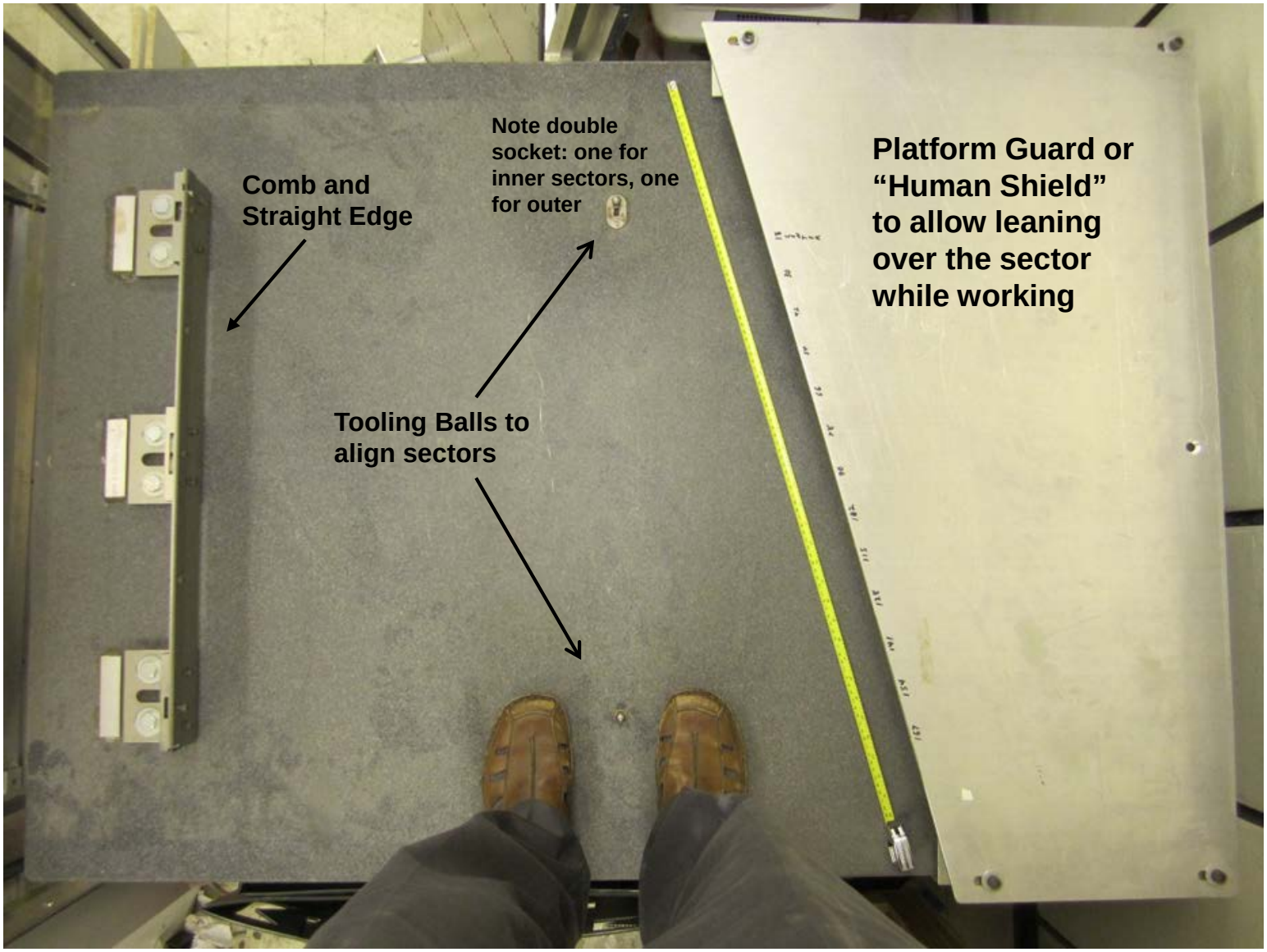
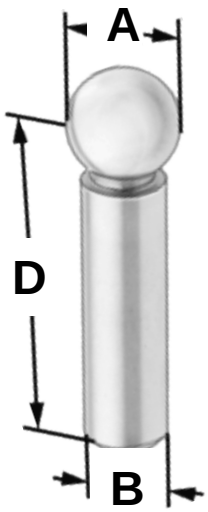
Comb and Tooling Balls exposed – note: table has 2 combs



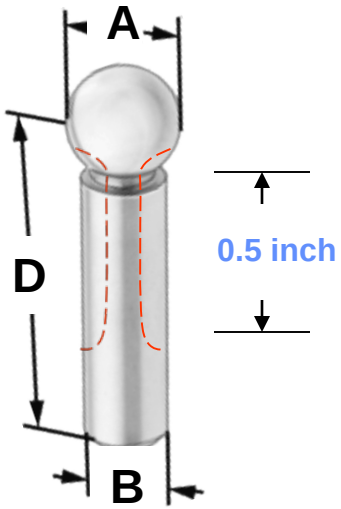
Tooling Ball #1 (lower ball in the figure)



- **The tooling ball is a ½ inch diameter ball sitting on top of a 3/8 inch diameter cylindrical shaft.**
  - **It is made from one piece of steel (not two pieces welded together). See McMaster-Carr (.com) part number 8484A15.**
- **Two of these tooling balls are inserted, vertically, into the granite table to align the sector with respect to the combs.**
  - **The top of the ball is 0.780 ± 0.020 inches off the surface of the table (~2 cm, its height is not critical). The tooling ball shafts are to be pushed into 3/8 inch diameter bronze sleeves that were previously drilled & epoxied into the granite table. Slip fit, not press fit. For example: shaft is 0.3750 +0.0000 – 0.0005, so sleeve should be 0.3753 ± 0.0002.**
- **The tolerances on the ball are very precise in order to provide a good match to the bronze sleeve in the sector strongback.**
  - **The ball is 0.5000 ± 0.0002 inches. The bronze sleeve in the strongback is bored to a diameter of 0.5003 ± 0.0002 inches. See drawings 24A3685B and 24A0212C.**
- **For an inner sector, the two balls are spaced 25.280 ± 0.001 inches apart on the table. This is the most precise dimension on the granite table. The ball and shaft must be vertical.**
  - **The alignment and spacing must be right or the sector will not fit over the tooling balls. An alignment jig that matches the sleeves in the sectors should be used when drilling and epoxying the sleeves for the balls into the table.**

Check the master drawings before believing any dimension quoted here

Tooling Ball #2



- **Tooling Ball #2 is very similar to tooling ball #1 except that the shaft under the ball has been modified to make it flexible.**
  - **The 3/8 inch diameter shaft has been machined down to a thickness of 0.067 inches (perhaps the goal was 1/16 inch … but I measured 0.067). See drawing to the left.**
  - **The pin is inserted into a steel fixture (or bronze sleeve) that was previously drilled, located precisely, and epoxied into the granite table.**
  - **The pin is inserted into the table so the thin axis of the tooling ball is perpendicular to the line between the two tooling balls. This allows the ball to flex in the direction of the other tooling ball.**
- **Alternatively, a "Diamond Pin" can be used.**
  - **The diamond has different dimensions on the long and short axes: they differ by 0.002 inches, or more. If the appropriate dimensions can be found (is 0.002 inch appropriate?) then a diamond pin would replace the need for a flexible pin. See:**

    http://www.invert-a-bolt.com/shop_locatingpins.shtml
- **More details about tooling balls and alignment pins:**
  - **http://us.misumi-ec.com/maker/misumi/mech/tech/locatingpinshowtheyareused/**