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The Datum Reference Frame[1]

Application of Datums

Datums and datum reference frames are considered to be absolutely perfect, which makes them imaginary. Measurements cannot be made from theoretical surfaces. Therefore, datums are assumed to exist in and be simulated by processing equipment such as surface plates, gages, machine tables and vises. Processing equipment is not perfect, but is made sufficiently accurately to simulate datums. The three mutually perpendicular planes of a datum reference frame provide origin and direction for measurements from simulated datums to features.

Immobilization of a Part

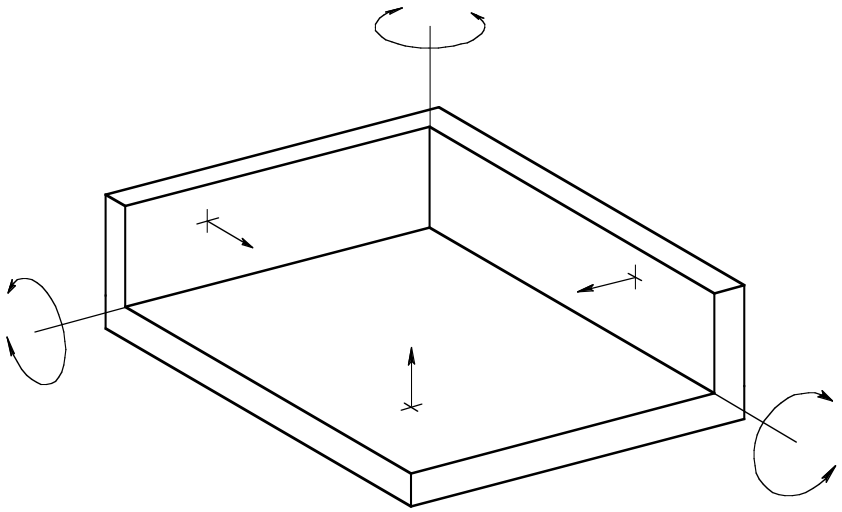

Figure 4-1 The three mutually perpendicular intersecting datum planes of a simulated datum reference frame.

[1]Cogorno, Gene R., ***Geometric Dimensioning and Tolerancing for Mechanical Design, Second Edition***, McGraw-Hill, New York, 2011, p. 50.

Parts are thought to have six degrees of freedom, three degrees of translational freedom and three degrees of rotational freedom. A part can move back and forth in the X direction, in and out in the Y direction, and up and down in the Z direction, and rotate around the X-axis, around the Y-axis, and around the Z-axis as shown in Figure 4-1.

A part is oriented and immobilized relative to the three mutually perpendicular intersecting datum planes of the datum reference frame in a selected order of precedence as shown in Figure 4-2. In order to properly place an imperfect, rectangular part in a simulated datum reference frame, the primary datum feature sits flat on one of the planes with a minimum of three points of contact that are not in a straight line. The secondary datum feature is pushed up against a second plane with a minimum of two points of contact. Finally, the part is slid along the first two planes until it contacts the third plane with a minimum of one point of contact. The primary datum feature on the part contacting the simulated datum reference frame eliminates three degrees of freedom, translation in the Z direction and rotation around the X-axis and the Y-axis. The secondary datum feature on the part contacting the simulated datum reference frame eliminates two degrees of freedom, translation in the Y direction and rotation around the Z-axis. The tertiary datum feature on the part contacting the simulated datum reference frame eliminates one degree of freedom, translation in the X direction.

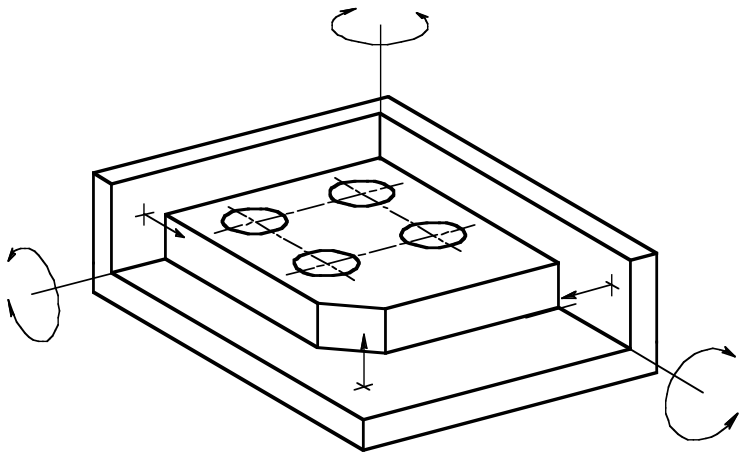

Figure 4-2 Immobilizing a part within the three mutually perpendicular intersecting datum planes of a simulated datum reference frame.

Not all parts can be positioned in the datum reference frame shown above. Below are some common parts and the datum reference frames used to immobilize them.

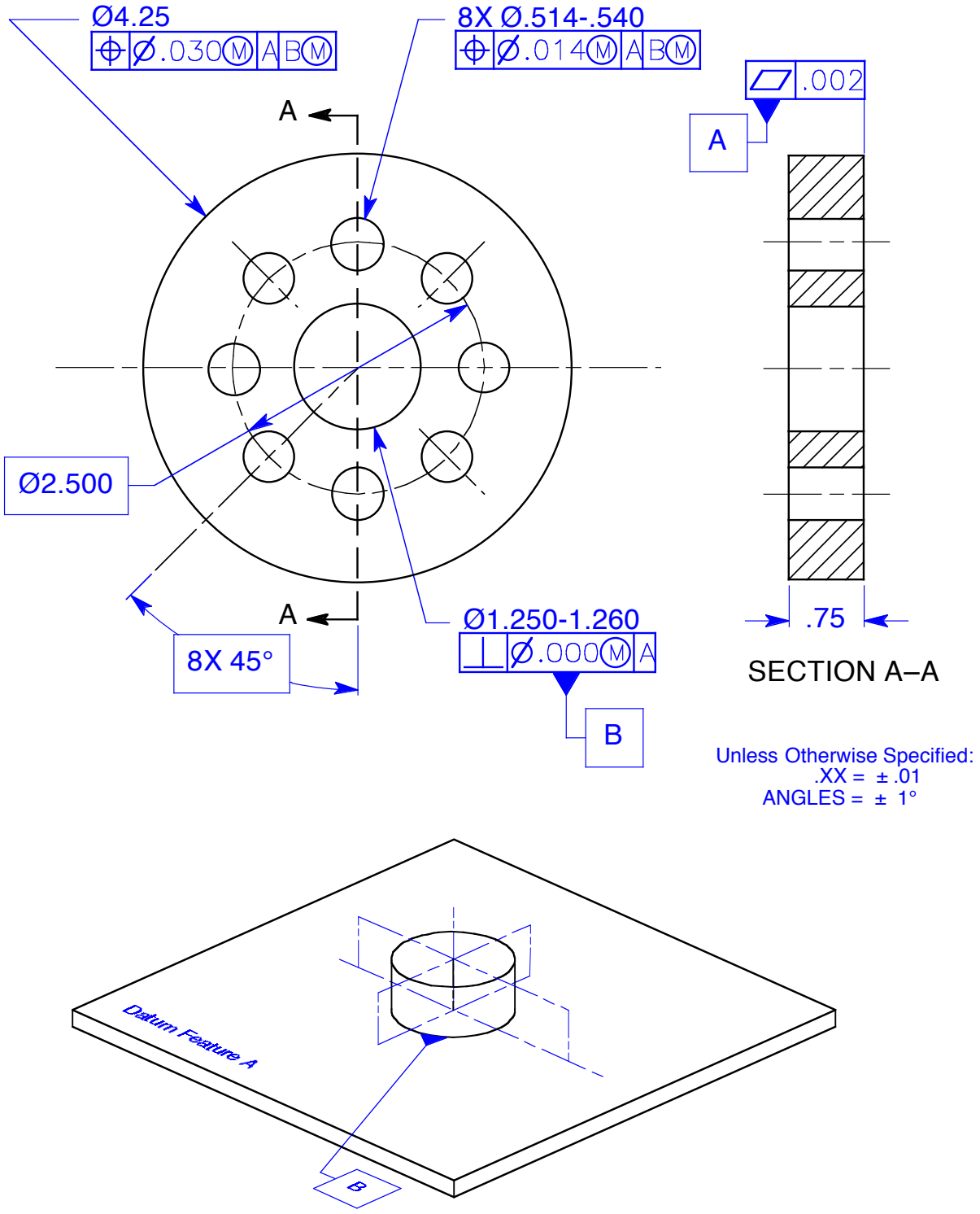

Figure 4-2A The three mutually perpendicular intersecting datum planes of a simulated datum reference frame consisting of a plane and a cylinder.

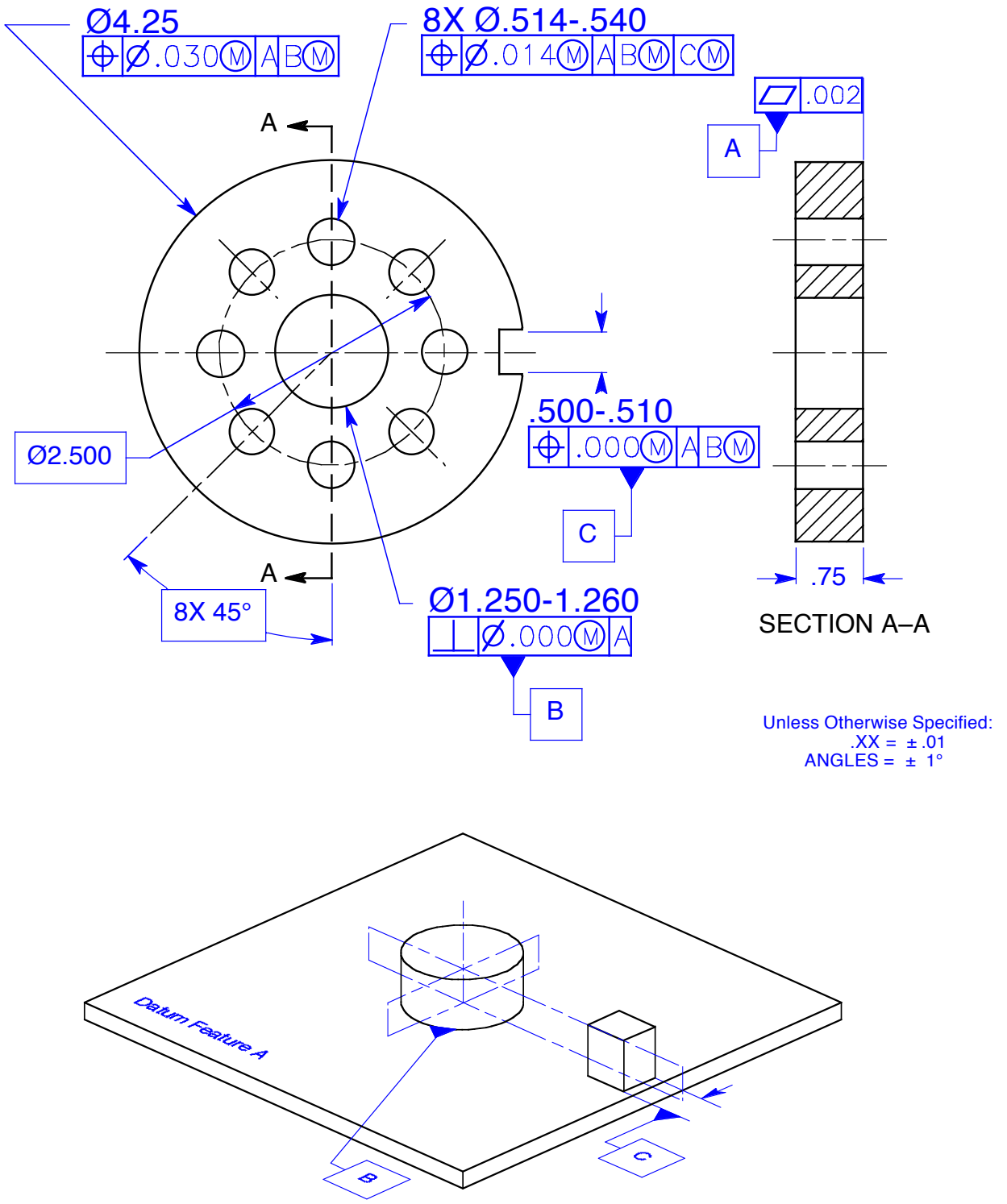

Figure 4-2B The three mutually perpendicular intersecting datum planes of a simulated datum reference frame consisting of a plane, a cylinder, and a key.

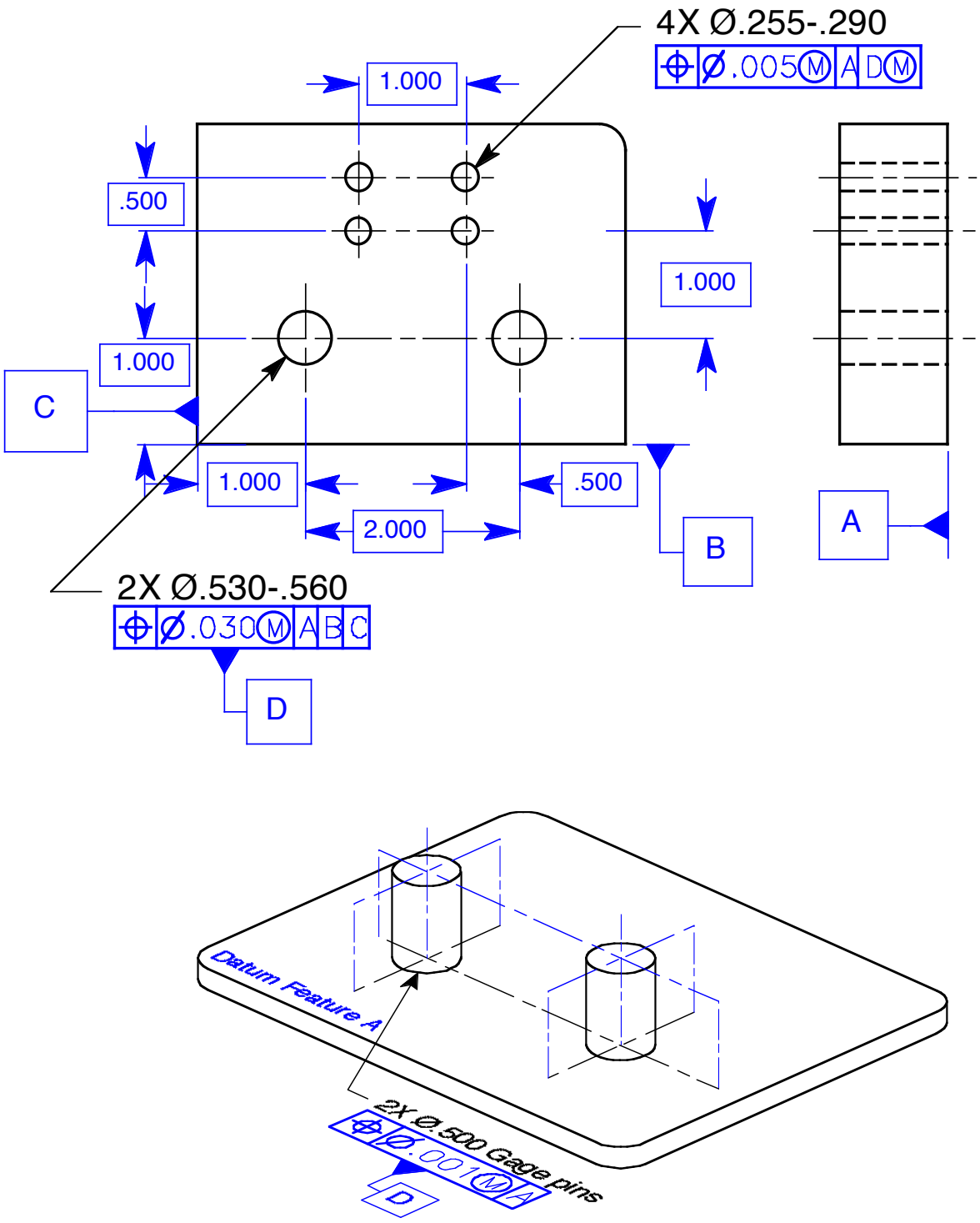

Figure 4-2C The three mutually perpendicular intersecting datum planes of a simulated datum reference frame consisting of a plane and two cylinders.

No mater what the configueration of the fixture or open setup, it must establish two, three, or four mutually perpendicular intersecting datum planes in order to properly position the part.