

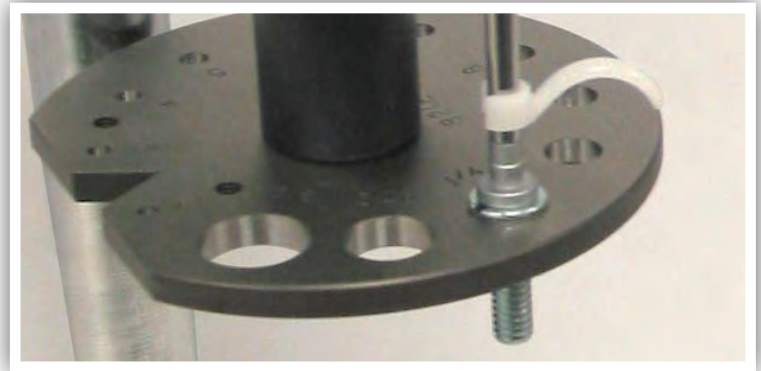
Measuring Flat Head Screws

by Larry Borowski

The measurement of flat head screws continues to cause confusion among fastener producers, resellers, and end users. The reason for this confusion is that flat head screws cannot be measured directly with calipers, micrometers, or optical comparators as can the features of most other head styles. The critical measurement of the flat head screw is referred to as the “protrusion above gaging diameter”.

Flat head screws are specified by users so that the heads will be at or slightly below the end products surface after installation. This is usually done to eliminate component interference, such as window tracks and hinges. Flat heads are also the predominant head design of fasteners used on aircraft exterior panels to minimize air friction and wind drag, which affect the vehicle’s performance and fuel economy. It is important when inspecting flat head fasteners that it be accurately determined if the heads will lay at or below the product’s surface when the fasteners are installed.

Many people still try and measure flat head screws from the top of their head to the juncture of the head to shank area to determine acceptability of the head. This is not an acceptable procedure. Anyone looking at any dimensional standard will see that this dimension is listed as “reference”, meaning that this is not a controlled feature. Part of the reason this dimension is not controlled as such is that the flat heads cannot be economically cold headed with the edge of the heads at “dead sharp”. When this is attempted



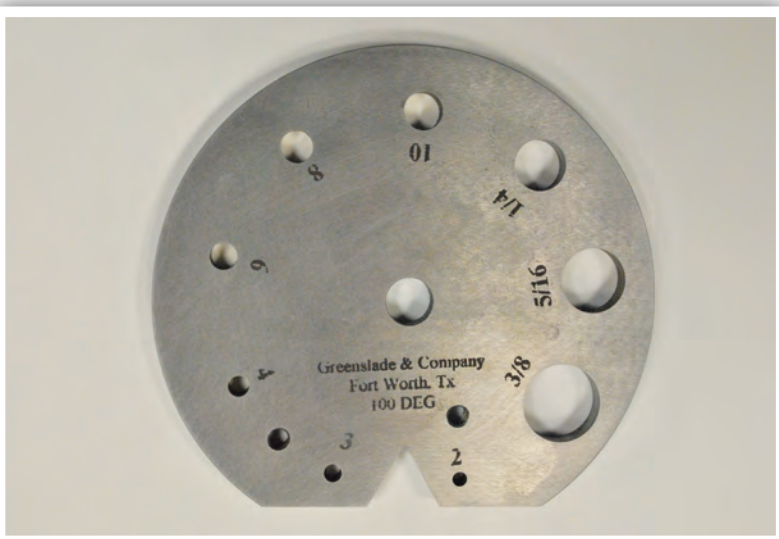
Measuring Flat Head

the tool life is very low. The punch must be kept away from the die face to allow some material to form above the head angle providing a kind of cushion between the punch and die to improve die life. This part of the head above the angle is very difficult to measure accurately. It is also very difficult to make an accurate measurement to the exact theoretical point where the head intersects with the screw body. This intersection is usually hidden by a generous radius making that precise location a guess at the very best.

The correct head acceptability feature to be measured is the “protrusion”. The head protrusion is the amount that the given head protrudes or projects above a gaging surface when the head is placed in a precise gage diameter. Most flat head screw specifications designate the “gage diameter” and the protrusion height.

These protrusion values are derived from a formula that is shown in ASME B18.6.3. The protrusion height limits are derived by plugging in the values of the screws theoretical maximum and minimum sharp head diameter dimensions along with the maximum and minimum head angle and selected gage diameter.

Protrusion height measurements were difficult to make in the past because every manufacturer and user had to produce their own gages. In recent years, gages have become more readily available specifically for measuring standard 82°, 90°, and 100° heads in accordance with ASME, ISO, or NAS standards. One simply rotates a gaging plate or chooses the correct protrusion block and positions it under an indicator. The indicator is zeroed on the surface of the plate or block next to the hole, the fastener is placed into the gaging hole,



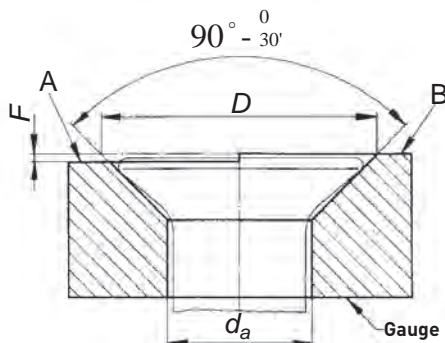
PHG Plate

and the indicator foot is placed on top of the fastener head. The resultant value is the Protrusion or Protrusion head height. The use of these protrusion gages has helped improve the correlation of measurement results between suppliers and end users.

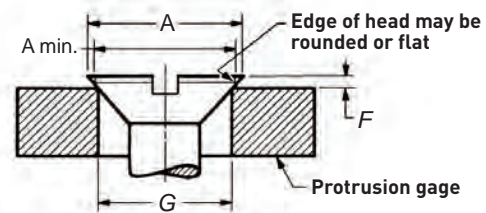
Unlike the other screw specifications, ISO 7721 which covers flat head screws requires a countersunk gaging hole rather than a cylindrical hole, which makes the gage more difficult to produce. By using the formula described above in the ASME standards, the protrusion limits can be derived from using the same cylindrical gaging diameters specified for standard 82° flat heads. This approach makes the inspection of socket flat heads simpler and correlations between suppliers and users much better. The adoption of this measurement approach can be found in Aerospace fastener standards as well as many proprietary fasteners standards.

All military fasteners flat heads are measured in a cylindrical gage diameter. One minor difference is that the indicator foot (stylus) takes on various shapes including a forked design to straddle the recess unlike the commercial approach with a flat foot that rests across the entire screw head. The military standards refer to this head feature as “flushness”, rather than protrusion.

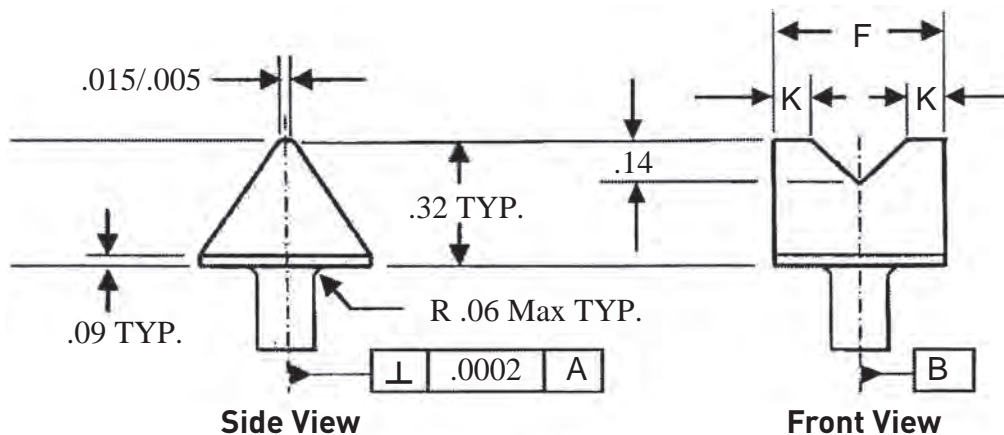
The correct measurement of flat heads is an area where there is still confusion between suppliers and end users. The resolution of this confusion is simple. Suppliers and users must simply read the applicable specifications and use the appropriate gages for the type of screw they are manufacturing or using. Flat head protrusion is a critical fastener characteristic which must conform to specific requirements if the fasteners are to perform their intended function properly.



ISO Style Gaging



ASME Style Gaging



Side View

Front View