## Applying Dual Angle System / Sweet Spot

**Angle Sum Variance:** +/- 30° for elite bowlers  +/- 20° for good bowlers  +/- 10° for average bowlers

### 1) Determine the Sum of Angles by analyzing bowler's ball speed & rev rate.

Speed = Revs use medium angle sums from around 95°
Speed Dominant use smaller angle sums between 60° - 90° (very speed dominant to slightly dominant)
Rev Dominant use higher angle sums between 100° - 130° (slightly rev dominant to very dominant)

### 2) Adjust Sum of Angles for very high or very low tilt & rotation.

Mo will also lower the sum of angles for those with very high tilt & rotation, or raise the sum for those with very low tilt & rotation.

Lower totals by about 10° for very high tilt
Raise totals by about 10° for very low tilt
Lower totals by about 5° for very high rotation
Raise totals by about 5° for very low rotation

### 3) Determine the angle ratio by analyzing the bowler's axis rotation and tilt.

Update: Elgavachon and Athery have put together a great chart on choosing angle ratios.
http://wiki.bowlingchat.net/wiki/index.php?title=DualAngleRatioGuide

### 4) Drilling Angle, Sum of Angles, & Ratio Adjustments

Make adjustments based on bowler specs that are extremes
(Medium Axis Rotation: 30° - 60°  Medium Axis Tilt: 12° - 18°)

Use lower drilling **angles** for high Axis Rotation
(this may reduce the ratio & sum of angles)

Use lower **ratios** for high Axis Rotation in conjunction with low Axis Tilt
(helps smooth out breakpoint)

Lower drilling **sum** slightly for high Axis Tilt
Lower drilling **sum** more for high Axis Tilt & high Axis Rotation
(helps ball get into transition quicker)

### 5) Adjust the angles for the pattern the bowler wants to use the ball on.

Use higher ratios for flatter or more demanding patterns to create a stronger reaction to friction
Use low ratios for easier THS Wet or dry patterns for more control and mid-lane reaction

### 6) Roll the ball, then use balance holes to fine tune reaction

Start with a smaller size hole (¾") at least 2½" deep
P1 hole = Reduces drilled dynamics
P2 hole = Maintains drilled dynamics
P3 hole = Increases drilled dynamics some
P4 hole = Increases drilled dynamics more

(Please visit http://www.morichbowling.com/Drilling/GradientLineBalanceHole/GradientLineBalanceHole.htm for more detailed information.)

**High tilt Bowlers:** Pin to PAP distances of 4½" - 5¾" (Asymmetrical), 3" - 4" (Symmetrical)
4 ½" Pin to PAP distance will make the ball come off the spot hard (more angular)
5 ¾" Pin to PAP distance will make the ball roll forward sooner

Asymmetrical Balls exhibit most flare at Pin to PAP distances of 2¾" to 6¼"
Symmetrical Balls exhibit most flare with Pin to PAP distances of 3" to 4"

If the ball design creates a later, sharp break point, use lower ratio (lower drilling angle to VAL)
If the ball design creates a sooner, forward rolling ball, use more ratio (higher drilling angle to VAL)

**After Drilling:** With a symmetrical ball use Pin to center of thumbhole for measuring layout! The Mass Bias is near the thumbhole when no balance hole is present and moves towards balance hole when present.

**Retaining Axis Rotation & Axis Tilt:** To retain Axis Rotation and Axis Tilt in SYMMETRICAL equipment, we would tend towards longer pin-pap (> 4") distances, while ASYMMETRICAL equipment we use shorter pin-pap distances (< 3"). We would also chose higher angle ratios (2:1 - 3:1) to promote a longer first transition to make the most of what Axis Rotation and Axis Tilt is available at release.

**Burning Off Axis Rotation & Axis Tilt:** To burn off Axis Rotation and Axis Tilt quicker in SYMMETRICAL equipment, we would tend toward Max flare pin positions (3" - 4"), while longer pin distances (4"+) in ASYMMETRICAL equipment. We would also chose lower angle rations (1:1 - 1:2) to get the ball to reach the first transition sooner, while trying to eliminate jumpy back end reaction that tends to accompany high Axis Rotation and Axis Tilt.

**Drilling Angle:** Smaller drilling angles are used to shorten the length of the 1st transition (skid to hook) because the PAP is closer to the Pin to Spin Line. Larger drilling angles increase the length of the 1st transition because the PAP is farther away from the Pin to Spin Line.

**Angle Sum:** Angle sum is the sum of the drilling and VAL angles. The main components that will affect this are ball speed and rev rate. An example of a well matched bowler would be 18mph speed and 300rpm (off the hand). For each 1mph increase or decrease in speed, a corresponding increase or decrease of about 50rpm would stay matched. Bowlers whose ball speed and rev rate are well matched will match up best with angle sums of 100° ± 30°. In general, the ± 30° will stay the same, and the 100° will shift. For bowlers that are speed dominant, you would want to lower the center of the range, to a minimum of 60° ± 30°. For bowlers who are rev dominant, you would want to raise the center of the range, up to a maximum of 130° ± 30°.

**Pin-PAP Distance:** Note that the following ranges refer to asymmetrical cores, which have different properties at longer pin-PAP distances than do symmetrical cores. Bowlers with medium tilt will match up best with pin-PAP distances in the 4" - 5" range. Bowlers with higher tilt would want to use slightly longer distances, while bowlers with lower tilt would want to use shorter pin-PAP distances.

**Angle Ratio:** Angle ratio is the ratio of drilling angle to VAL angle. Acceptable ratios range from 1:3 to 3:1. The range used by a bowler is dependent on axis tilt and axis rotation. The more axis tilt and/or axis rotation a bowler has, the lower the angle ratios the bowler should use. A bowler with 30° degrees of axis rotation and 15° of axis tilt would do best between 1:1 and 2:1. A bowler with 75° axis rotation and < 10° axis tilt, would do best between 1:3 and 1:1.