further document is the Equipment Specifications, but that was not part of this effort at revision.

lag. That way, they can get a better feel for the speed of the table. Of course, if both players adopted this strategy, the game would be called on account of darkness with no shot having been fired.

In straight pool, a stalemate rule has been added at the same time that the "nurse-safety" rule was removed. A nurse safety is where both players play safe on the same ball that is near a rail. Under the old rules, the ball was declared frozen after each player had played safe twice on the ball, which forces play in some other direction. All racks now can be declared a stalemate, meaning the balls are re-racked and the players lag for the break.

The rule for "No Rail" in the case of frozen balls was revised. The old rule was quite confusing and didn't really

WHEN WAS THE LAST TIME YOU READ THE RULES? NOW WOULD BE A GOOD TIME.

cover the reason for the rule. (The "No Rail" rule was intended to prevent repetitive safeties, like rolling the cue ball off a ball frozen to the rail.) Under the new rule, many strange exceptions have been eliminated. For example, if the object ball is frozen to the corner of the side pocket, and your shot causes it to rattle back and forth in the jaws of the side, you do not get credit for having hit a rail under the old rules. That has been fixed. You will need to understand the revised definition of "Driven to a Rail" in connection with this rule.

Several things were moved into "Unsportsmanlike Conduct" that were previously specific fouls. A major example of this is the intentional miscue. Under the rules currently being reviewed by the WPA, the only permissible way to set the balls in motion is by a forward stroking motion of the cue stick on the cue ball. To intentionally move the balls in any other way is completely outside the rules. The referee is allowed considerable latitude in penalizing unsportsmanlike conduct, ranging from a warning to expulsion from the tournament. Play fair.

The rules for black ball are included in the new rules along with 8-ball, 9-

ball and straight pool. Black ball is a game similar to 8-ball that is played in England and quite a few other countries. Among other rules that Americans might find surprising is that a foul is penalized with a "free shot." This allows the shooter to hit whatever he pleases, before starting his normal inning.

In 14.1 play, it is no longer an option to accept the balls in position after your opponent commits three successive fouls. Under the new rules, the fouler will always re-break under normal conditions, while still being penalized 18 points (3 for each foul and 15 for three consecutive).

One change that generated a surprising amount of controversy concerns the rack in straight pool. If you need to spot the 15th ball with an untouched 14-ball rack on the table, the referee is permitted to re-rack all 15 balls. If he can't make a proper 15-ball rack by simply placing the 15th ball on the foot spot, then he has to re-rack. The referee has to decide whether a re-rack is necessary. Evidently there was an unwritten rule used in some areas that the triangle was not to return to the table after racking. I think it's fairer to give the incoming player a correct rack if the spotted ball doesn't fit well on the original 14.

Finally, under the old rules, if you wanted to play a ball behind the headstring when you had cue ball in hand behind the headstring, the cue ball had to contact a cushion above the headstring before coming back. Under the new rules, the cue ball is just required to cross the headstring before any contact with a ball behind the string. That means that the two shots shown in the diagrams are now allowed. For the shot in **Diagram 1**, the referee will have to make a decision on whether the cue ball has crossed the line before contacting the object ball. As long as the cue ball has completely crossed the headstring before making contact with the 2 ball, this shot is legal.

Similarly, in **Diagram 2**, as long as the entire cue ball crosses the headstring, you can pocket the 7 ball without hitting a rail.

When was the last time you read the rules? Now would be a good time.



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KILLING ME SOFTLY?

The outbreak of the soft break threatens the game of 9-ball.



TWO RECENT competitions have shown what many have been saying for a number of years: the current game of 9-ball is fundamentally flawed as a test of skill. The rack and the break have become major problems, and tournament organizers have not found a good solution.

At the recently completed World Pool Championship in Manila, the problem was reported to be worst on the TV table, which was used for most of the live broadcasts. The players discovered that a fairly soft break almost guaranteed to pocket a wing ball, and the correct hit would get position on the 1 ball. (The wing ball is the ball on the "side corner" of the rack.) In one rack I saw on YouTube, a player who is known for hammering the balls shot a break that looked like a soft stop shot on the 1 ball. All the balls were on one half of the table and the run was nearly automatic.

In one sense, there's nothing wrong with this technique. The players have discovered that if they get a really tight rack, it's not necessary to risk losing the cue ball to get a good break. In fact, if the rack and the rules permit such a controlled break,

only a fool would smash the balls with all available force. It is a natural evolution of the game.

The problem is that it makes 9-ball a poor game to find the best pool player. If the break is automatic and the runout is usually easy with simple patterns, the game does not separate the champions from the also-rans. You might as well flipcoins.

The second event of note was December's Mosconi Cup, which was held in the MGM Grand in Las Vegas. To avoid

the dullness encountered in Manila, Matchroom Sport made three major changes to the break. First, the 9 ball was racked on the spot, which moved the natural line of the wing ball up the table — enough to make it very unlikely to go in. Second, the breaker was required to shoot from the middle half of the kitchen, which eliminated the normal angle used for the wing-ball break

Finally, the breaker had to get at least three object balls to cross the headstring or be pocketed to keep the table, which eliminated soft breaks. Each object ball could only be counted once, so that if a ball was pocketed in a head pocket, it was only counted once even though it both crossed the headstring and was pocketed.

It took the players a while to get used

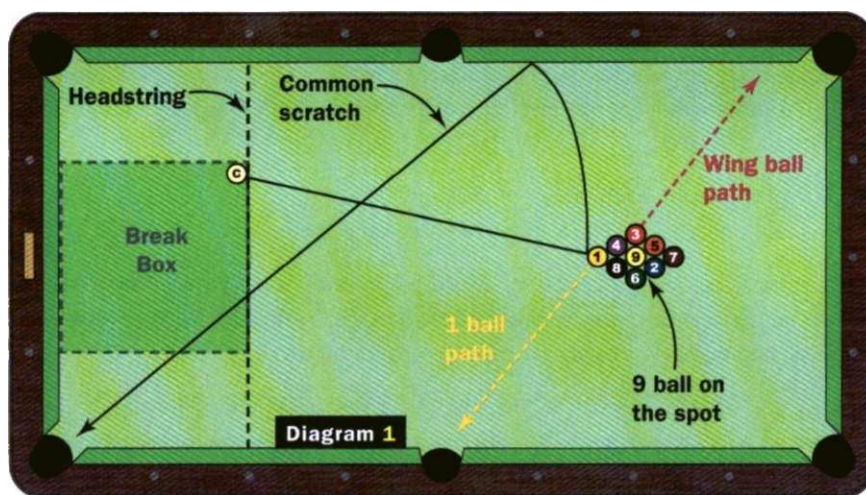
enough spin and draw that it went one rail into a head pocket. There were few break-and-runs.

Diagram 1 shows the break box, a typical cue-ball position, a typical path for the 1 ball and a common scratch. Also shown is the path that the "wing ball" takes due to the rack being higher on the table — it no longer goes straight into the pocket.

The so-called "three above the line" rule produced some strange results. On one or two breaks during the Cup, two balls were pocketed but no ball crossed the head string, so the breaker had to give up the table. On some breaks, a ball that was about to drift into the kitchen to validate the break was knocked away by a ball exiting the kitchen. Fortunately for the breakers, a "soft break" violation did not result in ball in hand; the breaker just lost his turn.

"Three above the line" is not a new rule. It has been in force on the Euro-Tour for some time to prevent the soft-break, easy-run problem. This is a large issue in Europe, because they have a technique that gets much tighter racks than you find in most

American tournaments. Their method is to "train" the table by tapping the balls into place, making small indentations in the cloth in the exact locations where the balls should be for the break. This is not done by tapping the balls in a full rack because that way will nearly always lead to gaps between the balls. Instead, a template like the one shown in **Diagram 2** is used, with one ball at a time being placed in each hole and then tapped to form the indentation in the cloth. The thin sheet of tough material has holes



to the breaking rules. The standard break was to place the cue ball as far to the left or right as possible and then hit the 1 ball toward the farther foot pocket with draw and some sidespin. This hit on the 1 ball often pocketed it in the side pocket. Without a full hit on the 1 ball, the cue ball had a lot more energy than the usual "park whitey" break shot, and it was common to see it go straight to the side rail from the 1 ball and then either go straight back and forth and scratch in a side pocket or catch the side rail with

punched through it in nearly the correct locations of the balls. I say "nearly" because if you space the holes apart by the regulation size of the balls — 57.15 millimeters or 2.25 inches — you will inevitably end up with some of the balls slightly misplaced. Instead, the holes need to be a little closer to each other than the ball diameter so that when the balls are sitting in their little craters, the sides of the craters will make the balls press together and be as close to perfectly tight as possible.

On a table that is trained like this, a triangle is not necessary. Just get each ball close to its assigned hole and it will fall into it. Among other advantages, this eliminates arguments over who should rack and how tight the rack is. As noted above, the large problem that results from such a consistent, tight rack is that

the wing ball nearly always goes in if the 1 ball is racked on the spot.

One additional problem that the "three above the line" rule causes is the need to count the number of balls that get above the head string. Once or twice during the Mosconi Cup, the refs had to refer to the instant replay for a ball count.

So, what do you think should be done about 9-ball? Some argue that a normal, slightly loose rack should be used, but this is not fair to the player who gets the "bad" racks while his opponent gets the "good" racks. Each player should have

the same chance on the break.

One possible change is for the breaker to always get the next shot. That at least would be fair, but the break might not be too exciting as soon as all the players figure out how to get position on the 1 ball.

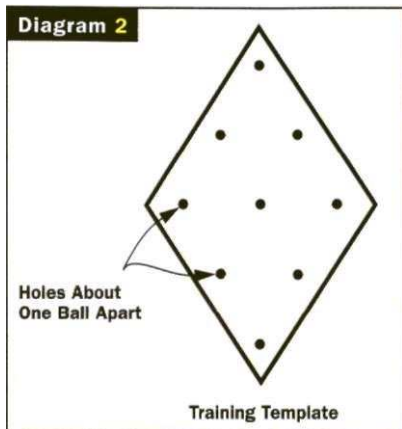
Another possibility is to require the incoming player to always play a push-out. Optimum push-out strategy is when your opponent is 50-50 to pass the shot back to you, so this assures that most racks will start fairly enough.


For any plan that does not require a tight rack, the 9 ball should be spotted if made on the break. If the rack is tight, the 9 ball only moves if kicked by a ball that comes back through the rack area. At the Mosconi Cup, the majority of 9 balls at the end of the game were shot off the foot spot where it started, and there were only one or two 9 balls made on the break. If the rack is loose and the 9 goes in, the non-breaker was cheated.

What do you think of the alterations used in the Mosconi Cup?

The final solution may be 10-ball. So far, no easy automatic break has been discovered for that game, although the 1 ball in the side is fairly easy to plan. As a hint of things to come, the WPA — the world governing organization for pool — has decided to publish official rules for 10-ball for the first time.

You may want to start practicing with one more ball on the table.





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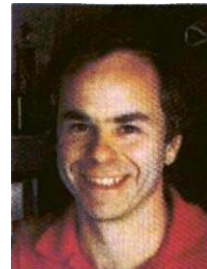
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BY Bob Jewett



FREEZING TO DEATH

Here is how the perfect rack changes the game of 9-ball.

LAST MONTH I discussed the problem with the rack and soft break at 9-ball. The issue has come up because it is now possible to get a consistently tight rack — and that allows nearly anyone to make a consistent, effective break. With the break drained of the smash-and-luck factor, it's not clear the game can survive.

There are several pretty simple shots that demonstrate how much the action of the balls changes if a pair that is supposed to be touching isn't quite. Shot A in **Diagram 1** is a standard shot in one-pocket. With the cue ball as shown and 8 ball spotted on the foot spot, it's possible to drive the 8 into pocket A simply by drawing the cue ball straight back. This shot only works if the two balls are really frozen, but many players can't see when two balls are truly frozen. If you are one of those, it may help to tap the balls against each other or to use white paper reinforcement donuts to force the balls to freeze. Tapping a ball down into the cloth with another ball creates a small dimple in the cloth that the ball "wants" to sit in.

It turns out that although many claim that you need draw on the cue ball to make the front ball follow into the pocket, you can make the shot without draw. To see this, place a third ball (the 2 ball in this case) in

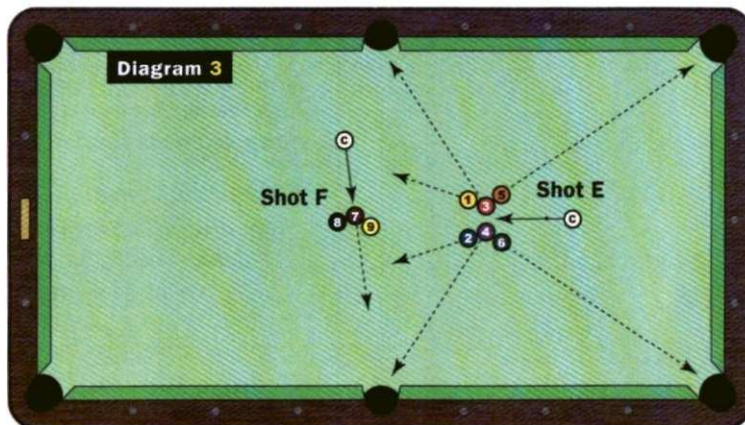
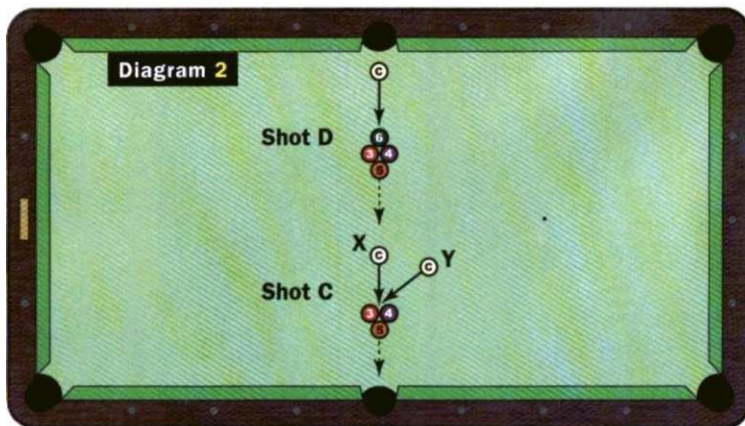
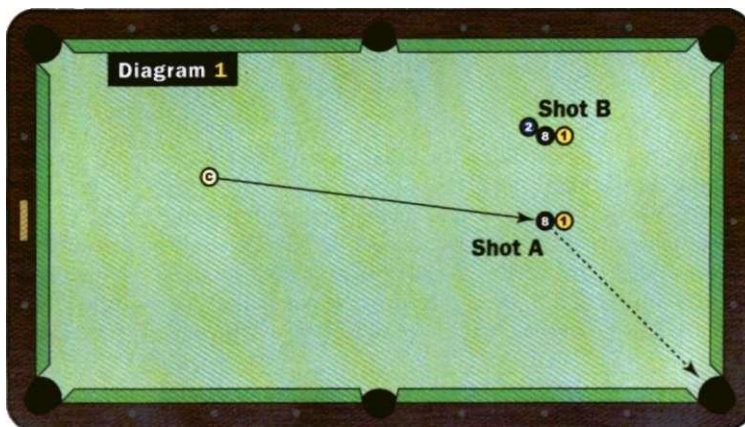
front of the other two and just slightly angled, like the balls shown in Shot B (but still having the 8 on the spot). See how the 8 ball is squeezed into the corner pocket? In theory, you should

be able to hit this three-ball group from almost anywhere and squeeze the middle ball into the pocket.

After you can get the shot to come close a fair percentage of the time, put a small gap between the back ball (the 1) and the ball that's supposed to go in (the 8). How much does it change the angle of the middle ball toward the pocket?

A second frozen-ball situation is shown in **Diagram 2**. It is developed from an old proposition shot that is in Shot C. The goal is to make the ball nearest the side pocket (the 5) in that side pocket. The client is likely to try shooting from cue-ball position X and to hit the two balls simultaneously. By symmetry, the far ball has to go straight into the pocket. Well, that would be true if there are no gaps between the balls and the cue ball really hits both balls together. The frozen part you can take care of by tapping. The simultaneous hit, however, is nearly impossible to achieve. Ball-to-ball contact takes only about 200 millionths of a second. In terms of how much left-to-right tolerance this gives you, you have to land centered on the two balls within a 1/50th of a millimeter. That's only about half the thickness of this magazine page.

The standard way to win the proposition is to play the cue ball from Y,



just graze the 4 ball and run into the 3 ball fairly fully. With a little practice, you will find the thickness on the 4 ball that drives the 5 over just enough that it is set for a second hit by the 3 ball into the pocket.

Shot D shows how to get that simultaneous hit all the time. Rack four balls together and make sure they are all touching, which is no easy task. On fairly new cloth, I couldn't get all four of them frozen together after five minutes of tapping and rubbing the cloth. Eventually, I had to put a piece of paper under them, so the tapping formed fairly deep craters that would keep the balls frozen in place.

With all the balls frozen, you can simply shoot the cue ball straight at the 6 ball and the 5 ball goes straight ahead into the pocket even from quite a distance away. While you have the balls properly frozen, try shooting the cue ball at different angles into the "head" ball and see where the back ball goes.

Now, try adding small gaps to the diamond-shaped cluster and note the new angles taken by the 5 ball. I find that even with nearly invisible gaps, the back ball goes wide of the pocket by a substantial margin.

Finally, **Diagram 3** shows a frozen-ball shot derived from the standard old trick shot, "The Butterfly." In the Butterfly, which is shown as Shot E, the cue ball is shot up the middle of the group of six balls. It drives the 3 and 4 balls into the balls in front of them and then they hit the balls behind them and are redirected into the side pockets. For the exact setup, you can check out pretty much any book that covers trick shots, or experiment on your own.

In the three-ball group shown in Shot F, if the balls are all frozen, you can shoot the 7 ball straight into the side pocket even though the kiss lines, which make the Butterfly work, are in the wrong directions. The middle ball seems to ignore the two balls touching it. Put a small gap in, and the shot no longer works. The 7 will end up taking the kiss-line off the ball that has the gap.

Note that to get the middle ball to go through at all, the three frozen balls have to form an angle greater than 90 degrees. The larger the angle — that is, the closer to a straight line the three balls are — the easier the shot is to

make work, but the range of angles that it will work for is pretty small. You must select an angle for the cue ball that drives the 7 ball into both of its neighbors (the 8 and 9 balls) at the same time, or you are back to the mechanics of the Butterfly shot, which is to first contact one neighbor and then to contact the other.

Although you may have learned some new proposition shots and some shots that come in handy on rare occasions,

the main point of this article is to convince you that the presence or absence of small gaps in clusters of object balls can have a huge influence on where the balls end up going. In the case of the rack in 9 ball, the result is that the wing ball is dead in the pocket if the rack is perfectly tight. Conversely, if your opponent (or the table) gives you a loose rack, the wing ball may not be dead. Even a small gap can change everything.

Viking CUES

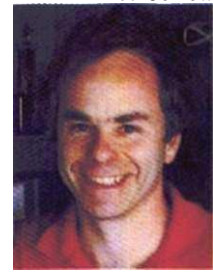
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BY Bob Jewett



MEASURED FORCE

Practicing shots on the outer limits of speed control.

THINGS THAT vary can be sorted into two main types: those that vary in steps and those that vary continuously, or without perceptible steps between all possible examples. The first kind of variation includes species of birds, gears in a manual transmission, the named colors in a rainbow (remember Roy G. Biv), and the number of balls pocketed in a ran. In the continuous category are your car's MPG efficiency, how long lunch takes, the actual colors in a rainbow, and the speed of the cue ball.

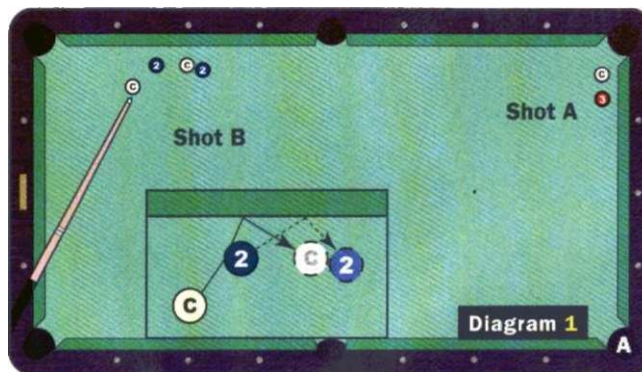
Humans like to put things into categories, even if they don't fit very well. If you look at the colors in a rainbow carefully enough, you will see that there are more colors than you could ever count — and not just the red, orange, yellow, etc. that people commonly name. At pool you see this in the division of shots into draw, stop and follow, and the pigeon-holing of cut shots into fractions of a ball such as a quarter, half, three-quarters and full. The reality is that there are infinite variations within and/or between the categories. The practicality is that the human mind tends to group like things into a manageable number of piles.

So, let's categorize shot speed. Several such arbitrary lists have been created, usually without rhyme or reason. Here is a shot speed system with some reason.

First, consider the full range of speeds used in games. At the high end is the break shot which is about 20 MPH for good players of usual ability. At the low end are soft safeties — shots in which you are either taking a foul (in games such as straight pool or one-pocket) or you are playing a safety on a ball very close to a cushion. Beginners often practice breaking but rarely practice the soft shots, and consequently they are frequently stumped by any shot below 1

MPH. Their comfortable speeds are medium, fast, and break speed.

The physics behind shot speed has a few interesting wrinkles. First, the practical quantity in a shot is how many diamonds it will travel on the cloth. It turns out that this is directly proportional to the energy in the ball (E) and



consequently proportional to the square of the velocity (V) of the ball. This follows directly from the equation for kinetic energy:

$$E = \frac{1}{2}mv^2$$

We will measure kinetic energy in diamonds traveled on a typical table rather than in the technical correct unit of joules.

A second aspect is that when a ball hits a cushion it loses roughly a fixed fraction of its energy. The fraction seems to change a little for hard shots versus soft shots, but a good average value is 2/3. Yes, the ball retains only a third of its energy in each full-on rail collision. This fact becomes very important in multi-rail shots.

For shots that don't hit any cushions, you can just measure the travel with the diamonds on the table to get their energies, while for longer shots you need to include the losses at the rails. As an example, if you shoot straight up and down the table at near break speed, you may be able to hit the far cushion three times with the cue ball traveling a total of five lengths of

the table. Using the one-third rail-loss factor, it's possible to deduce that if you had a table of unlimited length, that shot would have traveled 1,000 diamonds, where a diamond is 12.5 inches.

In making our list of categories, we need to cover the whole range of shot energies with a reasonable number of categories, and we need to distinguish between shots that seem fundamentally different. If we want to include safety shots with less than a diamond of energy, the steps better not be uniform or we would need 1,000 steps to get to the top end. Instead, let's use something like the scale used for earthquakes such that each magnitude step in the scale represents a constant ratio of energy larger than the next-lower magnitude. Since

a rail-contact causes reduction in energy by a factor of 3, it seems like a reasonable energy ratio to use, and it turns out that it simplifies the speed levels.

After a little math — contact me directly if you are really interested in the details — here is a table of shot speed categories. Note that the energy is listed as a distance.

CATEGORY NUMBER	DISTANCE, THEORETICAL	DISTANCE, ACTUAL SPEED,	SHOT MPH
1	1/3 inch	same	0.1
2	1 inch	same	0.17
3	3 inches	same	0.32
4	1 diamond	same	0.55
5	3 diamonds	same	1
6	9 diamonds	1 length+	1.7
7	31 diamonds	2 lengths	3.2
8	100 diamonds	3 lengths	5.5
9	310 diamonds	4 lengths	10
10	1000 diamonds	5 lengths	17

You may be puzzled by category 10 where a 1,000-diamond shot only goes 5 lengths (or about 40 diamonds). Let's go through the shot. Suppose you start on the head string and shoot straight up

and down the table. The ball arrives at the foot rail having lost 6 diamonds of its original 1,000 diamonds of energy — remember that distance and energy are equivalent for ball travel. The 994 is cut by a factor of three in the first rail contact leaving 331 (in round numbers). The ball arrives at the second cushion with 8 diamonds less than that due to the travel back, leaving 323. Coming off the second rail it has 108. Continuing the arithmetic, off the third rail it has 33, and off the fourth rail just 8 diamonds of energy, which barely gets the ball to the fifth rail.

How many of these categories are you comfortable using in actual play? Most players seem to struggle with any shot outside of just 6, 7 and 8. Some beginners never shoot as softly as 6, having learned that the farther the ball travels, the better chance it has to find a pocket.

As a drill for the high-speed end of the scale, try shooting the cue ball straight up and down the table five lengths to leave it within one diamond of the far rail and within a diamond of the center of the table, it may be that your table has cushions that take away even more

than two-thirds of the energy on each bounce, in which case five lengths may not be possible except with a bouncing cue ball that flies from cushion-nose to cushion-nose. Don't go to that technique; instead back off to four lengths. For completeness, try all of the speeds 6 through 10.


Diagram 1 shows two low-speed drills to help you with the low end. In shot A, the cue ball is close to the object ball, and the goal is to make the ball in pocket A taking as many shots as possible — no rail is required on each shot, but you must hit the object ball. Taking 10 shots is good for a beginner. Once you have mastered soft shots, 40 should be your goal. There is a simple cheat that allows you to take a few hundred shots if you have the patience, but don't use that cheat if you discover it.

In shot B, the object ball starts close to the cushion with the cue ball a little farther out. Pretend you are playing 8-ball. You have no real shot, and all your opponent's balls are up-table by Shot A. Play the cue ball to contact the ball, then the cushion and then freeze to the object ball. Count the freeze as good if you

leave the cue ball within a chalk's-width of the object ball. For a real safety, the idea is to leave no jump shot. See how many times you can do this in a row taking the cue ball in hand each time but leaving the object ball as is.

As another soft-shot drill, try this one that I got from Tom Riccobene, an instructor in New Mexico. Place all the object balls along the headstring spaced apart evenly. The cue ball is not involved in the shots. Knock the first ball as short a distance as you can up the table. The second ball has to go further than the first, and so on. See if you can shoot all 15 balls with constantly increasing distances. An alternative to this drill is to shoot each ball to try to freeze it to each successive diamond (or pocket) around the table — there are conveniently 15 such spots around the table outside the kitchen. Set your own tolerance on "freezing," such as a ball diameter or a hand span.

Of course, real shots often require far more speed precision than this arbitrary division into categories, but I think that spending a little practice using these steps will help your speed control.




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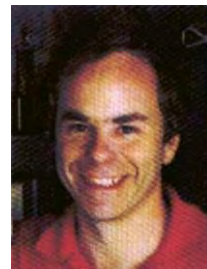


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THE LETTER OF THE LAW

In our sport, rules are made to be refined and reworded.



IN MY February 2002 column, I did a brief history of the rule changes in 8-ball. I was surprised by how many there had been. The Billiard Congress of America (BCA) had published annual rulebooks, sometimes with significantly different interpretations of the same rule from year to year. Three fouls for loss of game was in very briefly; and there have been perhaps six different sets of rules for what happens on the break. Of course, this proliferation is dwarfed by the variety of rules that you will find in your local taverns, but more than once I was startled by changes the BCA made for no apparent reason.

The global rules situation for pool is somewhat different now. The BCA is a member of the World Pool-Billiard Association (WPA), which has been the world governing body of pool since about 1990. (The BCA follows WPA rules, while the BCA Pool League, now a private organization, prints their own rules, separate from the WPA.) One of the most important policies of the WPA is enforcing a five-year period between rule changes. While there may be some wording adjustments between the revisions, you can expect few surprises most years.

About two years ago, I was asked to begin editing a new revision of the rules for possible adoption in January 2008. A first revision was put on the Web, and a lot of players provided feedback on both the wording and intent. In September 2006, about 15 delegates from around the world met for three

days near Chicago to work out the remaining details. The rules drafted from that meeting were distributed to the national federations for further feedback, and a *final* final version was finished in November.

The WPA's World Standardized Rules differentiates between Rules, concerning game play, and Regulations, the peripheral issues like dress code, referee behav-

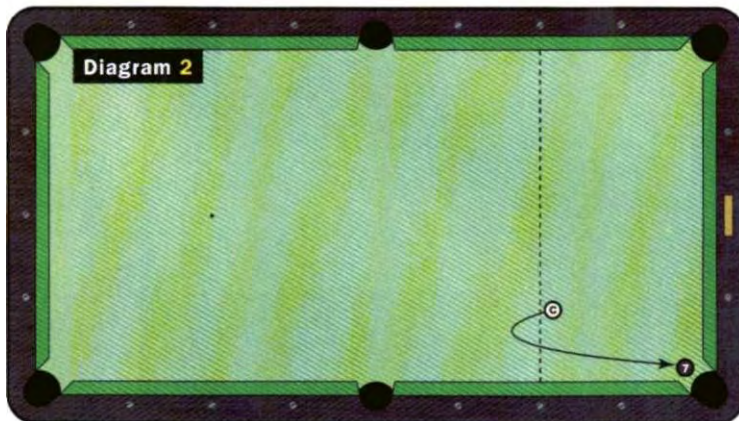
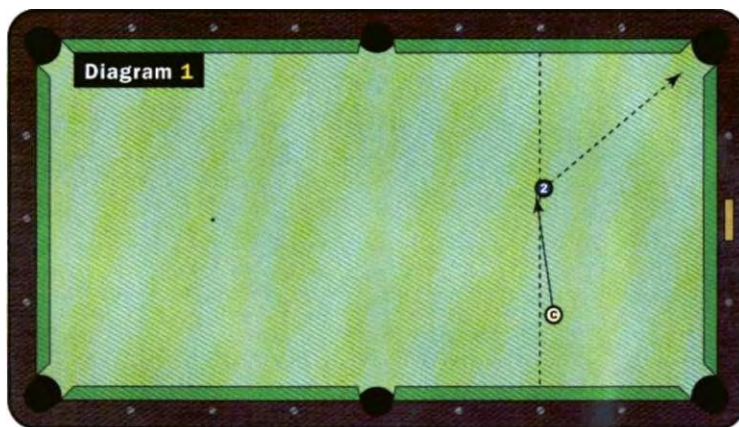
The WPA General Assembly will be meeting as this column is going to press, and will be voting on whether to adopt the new proposed Rules and Regulations. If they are adopted, you will notice a few minor changes, which we'll cover here.

The major change for U.S. players will be the disappearance of the old Rule 1.16, which suggested "cue-ball fouls only." This pertained to non-refereed matches: If the shooter accidentally move an object ball, it is not a foul. The non-shooter has the option of leaving the moved ball in position or moving it back to its original position. Basically, by discarding the option of cue-ball fouls only, all rules are to be applied in all matches. The Regulations suggest how to handle the situation where a referee cannot be continuously at the table.

The meeting in 2006 was a real eye-opener to me on this rule. It seems that the whole world — except the U.S. — is happy to apply all the rules all the time. If you brush a ball with your sleeve, it's a foul. While your local leagues may decide to play with the old rule (meaning cue-ball fouls only) since "all fouls" requires a level of sports-

manship that is too rare these days, I think they would be doing their players and the game a favor if they would try to implement this change.

Also under the proposed changes, a late lag is no longer penalized as a loss of lag. Instead, the lag will be replayed. Maybe you were unaware of this rule. Some players wait until their opponent's lag is nearly done before they



ior and shot-clock operation. While the Rules are intended to be changed only as absolutely necessary, the Regulations are considerably more flexible and had to be rewritten to match the new wording of the Rules. Together, the two documents amount to about 30 pages of text and diagrams. A further document is the Equipment Specifications, but that was not part of this effort at revision.

lag. That way, they can get a better feel for the speed of the table. Of course, if both players adopted this strategy, the game would be called on account of darkness with no shot having been fired.

In straight pool, a stalemate rule has been added at the same time that the "nurse-safety" rule was removed. A nurse safety is where both players play safe on the same ball that is near a rail. Under the old rules, the ball was declared frozen after each player had played safe twice on the ball, which forces play in some other direction. All racks now can be declared a stalemate, meaning the balls are re-racked and the players lag for the break.

The rule for "No Rail" in the case of frozen balls was revised. The old rule was quite confusing and didn't really

WHEN WAS THE LAST TIME YOU READ THE RULES? NOW WOULD BE A GOOD TIME.

cover the reason for the rule. (The "No Rail" rule was intended to prevent repetitive safeties, like rolling the cue ball off a ball frozen to the rail.) Under the new rule, many strange exceptions have been eliminated. For example, if the object ball is frozen to the corner of the side pocket, and your shot causes it to rattle back and forth in the jaws of the side, you do not get credit for having hit a rail under the old rules. That has been fixed. You will need to understand the revised definition of "Driven to a Rail" in connection with this rule.

Several things were moved into "Unsportsmanlike Conduct" that were previously specific fouls. A major example of this is the intentional miscue. Under the rules currently being reviewed by the WPA, the only permissible way to set the balls in motion is by a forward stroking motion of the cue stick on the cue ball. To intentionally move the balls in any other way is completely outside the rules. The referee is allowed considerable latitude in penalizing unsportsmanlike conduct, ranging from a warning to expulsion from the tournament. Play fair.

The rules for black ball are included in the new rules along with 8-ball, 9-

ball and straight pool. Black ball is a game similar to 8-ball that is played in England and quite a few other countries. Among other rules that Americans might find surprising is that a foul is penalized with a "free shot." This allows the shooter to hit whatever he pleases, before starting his normal inning.

In 14.1 play, it is no longer an option to accept the balls in position after your opponent commits three successive fouls. Under the new rules, the fouler will always re-break under normal conditions, while still being penalized 18 points (3 for each foul and 15 for three consecutive).

One change that generated a surprising amount of controversy concerns the rack in straight pool. If you need to spot the 15th ball with an untouched 14-ball

rack on the table, the referee is permitted to re-rack all 15 balls. If he can't make a proper 15-ball rack by simply placing the 15th ball on the foot spot, then he

has to re-rack. The referee has to decide whether a re-rack is necessary. Evidently there was an unwritten rule used in some areas that the triangle was not to return to the table after racking. I think it's fairer to give the incoming player a correct rack if the spotted ball doesn't fit well on the original 14.

Finally, under the old rules, if you wanted to play a ball behind the headstring when you had cue ball in hand behind the headstring, the cue ball had to contact a cushion above the headstring before coming back. Under the new rules, the cue ball is just required to cross the headstring before any contact with a ball behind the string. That means that the two shots shown in the diagrams are now allowed. For the shot in **Diagram 1**, the referee will have to make a decision on whether the cue ball has crossed the line before contacting the object ball. As long as the cue ball has completely crossed the headstring before making contact with the 2 ball, this shot is legal.

Similarly, in **Diagram 2**, as long as the entire cue ball crosses the headstring, you can pocket the 7 ball without hitting a rail.

When was the last time you read the rules? Now would be a good time.

KILLING ME SOFTLY?

The outbreak of the soft break threatens the game of 9-ball.



TWO RECENT competitions have shown what many have been saying for a number of years: the current game of 9-ball is fundamentally flawed as a test of skill. The rack and the break have become major problems, and tournament organizers have not found a good solution.

At the recently completed World Pool Championship in Manila, the problem was reported to be worst on the TV table, which was used for most of the live broadcasts. The players discovered that a fairly soft break almost guaranteed to pocket a wing ball, and the correct hit would get position on the 1 ball. (The wing ball is the ball on the "side corner" of the rack.) In one rack I saw on YouTube, a player who is known for hammering the balls shot a break that looked like a soft stop shot on the 1 ball. All the balls were on one half of the table and the run was nearly automatic.

In one sense, there's nothing wrong with this technique. The players have discovered that if they get a really tight rack, it's not necessary to risk losing the cue ball to get a good break. In fact, if the rack and the rules permit such a controlled break,

only a fool would smash the balls with all available force. It is a natural evolution of the game.

The problem is that it makes 9-ball a poor game to find the best pool player. If the break is automatic and the runout is usually easy with simple patterns, the game does not separate the champions from the also-rans. You might as well flip coins.

The second event of note was December's Mosconi Cup, which was held in the MGM Grand in Las Vegas. To avoid

the dullness encountered in Manila, Matchroom Sport made three major changes to the break. First, the 9 ball was racked on the spot, which moved the natural line of the wing ball up the table — enough to make it very unlikely to go in. Second, the breaker was required to shoot from the middle half of the kitchen, which eliminated the normal angle used for the wing-ball break

Finally, the breaker had to get at least three object balls to cross the headstring or be pocketed to keep the table, which eliminated soft breaks. Each object ball could only be counted once, so that if a ball was pocketed in a head pocket, it was only counted once even though it both crossed the headstring and was pocketed.

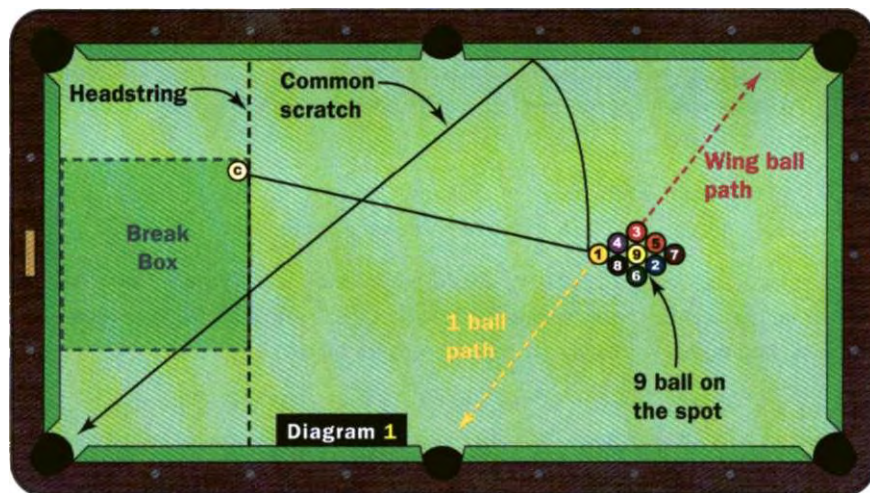
It took the players a while to get used

enough spin and draw that it went one rail into a head pocket. There were few break-and-runs.

Diagram 1 shows the break box, a typical cue-ball position, a typical path for the 1 ball and a common scratch. Also shown is the path that the "wing ball" takes due to the rack being higher on the table — it no longer goes straight into the pocket.

The so-called "three above the line" rule produced some strange results. On one or two breaks during the Cup, two balls were pocketed but no ball crossed the head string, so the breaker had to give up the table. On some breaks, a ball that was about to drift into the kitchen to validate the break was knocked away by a ball exiting the kitchen. Fortunately for the breakers, a "soft break" violation did not result in ball in hand; the breaker just lost his turn.

"Three above the line" is not a new rule. It has been in force on the Euro-Tour for some time to prevent the soft-break, easy-run problem. This is a large issue in Europe, because they have a technique that gets much tighter racks than you find in most



to the breaking rules. The standard break was to place the cue ball as far to the left or right as possible and then hit the 1 ball toward the farther foot pocket with draw and some sidespin. This hit on the 1 ball often pocketed it in the side pocket. Without a full hit on the 1 ball, the cue ball had a lot more energy than the usual "park whitey" break shot, and it was common to see it go straight to the side rail from the 1 ball and then either go straight back and forth and scratch in a side pocket or catch the side rail with

American tournaments. Their method is to "train" the table by tapping the balls into place, making small indentations in the cloth in the exact locations where the balls should be for the break. This is not done by tapping the balls in a full rack because that way will nearly always lead to gaps between the balls. Instead, a template like the one shown in **Diagram 2** is used, with one ball at a time being placed in each hole and then tapped to form the indentation in the cloth. The thin sheet of tough material has holes

punched through it in nearly the correct locations of the balls. I say "nearly" because if you space the holes apart by the regulation size of the balls — 57.15 millimeters or 2.25 inches — you will inevitably end up with some of the balls slightly misplaced. Instead, the holes need to be a little closer to each other than the ball diameter so that when the balls are sitting in their little craters, the sides of the craters will make the balls press together and be as close to perfectly tight as possible.

On a table that is trained like this, a triangle is not necessary. Just get each ball close to its assigned hole and it will fall into it. Among other advantages, this eliminates arguments over who should rack and how tight the rack is. As noted above, the large problem that results from such a consistent, tight rack is that

the wing ball nearly always goes in if the 1 ball is racked on the spot.

One additional problem that the "three above the line" rule causes is the need to count the number of balls that get above the head string. Once or twice during the Mosconi Cup, the refs had to refer to the instant replay for a ball count.

So, what do you think should be done about 9-ball? Some argue that a normal, slightly loose rack should be used, but this is not fair to the player who gets the "bad" racks while his opponent gets the "good" racks. Each player should have

the same chance on the break.

One possible change is for the breaker to always get the next shot. That at least would be fair, but the break might not be too exciting as soon as all the players figure out how to get position on the 1 ball.

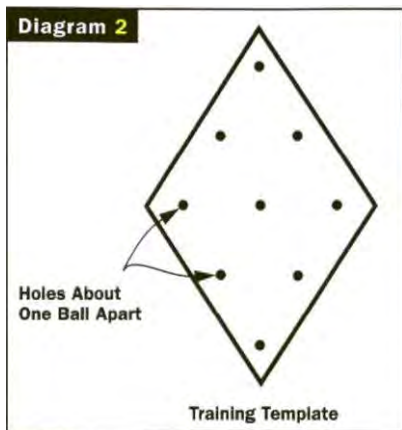
Another possibility is to require the incoming player to always play a push-out. Optimum push-out strategy is when your opponent is 50-50 to pass the shot back to you, so this assures that most racks will start fairly enough.

For any plan that does not require a tight rack, the 9 ball should be spotted if made on the break. If the rack is tight, the 9 ball only moves if kicked by a ball that comes back through the rack area. At the Mosconi Cup, the majority of 9 balls at the end of the game were shot off the foot spot where it started, and there were only one or two 9 balls made on the break. If the rack is loose and the 9 goes in, the non-breaker was cheated.

What do you think of the alterations used in the Mosconi Cup?

The final solution may be 10-ball. So far, no easy automatic break has been discovered for that game, although the 1 ball in the side is fairly easy to plan. As a hint of things to come, the WPA — the world governing organization for pool — has decided to publish official rules for 10-ball for the first time.

You may want to start practicing with one more ball on the table.





FREEZING TO DEATH

Here is how the perfect rack changes the game of 9-ball.

LAST MONTH I discussed the problem with the rack and soft break at 9-ball. The issue has come up because it is now possible to get a consistently tight rack — and that allows nearly anyone to make a consistent, effective break. With the break drained of the smash-and-luck factor, it's not clear the game can survive.

There are several pretty simple shots that demonstrate how much the action of the balls changes if a pair that is supposed to be touching isn't quite. Shot A in **Diagram 1** is a standard shot in one-pocket. With the cue ball as shown and 8 ball spotted on the foot spot, it's possible to drive the 8 into pocket A simply by drawing the cue ball straight back. This shot only works if the two balls are really frozen, but many players can't see when two balls are truly frozen. If you are one of those, it may help to tap the balls against each other or to use white paper reinforcement donuts to force the balls to freeze. Tapping a ball down into the cloth with another ball creates a small dimple in the cloth that the ball "wants" to sit in.

It turns out that although many claim that you need draw on the cue ball to make the front ball follow into the pocket, you can make the shot without draw. To see this, place a third ball (the 2 ball in this case) in

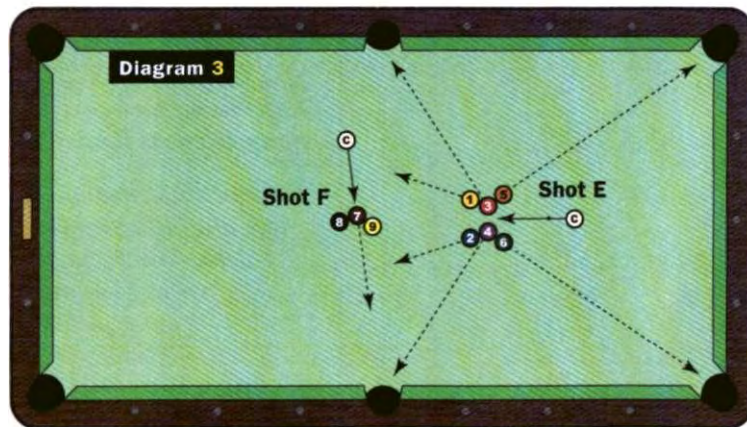
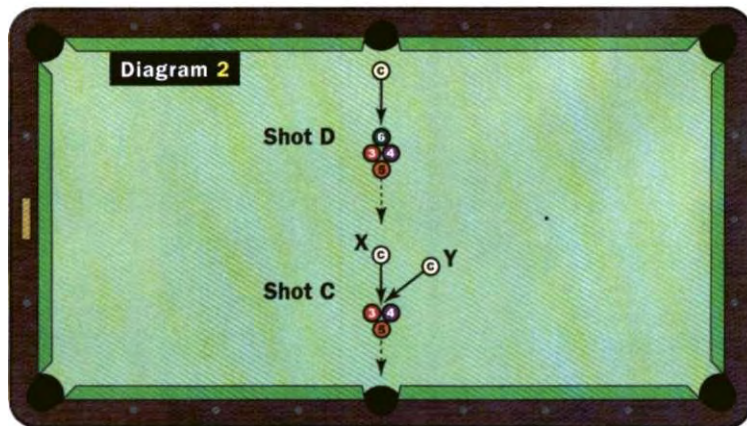
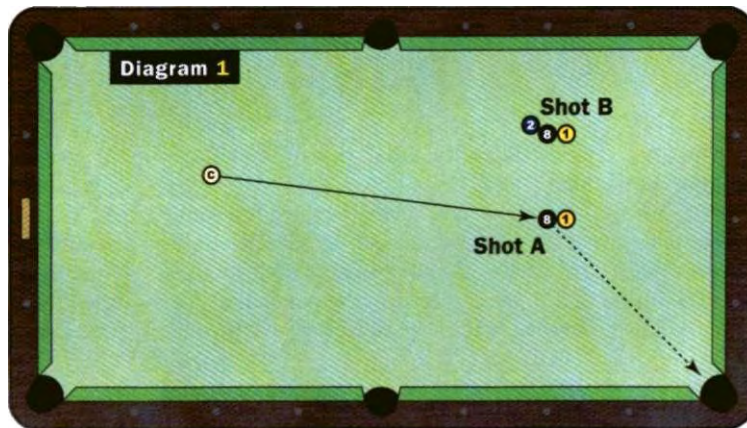
front of the other two and just slightly angled, like the balls shown in Shot B (but still having the 8 on the spot). See how the 8 ball is squeezed into the corner pocket? In theory, you should

be able to hit this three-ball group from almost anywhere and squeeze the middle ball into the pocket.

After you can get the shot to come close a fair percentage of the time, put a small gap between the back ball (the 1) and the ball that's supposed to go in (the 8). How much does it change the angle of the middle ball toward the pocket?

A second frozen-ball situation is shown in **Diagram 2**. It is developed from an old proposition shot that is in Shot C. The goal is to make the ball nearest the side pocket (the 5) in that side pocket. The client is likely to try shooting from cue-ball position X and to hit the two balls simultaneously. By symmetry, the far ball has to go straight into the pocket. Well, that would be true if there are no gaps between the balls and the cue ball really hits both balls together. The frozen part you can take care of by tapping. The simultaneous hit, however, is nearly impossible to achieve. Ball-to-ball contact takes only about 200 millionths of a second. In terms of how much left-to-right tolerance this gives you, you have to land centered on the two balls within a 1/50th of a millimeter. That's only about half the thickness of this magazine page.

The standard way to win the proposition is to play the cue ball from Y,



just graze the 4 ball and run into the 3 ball fairly fully. With a little practice, you will find the thickness on the 4 ball that drives the 5 over just enough that it is set for a second hit by the 3 ball into the pocket.

Shot D shows how to get that simultaneous hit all the time. Rack four balls together and make sure they are all touching, which is no easy task. On fairly new cloth, I couldn't get all four of them frozen together after five minutes of tapping and rubbing the cloth. Eventually, I had to put a piece of paper under them, so the tapping formed fairly deep craters that would keep the balls frozen in place.

With all the balls frozen, you can simply shoot the cue ball straight at the 6 ball and the 5 ball goes straight ahead into the pocket even from quite a distance away. While you have the balls properly frozen, try shooting the cue ball at different angles into the "head" ball and see where the back ball goes.

Now, try adding small gaps to the diamond-shaped cluster and note the new angles taken by the 5 ball. I find that even with nearly invisible gaps, the back ball goes wide of the pocket by a substantial margin.

Finally, **Diagram 3** shows a frozen-ball shot derived from the standard old trick shot, "The Butterfly." In the Butterfly, which is shown as Shot E, the cue ball is shot up the middle of the group of six balls. It drives the 3 and 4 balls into the balls in front of them and then they hit the balls behind them and are redirected into the side pockets. For the exact setup, you can check out pretty much any book that covers trick shots, or experiment on your own.

In the three-ball group shown in Shot F, if the balls are all frozen, you can shoot the 7 ball straight into the side pocket even though the kiss lines, which make the Butterfly work, are in the wrong directions. The middle ball seems to ignore the two balls touching it. Put a small gap in, and the shot no longer works. The 7 will end up taking the kiss-line off the ball that has the gap.

Note that to get the middle ball to go through at all, the three frozen balls have to form an angle greater than 90 degrees. The larger the angle — that is, the closer to a straight line the three balls are — the easier the shot is to

make work, but the range of angles that it will work for is pretty small. You must select an angle for the cue ball that drives the 7 ball into both of its neighbors (the 8 and 9 balls) at the same time, or you are back to the mechanics of the Butterfly shot, which is to first contact one neighbor and then to contact the other.

Although you may have learned some new proposition shots and some shots that come in handy on rare occasions,

the main point of this article is to convince you that the presence or absence of small gaps in clusters of object balls can have a huge influence on where the balls end up going. In the case of the rack in 9 ball, the result is that the wing ball is dead in the pocket if the rack is perfectly tight. Conversely, if your opponent (or the table) gives you a loose rack, the wing ball may not be dead. Even a small gap can change everything.

MEASURED FORCE

Practicing shots on the outer limits of speed control.



THINGS THAT van' can be sorted into two main types: those that van' in steps and those that vary continuously, or without perceptible steps between all possible examples. The first kind of variation includes species of birds, gears in a manual transmission, the named colors in a rainbow (remember Roy G. Biv), and the number of balls pocketed in a ran. In the continuous category are your car's MPG efficiency, how long lunch takes, the actual colors in a rainbow, and the speed of the cue ball.

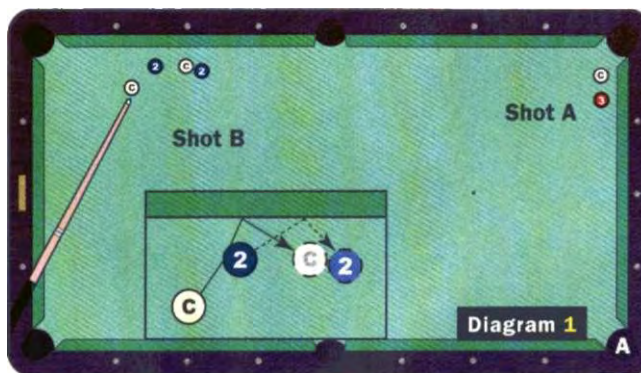
Humans like to put things into categories, even if they don't fit very well. If you look at the colors in a rainbow carefully enough, you will see that there are more colors than you could ever count — and not just the red, orange, yellow, etc. that people commonly name. At pool you see this in the division of shots into draw, stop and follow, and the pigeonholing of cut shots into fractions of a ball such as a quarter, half, three-quarters and full. The reality is that there are infinite variations within and/or between the categories. The practicality is that the human mind tends to group like things into a manageable number of piles.

So, let's categorize shot speed. Several such arbitrary lists have been created, usually without rhyme or reason. Here is a shot speed system with some reason.

First, consider the full range of speeds used in games. At the high end is the break shot which is about 20 MPH for good players of usual ability. At the low end are soft safeties — shots in which you are either taking a foul (in games such as straight pool or one-pocket) or you are playing a safety on a ball very close to a cushion. Beginners often practice breaking but rarely practice the soft shots, and consequently they are frequently stumped by any shot below 1

MPH. Their comfortable speeds are medium, fast, and break speed.

The physics behind shot speed has a few interesting wrinkles. First, the practical quantity in a shot is how many diamonds it will travel on the cloth. It turns out that this is directly proportional to the energy in the ball (E) and



consequently proportional to the square of the velocity (V) of the ball. This follows directly from the equation for kinetic energy:

$$E = \frac{1}{2}mv^2$$

We will measure kinetic energy in diamonds traveled on a typical table rather than in the technical correct unit of joules.

A second aspect is that when a ball hits a cushion it loses roughly a fixed fraction of its energy. The fraction seems to change a little for hard shots versus soft shots, but a good average value is 2/3. Yes, the ball retains only a third of its energy in each full-on rail collision. This fact becomes very important in multi-rail shots.

For shots that don't hit any cushions, you can just measure the travel with the diamonds on the table to get their energies, while for longer shots you need to include the losses at the rails. As an example, if you shoot straight up and down the table at near break speed, you may be able to hit the far cushion three times with the cue ball traveling a total of five lengths of

the table. Using the one-third rail-loss factor, it's possible to deduce that if you had a table of unlimited length, that shot would have traveled 1,000 diamonds, where a diamond is 12.5 inches.

In making our list of categories, we need to cover the whole range of shot energies with a reasonable number of categories, and we need to distinguish between shots that seem fundamentally different. If we want to include safety shots with less than a diamond of energy, the steps better not be uniform or we would need 1,000 steps to get to the top end. Instead, let's use something like the scale used for earthquakes such that each magnitude step in the scale represents a constant ratio of energy larger than the next-lower magnitude. Since

a rail-contact causes reduction in energy by a factor of 3, it seems like a reasonable energy ratio to use, and it turns out that it simplifies the speed levels.

After a little math — contact me directly if you are really interested in the details — here is a table of shot speed categories. Note that the energy is listed as a distance.

CATEGORY NUMBER	DISTANCE THEORETICAL	DISTANCE ACTUAL	SHOT SPEED, MPH
1	1/3 inch	same	0.1
2	1 inch	same	0.17
3	3 inches	same	0.32
4	1 diamond	same	0.55
5	3 diamonds	same	1
6	9 diamonds	1 length+	1.7
7	31 diamonds	2 lengths	3.2
8	100 diamonds	3 lengths	5.5
9	310 diamonds	4 lengths	10
10	1000 diamonds	5 lengths	17

You may be puzzled by category 10 where a 1,000-diamond shot only goes 5 lengths (or about 40 diamonds). Let's go through the shot. Suppose you start on the head string and shoot straight up

and down the table. The ball arrives at the foot rail having lost 6 diamonds of its original 1,000 diamonds of energy — remember that distance and energy are equivalent for ball travel. The 994 is cut by a factor of three in the first rail contact leaving 331 (in round numbers). The ball arrives at the second cushion with 8 diamonds less than that due to the travel back, leaving 323. Coming off the second rail it has 108. Continuing the arithmetic, off the third rail it has 33, and off the fourth rail just 8 diamonds of energy, which barely gets the ball to the fifth rail.

How many of these categories are you comfortable using in actual play? Most players seem to struggle with any shot outside of just 6, 7 and 8. Some beginners never shoot as softly as 6, having learned that the farther the ball travels, the better chance it has to find a pocket.

As a drill for the high-speed end of the scale, try shooting the cue ball straight up and down the table five lengths to leave it within one diamond of the far rail and within a diamond of the center of the table, it may be that your table has cushions that take away even more

than two-thirds of the energy on each bounce, in which case five lengths may not be possible except with a bouncing cue ball that flies from cushion-nose to cushion-nose. Don't go to that technique; instead back off to four lengths. For completeness, try all of the speeds 6 through 10.

Diagram 1 shows two low-speed drills to help you with the low end. In shot A, the cue ball is close to the object ball, and the goal is to make the ball in pocket A taking as many shots as possible — no rail is required on each shot, but you must hit the object ball. Taking 10 shots is good for a beginner. Once you have mastered soft shots, 40 should be your goal. There is a simple cheat that allows you to take a few hundred shots if you have the patience, but don't use that cheat if you discover it.

In shot B, the object ball starts close to the cushion with the cue ball a little farther out. Pretend you are playing 8-ball. You have no real shot, and all your opponent's balls are up-table by Shot A. Play the cue ball to contact the ball, then the cushion and then freeze to the object ball. Count the freeze as good if you

leave the cue ball within a chalk's-width of the object ball. For a real safety, the idea is to leave no jump shot. See how many times you can do this in a row taking the cue ball in hand each time but leaving the object ball as is.

As another soft-shot drill, try this one that I got from Tom Riccobene, an instructor in New Mexico. Place all the object balls along the headstring spaced apart evenly. The cue ball is not involved in the shots. Knock the first ball as short a distance as you can up the table. The second ball has to go further than the first, and so on. See if you can shoot all 15 balls with constantly increasing distances. An alternative to this drill is to shoot each ball to try to freeze it to each successive diamond (or pocket) around the table — there are conveniently 15 such spots around the table outside the kitchen. Set your own tolerance on "freezing," such as a ball diameter or a hand span.

Of course, real shots often require far more speed precision than this arbitrary division into categories, but I think that spending a little practice using these steps will help your speed control.

SPRINGS HAVE SPRUNG

Don't jump to conclusions with on-table collisions.



WHEN YOU look at the equipment used on the typical table — balls, cushions, cloth-covered slate and a cue — it all seems pretty solid. It may come as a surprise that every interaction between any two of those things, such as tip-on-ball or ball-on-ball contacts, requires the objects to compress and deform. If you look closely enough, it turns out that all materials are compressible, and that each object's compressibility is critical to how objects interact. Study also shows that each kind of contact has a characteristic time, and the relative lengths of those times are also important to play.

Let's look in detail at Shot A in **Diagram 1**. This is a standard trick shot in which the player escapes the trap by elevating the butt of the cue a little and jumping the cue ball off the cushion and over the blockers to the ball hanging in the pocket. The player brings the stick back and then forward to strike the cue ball. No big surprise here, but the details of what happens next defy intuition.

The stick comes forward and the tip meets the ball.

The tip starts to compress, and the force on the cue ball and its acceleration start to build up. The ball also starts to compress a little, since it too is not incompressible. The ball has started to move, but is not up to the speed of the stick yet, and the stick has started to slow down as its energy is transferred to the cue ball. This continues until the tip (and ferrule and joint and butt) reach maximum compression along their length. At this exact point, some amazing things are happening. The stick and

ball are moving at the same speed. The forces between stick and ball are at their maximum. The compression along the length of the stick (including the tip) is at its maximum. The energy stored in the spring-like compression of the tip (and stick and ball) is at its maximum. For a typical ball and cue, the speeds of the ball and stick are 75 percent of the original stick speed.

After this point of maximum compression, the ball is pushed forward from the tip by the compression system. The ball starts to move even faster from this delayed force, and the stick continues to slow down. This "unwinding" process continues until the ball finally leaves the tip. At that point, the ball is going at about 130 percent of

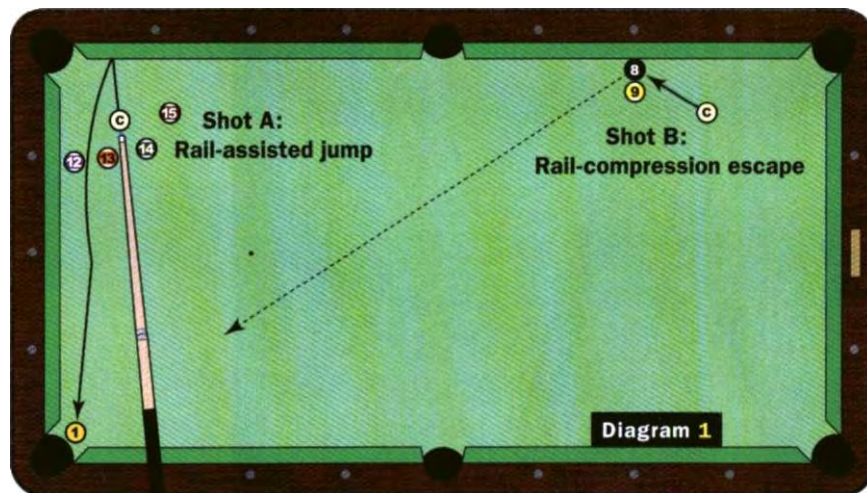
something colliding with the tip, which happens starting from the tip pushing on its neighboring region which pushes on its neighbor, and so on. (Note: The speed of sound in wood and metal is a lot faster than the speed of sound in air, which is only about 1,000 feet per second.)

The entire tip-stick-ball contact is over in about a millisecond — or one thousandth of a second. If you know the speed of the stick or cue ball, it is fairly easy to estimate about how far they move together while in contact. A surprising result is that the distance over which you maintain contact is about three times the amount that the tip is compressed during contact.

Now with the ball already on its way, the grip hand comes into play. Human flesh makes a much "softer" spring than the leather of the tip or the wood that is compressed along the length of the stick. Think of the tip as about the stiffest car spring you can imagine and your hand like a rubber band. The cue ball is gone by the time your hand — which is still moving forward at full speed — can wind up even

a little. As the hand winds up on the stick and relaxes, which takes about 20 milliseconds, the hand is slowed to about 80 percent of its initial speed, and the stick goes from 50 percent back up to 80 percent of its initial speed. Of course, this re-acceleration of the stick by your hand is useless because the cue ball is long gone.

In Shot A, the cue ball has started toward the cushion. Because it was shot down into the table, it bounces up — more on this later — and strikes the



the original stick speed, and the stick has slowed down to about 50 percent of its original speed. (The 130 percent would be 150 percent, but the tip is not perfect in springing back to its original shape, and energy is lost.)

The stick has transferred energy to the cue ball by compressing like a spring along its whole length. The compression wave happens at the speed of sound in the stick, which is about 13,000 feet per second. This speed is the fastest that the butt can learn of

cushion about at its equator. The cushion is rather compressible, as you can tell by poking it with your finger. It's not as firm a spring as the tip, and it is a little firmer than the flesh of your grip hand, giving a contact time of about 10 milliseconds. For a hard shot, the ball might go into the cushion a half-inch during that contact time.

The cushion goes through the compress-expansion cycle and the ball is sent back whence it came. As I mentioned in last months column about ball speed categories, the cushion is not very good about returning the invested energy, and a substantial fraction is lost — maybe half.

The cue ball continues its upward flight aided by the cushion, clears the balls and lands on the cloth. Again we have compression during the contact between the bed cloth and the ball. Most of this will be in the softest material involved, which is the cloth. The contact time can be judged from the amount the cloth is compressed, but I

don't have a good number for this. I'd guess it is a "stiffer spring" than the tip, since there is less distance to compress through.

The cloth also doesn't make a very good spring, which is not too surpris-

PLASTIC IS COMPRESSIBLE, SO THE BALLS BRIEFLY FORM A COMMON FLAT SPOT.

ing. In an experiment of bouncing a ball from an elevated ledge, I found that half the ball's vertical energy is lost in each bounce. This experiment is best done on your own table or you may encounter a really angry room owner.

We aren't done with springs yet. When the cue ball finally gets to the object ball, after a series of progressively shorter hops on the cloth, the balls collide. Plastic is compressible, and so the balls compress against each other and briefly form a common flat spot.

If you know the contact time, you can calculate the size of the flat spot, and vice versa. In his book, "The Physics of Pocket Billiards," Wayland Marlow describes an experiment he did to measure the time, and it turned out to be 0.2 milliseconds. This leads to a flat spot of about a quarter-inch diameter for a fairly hard shot. The spot can be observed directly by coating two balls with a thin film and then smacking them together.

Is any of this information important to practical play? Not really. There are a few special shots that can be predicted or explained by carefully studying these phenomena, but you will learn the shots faster by trying them on the table.

Back to the diagram, Shot B is one such shot. The 8 ball is trapped on the rail by the 9 and both are on the head string. From the position shown, hit as much of the 8 as you can see, and it will compress into the cushion, move past the nine and *spring* into the foot pocket.

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RULEBOOKS: REVISITED

End misinformation and accept the standardized set.



ON THE Internet discussion forums, a common kind of question is about rules. Usually a situation is described, and a ruling is requested. Often, a quick reference to a rulebook is sufficient to answer the question, but sometimes the problem points out a hole in the rules. All too often, a respondent will offer the rule his uncle Bernie told him 40 years ago; and since Bernie was the tri-city champion, it must be true.

The current standard for rules is the January 2008 revision of the World Standardized Rules (WSR), which are available on the WPA Web site at www.wpa-pool.com. These were developed over several years, starting from the previous rule set and with the participation of public and official representatives from around the world.

One reason that people have so many rules questions is that in the past they have changed fairly frequently. The WPA has slowed that process and achieved some stability in the rules by allowing changes only every five years. In the case of snooker and carom billiards, the pace of change has been quite slow for a long time. Both of those disciplines have had fairly strong governing bodies for a long time, and they take their rules seriously.

Unfortunately, lots of pool organizations, especially in the U.S., have decided to write their own rules. At the low end of the officiating food chain is the individual tournament director. I recall one TD who was asked about the three-foul rule. He said that if you fouled and your opponent made a ball on his next shot, then you were off the foul. Of course, you remain on the foul, and every written three-foul rule says so. I suspect that the TD was just making things up, never having actually read the rules. That, or he was giving his buddy a break with a little creativity.

One step up is the local independent pool league. Often they institute rules like no jump sticks or no masse shots as

a way to protect tables in participating rooms. Other times they make significant changes to the game. I played in one 8-ball league in which safety shots were not allowed. For an exercise in logical writing, try to formulate such a rule that can be understood and applied in a pub environment. The actual application was lax, and it was amusing to see the performances that some players would put on to make a safe look like an attempted shot. I think rules that encourage players to cheat are bad.

The next higher level of rules mucking is at the national league level. These leagues feel it is necessary to set their own rules of play rather than adopt the WSR. The result is usually somewhere between pitiful and stupid. I won't name names, but if you belong to a national league, try reading your league's printed rules to see where in that range they fall.

Problems can exist even with national organizations that are in the WPA (and so have agreed to accept the WSR). The new BCA Web site, GenerationPool.com, has a version of the WSR, but the site editor has removed some rules and added others. Here's my request to the BCA: at least provide a link to the complete, official rules.

One situation that has no clear solution from the Net was as follows. In league, a player was told to start his match while the other team captain found his opponent. He broke and sat down. The opponent came over and picked up a couple of balls being unaware that the match had started. How would you rule this? I think a player from Europe had the best solution: Since you must lag to start the game, the game had not started. Also, you should shake your opponent's hand before starting the match. Either one of those would have prevented the problem. Given that the "foul" did happen, my ruling would be to put the balls back and continue the game as if no foul had occurred. But the follow-up to this would be to get the

league management, including team captains, to be more careful about how matches are run.

Sometimes misunderstandings develop due to local or regional rules that aren't written down, but passed on by word of mouth. In one area, the rule in straight pool is that if the 15th (break) ball is close to the triangle and prevents racking but doesn't actually interfere with a ball in the rack, it is marked. The 14 balls are racked, and the break ball is put back. The rules have specifically covered this for a long time: The outline of the triangle must be drawn on the table and a ball overhanging the triangle is considered to interfere with the rack.

If you read my recent articles on the problems with the rack at 9-ball, you know about "tapping" or "training" the table. This is a technique widely used in Europe, in which a thin rack-shaped template is placed on the table. It has holes where the balls should be, and balls are placed in the holes and then tapped to make shallow dents in the cloth. (This technique for setting repeatable positions for the balls is standard for trick shot artists.) If tapping is used, you don't use a triangle to rack — you just roll the balls into the dimples. So, if no triangle is used, when does a break ball interfere with the rack? The ad-hoc solution the TD used was to draw the outline of a triangle just for the purpose of deciding interference.

A related question sometimes comes up for a break ball that has been spotted. It doesn't actually interfere with the rack since it is precisely on the head spot, but by the definition in the rules, it must be treated as interfering.

Sometimes instructors give advice that is against the rules. One example is the "lift safety" which I discussed in my October 1997 article. (My past articles are available on the www.sfbilliards.com Web site.) This technique is used when the cue ball is close to the object ball and the object ball is close to

a cushion. Rather than chance a double hit with a normal stroke, some instructors say to put the tip under the edge of the cue ball and then lift it straight up. This gets a little motion on the cue ball without the chance of hitting the cue ball twice. The problem is that this technique has been specifically ruled to be illegal, because a shot must be played with a forward stroke of the cue.

The well-read player may be tempted for this situation to use a technique that is used legally in snooker: Line up perpendicular to the way you want the cue ball to go, but put your tip so it is half-way outside the cue ball and shoot a soft, normal stroke. Of course a miscue is guaranteed, and the cue ball will just nudge the object ball to the cushion. Sadly for the snooker-savvy shooter, intentional miscues are specifically forbidden at pool and,

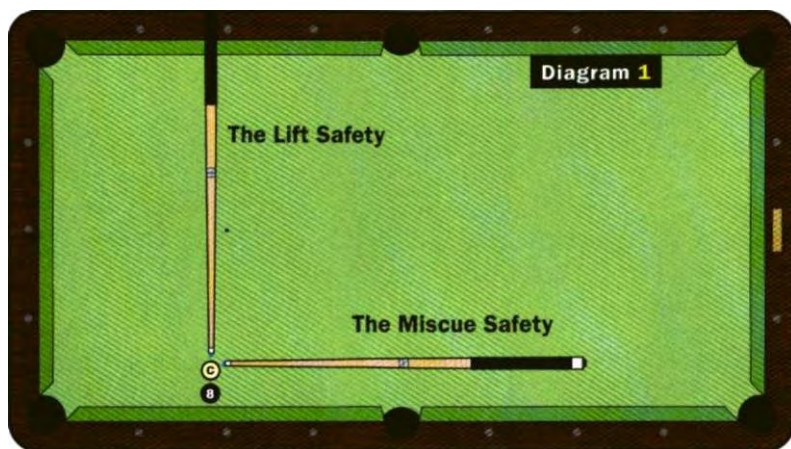
in fact, are considered unsportsmanlike conduct. These two illegal safeties are shown in **Diagram 1**.

Another instructor-propagated false rule is that you are permitted to arrange

cept, but that's the rule, and it doesn't help to have ignorant instructors and authors say otherwise. This particular rule evoked a lot of discussion by the Rules Revision Committee for 2008, and the best alternative — a specified, fixed order — was rejected.

Top players themselves set bad examples. A remarkable case was in a match between two Hall-of-Famers in the 2000 US 14.1 Open. Efren Reyes was playing Dallas West, and got into a tight position against the rack. He decided to take a foul and tapped the cue ball against the rack with the side of his stick. How would you rule that

shot? In fact, it's not a shot. You can only shoot, as mentioned above, with a forward motion of your cue stick. In that tournament, a 15-point penalty with a re-break was assessed against Efren for lack of knowledge. He clearly had not read the rules. Have you?



the order of balls in a rack of 9-ball for your benefit. In fact the rules require a random order, and if the player attempts to gain an advantage by the order of the balls in the rack, it is unsportsmanlike conduct. This may be a hard thing to police since "random" is a slippery con-

FOLLOW ALONG

Cranking the numbers to help you get on top of things.

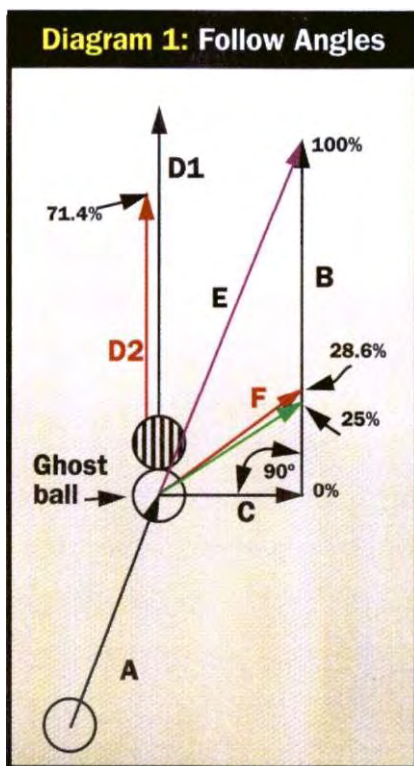


WHEN IT comes to controlling where the cue ball goes after contact with the object ball, there are two important rules of thumb that you probably already know: the 30-degree rule and the 90-degree rule. The 30-degree rule is also referred to as the half-ball follow angle, as it is the angle the cue ball takes when it strikes half the object ball while rolling smoothly on the cloth. The cue ball is deflected away from its original line between 25 and 35 degrees for contacts between about one-fifth full and four-fifths full. This angle of deflection is remarkably stable for hits around half full.

The 90-degree rule applies to shots that would be stop shots if the object ball were struck full — the cue ball has neither follow nor draw at the instant of contact. The cue ball will depart the collision at a 90-degree (or right) angle to the path of the object ball. This path is also called the kiss line or the tangent line. The cue ball will start along this path even if it has draw or follow, but any such spin will pull the cue ball away from the initial line to form an arc.

Let's look at the follow angle in more detail. While the 30-degree rule is useful in many situations, for precision play something more accurate is needed. **Diagram 1** outlines the geometry of a typical follow shot. The cue ball comes up at an angle from the bottom and strikes the object ball slightly more than half full, driving it straight up. The speed of the cue ball is represented by the arrow A. The cue ball is also shown at the instant of contact — this is called the "ghost ball."

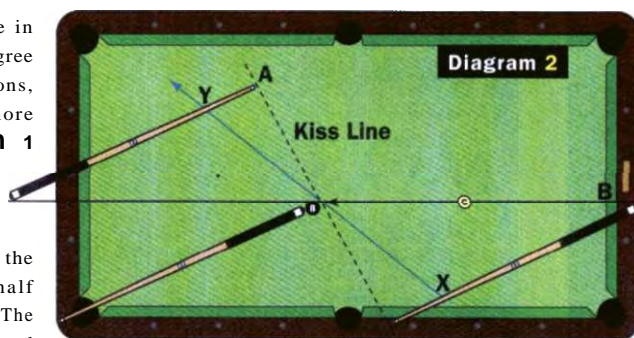
The speeds and directions of the cue ball and object ball immediately after the collision are easy to find in this drawing. Just draw the line E, which is the same length as A and in the same direction, but it starts from the center of the ghost ball. Draw the right triangle with sides B and C where B is parallel to (in the same direction as) the path of the object ball.



The cue ball at the same time is picking up speed. That's because it starts with follow that tends to move it in the direction of the E arrow. E represents the amount of follow the cue ball has at the instant of the collision. Right after the collision, all that follow is still on the cue ball, but the cue ball is moving along C. The final path will be some mixture of the follow and the kiss-line path. The amazing result from physics is that if we take a point along the B arrow that is 28.6 percent of the way from C to E, we get the final path of the cue ball, shown by E.

Turns out, in practice some follow is lost in the collision, and the cue ball only gets about 25 percent of the way from C to E, which is shown by the green arrow.

OK, so we have a geometric construction that tells us where the cue ball will go for any follow shot, but how many opponents will let us get out the protractor, ruler, tailor's chalk and calculator each time we need to play position? We need a practical way to construct the angle. That's what's shown in **Diagram 2**.



Complete the triangle with line C, which is perpendicular to the path of the object ball and is along the kiss line of the shot.

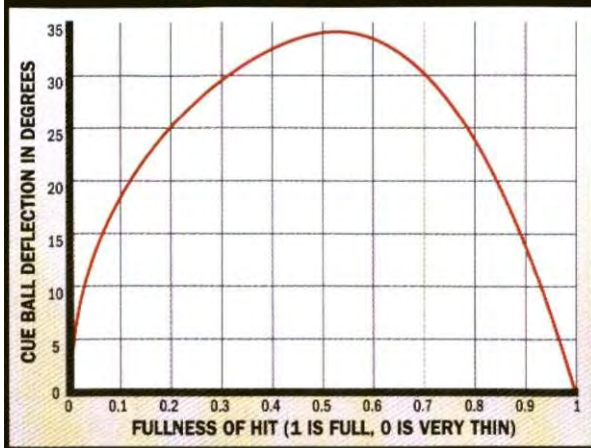
So, you can see that for this shot, the speed of the object ball (speed is represented by the length of D1) is initially almost as large as the speed of the cue ball before the collision. It starts out with no rotation, though, and is sliding across the cloth. As the object ball acquires top spin, it slows to five-sevenths of its initial speed, which is shown by the arrow D2.

We have a tough shot, and we would like to know if the cue ball will scratch if we let it roll. The sticks on the table show how to do the same geometry we did for Diagram 1. It can be done in two ways. First consider the stick with an X marked on its shaft. That stick is placed parallel to the path of the object ball. The ends are placed to make a right triangle like we had before, with the tip along the kiss line, but backwards on the kiss line, while the bumper is along the line of the shot. There is only one place you can put the cue stick where all three requirements are satisfied — parallel to the object ball's path, tip on the kiss line, and bumper on the shot line.

Now to find the path of the cue ball, just sight from the X in the middle of the shaft through the ghost ball and you will be looking along the path of the cue ball. In this particular case, there is no scratch.

Sometimes it is easier to judge the shot from the other side, as shown by the cue

Diagram 3: Follow Angles



stick with the Y in the middle of the shaft. Again, the ends of the sighting stick are respectively on the shot line and the kiss line, and the stick is parallel to the path of the object ball. The Y gives you a spot the cue ball will pass over on its way to the cushion.

The X and Y points are to be at 25 percent of the length of the stick, assuming the joint is in the middle. If you find that for your cloth and balls the percentage is

closer to the ideal 28 percent, that's the point to use. It is the same point for all follow shots.

There are various minor things to take into consideration. Of course, if you miss the shot, you calculated from the wrong parallel cue stick, so you can't expect the cue ball to go in the right direction. One exception is for shots that are close to a half-ball hit. **Diagram 3** shows just how insensitive the deflection angle is to fullness. You

can see that within fullnesses of 0.3 to 0.7, the cue ball's angle varies by only 4 degrees.

There are two other interesting things to note from Diagram 3. The first is that as you get to very thin hits, the cue ball's deflection varies rapidly with fullness, so controlling the carom angle on thin hits is most difficult.

The other thing to note from the graph is that at the other end of fullness — for a

nearly full hit — the deflection angle varies rapidly but in a nearly straight line versus fullness. This leads to a rule of thumb for follow shots where the hit is nearly full-ball: For each degree you cut a ball to the left, the cue ball is deflected three degrees to the right. A corollary of this is that for each little bit you miss the exact line for the object ball on such a shot, the cue ball is off by three little bits to the other side. In a sense, any error in aim is multiplied by three to get the carom error.

One final point is that if you want to find the path for a draw shot, it can be done in a similar way but is more complicated. First, you must have as much draw on the cue ball as a smoothly rolling cue ball would have follow. In Diagram 2, do your geometry for both cue sticks to find points A and B. B represents the backward spin which is combined with the kiss-line motion represented by A. The final draw path will be toward a point one-fourth of the way from A to B. I can't see any easy way to judge this with just one stick and no marks on the table. If you find a quick, practical way to do the geometry for draw, please let me know, and I'll do my best to make you famous.

AS EASY AS 1-2-3

Developing as a player requires a multi-faceted approach.



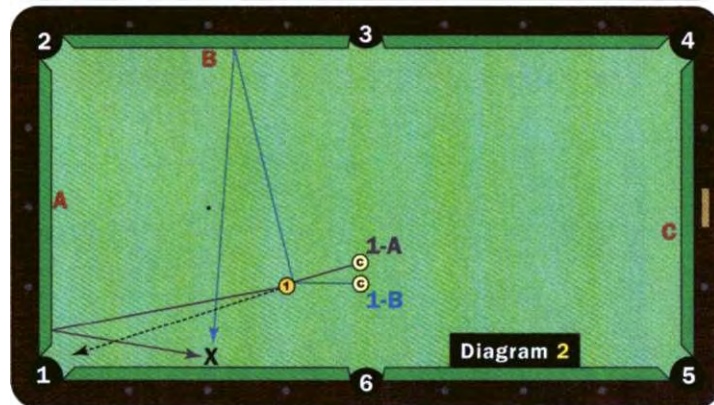
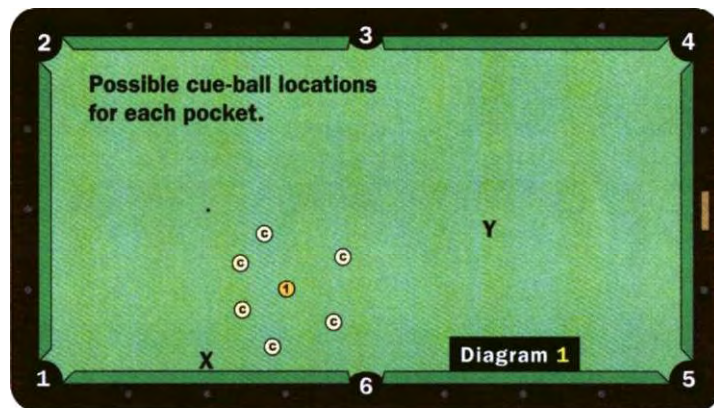
to me that there are separate phases or facets of learning to play **T SEEMS** The first part is getting the object ball into the pocket. This takes aim and reasonable fundamentals. The second part is learning to take the cue ball at the right speed and in a useful direction for the next shot. This takes knowledge of follow, draw and side spin, as well as feel for the required force and familiarity with chalk. The third main part of the game is learning to combine known shots into easy sequences to produce runouts. This is playing patterns, which is the hard part that many never achieve. It requires a feeling for which shots are not only possible but which are easy and natural, and the ability or knack to arrange a series of them into a run.

When watching beginning league players shoot after a foul with ball in hand, their lack of knowledge about what is possible and what is easy becomes all too clear. Often, I have to grit my teeth to suppress a scream of "Put it there! Shoot the straight-in!" The beginner usually is a reasonable shotmaker, but has not yet finished or even begun the second facet of play.

Try the following drill to see how quickly you can see the easy way.

The first part of the drill is to select two "random" spots on the table. I described one way to do this in my July 2005 column using playing cards and numbering the diamonds and half-diamonds to correspond to each card. You could also break a rack of 6-ball and take as your two practice spots the locations of the 1 and 2. Or, you could take some troublesome positions from your last match.

So, suppose we have as our two starting positions the 1 ball and the X. The goal is to take ball in hand, pocket the 1 and leave the cue ball on the X, as in **Diagram 1**. For the given position of the 1 ball (a diamond from the cushion and a diamond from the side pocket), you should be able to do that six different ways without using a cushion. Can you?



In playing this shot, try to find a position for the cue ball that makes it easy to send the cue ball anywhere you want for each shot. I was watching a beginner recently who put the cue ball at Y; a shorter shot is nearly always easier.

Depending on the shot, you can set your own goal regarding precision. For this shot, a target the size of a dollar bill is reasonable. Your goal should be to leave the cue ball at least overhanging the bill. For a harder shot with more

distance to travel, a hand-span can be allowed, and a coin can be the center of your target.

The main goal of this drill is to learn the easy path to get from the 1 ball to the X. Which of the six possible no-cushion paths is easiest? If you had to bet that you could overlap a coin at X — and make the object ball — where would you put the cue ball?

Diagram 2 offers more possibilities. The goal is to get from the 1 to the X using one cushion. The cushion right by the X doesn't count. We can describe each of the possibilities according to the pocket the 1 goes in and the cushion the cue ball contacts. I think the easiest cushion to use is at A, and the easiest pocket to use for that is 1. Let's call that shot 1-A (diagrammed in purple). It's played with a nearly full shot and plain follow. Since the cue ball has a much longer run to get to X, you may want to relax the position precision requirements some, perhaps to a hand span.

Which other pockets can you use to come off A to get to X? I think all of them are fairly easy except for pocket 3. Do you see immediately where to put the cue ball for each one? If not, you need

time on the practice table.

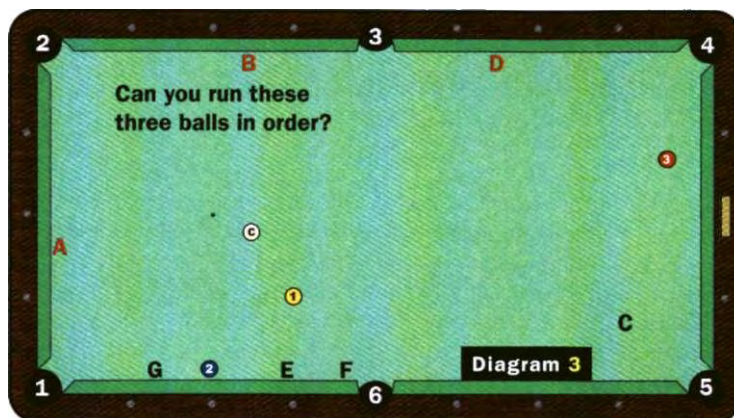
Shot 1-B (light blue in **Diagram 2**) seems to me the easiest for those shots using the B rail. Again, I think all six pockets can be used to go off B to X, with pocket 3 the most challenging. Further, I think you can do all of the paths without using side spin. The actual contact points may be different than the spot shown, depending on the pocket used and whether you decide to use some English.

I think there is only one remaining cushion that can reasonably be used for a one-cushion path, and that's C. Even pros are unlikely to have much success with some of these — such as 1-C, which takes a nearly full hit, plenty of draw to get to C and back, and probably a little right English to get the needed angle from C to X.

Can you see some two-cushion and three-cushion paths from the 1 ball? I think all six pockets offer at least one two-cushion path, while only one or two three-cushion paths have much chance. Can you make any three-cushion path work?

Now work on the next facet of your game by putting together small patterns. To do that, select a third point and place balls on each of the points, as shown in **Diagram 3**. Beginning with the **1** ball, which you have just practiced with for an hour, can you run the three balls in order?

The hard part for this particular sequence is to get from the 2 to the 3, and a good spot for position on the 3 is about C. You may want to practice



your "middle facet" with just the 2 ball for a while to find the easiest path for you. The simplest shot is probably to have the cue ball at G for the 2 and play the straight follow shot to C, but in this three-ball sequence, it seems very unlikely.

Many players would choose the four-cushion option, leaving the cue ball

about where the 1 ball is and going off the rail by the 2 ball to hit A-B-C. Is your side spin accurate enough to try this path? Do you already know the best angle to leave for the 2 ball to run around the rails? You may want to back up a facet.

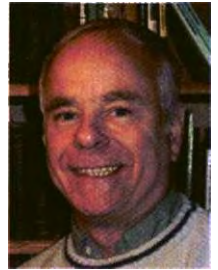
A simple and reasonable path is to leave the cue ball at E or F from the 1 ball and then draw from the 2 ball straight back to C. If you remember the speed you learned in Diagram 1, you should be able to leave the cue ball very close to the rail. The position F is better for left-handed players due to the reach required.

A final path is to leave the cue ball near the I and use left draw on the cue ball to hit at D and end near C, a zig-zag three-cushion path.

Mastering the position in Diagram 3 will get you started on perfect play. According to one estimate, there are only 216 quintillion other three-ball positions to cover.

SAFE DRILLING

Controlling the cue ball opens up defensive opportunities.



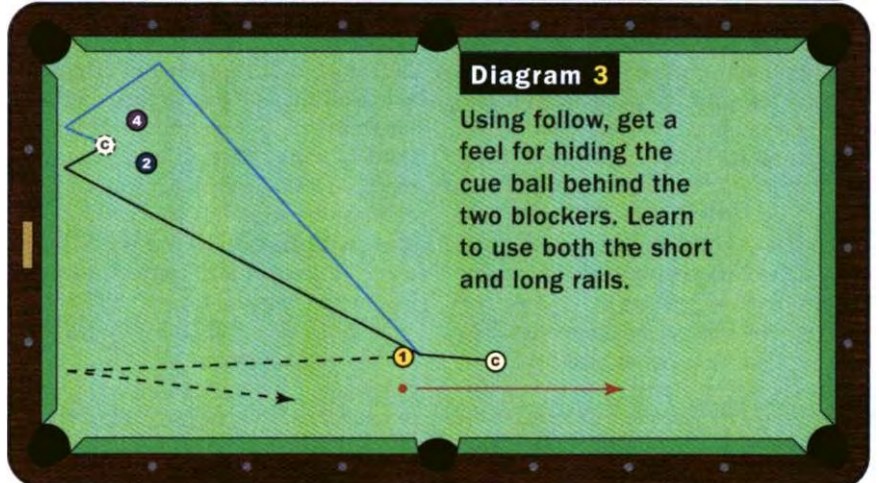
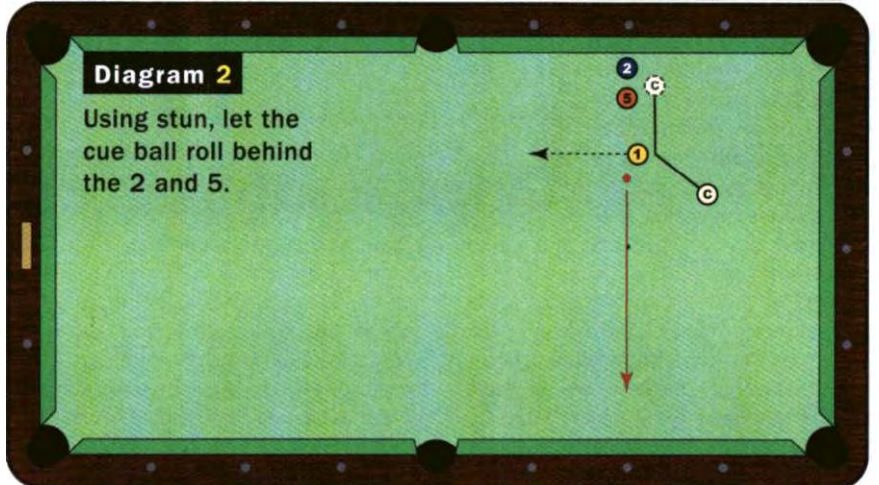
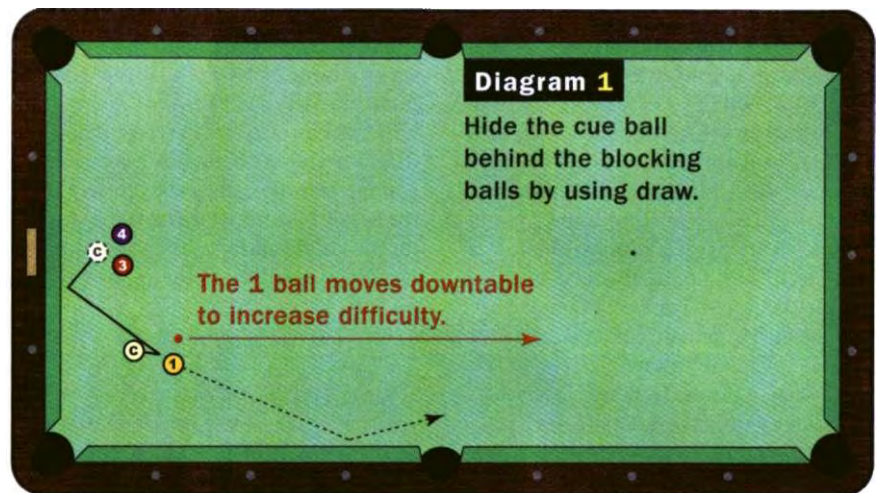
DO YOU need work on your safety toolbox? When I first saw some above-average 9-ball players, about 40 years ago, I was startled and amazed by the safeties they could execute. In the backwater rec room where I learned to play the game, there was no one who played much safe — for no other reason than we were mostly so bad there wasn't any need for defense. But as you progress from one level of play to another, good safeties are a mark of a well-developed player — one who understands more complex strategy. So here are some drills to help you develop.

For all of the examples, assume you are playing 9-ball, so the object ball is the one to hide from the cue ball. Mostly these techniques can also be applied to 8-ball, but you don't have to be so careful about hiding the ball you hit.

In **Diagram 1**, the goal is to leave the cue ball frozen behind a blocker using draw. Begin with the object ball fairly close to the blockers and take cue ball in hand to play the shot. Mark the position of the object ball with a coin. Consider the shot successful if there is no way to hit the object ball directly. If you make a good safe, move the coin a few inches farther away from the blockers and try again. Continue until you fail to get a snooker, at which time you can move the coin back toward the blocking balls a little. After each shot, remember to move the coin and so make the shot easier or harder, according to your success or failure.

In **Diagram 2**, the goal is to stun the cue ball to get it behind the blockers. (A stun shot is like a stop shot but at an angle, so the cue ball moves more or less at a right angle from the path of the object ball.) For this shot, the coin and the object ball move away from the blockers to make the shot harder. Try to do this shot without drawing to the end rail with the cue ball.

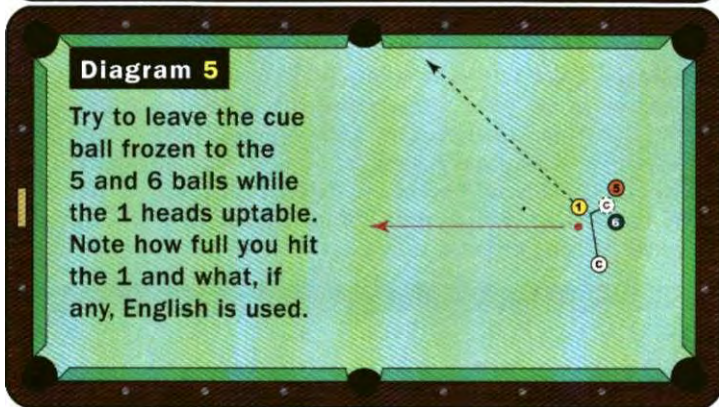
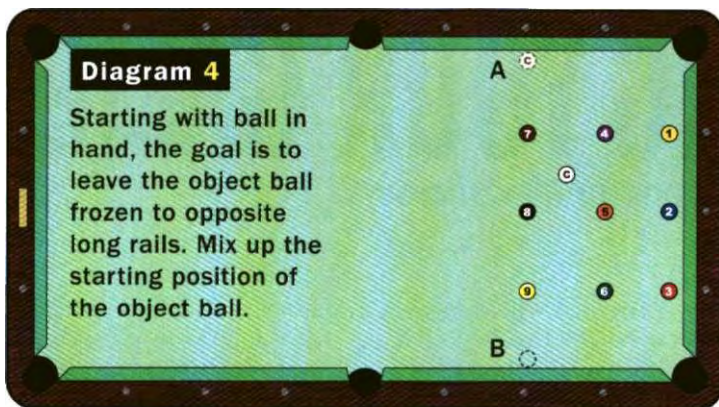
In **Diagram 3**, you have to follow to get behind the blockers. When you choose the position for the cue ball, pick a spot



that will both drive the object ball directly to the end rail and allow the cue ball to get behind the blockers. This drill will force you to learn the follow angle for nearly full shots. Again, the shot is made more difficult by moving the object ball away from the blockers.

A second drill using Diagram 3 when the object ball is back about as far as the side pockets is to take the cue ball off the long rail to get behind the blockers (shown in blue). I think you will find the angle easier to judge for this side-cushion path.

In **Diagram 4**, the goal is to leave the cue ball and the object ball on opposite side cushions. This time I don't see any easy way to make the shot more difficult, so just try each of the initial object ball locations. For



each shot, the goal is to leave the object ball near A and the cue ball near B, which shooting a legal safe. Consider a shot successful if you leave the ball within a certain distance, such as a hand-span, of the goal.

Finally, in **Diagram 5**, the goal is not to snooker your opponent but rather to leave him "jacked up" by the helper balls. With ball in hand, play the object ball to the other end of the table and try to leave the cue ball frozen to both helpers. Consider the shot successful if the cue ball is within a chalk width of the helper ball. While this kind of safety is not perfect, it is often very effective if the object ball is left far from the cue ball. You will need to perfect your "finesse stun" for this drill.

CLOSE CALLS

Split hits can be sticky situations for players and refs.



AT THE end of August I had the pleasure of spending a weekend in BD columnist Dave Alciatore's basement in Colorado. Like some basements, it's equipped with a pool table, but it uniquely also has a high-speed video camera setup. Among various experiments, we taped some sequences of close hits to illustrate some common problems in telling which ball is struck first. The clips will probably be available through Dave's Web site (at billiards.colostate.edu) by the time this column sees print.

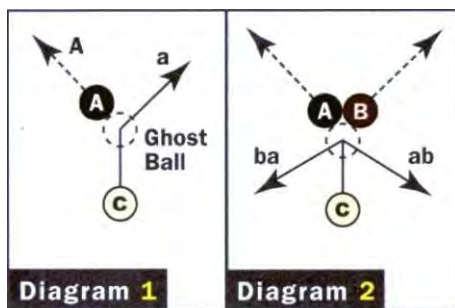
Below are the situations we covered, as well as some other shots that I thought about later. Understanding these is very important for any referee so he or she can make the right call at 8-ball or 9-ball, and for players so they can accept the call as made or have a little ammunition in case the call defies physics.

The shot in **Diagram 1** is not hard to call — the cue ball hits a single ball at an angle — but it illustrates the basic reasoning that underlies all of the other, more complicated situations. The cue ball hits one side of the object ball, and the object ball is cut to the opposite side along the line joining its center and the center of the cue ball at the instant of contact. The cue ball moves generally to the first side, and the paths of the object ball and the cue ball form a 90-degree or right angle. The cue ball at the instant of contact with the object is also called the "ghost ball."

In the diagrams where there might be several outbound paths of the cue ball, I will label each exit arrow with the object ball letters in the order they were struck. For the "A" ball, the cue ball has no choice, and it has the path "a" due to striking that ball. (Note that the arrows for the cue ball apply to the direction of movement at the first instant after the hit; if the cue ball has draw or follow, the spin may curve the cue ball's path away from the carom line.)

Diagram 2 shows a more interesting case. Two object balls are touching, and you have to determine which is struck first, even though the shooter appears to

be shooting to split the balls. As in most situations, you can work out the path of the cue ball by repeated application of the 90-degree rule. If you draw the ghost ball out carefully, you will see that, after contact with ball A, the cue ball will be



headed toward the outside edge of ball B and will be redirected along line "ab."

Similarly, if the cue ball hits ball B first, it has to emerge along arrow "ba." This shot is set up so simply — as far as the hit goes — that you could be standing across the room and make a good call even if the shooter shot hard.

There is a third possibility, and that is that the cue ball might hit both object balls simultaneously. Although very unlikely, it is not impossible. Because the balls are slightly compressible, if the cue ball hits one ball a millionth of a second first, it will still be in contact with the first ball when it hits the second. It will have compressed into the first ball on that side, and the edge on the other side will come into contact with the other object ball and start compressing there as well.

In general, situations like this have no easy solution. For this particular case, the outbound path of the cue ball will go smoothly from the "ab" direction to the "ba" direction as cue ball contact moves from hitting A separately from B, then both together but more A, then A and B exactly the same, then more B than A, then B separately from A. With a little math, it turns out that if you do manage to hit both at the same instant, the cue ball will come straight back toward you with one-fifth of its starting speed.

Once while giving a course to referees, I was shooting this shot so they could call A or B as practice. The cue ball came straight back, which gave us a chance to discuss "split hits." Do you know what the rule is on simultaneous hits? I don't expect to make the shot again, but I keep trying. We didn't manage to get it on video.

In the shot in **Diagram 2**, the speed of the object balls can also indicate which was struck first. The first-struck ball will be going twice as fast as the second-struck ball. This works for the ideal situation shown, but in more general cases the speed of the object balls is not necessarily a good indicator, and you would need a calculator, a protractor and two radar guns to make the call.

In **Diagram 3**, A and B are farther apart. For a close hit, the cue ball will ricochet to hit the second ball half-full, but on the "inside edge" (unlike **Diagram 2**.) By now you should understand the 90-degree principle well enough to come up with the "ba" and "ab" lines on your own. In this case, the second ball struck will be moving faster. Do you see how that can happen? Again, it is possible to hit the balls simultaneously (or with contact time overlap) so all paths between the two arrows are possible but unlikely.

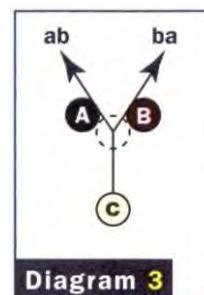


Diagram 4 is sort of a trick, and is the best way to illustrate split hits. The balls are arranged so A, B and the ghost ball form a right angle. If you strike A first, the cue ball will carom straight into B and stop dead. If you strike B first, the cue ball will go straight into A and stop dead. In either case, the object balls will have identical speeds equal to 70 percent of the initial speed of the cue ball. If you place the balls cleverly on the table, you can have A and B enter pockets at the same instant.

Hint: Use the spot, Luke.

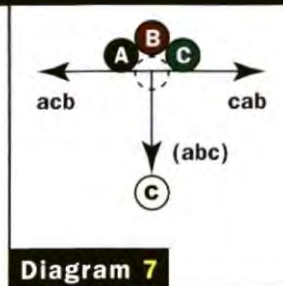
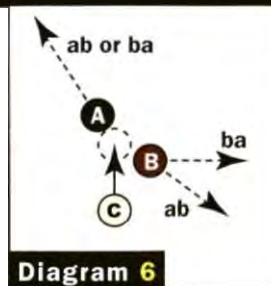
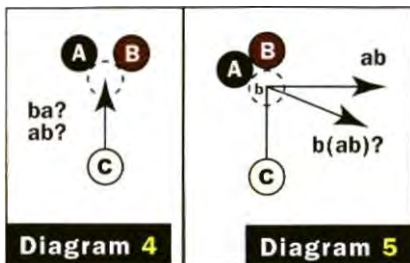
Diagram 5 shows one of the problems

in trying to extend the fairly simple reasoning of the 90-degree rule to all situations. This is like the shot in Diagram 2, but the cue ball is coming in from an angle where it can barely hit B full if it hits both balls simultaneously.

I have marked a "b" for the stop shot on ball B, trying to indicate no movement at all after contact, but it is not quite correct. Suppose the cue ball lands on B with the tiniest possible separation remaining between itself and ball A for the good hit on B. As the cue ball compresses into ball B — and the amount of compression might be more than a millimeter — it will move forward and come into contact with ball A. The force from A on that side will cause the cue ball to move to the right just as if it had struck ball A first. I think that the "B first and then A and B together" line, or "b(ab)," might be a little different from "ab," but I'm not sure by how much, and it may depend on speed. If you try to hit B first, and the cue ball

scoots off along the "ab" line, I think you will lose the "but it compressed into A!" argument with most referees.

One improbable hit that Dave and I did manage to catch on high-speed video is in **Diagram 6**. The goal is to pocket A along the "ab" line with B nearly blocking the shot. If you happen to hit B going in, it will go along line "ba," but a good hit will drive ball B along "ab" as the cue ball comes off the side of A and drives B partly backward. (The path of the cue ball will be generally off to the lower right for both hits.) What we managed to capture on video after a few dozen takes was the cue ball just barely wagging the B ball on the way in, driving A along the intended line, and then coming back into B to drive it along the "ab" line. The human eye is not fast enough to see the first hit, and it's



possible for a good referee to make a bad call on this shot.

Finally, **Diagram 7** adds a third object ball to the mix. The balls are sitting so that the cue ball could freeze to all of them at once. An extension of Diagram 3 should let you see how to get the rather amazing "acb" and "cab" lines. If you hit A first, the cue ball ends up going straight to the left! If you manage to thread the needle and hit all three balls simultaneously, I expect the cue ball to come back along "(abc)" but I haven't worked out the physics.

My personal solution to the split hit problem is to avoid it by concentrating on 14.1 and one-pocket, but if you find yourself in either a hit-caller or hit-callee situation, remember the 90-degree rule and its manifold manifestations above.

GET SNOOKERED

Looking for a new challenge? Try the U.K.'s pastime.



WHEN I was first learning to play, I had three kinds of tables to learn on: pool, snooker and carom. Most of the good players in the room — guys who could run four or five balls in a row regularly at straight pool — played at least occasionally on all the tables. Each table has its own thing to teach the new player: Accuracy of aim is paramount at snooker, spin and cushion reaction is essential for carom play, and I think position play is pool's strong suit.

The snooker tables we had were only 10-foot tables, but on trips to "The City" we sometimes tried the 6-by-12s for a "frame" or two. Any ball pocketed was a triumph. The best players in San Francisco would often play "pink ball" on the snooker tables, which is a rotation game played by a group of players using six object balls, with one point for each ball pocketed and two points for the pink ball.

Where I play now, we are lucky to have two full-sized tables, and they are kept quite busy by recent immigrants from former British colonies and those of us who like a challenge. I think you will like this challenge if you give it a try. Don't expect too much at the start, and be sure to work on your fundamentals to help your progress.

The basic rules of snooker are fairly simple. You need to be a little careful because there is an American version of the rules used in some places, but what I describe here is the "real" version of the rules, used by all of the top players. Also, if you are playing with people familiar with the standard rules, their vocabulary is a little different from pool — I'll try to introduce some of those snooker terms as well. It's handy to have a printout of the rules, available on the U.S. Snooker As-

sociation (USSA) Web site at www.snook-erusa.com.

The game begins with 15 reds packed in a triangle and six other balls, called "colors," on designated spots as shown in **Diagram 1**. The point value of each color is shown, and the reds are worth one point each.

You score points by first pocketing a red ball and then pocketing any color, getting

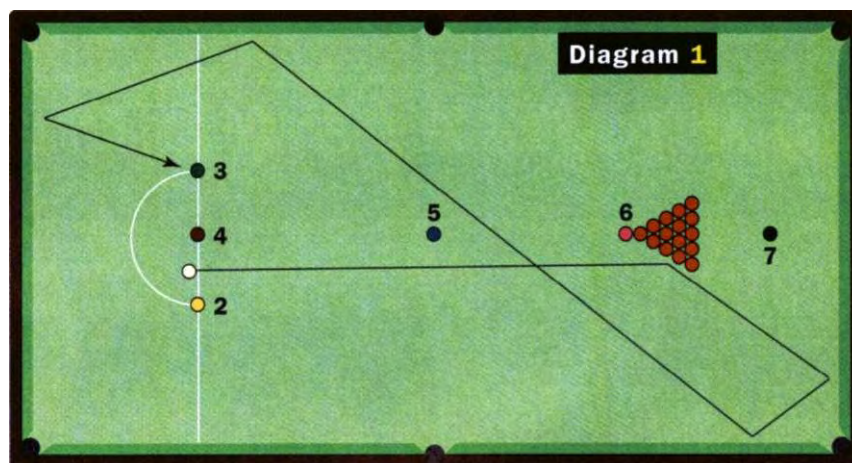
The positions of the "high" balls are easy to remember once you know their point values — blue, pink and black increasing toward the "top" cushion. (The British seem to have gotten the head and foot of the table confused some time in the past 200 years; you break from the "bottom" of the table towards the "top.") The order of the colors on the D can be remembered by the mnemonic "God Bless You" for green, brown and yellow from left to right.

Since individual shots are harder than on a pool table, defense tends to be a much larger part of the game. If the cue ball is left on the "balk cushion" and all the reds are 10 feet away, most players will opt for safety rather than offense, unless a red is "over a pocket."

A major point in snooker safeties is that no cushion contact is required after the cue ball contacts a ball. For example, suppose that a red had fallen in on the break off in **Diagram 1** and the cue ball had rolled up nicely behind the green. The striker would then be required to play for a color, but he could choose the green and barely tap it, leaving the cue ball stuck tightly to its backside. You could also play the break-off as a very soft shot that just touches the pack, but no one does.

Another major point is that when you are snookered — and on any shot for that matter — you must try to hit a ball that's on. In the case of being stuck behind the green, the striker must figure out some way to hit the reds, presumably off cushions. While masse shots are permitted, jump shots are not; you may not cause the cue ball to pass over a blocking ball to get a hit on a ball on.

The penalty for a foul depends on the balls involved. The minimum penalty is



the corresponding number of points for "potting" it. You have to say which color you are going for, but you don't have to specify the pocket. The reds are not returned to the table except in very rare situations, but the colors come back up to their spots if any reds remain on the table. Once all the reds have been potted, and the shooter ("striker") has tried for his color after the last red, the colors are cleared off in numerical order, ending with the black.

The first shot of the "frame" is as shown, with the cue ball beginning in the "D." The only requirement is that you contact a red first, so although no cushions are required, most players play a safe as shown that looks a lot like a straight-pool safe. Ideally, the cue ball on the "break-off" will roll up to the back of the green, leaving the next player "snookered" — technically defined as being unable to hit both extreme edges of any permitted target (a "ball on").

four points, but it is increased to the value of the highest ball involved. For example, if you were snookered by the green as above, and you tried to bank off two cushions and touched the green with your cue stick, it would be a four-point foul. But if the cue ball went two cushions and the first ball it struck was the pink while trying to hit a red, you would lose the value of the pink, or six points. All fouls count in snooker, unlike most non-refereed pool matches.

When you foul, you score whatever legal points you had on previous strokes, and your opponent gets the point value of the foul. He also has the option to have you shoot again. If you foul and leave your opponent snookered, he has an additional option of a "free ball." Under this rule, he can name any ball to be the next legal target (usually as a red ball, since his turn is starting). So, in the snookered-behind-green scenario, if you try to bank the cue ball and just tap it three inches leaving all the reds hidden, your opponent could declare the brown ball to be a red, shoot it in for one point, have it spot up and shoot it in again for four more points.

Some other fouls to note are pocketing a color when trying for a red, pocketing the wrong color, pocketing a red when going for a color, and not hitting the ball on first. It's not a call-shot game, but slop usually goes against you, although it's OK to pot two reds — you get one point each.

Toward the end of the game, it may happen that you need more points than are left on the table. You then need to try to snooker your opponent. Usually it is considered bad form to continue when you need several snookers; most players concede if they are that far behind.

Snooker is tremendously popular on TV in Europe and especially in the U.K. Although the snooker frenzy has subsided somewhat in the past 20 years, you can still see many hours of live snooker on BBC each year.

There are also lots of great snooker matches on YouTube. Many of the matches from the last world championship were online shortly after play ended. Try searching for the names Stephen Hendry, Ronnie O'Sullivan, Mark Williams, Steve Davis and Alex Higgins. A typical quick frame of snooker takes about 10 to 12

minutes, and many of the online frames include a "century break" (running over 100 points). Some championship matches are up to best of 35 frames.

Although snooker is far less popular in the U.S. than it is in other former British colonies, there are several very nice places to play here, and a few rooms have as many as 12 full-sized tables. Conditions can vary quite a bit, and in the U.S. the tables are sometimes set up with very small pockets and very fast cloth to accommodate a game called "golf." You can recognize a regulation snooker table by pockets that permit a ball on the cushion to be playable along the rail if struck well, cloth that has a noticeable nap which runs from the D to the rack and, of course, 6-by-12-foot dimensions.

The United States Snooker Association is starting a tour to encourage play in the U.S. Tournaments can be played on as few as two full-size tables, and the USSA has arranged sponsorship so the host room will get new English wool cloth and new regulation 2 1/16-inch diameter balls. If you know of a candidate room, the USSA would like to hear from you.

GAME CHANGERS

9-Ball rules have changed a bit in the last four decades.



IN 1966, the BCA had a problem with its rules for 9-ball. It didn't have any. The rules for 16 other pool games were listed in the Official Rule Book, but 9-ball was not among them. This might not have been a problem, except for the resurgent interest in pool and the "hustler" tournaments that had been held in Johnston City, Ill. Two of the games featured in the Jansco brothers' tournament were 9-ball and one-pocket, and any reader of the resulting articles in *Sports Illustrated* or viewer of the games on ABC's "Wide World of Sports" who sought the rules would be frustrated by their absence.

In 1967, the rechristened "Rules and Records Book" included a version of the rules of 9-ball. (A brief set of one-pocket rules also appeared at that time.) Let's take a look at how they evolved.

The original set of rules, which were unchanged until 1980, had some interesting twists. The order of the balls in the rack was partly specified, with the 2, 3 and 4 on the "corners" in counterclockwise rotation (as shown in **Diagram 1**). There was no ball in hand by standard rules, and the loser of each game broke the subsequent rack. Players were expected to try to hit the lowest ball as best they could — there was no penalty at all for failure to hit the lowest ball first and/or failure to get to a cushion after a hit.

An optional "shoot out" rule was specified, and that's the way most money games were played at the time. If you didn't like the shot you had, you could roll the cue ball to any point you liked, just like the modern push-out shot after the break. Your opponent could take the new shot or pass, but a bad hit on the new shot by either player gave ball in hand anywhere on the table to the non-fouler.

I remember this rule as slightly different from what I described above. It was usually stated as "two fouls for ball in

hand," which meant that if you scratched on a shot, your opponent could have you shoot from behind the line for the hit, but if he took the shot after a scratch and fouled himself, you got ball in hand. Or the two fouls might be you pushing out, and your opponent getting a good hit but scratching.

The 1967 rules aren't perfectly clear, but they seem to say that any illegally pocketed ball is spoiled. They also don't specify what to do after a scratch, but the usual practice was to shoot from behind the headstring, and if the lowest ball was behind the headstring, it was spotted.

a third time if he had missed the ball twice. Under shoot-out, a scratch gave ball in hand behind the line, and any lowest object ball behind the line was removed, not spotted.

As with most pool games of the time, it was OK to jump object balls off the table — they would be spotted, and you would continue your turn if you had legally pocketed a ball.

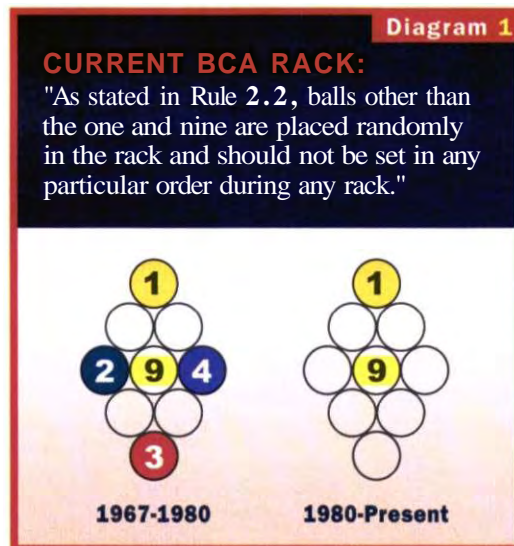
On a bad break — meaning fewer than four balls went to the cushions — the incoming player had the choice of taking ball in hand behind the line or breaking himself. Either the winner or the loser would break subsequent racks, as specified at the start of the tournament.

In 1985, another set of major changes was adopted. The shoot-out option was permanently dropped, while the push-out after the break made its first appearance in the rule book. Other notable changes included no balls spotted; "winner breaks" was specified; and a bad break gave the incoming player ball in hand anywhere on the table.

The most significant change was that the game of 9-ball became call-shot, although any ball made on the break counted. If you made a ball in the wrong pocket, your opponent could have you shoot again. In a bizarre twist of the concept of safety, if you called safe, your opponent could have you shoot again. If you wanted to play safe, you had to call a pocket and then miss the ball.

If an object ball was jumped off the table, it stayed down and wasn't a foul, but your opponent could require you to shoot again.

Also, the rule known as "cue-ball fouls only" appeared for the first time, but televised matches or tournament finals were played with all fouls. The start of the game was defined as when the cue ball crossed the headstring, so if you just tapped the cue ball on your break-shot warm-up strokes, it was OK.



The rules as written seem to say that masse and jump shots were not allowed to hit a hidden ball, but that probably was not intended.

A major rewrite of the whole rule book occurred in 1980, and 8-ball and 9-ball got promoted to "tournament games." Ball in hand for any foul first appeared, along with loss of game for three consecutive fouls by the same player. The fixed order of the rack was discarded, except for the 9 ball in the center and the 1 in the front. All illegally pocketed balls were spotted, except on coin-op tables.

The shoot-out option was still given, but you could have your opponent shoot

More rules riddling was seen in the 1986 edition. If the rack was missed entirely on the break, the incoming player had the choice of who would rebreak. The game was still call-shot, but a safe call was permitted. Your opponent could require you to shoot again if you made a ball when playing safe or you made a called ball in the wrong pocket on a normal shot.

In 1990, the rule book had two sets of 9-ball rules to help the confusion. The regular rules were the same as in 1986, but the "Professional Rules" as specified by the Men's Professional Billiard Association were also included. In the MPBA rules, the game was again not call shot. All balls jumped or pocketed illegally were spotted. A scratch or cue ball off the table on the break gave ball in hand behind the headstring. An "open" break was required, but not defined as four balls to the cushions. The start of the rack was defined as the cue ball striking the 1 ball. "Cue-ball fouls only" was better defined, so that movement of an object ball that changed the outcome of the shot became a foul.

In 1992, the amateur rules were omitted, and only the PBT rules were given. (The PBT was the successor to the MPBA.) The only significant change was that a double hit was defined and was a foul, whereas the rules from 1990 had been silent on the subject.

The "World Standardized Rules" made an appearance in 1993, under the auspices of the World Pool-Billiard Association (WPA), the newly-established world governing body for pool. Again, there were major changes to the rules. No balls were ever spotted. While "winner breaks" was recommended, suggested options included loser breaks, alternate breaks and player behind in score breaks. The open break was defined as four object balls to cushions. Jumped balls became fouls for all pool games including 9-ball. The beginning of the rack went back to the cue ball crossing the headstring. And "cue-ball fouls only" was better defined.

Since 1993, the pace of change of the rules has slowed, largely as a result of the WPA requiring five years between any changes to the World Standardized Rules. In '02, the start of the game was defined as any tip-to-ball contact, and the addition of a stalemate rule was added in 2006.

A complete rewrite of the rules came into effect in January 2008, and should

remain in force until 2013. Few actual changes appeared in this current revision. Alternate break is suggested, but options are allowed. A specified ball order for the rack was considered by the rules revision committee, but was thought to be too much of a change to include. An open break remains four balls to cushions, but the Regulations (which are separate from the "Rules") provide for other requirements on the break. A common requirement on the EuroTour is that three

balls must go above the headstring or be pocketed. The concept of "cue-ball fouls only" is mostly discouraged, but is still allowed if there is no referee around.

In my experience, most people learn the rules from the people they play with. If you would like to get them directly from the source, visit the WPA Web site at www.wpa-pool.com. The Rules and Regulations are in separate downloadable documents and total about 30 pages.