Pipe Problem

Using the fact that a right angled isosceles triangle is formed by the center of the circle C, the corner A of the carpenter's square and the point of tangency of the square to the circle we have:

\[(d + r)^2 = r^2 + r^2\]

\[(r + d)^2 = 2r^2\]

Expanding, placing all terms on the left hand side of the equation and collecting terms gives a quadratic equation in \(r\):

\[\text{expand}\left((r + d)^2 = 2r^2, \ r\right)\]

\[r^2 + 2dr + d^2 = 2r^2\]

\[\text{ans} - 2r^2\]

\[-(r^2) + 2dr + d^2 = 0\]

Solving this equation for \(r\) in terms of \(d\) with \(d > 0\) and \(r > 0\) gives:

\[\text{solve}\left(-(r^2) + 2r\cdot d + d^2 = 0, \ r\right) \mid d > 0 \text{ and } r > 0\]

\[r = d\left(\sqrt{2} + 1\right)\]

The above result is the exact answer. An approximation that could be used in the real situation would be:

\[r = \left(\sqrt{2} + 1\right)d\]

\[r = 2.41421\ d\]