Proposed Launch Condition Limits for Optimization of Overall Distance

R&A Rules Limited/United States Golf Association

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1 Introduction

Ranges of launch angle and spin ('launch conditions') are proposed that would be appropriate to evaluate Overall Distance. These ranges are based on information available for groups of elite (highly skilled) golfers.

This paper additionally includes analysis of PGA TOUR RADAR data collected between 2015 and 2019 (as the richest source of available information on how elite golfers drive the golf ball) with a focus on shots where the model of golf ball used can be positively identified. This demonstrates the range of achievable launch conditions for a given ball type, and how this relates to the current single set of 'Actual Launch Conditions' used to evaluate Overall Distance.

2 The variability of launch conditions observed for the same ball type

The Overall Distance Standard (ODS) for a given model of golf ball is currently evaluated at a single set of launch conditions (ball speed, launch angle, backspin) with the club set up to strike the ball in a specific manner (as detailed in the Overall Distance Standard and Symmetry Test Protocol). However, these 'Actual Launch Conditions' (ALC) for a given ball do not represent the range of launch conditions actually generated by elite male professional golfers.

Data acquired from the PGA TOUR ShotLink system (2015-2019) has been cross-referenced with Darrell Survey data to allow determination of the variability of launch conditions achieved by different players when using the same ball type Figure 1 shows the range of launch conditions achieved by players using a popular model used on the professional Tours.

While the ALC launch conditions (along with those of a recent 'check test' which uses the same test setup as ODS) are comfortably within the range of launch angles and spin rates observed for these players, a range of spins from 2260 to 2998 RPM and launch angles from 8.2 to 13.1 degrees would be necessary to represent the range of launch conditions observed per the 95% confidence interval plotted on the chart.

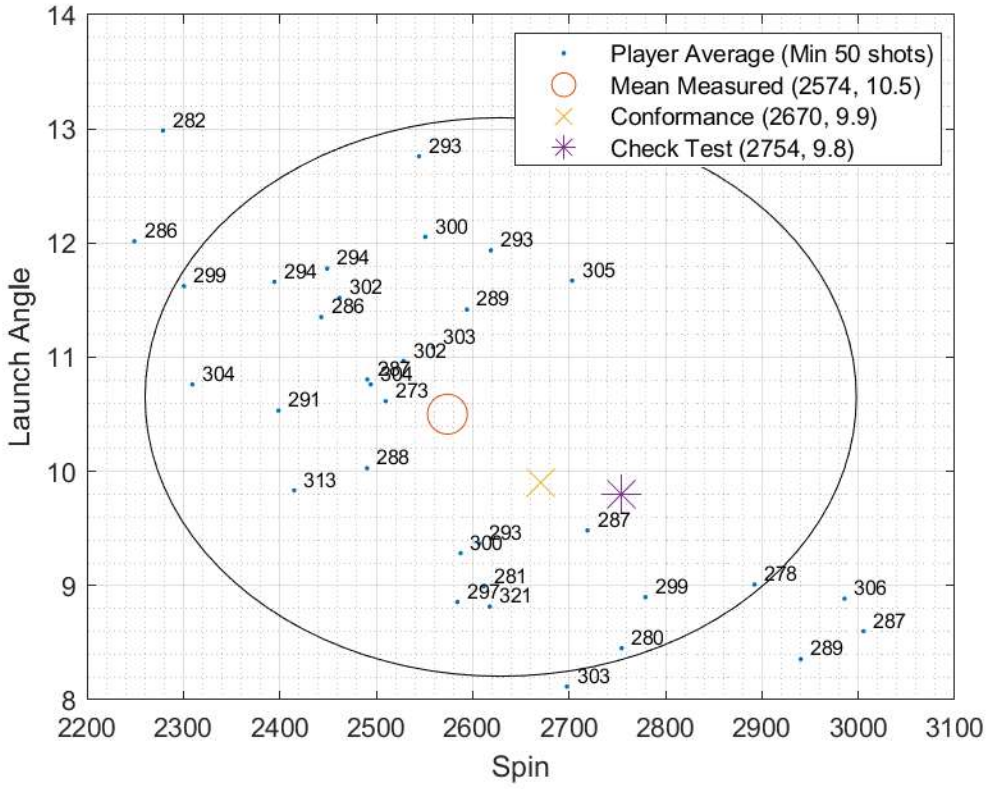

Figure 1: Average launch conditions measured between 2015 and 2019 with the stated ball model, where the player has hit more than 50 measured shots with the ball. The ellipse encloses the 95th percentile confidence intervals of the launch and spin. The check test value presented was measured at a 2019 tournament, and the data points are annotated with each player's average driving distance over the measured shots.

Similar observations can be made for other models with the data summarised in Table 1. Figures equivalent to Figure 1 are shown in the Appendix.

Table 1: Spread of values observed for eight ball models.

Ball Model	Total Players	"ALC"		Mean		Range (95% CI)		Difference (ALC-Mean)	
		Launch Angle, °	Spin, RPM	Launch Angle, °	Spin, RPM	Launch Angle, °	Spin, RPM	Launch Angle, °	Spin, RPM
A	35	9.9	2670	10.5	2579	4.9	738	0.6	-91
B	21	10.2	2730	10.8	2607	5.4	761	0.6	-123
C	20	10.1	2670	10.0	2552	6.0	729	-0.1	-118
D	30	9.9	2532	10.8	2512	4.7	543	0.9	-20
E	31	9.8	2658	10.5	2562	5.7	697	0.7	-96
F	13	10.1	2718	9.9	2658	4.3	666	-0.2	-60

3 Proposed Launch Condition Range

The dataset was expanded to consider the average launch conditions achieved by all players (who have had 50+ drives recorded) on the PGA TOUR between 2015-2019 irrespective of ball type, Figure 2.

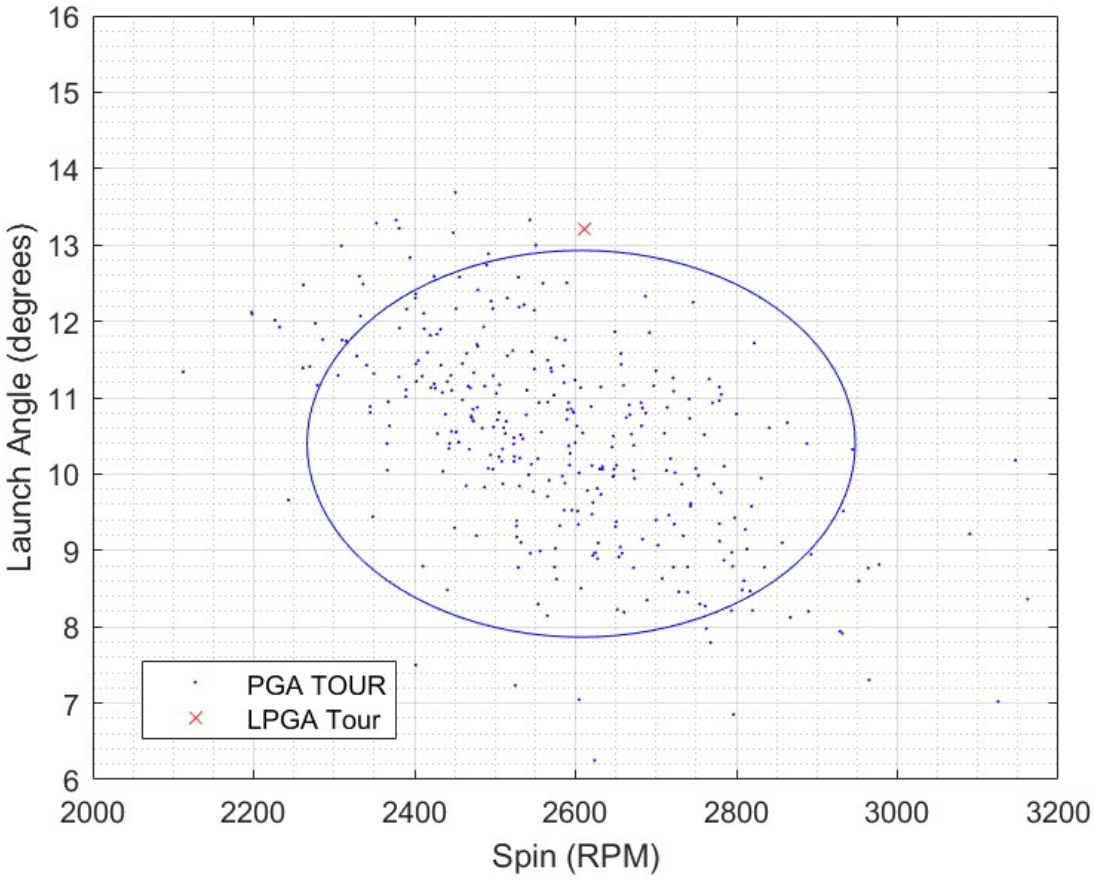

Figure 2: Distribution of average launch and spin values by player. The average launch conditions for the LPGA players from 2017 are shown as a red cross. "LPGA Tour" indicates the average.

Table 2 summarises the average launch conditions of these elite male professional golfers along with the bounds of the CI's on the ellipse.

Table 2: Range of CI by average for all players on the PGA TOUR with 50+ drives recorded (2015-2019).

	Players	Low CI – Launch Angle, °	High CI - Launch Angle, °	Low CI – Spin, RPM	High CI – Spin, RPM	Mean Launch Angle, °	Mean Spin, RPM
Range (95% CI)	323	7.9	12.9	2266	2948	10.4	2582

An appropriate range of launch conditions over which to evaluate ODS which is representative of those observed for elite male professional golfers would be as detailed in Table 3. Bounds are rounded up (upper bounds) or down (lower bounds) to the nearest 0.5° or 100 RPM.

Table 3: Proposed Launch Condition Range for ODS evaluation based solely on elite male professional golfers.

	Lower	Upper
Launch Angle, °	7.5	13.0
Backspin, RPM	2200	3000

While data with the equivalent level of granularity are not available for elite female professional golfers, average launch conditions for golfers on the LPGA Tour have previously been published (TrackMan, 2017), Table 4.

Table 4: LPGA & PGA TOUR average launch conditions - 2017 (TrackMan, 2017).

	Ball Speed, MPH	Launch Angle, °	Spin Rate, RPM
LPGA	140	13.2	2611
PGA TOUR	167	10.9	2686

These data demonstrate that while the average spin for male and female elite golfers is generally similar, the average launch angle for elite female golfers is over 2 degrees higher than the equivalent average for elite male golfers. This average is also presented in Figure 2 and is demonstrated to be outside the launch angle range previously proposed for elite male golfers, Table 4.

As such it is proposed that the optimization bounds be expanded to accommodate the range of launch angles and spins observed for both elite male and elite female golfers. The updated proposed optimization bounds are detailed in Table 5.

Table 5: Proposed Launch Condition Range for ODS evaluation based on the launch conditions of both elite male and elite female golfers.

	Lower	Upper
Launch Angle, °	7.5	15.0
Backspin, RPM	2200	3000

4 Reference

TrackMan (2017), '2017 PGA and LPGA Tour Avg.', https://blog.trackmangolf.com/2017-pga-lpga-tour-avg/

5 Appendix

5.1 Model B

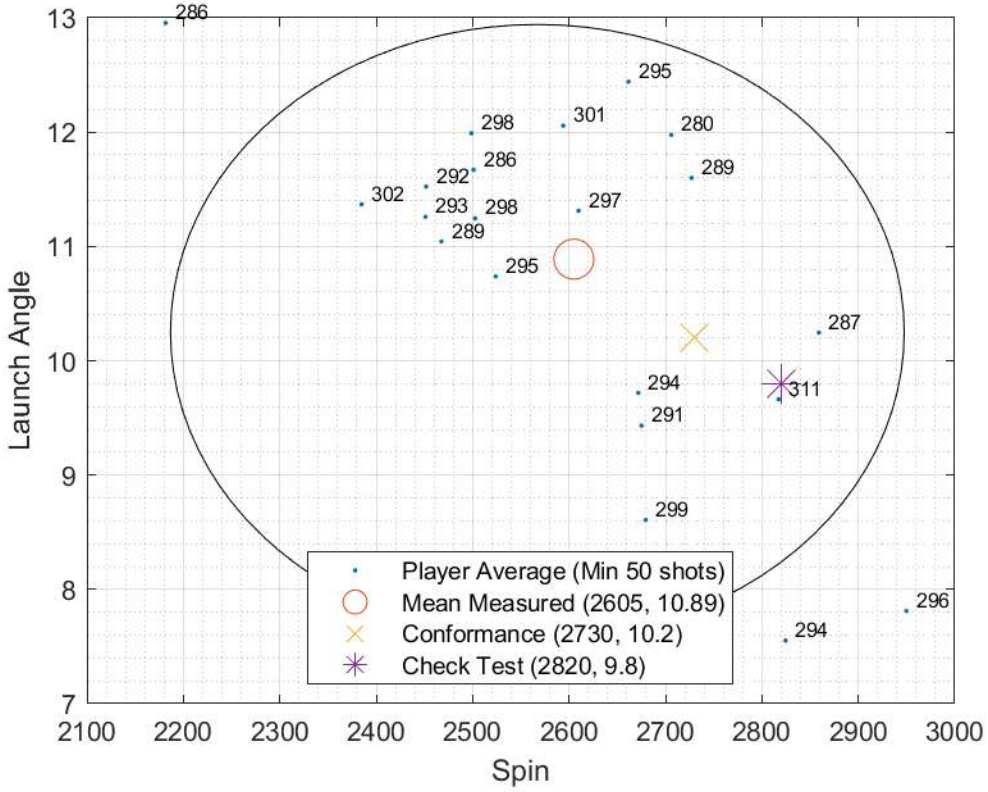

Figure 3: Spread of average launch conditions by player hit with ball model B.

5.2 Model C

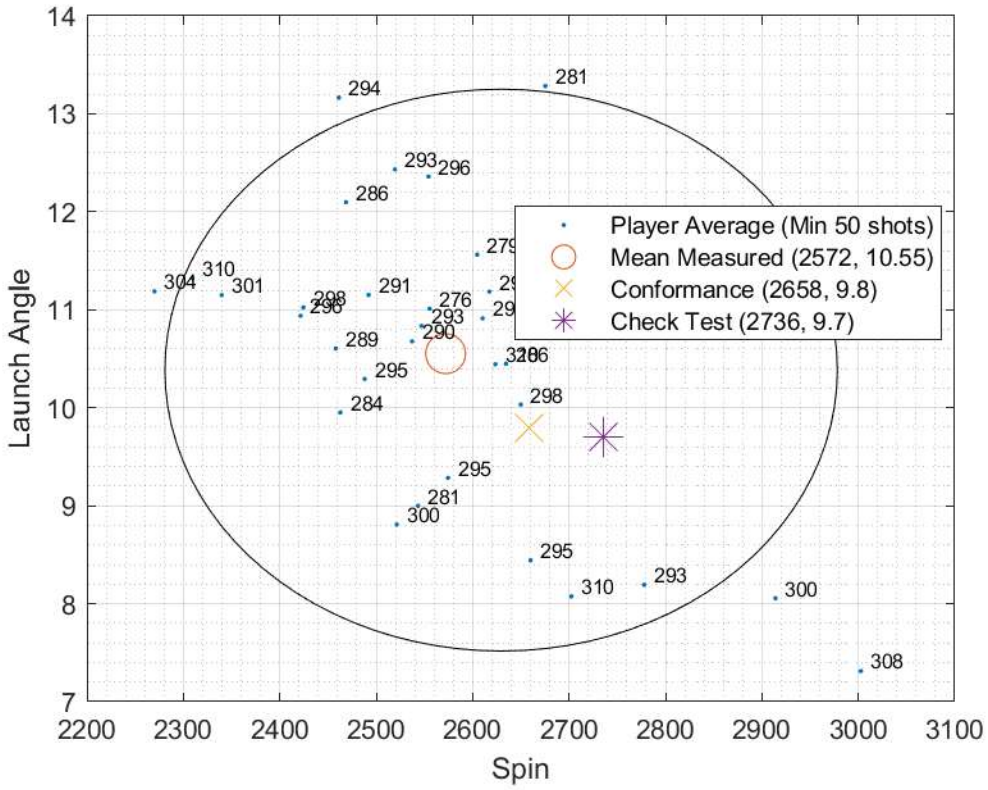

Figure 4: Spread of average launch conditions by player hit with the ball model C.