CAIN BOLT & GASKET INC.

GASKET INSTALLATION PROCEDURES AND LEAKS

I. Installation Procedure:

To obtain a satisfactory seal, it is necessary that basic procedures are followed during installation. These procedures are of fundamental importance for a successful operation no matter what style of gasket or material used.

a) Inspect the flange sealing surface. Check for tool marks, dents, scratches or corrosion. Radial tool marks on the sealing surface are difficult to seal regardless of the style of gasket. Be sure that the finish is adequate for the style of gasket being used.

b) Inspect the gasket. Verify to be sure the gasket material is compatible with the intended service. Check for defects and shipping or storage damage and tool marks on solid gaskets.

c) Inspect and clean bolts, nuts, and washers.

d) Lubricate bolt threads and the nut contact surfaces. Do not install bolts and nuts without lubrication. The lubricant should be compatible with the service temperature.

e) For raised or flat faced flanges installed vertically, installation is started by the bolts on the lower part. Install the gasket then the other bolts.

f) For male and female or tongue and groove flanges, the gasket should be installed in the center of the groove.

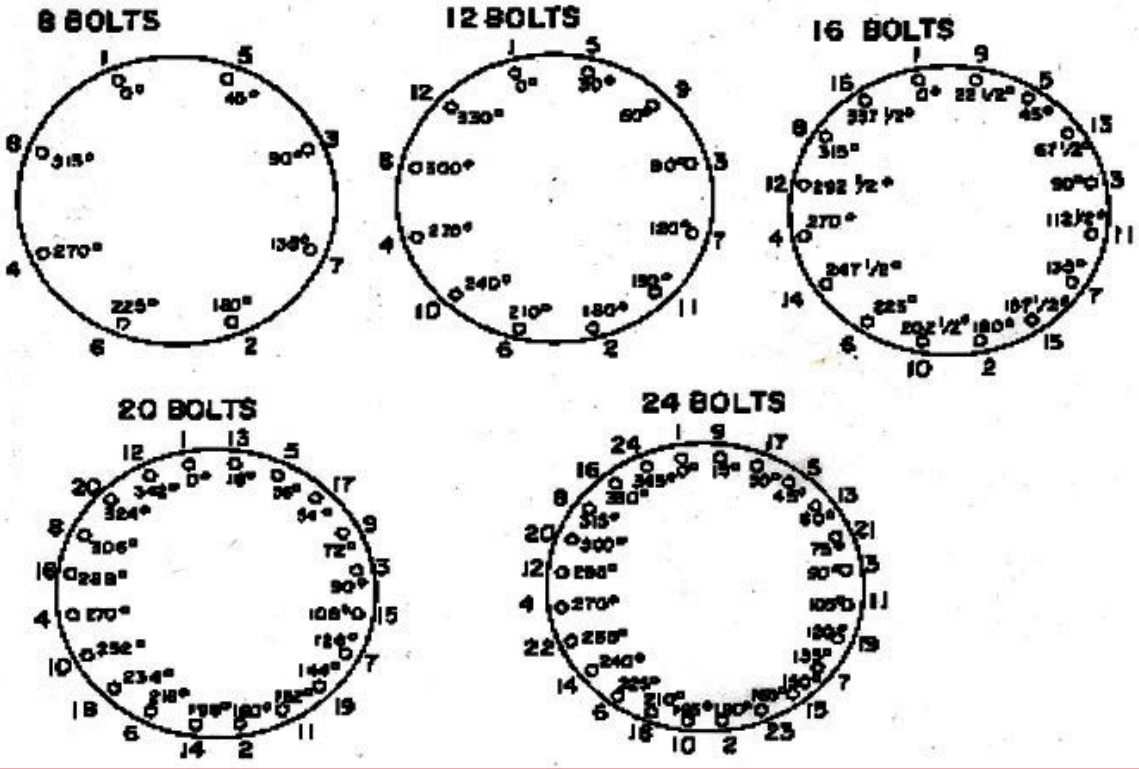
g) Tighten the bolts approximately 30% of the final torque following the sequence shown in the below diagrams for the different types of flanges. Number the screws to facilitate following the tightening order. If the correct tightening sequence is not followed, the flanges may be misaligned, making it impossible to have a uniform seating of the gasket.

h) Repeat step g, elevating the torque from 50% to 65% of the final value.

i) Continue tightening in the recommended sequence until the final value is reached. The same bolt normally has to be tightened more than once.

j) All gaskets relax after seating. Retightening is recommended 24 hours after installation to compensate for the relaxation.

II. Tightening Sequence:



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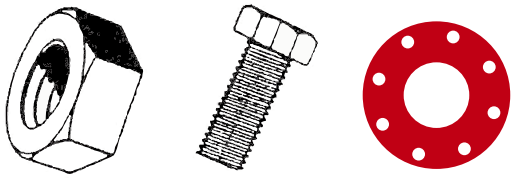


III. Torque Values:

The most correct method for obtaining the correct seating stress is to apply the bolt load by direct measuring its tension. However, in practice, this procedure is cumbersome and of difficult execution. If direct tension measuring is not possible, it is recommended to use a torque wrench or hydraulic tools. The use of manual tools without torque control is acceptable only in non-critical applications.

IV. Allowable Bolt Stress:

The ASME Pressure Vessel and Boiler Code, Section VIII, Appendix S specifically deals with the bolt stress. For example, the designer of the flange should determine the necessary tightening for the temperature and pressure in specific operational conditions according to the allowable bolt stress at the operating temperature.

Hydrostatic testing, which in the majority of cases is necessary to verify the system, is done at one and a half times the operational pressure. Consequently, a flanged joint designed in accordance with the ASME Code, which should be hydrostatic tested with a pressure higher than the design pressure, has to be tightened for the test.

The ASME Pressure Vessel and Boiler Code, Section VIII, Appendix S established that in order to pass the hydrostatic test, the bolts must be tightened up to the torque necessary for that purpose. If, in this case, the tension is greater than what is admissible, bolts made with a higher allowable tension material should be used observing the following procedure:

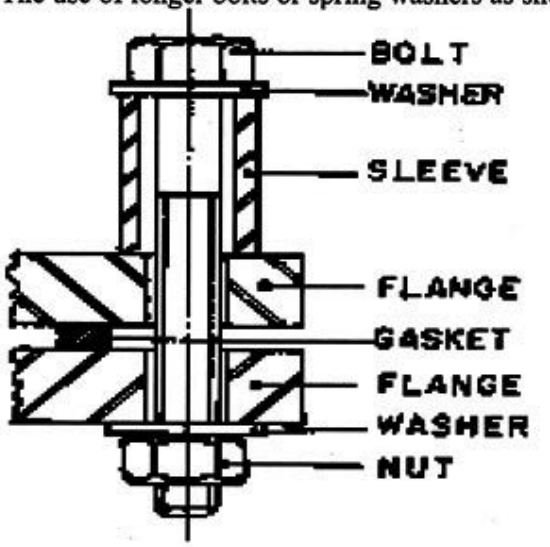
- Use bolts with allowable tension compatible with the one necessary to pass the hydostatic test, following the normal installation procedure for the gasket.
- After the hydrostatic test is completed, loosen the bolts approximately 50% of the initial tension.
- Replace the bolts used for the test with the originally designed bolts, one at a time, tightening until reaching the torque of the other bolts.
- After replacing all bolts, tighten them up to the design torque following the recommended sequence.

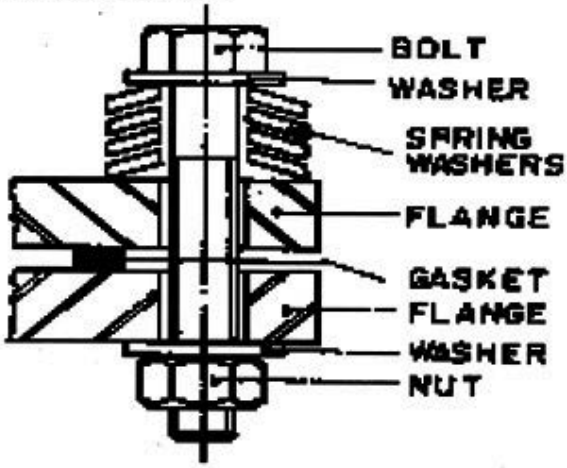
V. Thermal Growth:

When the bolts are tightened to resist the existing forces of the system, care should be taken with tensions caused by different thermal growth coefficients of the materials and by the temperature gradient in the flanges and bolts.

Whenever thermal growth is a serious problem it is recommended that the gasket be seated up to a point to allow an additional seating when the operational temperature is reached.

The use of longer bolts or spring washers as shown below is also recommended.





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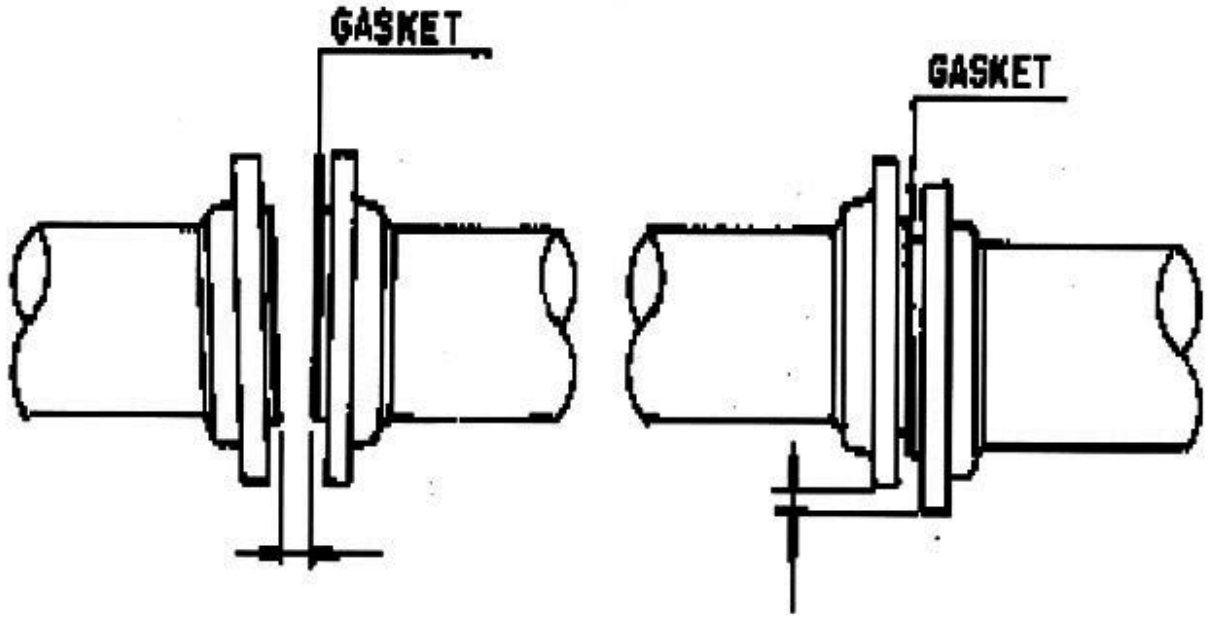
VI. Leakage:

One of the most efficient ways to analyze the causes of leakage is to carefully analyze the gasket used when such a leakage has taken place as shown below.

- A very corroded gasket: select a material with better corrosion resistance.
- A very extruded gasket: select a material with a better cold flow resistance or with a higher seating stress, use a compression limiter ring or redesign the flanges.
- Gasket with a damaged sealing surface: verify the gasket and flange dimensions. It could be that the gasket has the inside diameter smaller that the inside diameter of the flange or the outside diameter of the gasket is larger than the outside diameter of the flange.
- Gasket not seated: select a softer gasket or reduce that contact area between gasket and flange.
- Gasket thinner at the outside diameter: indication of a "rotation" or flange deflection. Change the gasket dimensions in a way that it fits closer to the bolts to reduce the rotational torque. Select a softer gasket that requires a lower seating stress. Reduce the area of the gasket. Reinforce the flange to increase its rigidity.
- Gasket irregularly seated: incorrect procedure in tightening the bolts. Make sure the tightening sequence of the bolts is followed properly.
- Gasket with regularly varying thickness: indication of flanges with excessive distance between bolts or without sufficient rigidity. Reinforce the flanges, reduce the distance between bolts or select a softer gasket.

VII. Misaligned Flanges:

When the flanges are not aligned, as shown below, it is not recommended to align them by tightening the bolts. Misalignments must be corrected.



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