

Correctly Measuring a Hydraulic Flange

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A hydraulic flange provides a threadless, virtually leak-free connection to a port. When replacing a flange, the new flange needs to match the bolt pattern of the port on the connecting part. These bolt patterns are commonly drawn from standards, so determining the flanges needed is easy if the standard is known. The flange envelope dimensions are of secondary interest because they can vary depending on production methods. If the standard is not known, the bolt pattern is a major factor used to determine the correct replacement flange. This paper will discuss how to determine the bolt pattern of the flange and share an easy way to measure key dimensions. Remember that a few OEMs use special patterns that might not conform to any standards.

DETERMINING THE NUMBER AND ORIENTATION OF THE BOLT HOLES

The flange that is being replaced is a manufactured product and will not exactly match the nominal bolt spacing dimension of any standard flange pattern, but it should be within tolerance. Flange standards always use rational nominal dimensions (2 5/8 inches, 98mm, etc.), but which bolt spacing dimension is the nominal one? Is the pattern rectangular, square, circular, or a double pattern? Are the basic dimensions inch or metric? All major national and international standards for hydraulic flange connections specify an even number of bolts (I will use the term bolts to match the phases “bolt pattern” and “bolt circle,” however normally a screw is used.) If there are eight bolt holes that are not equally spaced, this might indicate two rectangular four-bolt patterns. If there are six or more boltholes, equally spaced, arranged in a circle, you should measure the bolt center to bolt center spacing on the diagonal (called a bolt circle).

Sometimes only adjacent bolts can be measured. The bolt circle measurement is given by dividing the center-to-center adjacent bolt measurement by the factors on the right.

Number of Bolts	Divisor
4	.707
6	.500
8	.383
12	.259

If four bolt holes form a rectangle, the pattern probably conforms to SAE J518 and/or ISO 6162-1 or ISO 6162-2, and you should measure between the centers of adjacent bolt holes. If there are four bolt holes equidistant from each other, you have either a bolt circle pattern, which is measured on the diagonal (the nominal dimension is the diagonal), or a bolt square pattern (the nominal dimension is between adjacent bolts), which is measured using adjacent bolt holes. Figure 1 illustrates the terms “bolt square” and “bolt circle” and how the different patterns are measured.

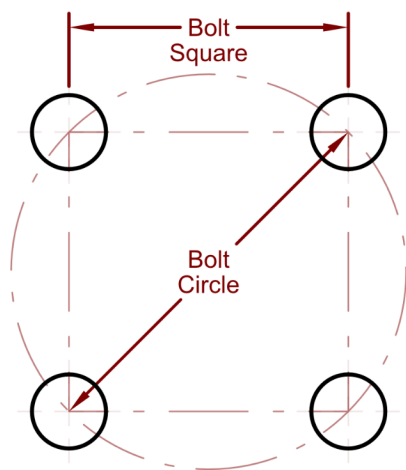


Figure 1 – Illustration of dimensions to measure on bolt square vs. bolt circle patterns

In all cases, bolt hole patterns typically have a tolerance of +/- 0.25 mm

MEASURING THE DISTANCE BETWEEN CENTERLINES OF BOLT HOLES

Here is an easy way to measure the bolt square or bolt circle dimensions shown in figure 1 if the bolt holes are inaccessible. If the bolts are installed but accessible, the procedure below will give you fairly good results. This procedure can be made while the flange is still in service.

1. Using digital calipers, measure one of the bolt heads, then zero out the display. The measurement of the bolt head is normally about 1.5 times the bolt size. Figure 2 shows the calipers after measuring the bolt head and zeroing out the display.

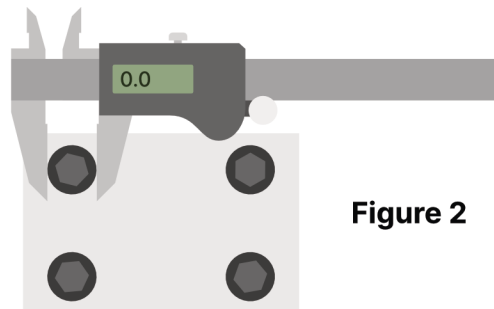


Figure 2

2. Using the zeroed-out calipers, measure the bolt square or bolt circle to the outside of the bolt heads. Figure 3 shows how this is done. If you are not sure if the flange pattern is inch or metric, measure in inches, and if the resulting measurement is more than a few thousandths of an inch from a simple rational number, the flange is possibly metric. To check, hit the in/mm button on the calipers or multiply the inch measurement by 25.4. If the number is close to a simple rational number in metric, you can assume that the flange is metric.

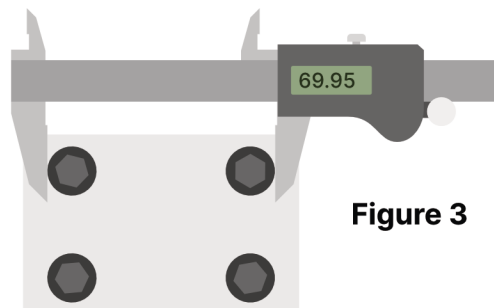


Figure 3

3. Because the zeroing process in the first step accounts for the radii of both bolt heads and bolt holes, the dimension on the calipers' display is the distance between the center-lines of the bolts. Use this dimension when ordering your replacement flange. Note that in figure 3, the calipers display a dimension of 69.95mm. This would be the actual dimension measured ($\pm .05$ mm) but in this case, the nominal dimension for the relevant standard is 69.9mm ($\pm .25$).

If the bolt holes are accessible, use the shorter ID measuring nibs to measure the ID of the holes instead of the OD of the bolt holes in step 1. Then, measure the outer arc of the bolt hole diameters similar to figure 3 to achieve the same result.

EXAMPLES

Figure 4 shows how many typical flange bolt hole patterns can be easily confused with each other, and how important it is to measure the correct dimension and measure it precisely. The values on the left are measurements made according to the bolt square convention between 2.728 and 2.828 inches; however, some of these bolt hole patterns are actually bolt circles, or metric, or both. The numbers in parentheses indicate the actual design. An additional point of differentiation is the bolt size.

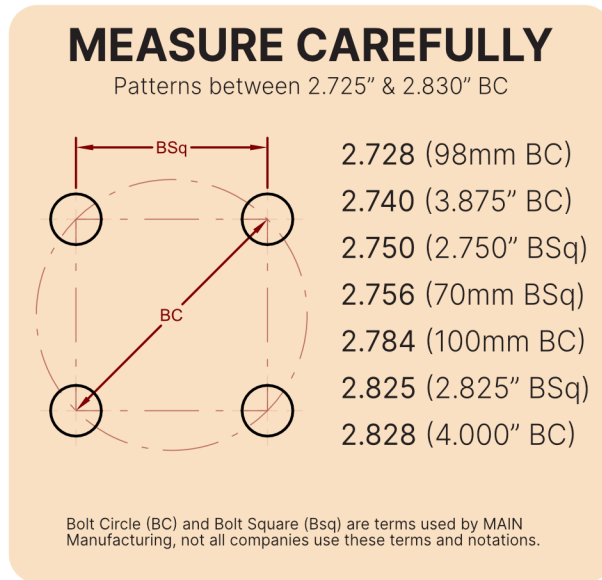


Figure 4

SUMMARY

Careful, accurate measurement of flange bolt hole patterns will help ensure that you get the right flange for your application, and with the method described above, it can be relatively easy to do. Of course, your flange supplier will be happy to help you find the correct product.

For more information, visit <https://www.mainmanufacturing.com>

