R22-06 Initial investigation: Effects of tee height on drive distance

United States Golf Association, R&A Rules, Ltd.

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1 Summary

Mechanical golfer testing was conducted in order to estimate the effects of reduced teeing height on total distance. It was found that given a constant club trajectory, reducing tee height led to disadvantageous angle and spin conditions, though ball speed was not affected in the same way. In all cases, ball distance was reduced at the lowest tee height: the degree to which ball distance was reduced was highly ball- and club-dependent and ranged from 2 yards to 13 yards.

2 Test setup

Golf clubs were assembled using two driver heads currently in the marketplace and used by elite professional golfers, as well as an 'Aeson' 360 cm³ titanium control club as specified in the Overall Distance Standard (R&A Rules, Ltd./USGA, 2019) or 'ODS'. Testing for all clubs was conducted at 120 MPH in accordance with the setup conditions of the ODS.

The height of the tee was then lowered in 0.2-inch increments, and 12 impacts measured at each location using each of two modern, multilayer golf balls used in elite competition: one having high spin, and one having lower spin. Examples of the 'setup' height, approximately 0.2 inch above face center, and the lowest tee position can be seen in Figure 1 and Figure 2, respectively.
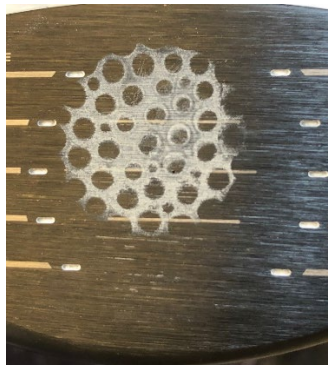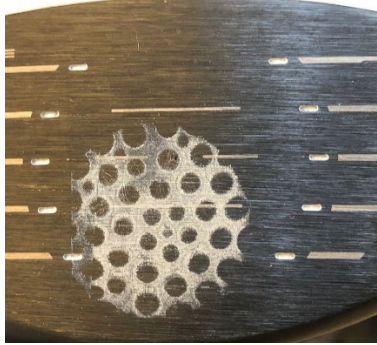

Figure 1: Imprint of ball impact at setup location.

Figure 2: Imprint of ball impact at lowest tee position.

3 Results

3.1 Effects on launch conditions

Ball speed, in general, increased as the tee height and impact position were lowered, decreasing again slightly at the bottom-most position. However, the benefits of this ball speed increase in terms of distance were more than offset by adverse trends, i.e., decreases in angle and increases in spin, at low tee heights (next section).
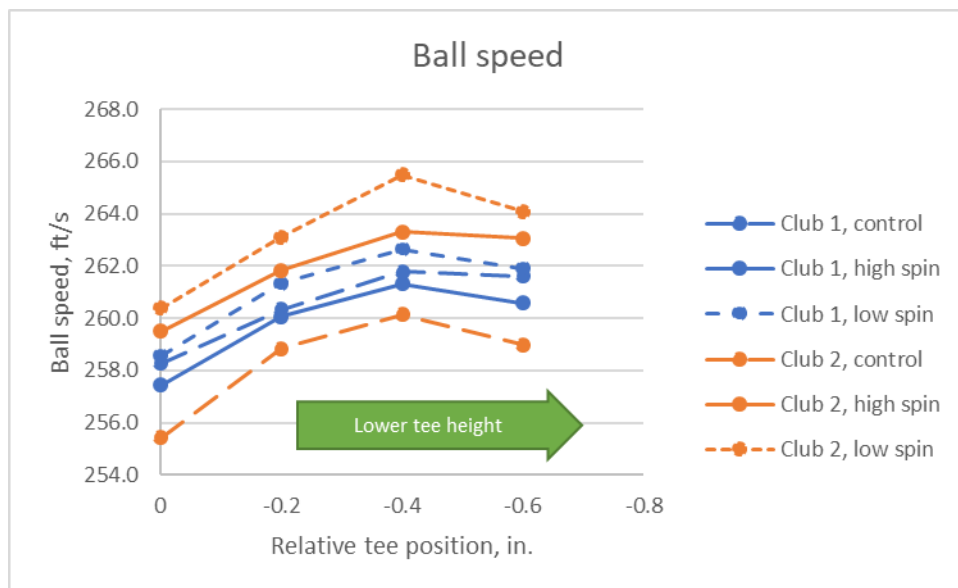

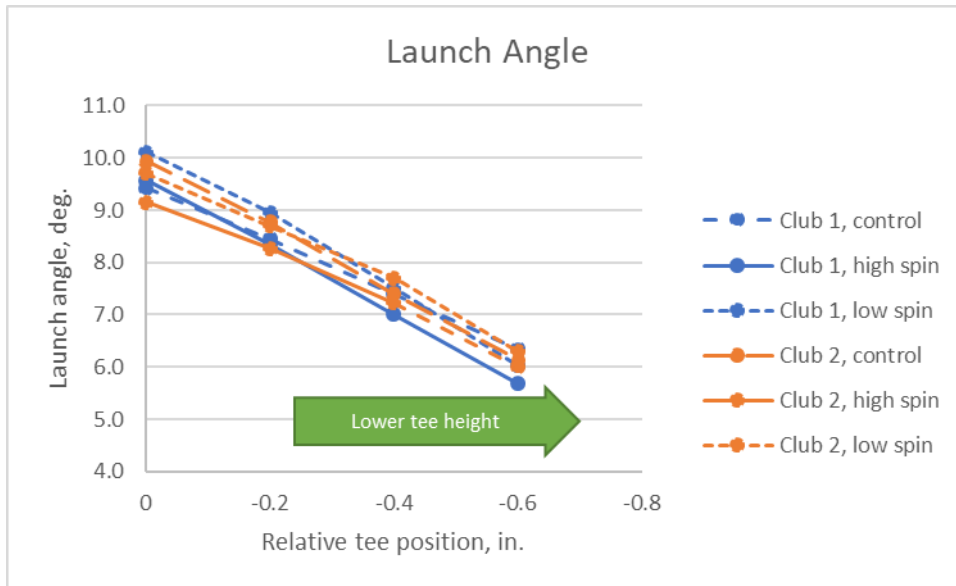*Figure 3: Effects of tee height on ball speed.*
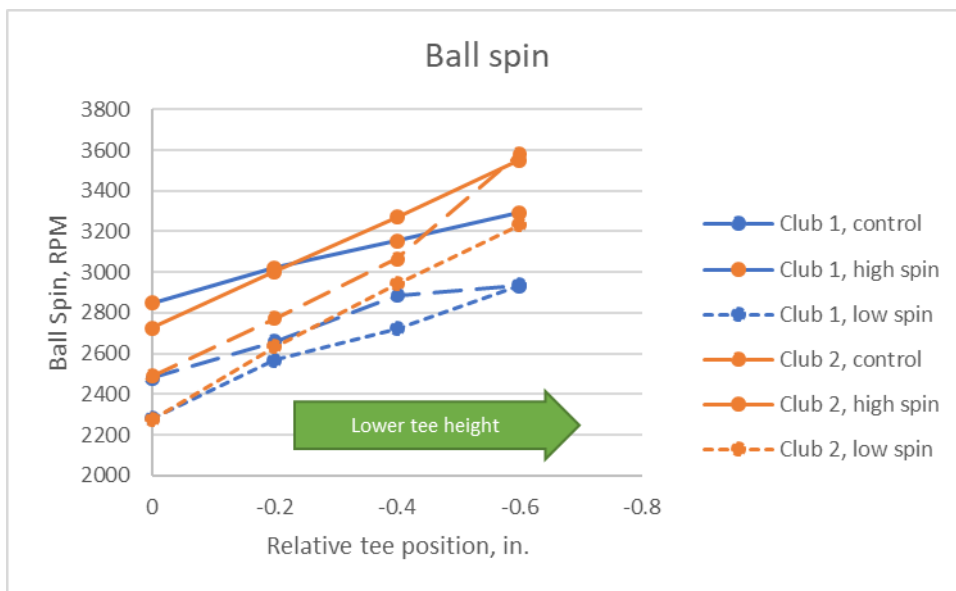
Figure 4: Effects of tee height on launch angle

Figure 5: Effects of tee height on ball spin

3.2 Distance

3.2.1 Simulation

Distances were simulated using the initial conditions associated with each different ball/club/tee height combinations. These simulations used a robust set of aerodynamic data (one associated with a higher-spin ball and one with a lower-spin ball) that captured the full range of aerodynamic performance associated with these experiments. Given the range of terminal (carry) conditions, a simplified bounce model applicable to a wide range of such conditions was utilized (Quintavalla, 2020).

3.2.2 Distance results

Individual results for the different clubs studied, demonstrating the interactions with ball type, are shown in Figure 6 - Figure 8. In these, we see that as we approach face center, ball distance increases for half of the interactions compared to the setup point, namely the 360cc control club with the low-spin ball, and Club 1 and Club 2 with the high-spin ball. For all club types, the lowest tee position was usually associated with the shortest drive distance.
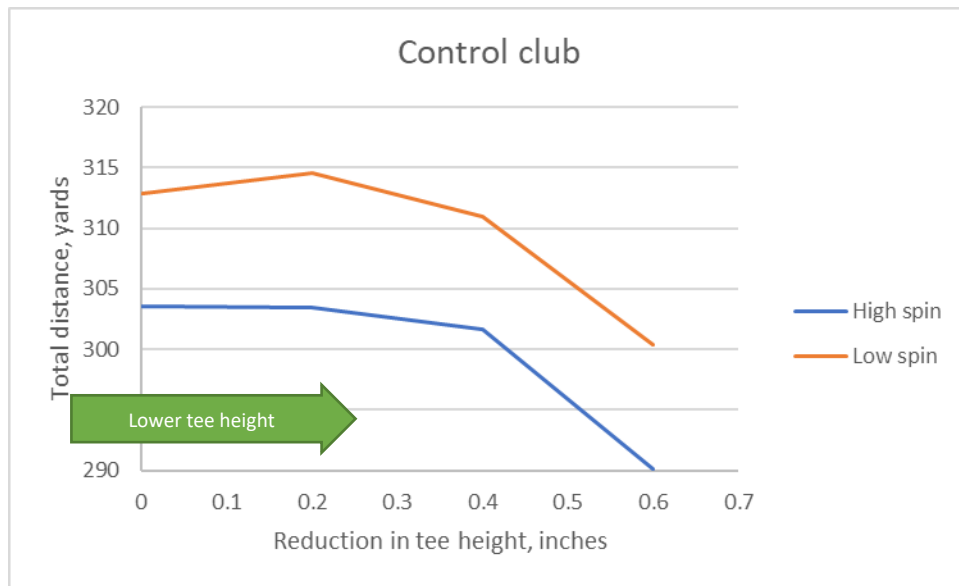

Figure 6: Total distance as a function of tee height change, 'Aeson' control club, two different ball types

Figure 7: Total distance as a function of tee height change, club 1, two different ball types.

Figure 8: Total distance as a function of tee height change, club 2, two different ball types.

Figure 9 shows the relative performance between the maximum-distance tee height and the lowest-position tee height for the above noted club-ball combinations. The lower-spinning ball was, in general, most affected by lowering tee height. Notably, it can also be seen that the club used had a significant effect on the outcome: the 360cc control club saw reductions of 13-14 yards, while Club "1" saw a much lower reduction, 2-4 yards (with Club "2" in between).
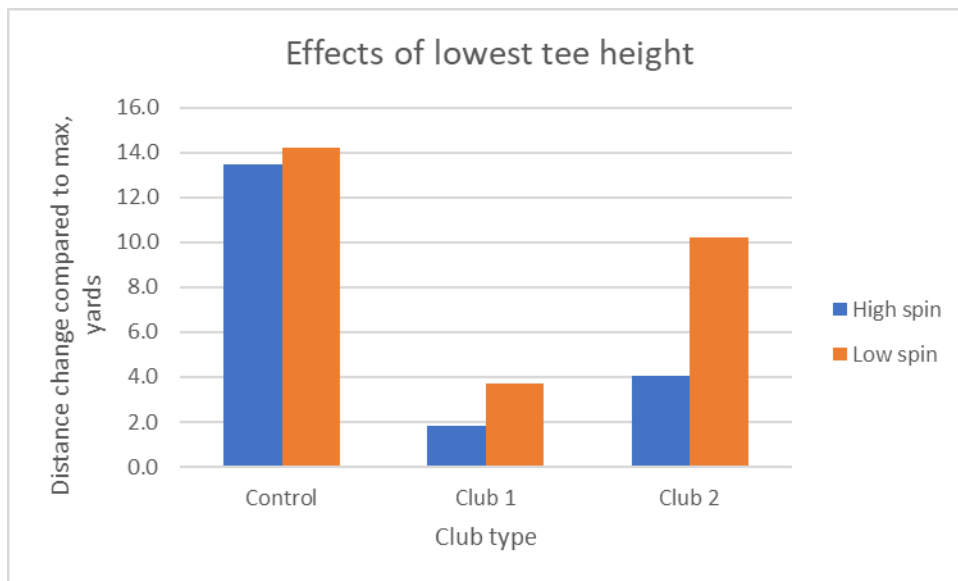

Figure 9: Effects of lowest tee height versus setup or nominal tee height. Distance change was found to be highly ball- and club-dependent.

4   Conclusions

It has been found that significantly lower tee height can reduce the drive distance under the test conditions identified here; a 120 MPH swing speed and setup conditions analogous to those of the

Overall Distance Standard. However, the degree to which ball distance was reduced was highly ball- and club-dependent and ranged from 2 yards to 13 yards.

5 References

R&A Rules, Ltd./USGA. (2019). *Overall Distance and Symmetry Test Procedure.* St Andrews, Liberty Corner: R&A Rules, Ltd., United States Golf Association.