"Blueprint" Assembly Process
(Irons with Parallel Tip Shafts)

If there were one clubmaking rule, it would be "everything affects everything else." It takes a lot of mistakes and years of experience for clubmakers to learn this rule.

While most clubmakers consider the clubhead and shaft in separate terms, I have concluded the dynamic interaction between the two is a critical step in assembling the best performing clubs. My Dynamic Interaction Alignment Test (DIAT) is an integral part of the blueprinting process which takes into consideration how specifications interact in the final product *before* assembly, makes adjustments to allow for them, and results in the most accurate post-assembly specifications possible.

Blueprinting is a five-step process:

Component Selection – During the fitting process, the type of clubhead, shaft, and grip is selected and the specifications for length, flex, loft and lie angles, swingweight, grip size, and cpm slope determined. During this process the shafts and grips are selected for exactly matched weights. Variations in weight will have detrimental effects on properly matching the clubs, therefore, *exactly* matching weights are critical to blueprinting.

1 - Select the shafts (plus one extra) to identical weights.

2 - Perform the ball-bearing spinefinder test and mark the top of shaft,

3 - Butt-frequency test the shafts and arrange them by low-to-high frequencies.

4 - Select the grips (plus one extra) to identical weights.

Clubhead Adjustments – Post-assembly adjustment of the clubhead loft and lie angles or weight can affect the dynamic interaction between the clubhead and shaft, the shaft flex, swingweight, and length. Establishing the clubhead lie, loft, and weight before assembly is an essential part of blueprinting.

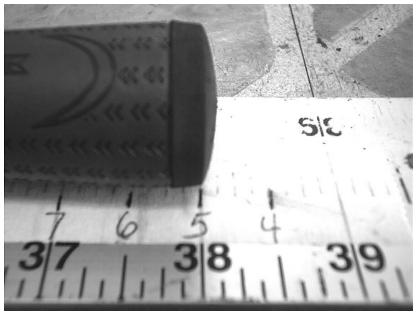
1 - Set the clubhead loft and lie angles to those determined during the fitting session.

2 - Install the extra grip on the extra shaft with the taping pattern that will be used on the production clubs.

3 - If the clubhead requires a ferrule, slightly drill out a ferrule identical to one that will be used on the clubs so that it will easily slide up and down the shaft tip.

4 - Insert the gripped shaft into the longest clubhead, calculate how much to tip trim to achieve the final playing length, then trim to length.

5 - Slide the ferrule onto the shaft and insert the shaft into the clubhead.



6 - Verify the total club length is *exactly* as desired. If necessary, re-trim the shaft to achieve the *exact* length desired, then slide the ferrule down to the hosel.

7 - Check the swingweight. It should be ½-point lower than desired for final assembly. (The weight of the epoxy during final assembly will add the final ½-point.)

NOTE - If the swingweight is lower than desired, wrap lead tape around the hosel exterior until the target swingweight is achieved.

NOTE - If the swingweight is higher than desired, 2-3 grams can be removed by deep drilling the hosel. Use a smaller-than-bore drill bit, and ensure the bit does not penetrate the hosel as it nears the offset.

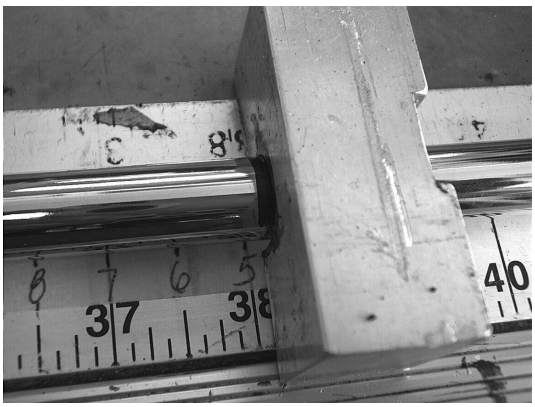
NOTE -Grinding and finish restoration can also be used to reduce clubhead weight. Seven grams were removed from the sole trailing edge and top line of this clubhead by grinding and polishing.

Repeat the above steps for all clubheads to achieve the desired target swing-weights.

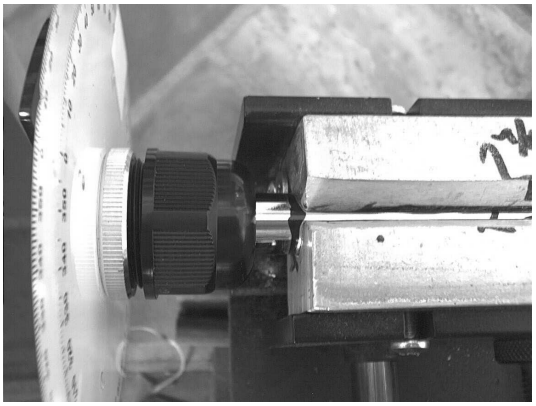
The photo below shows the final weight adjustments achieved by taping, drilling, and grinding for this complete set of Golfsmith Special Forces irons.

Dynamic Interaction Laser Alignment Test (DILAT) – It is my opinion that testing the shaft dynamics with the club in as near a playing condition as possible is a far better than testing just the shaft in an untrimmed state. The following procedures test the dynamic interaction between the clubhead and shaft and orient the clubhead and shaft to obtain a Stable Bending Plane (SBP). DILAT considers how the shaft and clubhead dynamically interact with no extraneous attachments to the shaft that can potentially affect its motion.

1 – Use a piece of bubble-wrap to force fit the lowest-frequency shaft into the longest clubhead. To obtain an accurate shaft frequency, it is imperative the clubhead fit tightly to the shaft. Layer the bubble wrap to ensure a tight fit, and if necessary use a hammer and butt plug to seat the shaft in the clubhead.



2 - Position the spine mark away from the target, and mark the shaft to the desired playing length.



3 - Clamp the shaft in a frequency meter at the playing length mark

4 - Position the spine mark at 3 o'clock. Positioning the mark away from the target installs the shaft's natural curvature toward the target. In my opinion, this orientation promotes a freer release of the shaft through impact by reducing compression forces on the target side of the shaft and reducing tension forces on the backside of the shaft. A Stable Bending Plane is generally located within a few degrees of the spine mark.

5 - Align the clubhead using the vertical laser and apply and mark a small piece of masking tape at the horizontal laser beam.

6 - Pull the club with the horizontal laser beam and dot aligned.

7 - Release and observe the dot orientation relative to the horizontal laser beam. Reorient the shaft and clubhead as necessary and repeat this test until the shaft moves straight back and forth with no off-plane oscillation to achieve the Stable Bending Plane. Most of my clients comment how every club feels and hits alike once the Stable Bending Plane is aligned perfectly perpendicular to the clubface.

Trimming Shaft to Frequency - Once SBP is achieved, measure the frequency. If necessary, disassemble the club, trim the shaft tip, reassemble the club, remark to length, and repeat the DILAT process until the desired cpm and SBP are achieved.

Once all three factors are achieved (length, cpm, SBP) mark the back of the shaft and hosel with a straight line. Align these marks during assembly to maintain the SBP orientation.

Repeat this process for each clubhead.

Post Adjustment and Test Assembly -

1 - Assemble the shaft, clubhead, and ferrule using standard assembly techniques.

2 - Turn and polish the ferrules.

3 - Recheck/reset the loft and lie angles.

4 - Cut all clubs to final length.

5 - Measure and record the no-grip swingweight for each club. They should be within ½ swingweight point for each club unless heavier swingweights are desired for the wedges.

6 - Remove the lead tape from the hosels then swingweight with lead powder and corks to the target swingweights recorded in step 5.

7 - Check the no-grip frequencies. They should be within one cpm of desired.

8 - Install and align the grips to identical lengths.

9 - Install shaft bands and clean/polish clubs in preparation for delivery or packing.