United States Golf Association
and
R&A Rules Limited

GROOVE MEASUREMENT PROCEDURE OUTLINE

USGA-TPX3001

Revision 1.0.0

August, 2008

Change Record

Page	*Section*	*Date*	*Details*

DETERMINATION OF GROOVE CONFORMANCE

(Impact Area Markings (App II, 5c) Measurement Procedure)
August, 2008

This procedure describes the methods used to determine the conformance of impact area markings to the Rules effective January 1, 2010.

1. IMPACT AREA

The impact area on irons will be taken to be the entire extent of the face where a face treatment has been applied (for instance grooves, sandblasting etc.) or the central strip down the middle of the clubface having a width of 1.68", whichever is greater.

Effective January 1, 2010 the impact area on drivers, fairway woods and hybrids will be defined as the central strip down the middle of the clubface having a width of 1.68".

Any groove which encroaches into the impact area on a driver, fairway wood or hybrid by less than 0.25" will not be considered to be within the impact area, unless it is designed to unduly influence the movement of the ball.

2. CALCULATION OF GROOVE PARAMETERS

2.1. Obtaining the Groove Profile

2.1.1. Insure that the area to be measured is free from debris and paint/coatings.

2.1.2. For each club determine a line perpendicular to the grooves on the clubface where the groove trace is to be conducted. This location will be typically (but not restricted to) the center of the impact area.

2.1.3. The profile should start and finish beyond the extreme grooves being measured.

2.1.4. The profile should include as many grooves as practical, without leaving the impact area appropriate for that club.

2.2. Measuring the Club Loft

The loft of the club will be determined using manufacturer's specifications and/or markings or will be measured using a suitable gauge.

2.2.1. If there is doubt about whether a club loft is above or below 25 degrees then measure the loft of the club according to the instructions in Appendix A.

2.3. Measuring the Grooves from the Profile
For each groove in the measured groove profile:

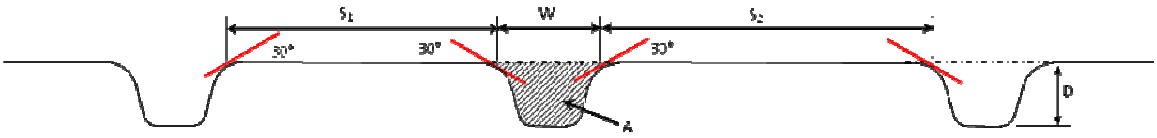

Figure 1

2.3.1. Using the 30° method of measurement (see Appendix B), identify the contact points on the groove and the adjacent grooves (if applicable). Determine the groove width (W) by measuring the distance between the marked 30° contact points.

2.3.2. Determine the spacing (S_1 and S_2) between adjacent grooves by measuring the distance of the land area between the 30° contact points identified in 2.3.1.

2.3.3. The adjacent land areas are joined by a line. Determine the groove depth (D) by measuring the perpendicular distance from the land area extension line down to the lowest point of the groove cross-section.

2.3.4. Determine the area (A) of each groove by measuring the area on the tracing that is bounded by the groove profile and the line connecting the adjacent land areas that was used to determine depth. Divide this value by the sum of the groove width (W) and the **minimum adjacent** spacing (S_1 or S_2) or, in the case of a top or bottom groove, the adjacent spacing.

3. DETERMINING THE CONFORMANCE OF IMPACT AREA MARKINGS

The following algorithm, along with the parameters measured in the previous section, will be used to determine the conformance of clubs to the Rules on impact area markings. Within the following procedure, the inherent difficulty of manufacturing grooves has been taken into consideration. However, it should be noted that clubs must be designed and manufactured with the intent of conforming to the Rules.

Note that, for all dimensional limitations described below, each measurement will be based on a confidence level of at least 95% confidence as determined by standard Gage R&R procedures. Improvements to measurement techniques and consequently the associated measurement tolerances may be introduced at any time.

3.1. Groove Width
(applies to all clubs with the exception of putters)

3.1.1. If 50% or more of the measured groove widths exceed 0.035" then the club is non-conforming.
3.1.2. If any single measured groove width exceeds 0.037" then the club is non-conforming.

3.2. Groove Depth
(applies to all clubs with the exception of putters)

3.2.1. If 50% or more of the measured groove depths exceed 0.020" then the club is non-conforming.
3.2.2. If any single measured groove depth exceeds 0.022" then the club is non-conforming.

3.3. Groove Separation
(applies to all clubs with the exception of putters)

3.3.1. If 50% or more of the measured groove separations are less than three times the maximum adjacent measured groove width then the club is non-conforming.
3.3.2. If any single measured groove separation is less than three times the maximum adjacent measured groove width minus 0.008" then the club is non-conforming.
3.3.3. If 50% or more of the measured groove separations are less than 0.075" then the club is non-conforming.
3.3.4. If any single measured groove separation is less than 0.073" then the club is non-conforming.

3.4. Groove Consistency
(applies to all clubs with the exception of putters)

3.4.1. The range of measured groove widths cannot exceed 0.010".
3.4.2. The range of measured groove depths cannot exceed 0.010".

It should be noted that grooves must be designed and manufactured with the intent of being symmetric, parallel and consistent throughout the impact area.

3.5. Area over Width Plus Separation
(applies to all clubs with the exception of drivers and putters)

3.5.1. If 50% or more of the measured values of A/(W+S) are greater than 0.0030" then the club is non-conforming.
3.5.2. If the measured value of A/(W+S) value for any single groove is greater than 0.0032" then the club is non-conforming.

3.6. Edge Radius

(applies to all clubs with claimed, marked or measured lofts of 25 degrees or more)

Rounding of groove and punch mark edges shall be in the form of a radius having an ***effective*** radius not less than 0.010" as determined by the two circles method described in Appendix C, nor greater than 0.020". The following two criteria are used for determining conformance:

3.6.1. If 50% or more of the upper groove edges or 50% or more of the lower groove edges fail the two circles method subject to a 10 degree angular allowance, then the club is non-conforming.

3.6.2. If any single groove edge protrudes more than 0.0003" outside the outer circle (refer to Appendix C), then the club is non-conforming.

Refer to Appendix C for complete measurement details.

3.7. Punch Marks

(applies to all clubs with the exception of putters)

3.7.1. The area of punch marks must not exceed 0.0044 square inches.

3.7.2. The distance between adjacent punch marks (or between punch marks) and adjacent grooves must not be less than 0.168", measured from center to center.

3.7.3. The depth of any punch mark must not exceed 0.040".

3.7.4. The volume of punch marks in the impact area must not exceed the allowable for an equivalent groove (i.e., 0.0030 in^3 per square inch of impact area covered by punch marks).

3.7.5. If 50% or more of the punch mark edges fail the two circles method subject to a 10 degree angular allowance, then the club is non-conforming.

3.7.6. If any single punch mark edge protrudes more than 0.0003" outside the outer circle (refer to Appendix C), then the club is non-conforming.

Appendix A
USGA METHOD FOR MEASURING CLUB LOFT

1. SUMMARY

The USGA currently uses a Golf Instruments M-300 Loft-Lie Gauge for measuring club loft. The measurement loft should be made at the center of the impact area as described in Section 1 of the main body of this procedure.

2. DESCRIPTION OF METHOD

2.1 Gauge Set-up

- Clamp the 5/16" rod into the club clamp with the bottom approx. 1/4" above base plate.

- While holding the setting bar (two dowel pins up) against the rod and down onto the base, loosen the lie bar lock knob (on the back of the gauge) and then retighten it. This will square the club clamp to the base. Lie pointer should read 0°. Adjust by repositioning pointer if necessary.

- Place the setting bar dowel pins into the two holes in the base plate.

- Push the open-close indicator (the block with the four little pins) against the setting bar and hold firmly.

- Both loft and open-closed pointers should read 0°. Bend to adjust as necessary.

2.2 Measuring the Club Loft

- Clamp the club into the gauge with the sole approximately 1/8" above the base plate. The clamp should be moderately tight.

- Loosen the lock knob on back of the gauge and move the club until score lines on the face of the club are parallel to the top of the open-close indicator. When the indicator is pointing at 0°, lock the knob.

- Push the open-close indicator against the face of the club and hold there. Adjust vertically using the knob on the left of the gauge so the four pins are between the score lines. Rotate the shaft of the club in the clamp (if necessary) until the open-close pointer reads 0°, tighten the clamp.

- Re-check to see if the score lines are still parallel to the top of the open-close indicator. Re-adjust (step 2 under Measuring) if necessary.

- Read pointers for loft and lie.

- Make sure to take the measurement in the center of the face, both left-to- right, and top-to-bottom.

Appendix B
30° METHOD FOR MEASURING GROOVE WIDTH

1. SUMMARY
The method for measuring groove width using the 30° method is presented. It is generally understood that the groove in a club face starts where there is a significant departure from the plane of the face (land area). This method specifies where the measurement of the groove width should be taken when the edges of the grooves are rounded.

2. DESCRIPTION OF METHOD
The sidewall of a groove generally meets the face of the club (land area) with a filleted transition. The groove width measurement (W) is made between two points where a line, inclined at 30° to the land area of the club face, is tangent to the edge of the groove. This is shown in Figure B.1.

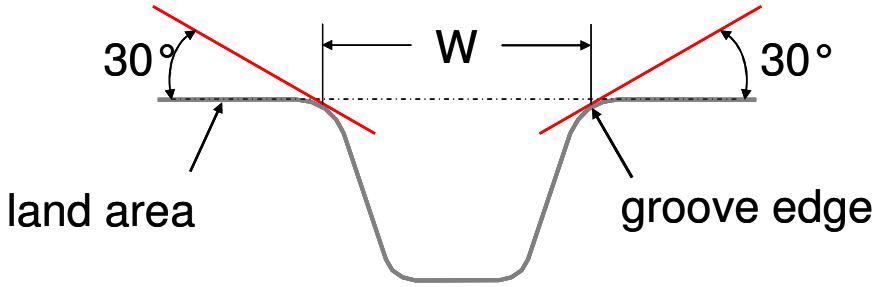

Figure B.1: Groove edge radius

If the tangent point using the 30° method occurs at a location that is more than 0.003-in below the land area, then the width measurement shall be made at the points on the groove that are 0.003-in below the land area. This is illustrated in Figure B.2.

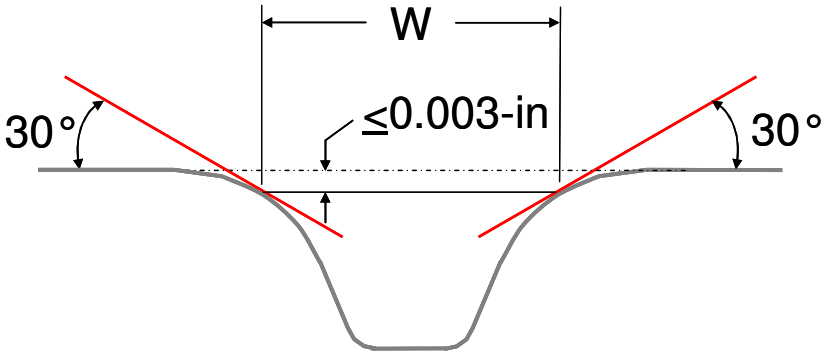

Figure B.2: Maximum allowable deviation of the tangent point from the land area

APPENDIX C
METHOD FOR LIMITING
THE SHARPNESS OF GROOVE AND PUNCH MARK EDGES

1. SUMMARY

The method for limiting the edge radius of grooves and punch marks is presented. This method provides three important features:

- The edge radius limit is implicitly a function of the draught angle of the groove sidewall.
- Allowances for manufacturing variability are incorporated.
- The method is insensitive to small local variations in edge fillet radius

2. ANALYSIS OF GROOVE AND PUNCHMARK EDGE

The groove or punch mark sidewall meets the land area with a filleted transition. This is shown in Figure C.1.

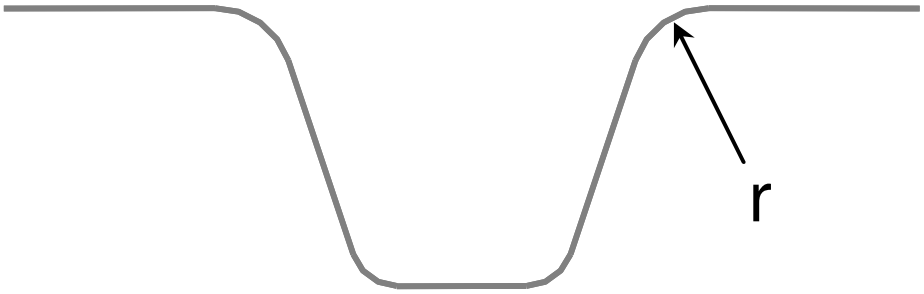

Figure C.1: Groove or punch mark edge radius

In order to determine whether such an edge is excessively sharp, a circle having a radius of 0.010" is drawn tangent to the groove sidewall and the adjacent land area. A second circle, concentric with the first and having a radius of 0.011" is drawn next. This arrangement is shown in Figure C.2.

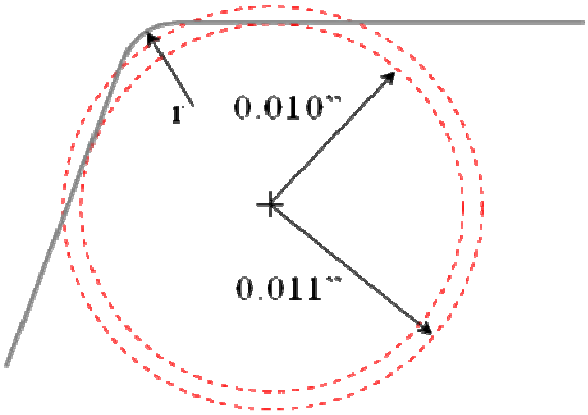

Figure C.2: Arrangement of concentric circles

By this method, a groove edge is deemed to be too sharp if any portion of the groove edge protrudes from the outer circle. The groove in Figure C.2 is such an example. The groove in Figure C.3, on the other hand, is not deemed to be too sharp, as the edge does not protrude from the outer circle.

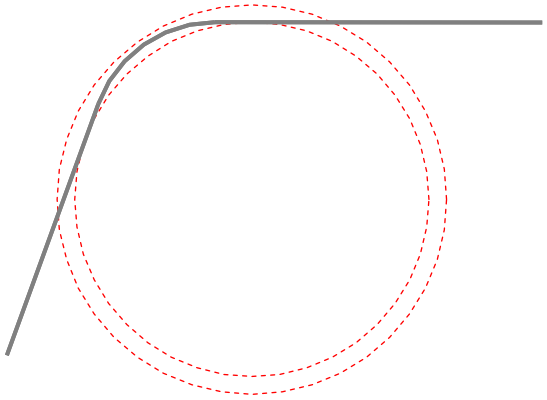

Figure C.3: Conforming groove edge

To be confident that the groove does in fact protrude from the outer circle and that this protrusion is not a measurement artifact or manufacturing abnormality, two additional criteria are provided for determining conformance.

2.1. Angular Extent of Protrusion from Outer Circle

Two lines are drawn from the centre/center of the concentric circles extending to the locations where the edge protrudes from the outer circle. The angle between these lines is the angle of protrusion as shown in Figure C.4. If the protrusion angle is greater than 10 degrees on fifty percent or more of the upper groove edges or lower groove edges or punch mark edges, the club is non-conforming

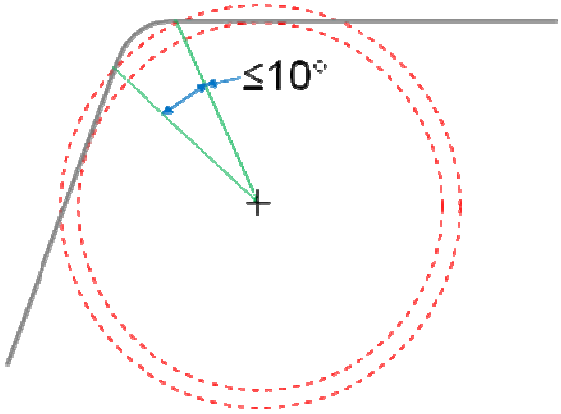

Figure C.4: Maximum angular extent of edge protrusion

2.2. Maximum Protrusion

If any single edge protrudes from the outer circle by more than 0.0003” (measured as shown in Figure C.5) then the club is non-conforming.

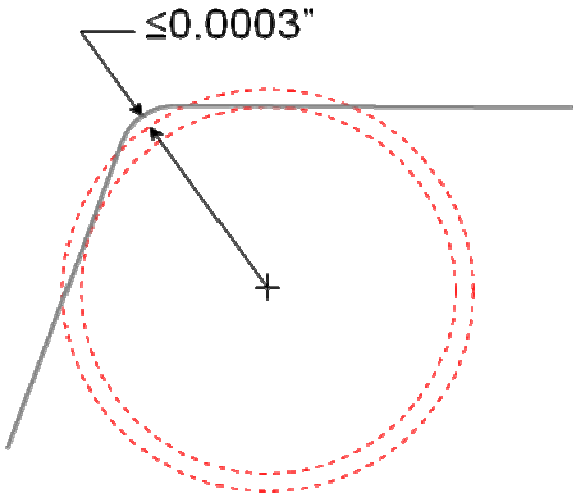

Figure C.5: Maximum protrusion