



**A STUDY OF THE EFFECT OF ROUGH HEIGHT ON TOUR PLAYER
PERFORMANCE USING U- AND V-GROOVED IRONS**

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The R&A and the USGA have conducted a comprehensive study on spin generation^{1,2}. Early player testing demonstrated that modern club faces with U-grooves have significant performance improvements over clubs with the traditional V-groove in grassy lies representative of light rough in terms of spin retention. Building on the results of the initial player testing, extensive laboratory testing was conducted using grass surrogate materials, which led to the development of a set of modified groove specifications for groove profiles that were not V-shaped but would produce spin performance similar to that of a traditional V-groove from grassy lies. These laboratory results were confirmed in subsequent tests conducted with PGA Tour players.

Based on the results of the spin generation study The R&A and the USGA have proposed to modify the Rules governing grooves. The objective of this change is to limit the spin generation potential of grooves on shots from the rough to that of the traditional V-groove design. This amounts to a combination of a restriction on groove area divided by pitch and a restriction on edge sharpness. It has been suggested that the spin performance differences that result from changing the groove specifications might also be achieved by increasing the height of the grass in the rough. To evaluate this hypothesis a study was conducted where several players currently competing on a professional developmental golf tour were asked to hit shots from lies in medium and long rough using a variety of different loft clubs with both U- and V-grooves.

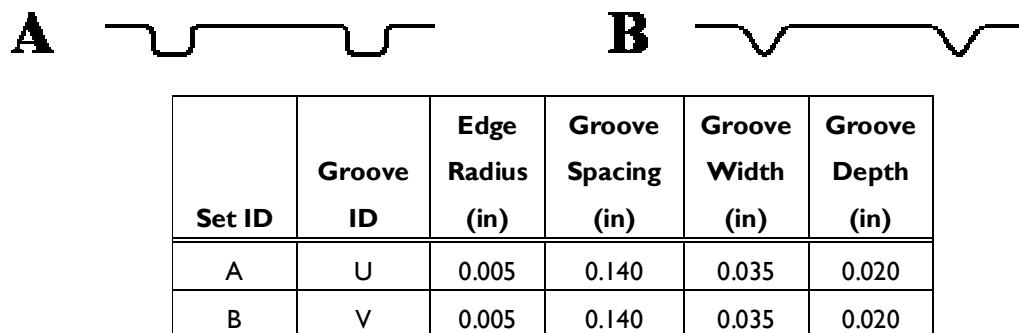
TEST EQUIPMENT

A subset of the clubs used in the previous player testing was used in this study. Each set contained a 5 iron, an 8 iron and a sand wedge. The clubs used in all of the sets were forged muscle-back irons. These clubs were obtained from the manufacturer without grooves in the face. The faces were pocketed using a CNC mill to accept machined face inserts with the desired groove configurations and surface roughness. All sets were matched for length, lie and swingweight.

Since previous tests demonstrated the efficacy of groove configurations that were designed

to produce V-like groove performance, only the U-groove and V-groove test clubs were selected for this study. The details of the grooves, which are R102 and R402 from the original study respectively, are given shown in Figure I.

Figure I –Groove Profiles for Player Test Clubs



DEVELOPMENTAL TOUR PLAYER TESTING METHODOLOGY

The testing was performed by seven professional golfers currently competing on a developmental tour. Each player was asked to hit shots using each loft of the U-groove and V-groove sets from medium and long rough (they were also asked to hit the U-groove clubs from a fairway lie where there was no grass/debris between the clubface and ball, hereafter referred to as the dry condition.) Figures 3 and 4 show typical lies in the medium and long rough, respectively. (A typical light rough lie from the earlier developmental player testing is shown in Figure 2 for reference.) Unlike the earlier player testing where all of the venues had Bermudagrass rough, the rough at the venue where this testing was conducted was a perennial rye / Kentucky blue grass mixture.



Figure 2 – Light Rough
(L = 1/2 ball diameter)



Figure 3 – Medium Rough
(L = 1 full ball diameter)



Figure 4 – Long Rough
(L = 2 full ball diameters)

For each shot radar was used to track the launch conditions and the resulting trajectory, and high speed video was used to capture the incoming club trajectory and a redundant set of initial ball launch conditions (although these could be used to verify the fidelity of the acquired radar data). The testing was conducted so as to randomize as much as possible the test variables while maintaining test efficiency.

DEVELOPMENTAL TOUR PLAYER TEST RESULTS

The results of the previous PGA Tour player testing that was used to confirm the laboratory findings are shown in Figure 5. The individual player results of the groove configurations were grouped for clarity and consistency and as noted earlier, represent shots from lies in light rough where the grass was Bermudagrass.

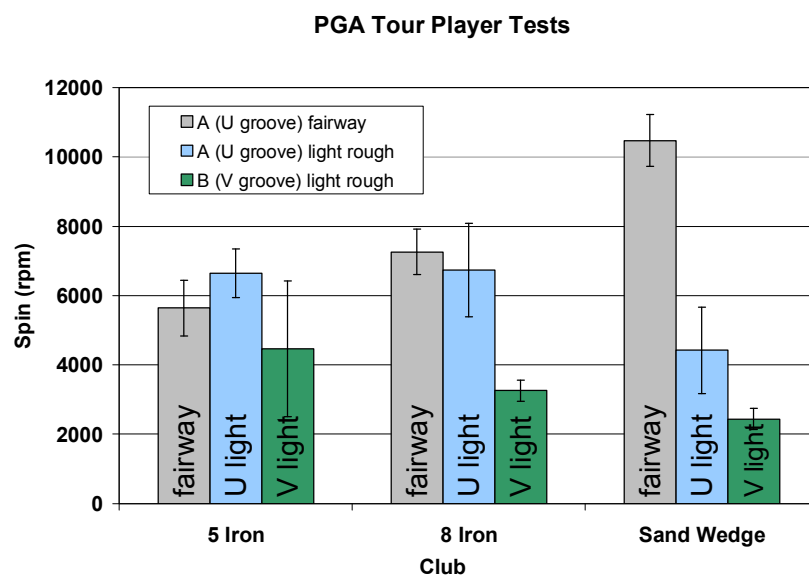


Figure 5 – PGA Tour Player Test Results

From the data it can be observed that for all lofts the V-groove clubs demonstrated significantly lower spin rates than the U-grooves (in the case of the 8-iron and sand wedge, these differences were significant at the 95% confidence level.) The results also indicate that the U-grooved 5- and 8-irons produced comparable or greater spin rates on shots from the light rough compared to the spin rates of the shots from the fairway.

Figure 6 shows the results of the tests conducted with the developmental tour players from the medium and heavy rough. As before, the individual player results of the groove configurations were grouped.

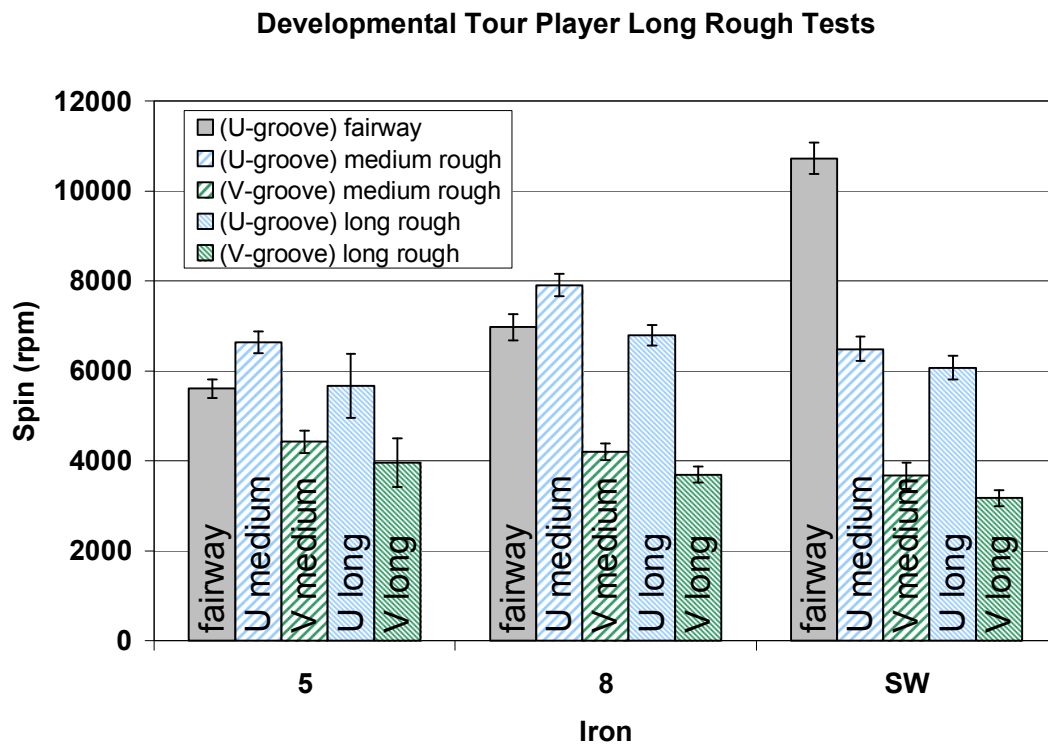


Figure 6 – Developmental Tour Player Long Results (Spin)

Similar to the data from testing in light rough, this data shows that for all lofts the V-groove clubs demonstrated significantly lower spin rates than the U-grooves in both the medium and long rough. Once again the U-grooved 5- and 8-irons produce the same or greater spin rates on shots from the light rough compared to the spin rates of the shots from the fairway. Across all lofts the spin rate decreased when going from medium to long rough.

The effects of rough height are also evident in the ball speed and launch angle, Figures 7 and 8. Consistent with the testing in the light rough, in the medium and long rough the V-groove provides a higher launch angle than the U-groove but it also loses more ball speed.

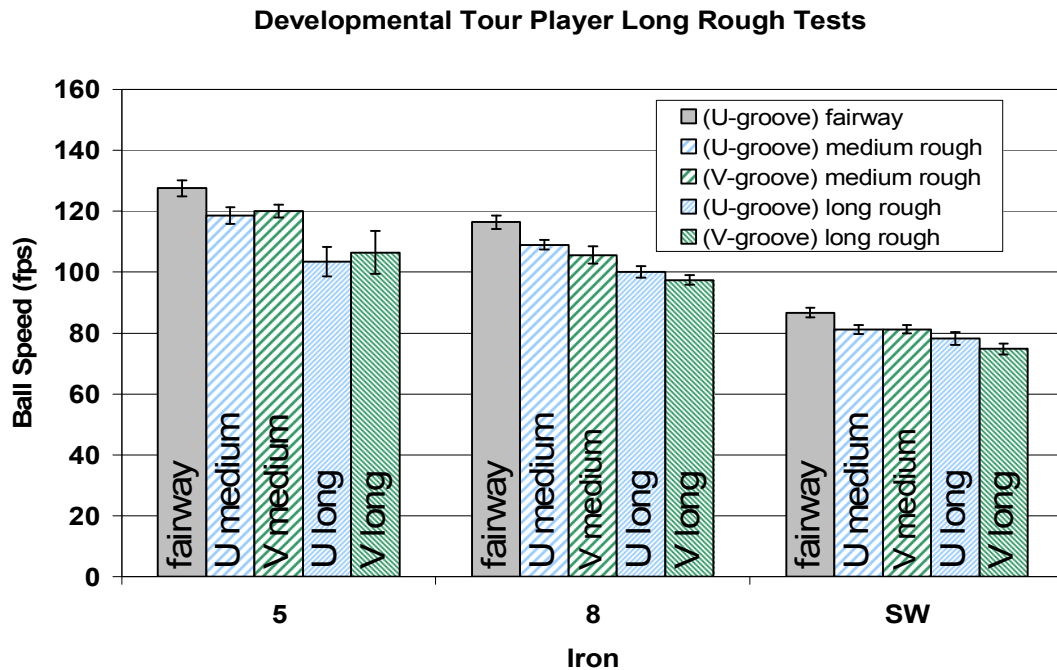


Figure 7 – Developmental Tour Player Long Results (Ball Speed)

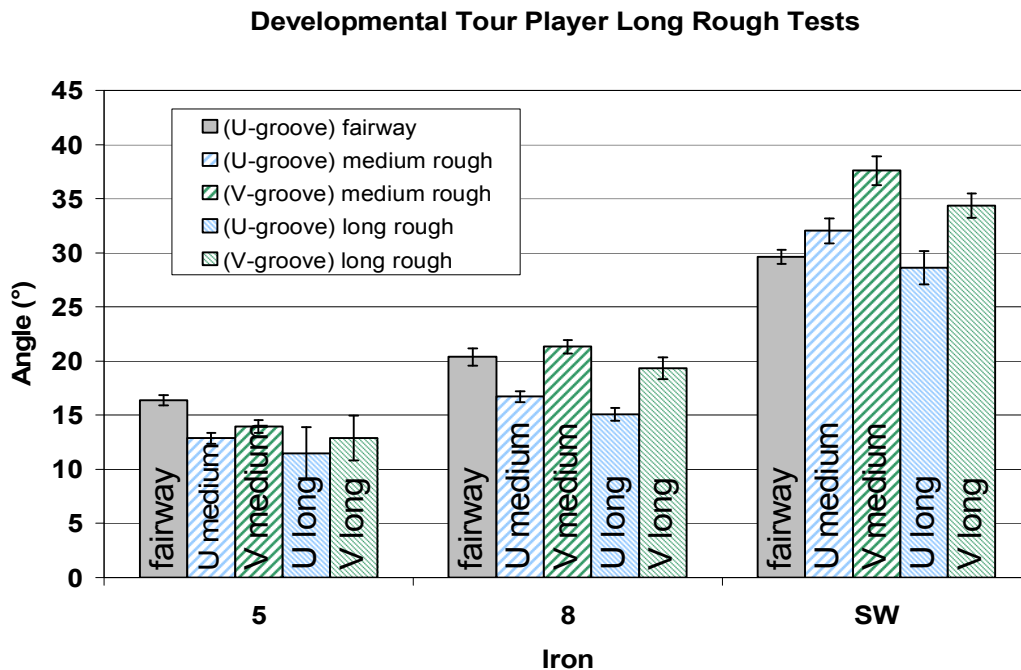


Figure 8 – Developmental Tour Player Long Results (Launch Angle)

SUMMARY AND CONCLUSIONS

The hypothesis that the spin performance differences that result from changing the groove specifications could also be achieved by increasing the height of the grass in the rough has been tested using players currently competing on a developmental to hit shots from lies in medium and heavy long rough using clubs with both U- and V-grooves. The results show that the performance advantages observed by the U-grooved clubs over the V-grooved clubs in lies in light rough are also exhibited in medium and heavy rough. The majority of the players tested indicated that they would not consider hitting a 5- iron from the long rough lie created during these tests. Players indicated that they would likely hit a 7- iron from this lie during a competition. The tests also show that the performance advantages are present in at least to types of grass; Bermudagrass and a perennial rye / Kentucky blue grass mixture. Based on this study, simply growing the rough longer will not bring the performance of U-grooved clubs to the level of V-grooves in terms of spin generation.

REFERENCES

1. Interim Report on Study of Spin Generation, August 7, 2006.
2. Second Report on Study of Spin Generation, January 11, 2007.