

ENGINEERING REPORT

Subject: Bowler Test Results
Date: 4/3/17
Place: International Training & Research Center
Present: Danny Speranza

Purpose:

Test balls with different RG and differential RG values to measure ball path changes.

Summary:

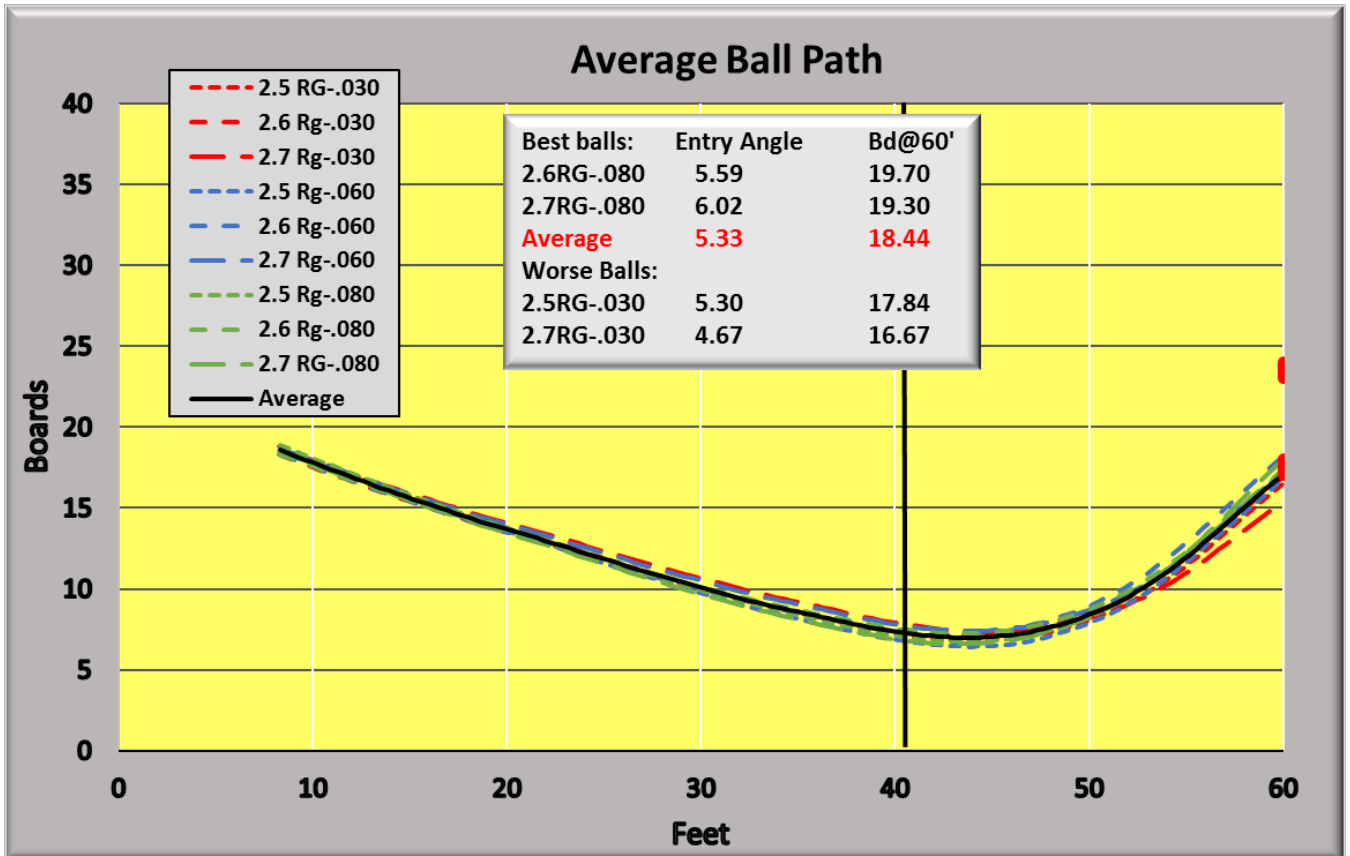
The test results from a bowler throwing a group of RG and differential RG balls followed the correct order bowlers would expect. The .030 differential balls tended to hook less, and the .080 balls tended to hook more. The 2.5 RG balls had the most similar ball paths, regardless of the differential RG. The 2.7 RG balls had a larger variance in the ball paths as the differential RG was changed.

Data:

For this test, a 220-average bowler threw a series of 10 shots for each ball with RG values of 2.5, 2.6, 2.7 and differential RG values of .030, .060 and .080 on a house pattern. The ball paths were tracked with BOLTS, and COF results were measured with the new speed traps installed on lane 19. A few shots were removed from the analysis when they did not match the initial trajectory of most shots. These bad shots were not thrown along the same path as other shots in the test, which would affect the results when tugged into the heavy oil or swung wide into the dry boards (outliers were removed).

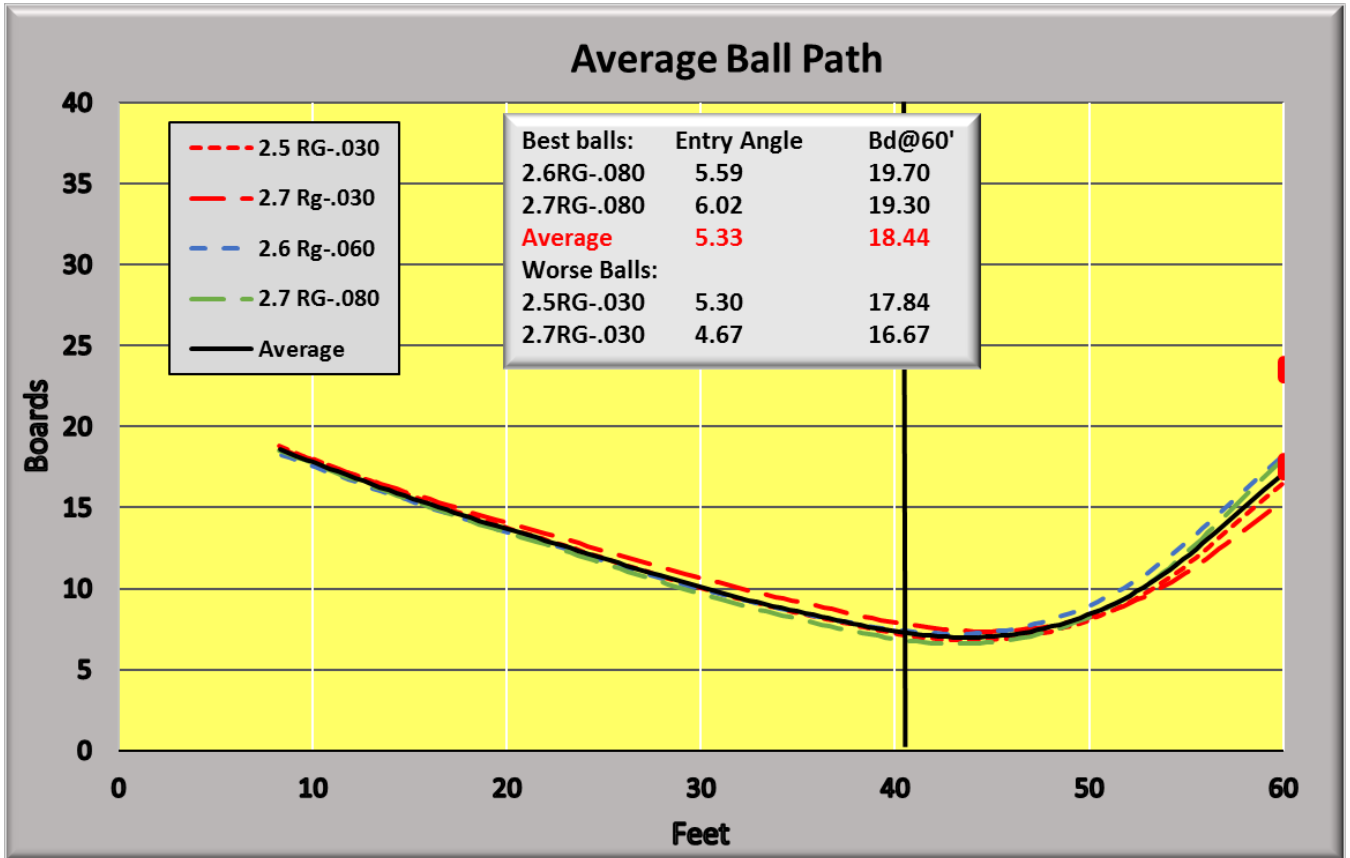
Below is the average ball path for all balls in the test. The black ball path is the average for all the tests.

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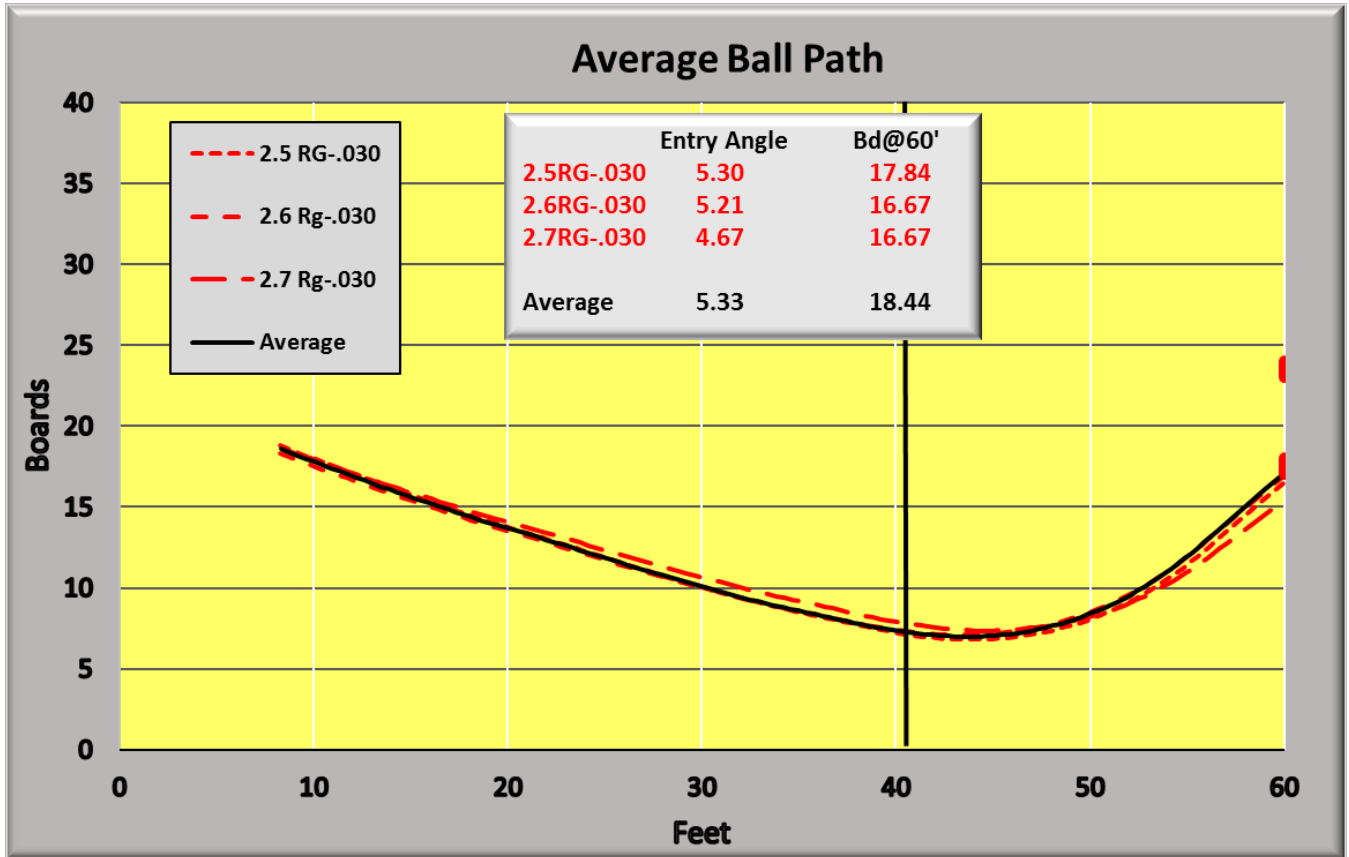
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Below are the two best (strongest) and two worst (weakest) balls during the test compared to the average ball path for all the balls. The difference between the best and worst is about 1.3 degrees of entry angle and three inches of total hook.



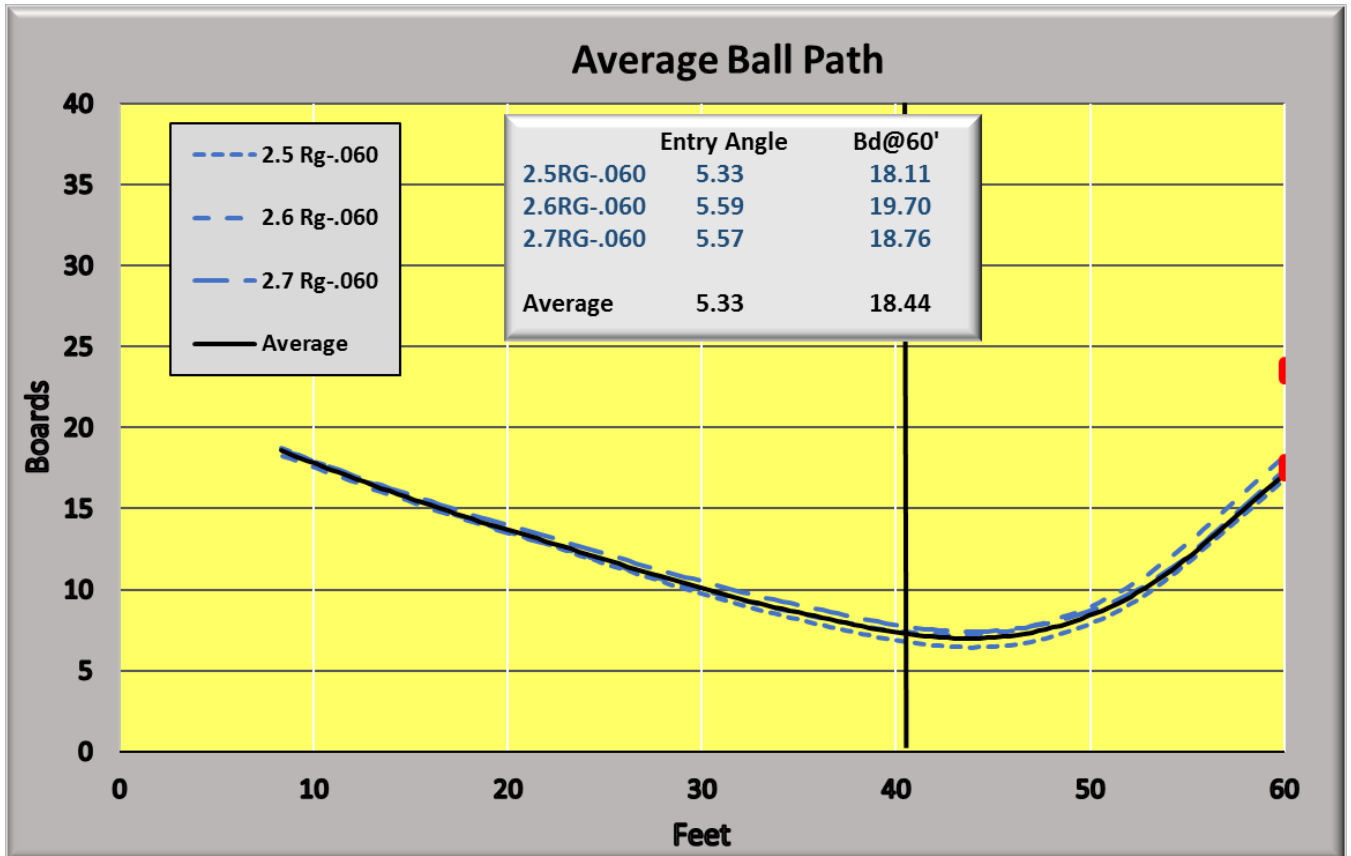
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Below are the 0.030 differential RG balls. They all hooked less than the average ball path.



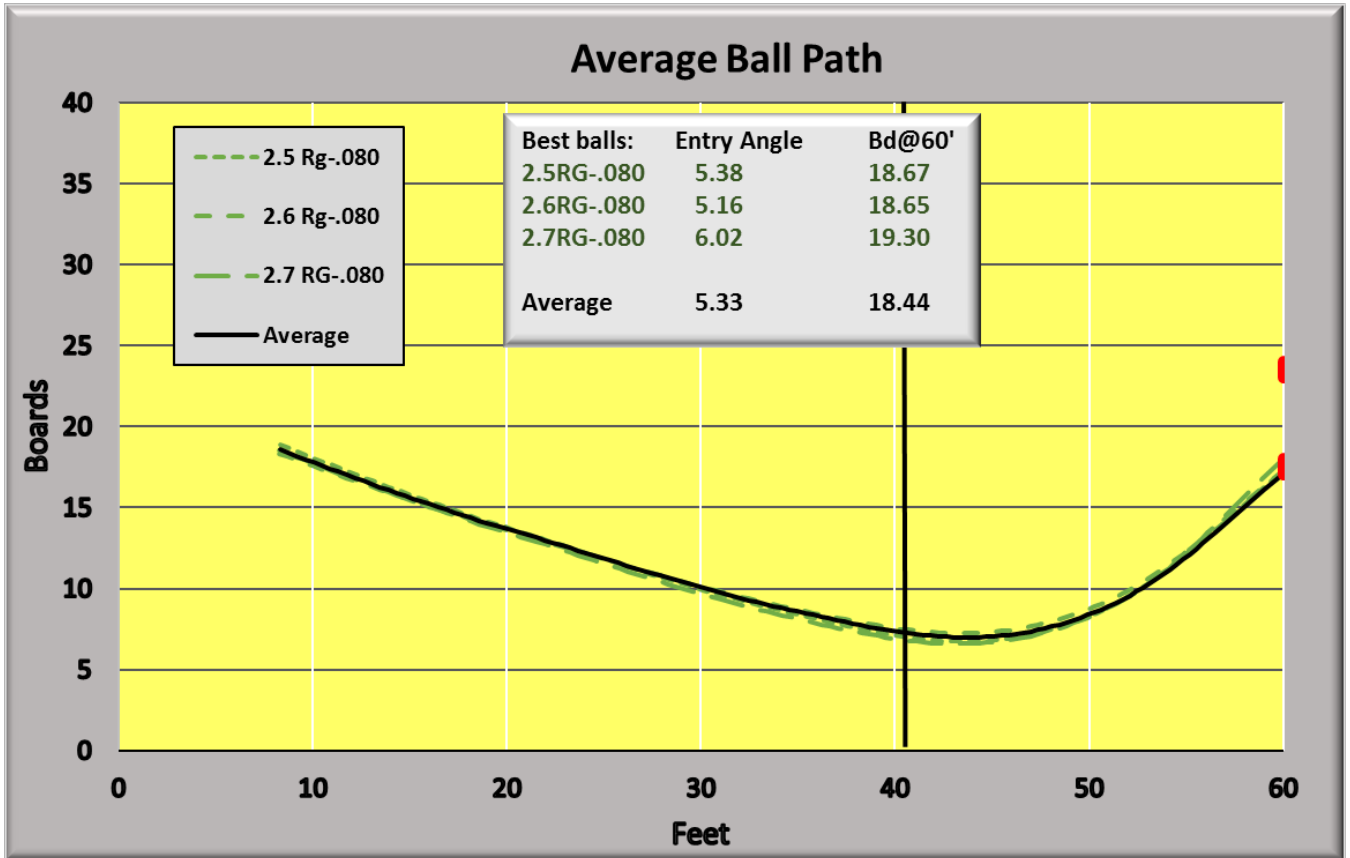
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Below are all the .060 differential RG balls. They are all close to the average ball path or hook slightly more.



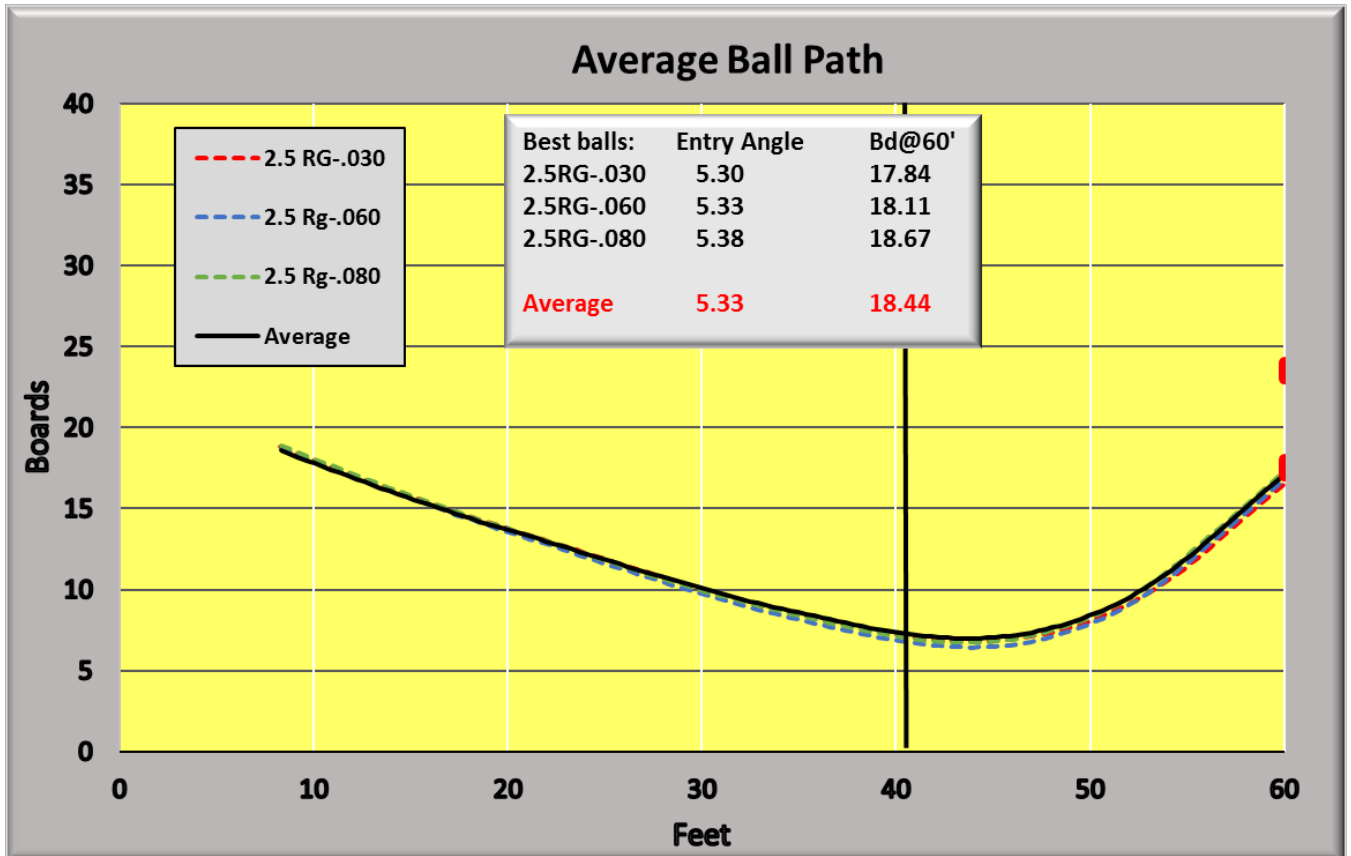
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Below are all the .080 differential RG balls. They all match the average ball path or hook slightly more, but the 2.6 Rg-.080 ball has less entry angle than the average, although it had more overall hook.



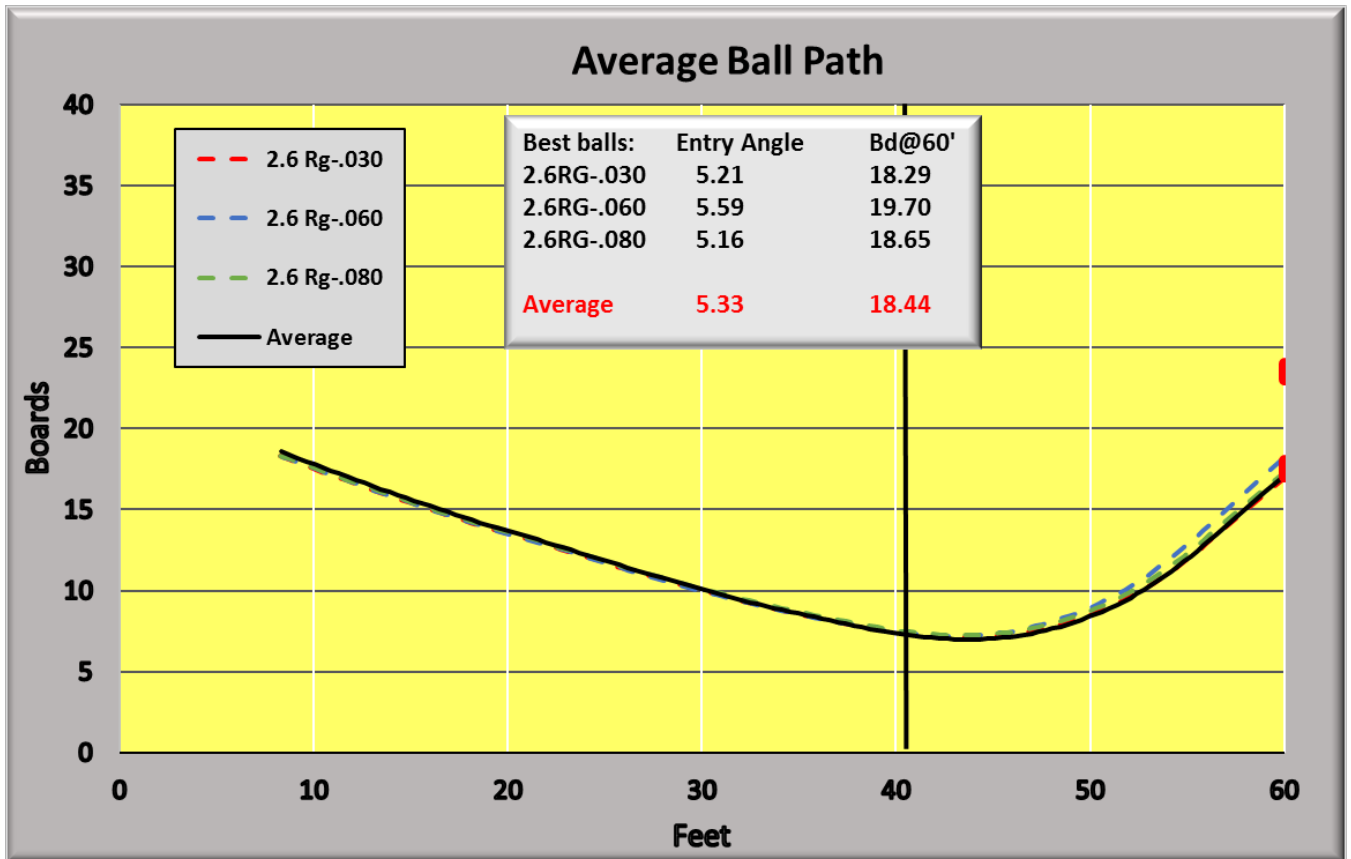
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Below are all the 2.5 RG balls. They are all very close to the average ball path with the amount of hook and entry angle increasing slightly as the differential increases.



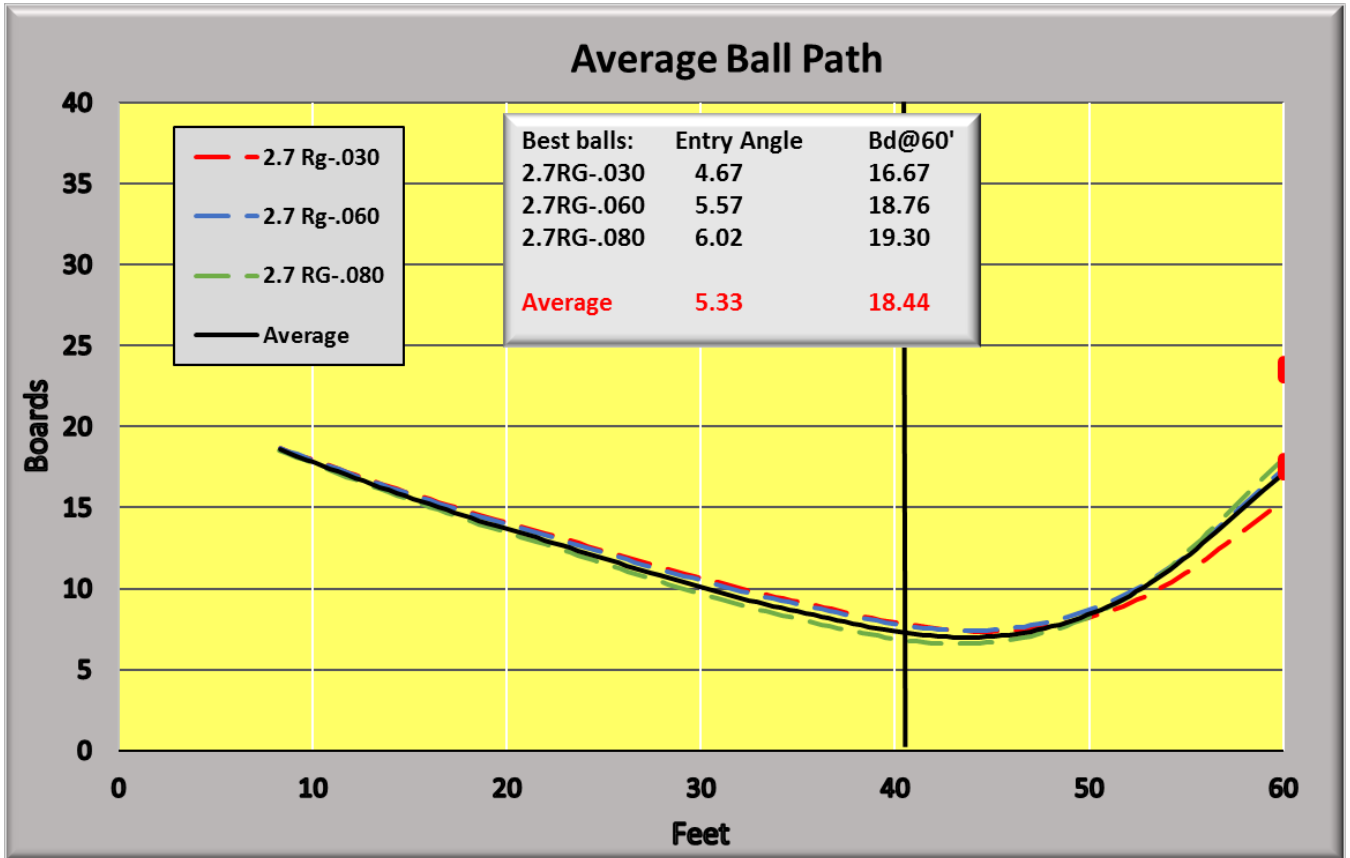
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Below are all the 2.6 RG balls. They are all close to the average ball path or slightly more hook.



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Below are all the 2.7 RG balls. They have the largest range of ball paths with the .030 hooking a lot less than the average ball path and the .080 hooking a lot more. The .060 hooked slightly more than the average.



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While the bowler was bowling, he and a coach observed the ball motion difference between all the balls.

The left table below is their combined predictions. They felt balls 12, 8, and 4 were the most hooking balls, and ball 10 was the least. Many of the other balls were close in their opinions. The three balls they selected as being the most hooking were the three balls with maximum differential (.080). The least hooking ball they selected (#10) was the high RG with low differential (.030). The table on the right is the actual correct order for all the balls. They selected four correctly (the green cells on the right).

Bowler and coach's Prediction				True ball values					
		med diff 0.03	high diff 0.06	super high diff 0.08			med diff 0.03	high diff 0.06	super high diff 0.08
High Rg	2.7	10	11	4	High Rg	2.7	10	11	12
Med Rg	2.6	6	3	8	Med Rg	2.6	6	7	8
Low Rg	2.5	7	2	12	Low Rg	2.5	2	3	4
notes: 3 and 2 close				most hooking	Correct Prediction				
most hooking balls= 12 most motion, then 8, then 4									

	early								late
length:	12	8	4	3	2	11	7	6	10
COF in oil	0.046 most	0.042 3rd most				0.040 2nd least	0.045 2nd most	0.041 3rd least	0.036 least
COF dry	0.214 2nd most	0.218 most				0.194 least	0.209 3rd most	0.198 3rd least	0.195 2nd least
COF total	0.068 most	0.065 3rd most				0.061 2nd least	0.067 2nd most	0.062 3rd least	0.057 least

Above is the order the bowler and coach ranked the balls from most to least hooking. The new speed traps were used to calculate (1) the frictions in the oil, (2) COF on the dry backend and (3) a total friction (COF) from the first speed trap to the last speed. Below is the friction table. The bowler ranking order tends to follow the COF order. The earliest ball had the most COF in the oil. Friction is a good indicator for ball reaction compared to a bowler's opinion.

serial #	Ball #	RG	Differential	RG	COF oil	COF dry	COF total	Bowler Tanking
76	2	2.5	0.030					5th soonest
77	3	2.5	0.060					4th soonest
78	4	2.5	0.080					3rd soonest
80	6	2.6	0.030	0.041	0.198	0.062		8th, 2nd to last
81	7	2.6	0.060	0.045	0.209	0.067		7th, soonest
82	8	2.6	0.080	0.042	0.218	0.065		2nd soonest
84	10	2.7	0.030	0.036	0.195	0.057		last (longest)
85	11	2.7	0.060	0.040	0.194	0.061		6th, soonest
86	12	2.7	0.080	0.046	0.214	0.068		earliest