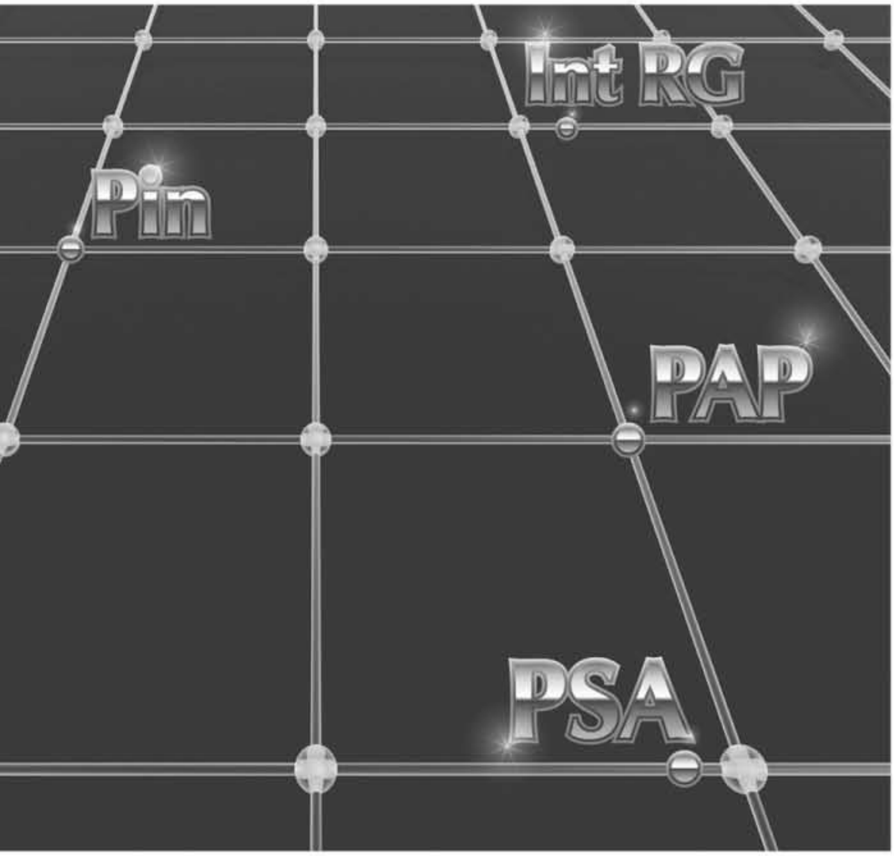

RG and ball motion

Which RG actually matters?

In discussions about bowling technology, we hear about RGs all the time. The question I ask is "Which RG actually matters to a ball's motion as a drilled ball travels down the lane?" It's a whole lot different than you probably think. RGs became part of the bowling vocabulary when specifications were placed on them in the original System of Bowling, which was instituted in 1992 by the (then) American Bowling Congress (ABC) and the Women's International Bowling Congress (WIBC). Those two organizations have since merged to form the United States Bowling Congress (USBC).

Manufacturers list RGs on all their spec sheets. The RG the manufacturers publish is the RG of the low RG axis. This is the minimum RG that exists on the ball being discussed. The question is, "Does that RG actually come into play when the ball is rolled down the lane?" The answer to that question is very interesting. To start with, let's discuss exactly what RGs measure.

RGs measure the amount of effort that is necessary to rotate the ball about a specific axis. When measuring RGs, the specific axis about which the ball is being rotated and the RG being measured has to be determined. With a bowling ball, there are an infinite number of axes about which a ball can be rotated and an RG can be measured.

When discussing bowling balls, we are interested in specific axes about which RGs need to be measured to determine ball motion potential. The USBC has

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set certain specifications for RGs about different axes. The USBC has set 2.800" as the maximum RG that can be present in an approved undrilled ball. 2.460" is the minimum RG that can exist in an approved undrilled ball. The USBC also says that the difference between the RG of the high RG axis and the RG of the low RG axis of any approved bowling ball cannot exceed .060". This is referred to as the total differential of the ball.

> *Studies show that the RG of the bowler's Positive Axis Point (PAP) at release is the only RG that matters when the ball is rolled down the lane.*

The RGs of the ball measure the potential of a bowling ball to rev up as it travels down the lane and the total differential of the ball measures the track flare potential of the ball. At this point, we should discuss the effect of these two factors on ball motion.

The ability of a ball to rev up quickly affects how much the bowling ball can react to the lane condition and how well it will carry when it hits the pins. This definitely affects a bowler's score. Track flare affects the amount of friction present between the ball and both the oiled and dry parts of the lane. It also affects scoring because of the amount of hook that a flaring ball can generate. The more a ball flares, the more friction present between the ball and the lane and, therefore, the more hook potential the ball has.

Hook manifests itself in the entry angle present when the ball hits the pins. Rev rate and entry angle are key factors in scoring. Higher rev rates of the ball at the pins and larger entry angles tend to improve scoring by improving pin carry. Bear in mind that bowlers are rewarded by how many pins they knock down, not just how many times they hit the pocket. For a bowler to score better, they must knock down all ten pins as often as possible when they hit the pocket. Higher rev rates and larger entry angles increase the probability of doing just that. A bowler's accuracy definitely improves the chances of hitting the pocket, but in addition to just being accurate, the bowler must carry all ten pins as often as possible when hitting the pocket to score effectively.

Studies show that the RG of the bowler's Positive Axis Point (PAP) at release is the only RG that matters when the ball is rolled down the lane. The RG of the PAP reflects the potential of the ball to rev up as it travels down the lane because that is the axis about which the bowler has rotated the ball. This is true because the RG of the migrating axis remains the same during the ball's entire path to the pins, even if it's flaring. This was accurately proven by the Equipment and Specs Department of the USBC in an exhaustive study they conducted.

The PAP of the ball will follow the RG contour of the ball as the ball travels down the lane. The RG contour is, by definition, all the points of the surface of a bowling ball that have the same RG value. On a flaring bowling ball, the PAP will change on each revolution as the ball flares down the lane, but the RG value of the PAP will remain the same. Knowing this means that once we measure the RG of the bowler's initial PAP, we will know exactly how easily the ball will rev up as it travels down the lane. The question then becomes, "What do we know about the RG of the bowler's PAP from the RG information given us on the manufacturer's spec sheet?"

The answer to that question is that we know the range of possible RGs for a drilled version of the ball for which we have the manufacturer's specs. However, we do NOT know the specific RG of the bowler's PAP for that ball after drilling. Given the manufacturer's specs, we do know that the RG of the bowler's PAP for the drilled ball will be between the RG of the low RG axis and the RG of the high RG axis after drilling.

The value of the high RG axis is equal to the RG of the low RG axis plus the total differential. For all practical purposes the exact value of the low RG axis does not tell us the RG of the bowler's PAP. In my opinion, listing the RGs of bowling balls in categories is accurate enough to describe the potential of balls to rev up as they roll down the lane. Categories of low RG, medium-low RG, medium RG, medium-high RG, and high RG should tell us all we need to know about the real ability of a ball to rev up.

The following chart and pictures show the difference between the manufacturer's published low RG value and the RG of the bowler's PAP using two very different drillings. The drillings we will be using are 20 degrees by 5 ½ by 45 degrees and 90 degrees by 2 ½ by 40 degrees. The bowler's PAP on those layouts is 5″ over by 3/8″ up. The layouts look like this (See Diagrams 1 & 2):

Strong Asymmetrical Ball			
Manufacturer's Specs	Undrilled	90°x2½"x40° Drilling	20°x5½"x45° Drilling
Low RG	2.472	2.474	2.480
Int RG	2.487	2.488	2.490
High RG	2.523	2.531	2.525
Int Diff	0.036	0.043	0.035
Total Diff	0.051	0.057	0.045
RG of PAP	NA	2.476	2.513

Symmetrical Ball			
Manufacturer's Specs	Undrilled	90°x2½"x40° Drilling	20°x5½"x45° Drilling
Low RG	2.472	2.477	2.480
Int RG	2.526	2.525	2.522
High RG	2.526	2.533	2.533
Int Diff	0.000	0.008	0.011
Total Diff	0.054	0.056	0.053
RG of PAP	NA	2.488	2.521

Diagram 3

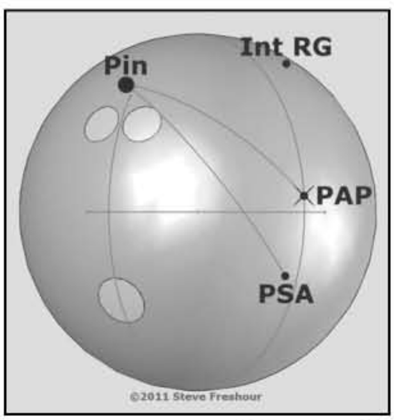

Diagram 1

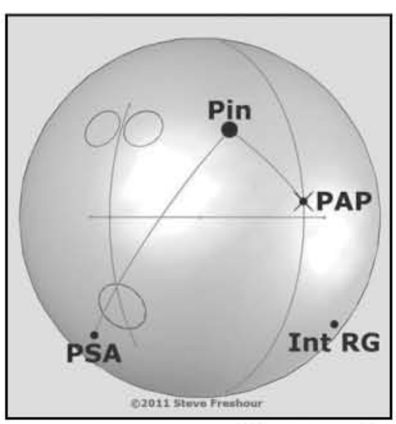

Diagram 2

The chart above (Diagram 3) shows all the RGs and differentials for both a strong asymmetrical ball and a symmetrical ball with the same low RG. It will show the RGs and the differentials of the undrilled balls as well as balls drilled with both those layouts.

To help clarify the RG of the bowler's PAP in relation to the published RG, let's look at the exact numbers for both drillings for two different types of balls with the same low RG. First, we'll look at a strong asymmetrical ball. The diagram will show the RGs of all of the axis points and the RG of the bowler's PAP. This diagram shows the ball with the 20 degree by 5 1/2″ by 45 degree drilling (Diagram 4):

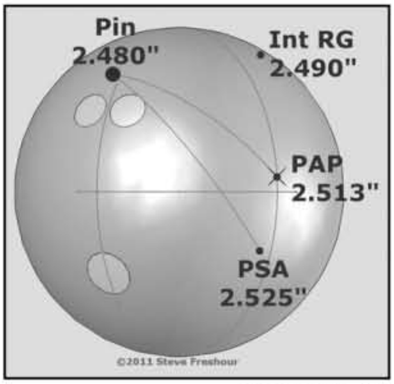

Diagram 4

Now we'll look at the RGs of the same strong asymmetrical ball with the 90 degree by 2 ½" by 40 degree drilling (Diagram 5):

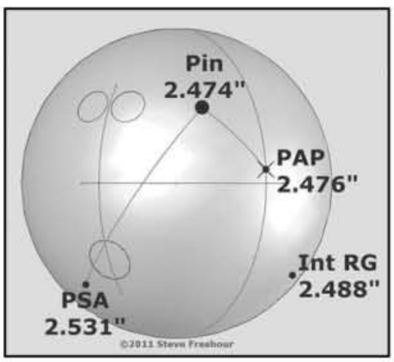

Diagram 5

When looking at the balls with those two drillings, you will notice that the low RG axis of the undrilled ball is 2.472", while the RG of the bowler's PAP is 2.476" for one of the drillings and 2.513" for the other. That's quite a bit of difference. Remember, the drilled ball will rev up based on the RG of the bowler's PAP.

Let's examine the difference between the low RG axis of a symmetrical ball compared to the RG of the bowler's PAP for the two different drillings. First, the 20 degree by 5 ½" by 45 degree drilling (Diagram 6):

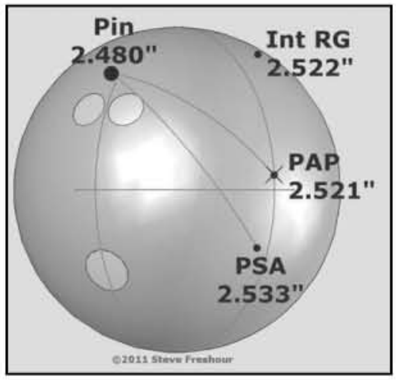

Diagram 6

Now, the symmetrical ball with the 90 degree by 2 ½" by 40 degree drilling (Diagram 7):

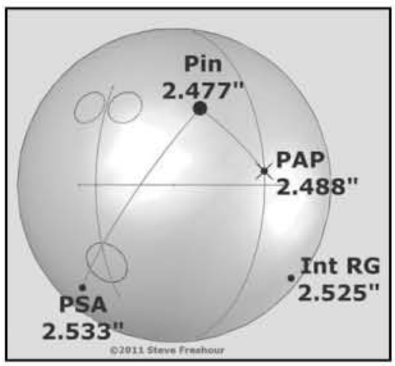

Diagram 7

The low RG of the undrilled ball is 2.472" while the RGs of the bowler's PAPs of the drilled balls are 2.488" and 2.521". Again, that's quite a difference.

In reviewing the chart and the pictures, you see that both the two undrilled balls had a low RG of 2.472", while the RGs of the different PAPs varied from a low of 2.476" to a high of 2.521". The difference between the PAPs is .045", which is definitely a noticeable difference.

So, what did we learn by studying the RGs of the PAPs of the two different balls with two different layouts when compared to the RG specification of the undrilled balls? We learned that knowing the low RG of the undrilled ball tells us what type of ball it is dynamically, but does not tell us exactly how the ball will roll with different layouts. That is the beauty of being able to adjust the reaction of a drilled bowling ball to fit the exact ball motion a bowler will most benefit from. Keep in mind that balance holes weren't used in this study. Balance holes can make the difference in the RGs of the PAPs even greater, which helps increase the versatility of the reactions possible from a specific ball.

Today's higher performance bowling balls are the most technically advanced and versatile balls ever manufactured. Knowing layouts, balance hole locations, RGs, differentials, coverstocks, and surface preparation are the skills that allow ball drillers to provide the best possible ball reactions for their bowlers. It is my hope that this article will help increase people's understanding of ball dynamics and ball motion to increase their enjoyment and understanding of the modern bowling game.