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# Specifying the Clocking of Patterns of Features[1]

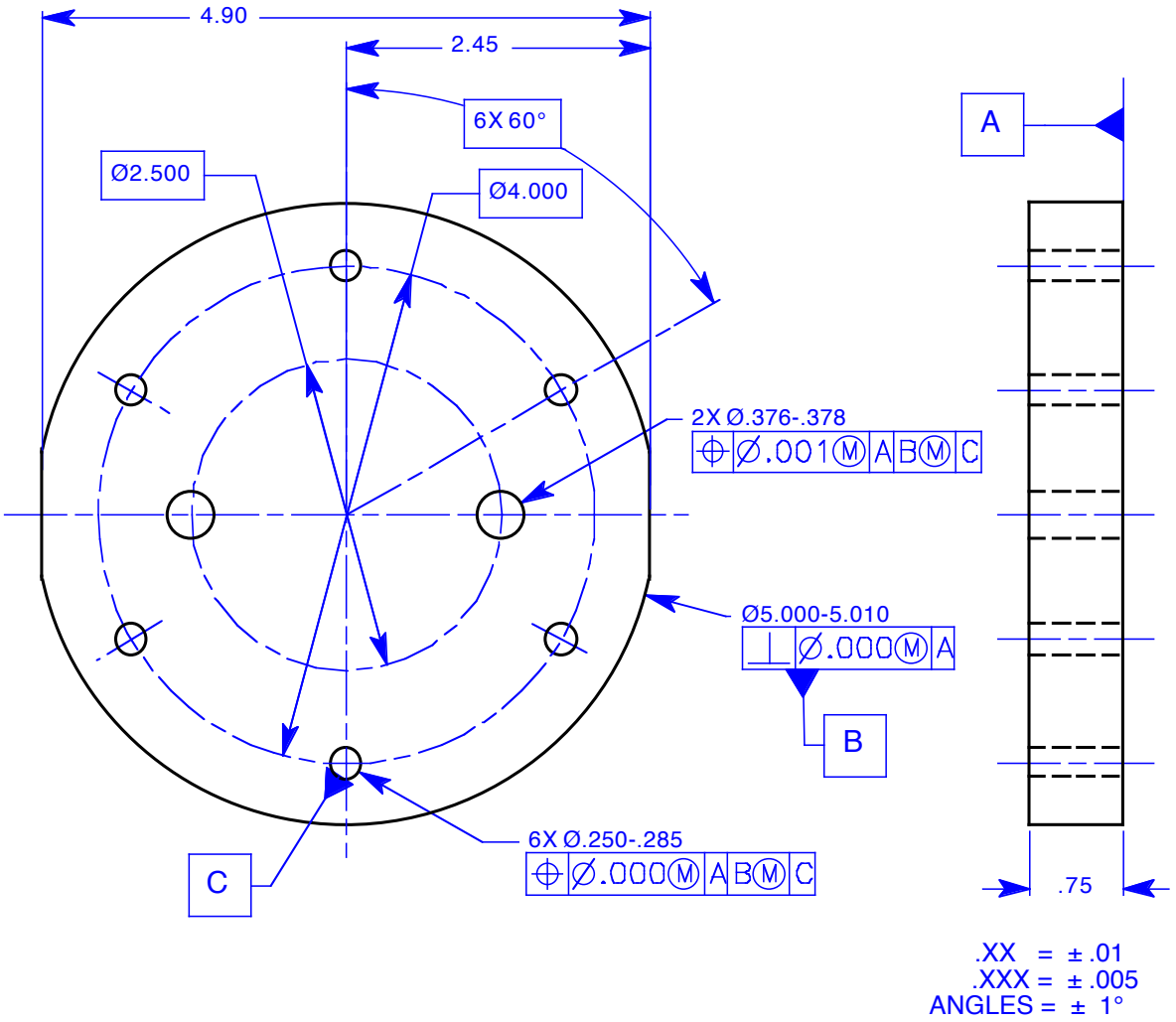


**Figure 1** An example of patterns of features incorrectly clocked to a datum feature.

In Figure 1, datum feature C is incorrect. The six-hole pattern is clocked to one of the holes in the pattern. It looks like the designer wants to control the clocking of the two hole patterns. The two patterns are locked together as one composite pattern , but datum feature C is free to rotate anywhere around the axis of datum feature B as long as it is on the Ø4.000 bolt circle. Consequently, the two hole patterns are free to follow datum feature C.

1. There is no need to clock the other five ¼ inch holes to the sixth hole, datum feature C, because angular separation between the six holes on the basic 4-inch diameter bolt circle has been accomplished with six basic 60° angles.

[1]Cogorno, Gene R., ***Geometric Dimensioning and Tolerancing for Mechanical Design, Second Edition***, McGraw-Hill, New York, 2011, p. 239

2. The engineer may have been trying to clock the two-hole pattern to the six-hole pattern. But that has already been accomplished, since multiple patterns of features are to be considered one composite pattern if they are located with basic dimensions, have the same datums, in the same order of precedence, and at the same material conditions. This is the case here. Datum feature C is not required to clock the two patterns to each other. A better way to clock the two-hole pattern to the six-hole pattern is shown in Figure 2. In this case, the two hole patterns are clocked together as multiple patterns of features, explained above, however they are free to rotate about the axis of datum feature B.

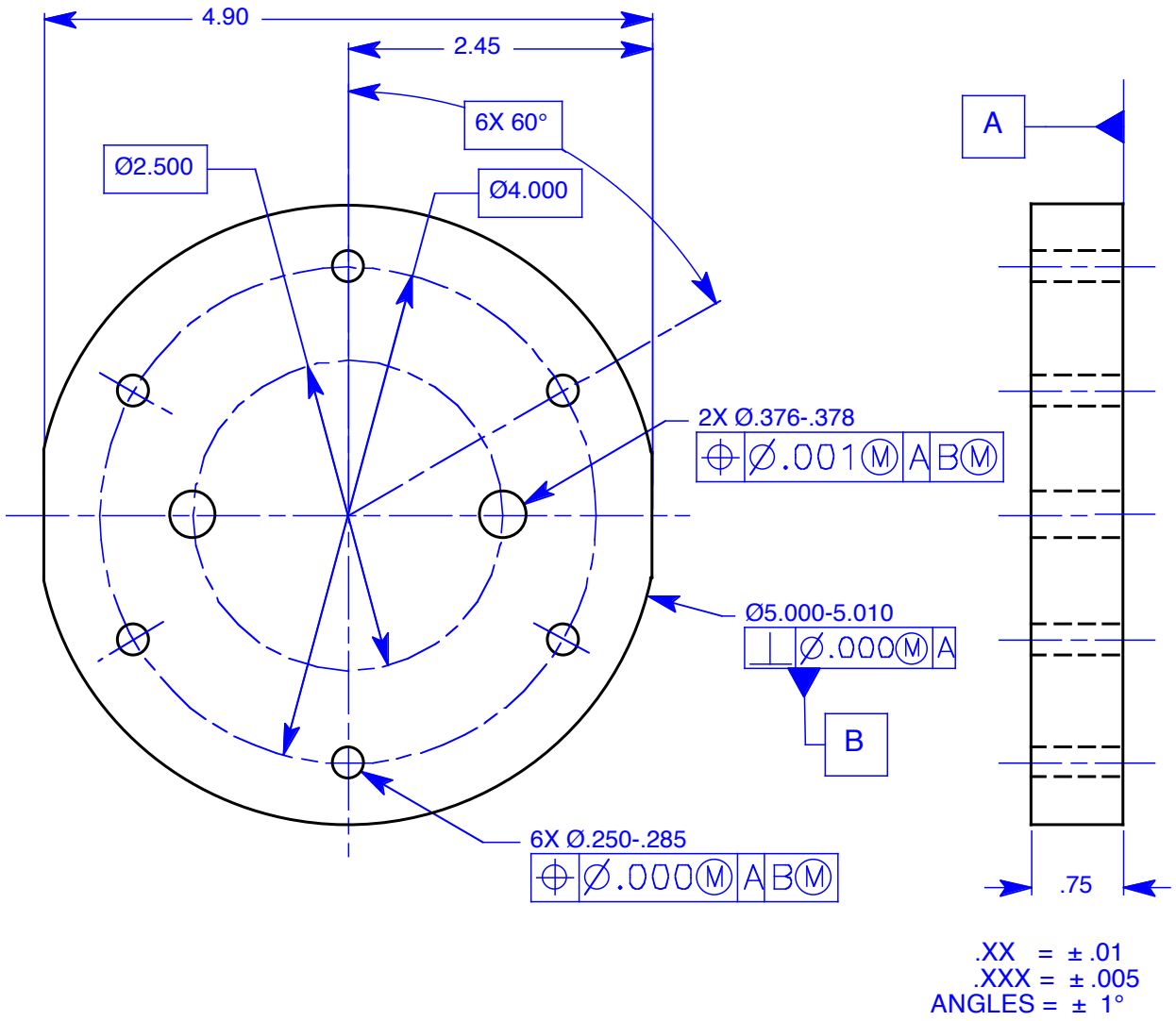


**Figure 2** A correct example of patterns clocked only to each other but free to rotate around the axis of datum feature B.

3. It appears that the engineer was trying to clock both hole patterns to one or both of the flats on the 5-inch outside diameter since the flats are located to the center plane that passes through two of the holes in the six-hole pattern. If this is the case, one or both of the flats should have been specified as datum feature C as shown in Figure 3.

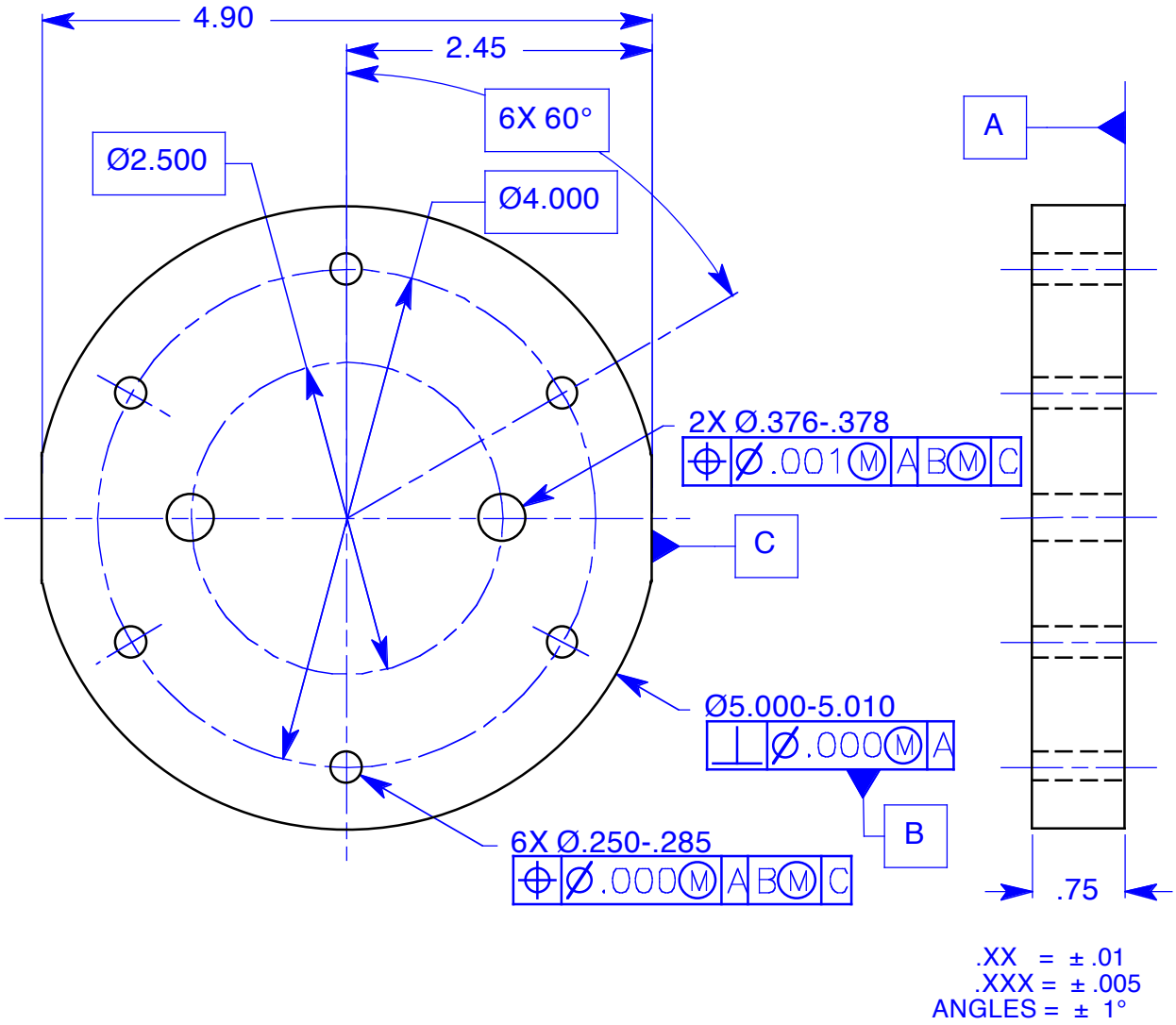


**Figure 3** A correct example of patterns of features clocked to each other and to datum feature C.

In Figure 3, the two position controls specifically orient the hole patterns perpendicular to datum feature A, locate the bolt circles to the axis of datum feature B at maximu material boundary, clock the patterns to the flat, datum feature C, and lock the two patterns together as one composite pattern. The flats on each side of the part are parallel to each other within the title block tolerance of ± 1°.

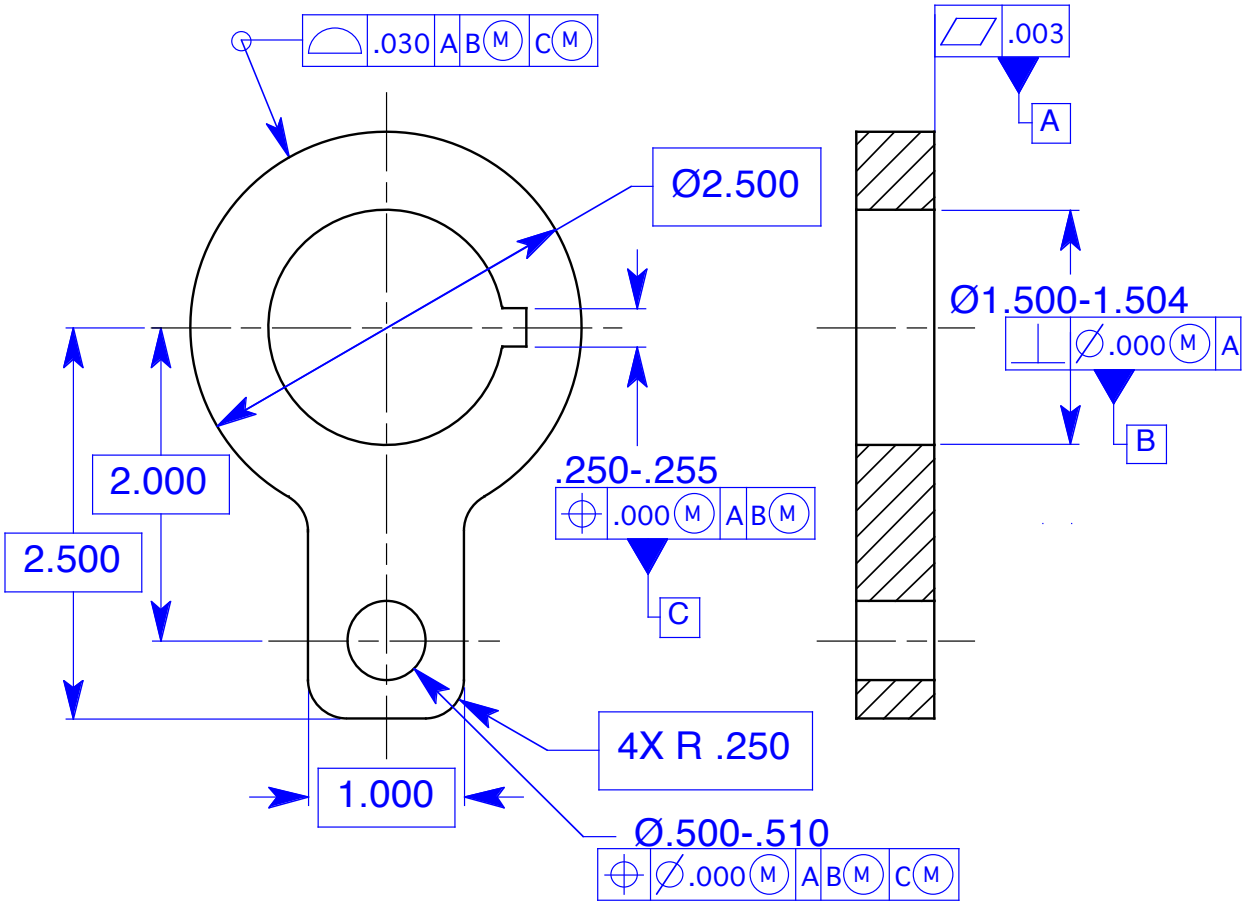


**Figure 4** A good example of features clocked to a datum feature.

The datum selection, the datum sequence, and the application of geometric controls were all very well done on the drawing in Figure 4.

1. The primary datum feature, datum feature A, is required to be flat within .003.

2. The secondary datum feature, the Ø1.500 hole identified as datum feature B, is oriented to datum feature A within a zero perpendicularity tolerance at maximum material condition. This means that if the diameter of the hole, datum feature B, is produced at 1.502, the hole may be out of perpendicularity by .002 and still be within tolerance.

3. The keyway is perpendicular to datum feature A and located to Datum feature B within a zero positional tolerance at maximum material condition. In other words, if the keyway is produced .253 wide, it may be out of perpendicularly to datum feature A and out of position to datum feature B within a tolerance of .003.

4. And finally, both the Ø.500 hole and the profile have been properly oriented, perpendicular to datum feature A, located to datum feature B at maximum material boundary, and clocked to the keyway, datum feature C at maximum material boundary. The Ø.500 hole and the profile are locked together as one composite pattern.