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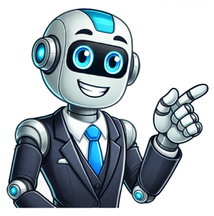

29 Dec 2024 Tags: Mechanical Engineering Mechanical Design Bolted Joints Bolt Sizing for Flanged Connections Popularity: Bolt Size Calculation for Flanged Connections This calculator determines the required bolt size for a flanged connection using API 6A and ISO 13628-3 standards. Explanation Calculation Example: The required bolt size for a flanged connection can be determined using the formula: R = (P * F) / (A * S), where P is the axial load on the bolt, F is the factor of safety, A is the bolts tensile stress area, and S is the allowable bolt stress. This formula ensures that the bolt can safely withstand the applied load. Q: What are the key considerations in selecting the appropriate bolt size for a flanged connection? A: Key considerations include the axial load, the allowable bolt stress, the factor of safety, and the bolts tensile stress area. These parameters need to be carefully evaluated to ensure the bolt can withstand the applied load and maintain the integrity of the connection. Q: How do API 6A and ISO 13628-3 standards guide bolt selection for flanged connections? A: API 6A and ISO 13628-3 provide specific requirements and guidelines for bolt selection in flanged connections, including material properties, allowable stresses, and design considerations. Adhering to these standards ensures the safety and reliability of the connection. Variables Symbol Name Unit P Axial Load N A Tensile Stress Area mm^2 S Allowable Bolt Stress N/mm^2 F Factor of Safety - Calculation Expression Required Bolt Size: The required bolt size can be determined using the formula: R = (P * F) / (A * S) Calculator Calculated values Considering these as variable values: P=100000.0, A=200.0, S=400.0, F=2.0, the calculated value(s) are given in table below Derived Variable Value Required Bolt Size 2.5 Similar Calculators Explore Calculator Apps Share This Story, Choose Your Platform! Post navigation Flanges play a vital role in pipeline systems. They connect steel pipes to pipe fittings or valves. So how do you choose the right flange? First, you need to know how to measure flange size. Of course, flange sizes are specified according to flange standards. Such as ASME B16.5 and DIN. If you need accurate sizes, you can measure them during use.Why Measuring Flange Size MattersMeasuring flange size is important for proper installation because1. Incorrect size may cause leakage.2. Incorrect size measurement will cause welding failure with steel pipes.3. Flange sizes of different standards are somewhat different.4. The bolt holes of flanges of different standards must also be determined to correspond.Key Dimensions for Measuring a FlangeWhen measuring a flange, pay attention to the following aspects:1. Size standardNPS: Nominal pipe size, mostly used in North America, expressed in inches.DN: Nominal diameter, commonly used in international regions, mostly expressed in millimeters.2. Outer diameterThe outer diameter size of the flange.3. Bolt circle diameterThe diameter of the bolt hole is crucial to ensure that the flanges are connected correctly.4. Number of Bolt HolesFlanges have different bolt holes for different sizes according to different standards. There are usually three regular numbers of holes: 4, 6, and 8. When connecting flanges, in addition to ensuring the same size, the bolt holes must also be the same.5. Bolt Hole DiameterThe bolt hole diameter also varies according to different standards. Usually it ranges from to 16. Flange ThicknessIn addition to the flange standard, the thickness of the flange is also related to the concave and convex surface. The thicker the thickness, the greater the pressure it can withstand.Tools Needed to Measure a FlangeThe commonly used dimensions for measuring flanges are: tape measure, caliper, and ruler.Tape measure: used to measure OD and BCD.Caliper: used to accurately measure the diameter of the bolt hole.Ruler: used for plane measurement.Step-by-Step Guide to Measuring Flange SizeStep 1: Measure the Outer Diameter (OD)Use a tape measure or ruler to measure the dimensions of the outer edges of the flange. Usually in inches or millimeters.Step 2: Determine the Bolt Circle Diameter (BCD)The diameter of the bolt hole is usually measured with a caliper.The distance between the two ends of the bolt hole.Step 3: Count the Number of Bolt HolesCheck whether the number of bolt holes is consistent with the standard.Step 4: Check the Flange ThicknessWhen measuring the thickness of the flange with a caliper, first exclude the concave and convex surfaces.Step 5: Identify the Flange Pressure RatingGenerally, flange manufacturers will mark the size specifications on the flange. Such as CLASS 150 of ASME standard or PN16 of DIN standard.Common Flange Size ChartThe following table is a common ASME B16.5 specification chart:NPS (Inches)OD (inches)BCD (inches)No. of Bolt HolesBolt Hole Size (inches)3.502.38414.253.12426.004.75449.007.508611.009.508813.5011.7581016.0014.25121219.0017.0012 Measuring Flange Sizes for ASME vs. DIN StandardsASME B16.5 (North America)NPS pipe specification size, unit is inches.Class standards: class 150, 300, 600, 900, 1500, 2500.DIN European StandardUse DN nominal size, unit is millimeter.Pressure level: PN6, PN10, PN16, PN25, PN40Common Mistakes to AvoidOD and NPS are not clear, OD refers to the outside diameter, NPS refers to the inside diameter of the pipe.The bolt holes are not aligned.The pressure level does not match.SummaryCorrectly measuring the size of the flange is an important step in connecting the pipeline system. Correctly selecting the flange is the basis for ensuring the safety of the pipeline without the risk of leakage.The above article introduces how to measure the dimensions of flanges of different standards, including inner diameter, outer diameter, thickness, bolt hole, and inner diameter of the hole. It also introduces how to use the tools that can be used.I hope this article can help you understand the dimension measurement of flanges.High-pressure applications require flanges that can withstand intense stress and maintain a secure seal under extreme conditions. Calculating the correct flange dimensions for these applications is crucial to ensure safety, reliability, and performance. This guide will provide you with the essential steps and considerations for accurately determining flange dimensions for high-pressure systems.Learn more about flange compatibility and standards in our other in-depth posts.How Flange Dimensions Affect System ScalabilityHigh-pressure applications are typically found in industries such as:Oil and Gas: High-pressure pipelines, drilling operations, and processing facilities.Chemical Processing: High-pressure reactors, heat exchangers, and transfer lines.Power Generation: Boilers, steam turbines, and high-pressure feedwater systems.Water Treatment: High-pressure pumps and filtration systems.In these environments, flanges must endure significant pressure without compromising the integrity of the connection.The following dimensions are critical when designing flanges for high-pressure systems:Outer Diameter (OD): The overall diameter of the flange.Inner Diameter (ID): The diameter of the opening that matches the pipe size.Bolt Circle Diameter (BCD): The diameter of the circle formed by the centers of the bolt holes.Bolt Hole Diameter: The size of the holes for the bolts.Flange Thickness: The thickness of the flange, which must be adequate to handle high pressures.Raised Face (RF) Height: The height of the raised face, if applicable, to ensure a proper seal.To calculate the appropriate flange dimensions for high-pressure applications, follow these steps:Maximum Pressure: Identify the maximum operating pressure the flange will be subjected to.Temperature Range: Consider the temperature range the flange will experience, as it affects material strength and seal integrity.Material Strength: Choose a material that can withstand the pressure and temperature conditions. Common materials include carbon steel, stainless steel, and high-alloy steels.Corrosion Resistance: Ensure the material is resistant to corrosion from the process fluids.ASME B16.5: Provides dimensions and pressure ratings for pipe flanges and fittings.ANSI: Offers standardized dimensions for various types of flanges.DIN: Specifies flange dimensions for different pressure ratings, commonly used in Europe.Pressure Class: Based on the operating pressure, determine the required pressure class (e.g., 150, 300, 600, 900, 1500, or 2500).Wall Thickness: Use standard charts or formulas from the relevant standards to calculate the required flange thickness for the selected pressure class.Bolt Size: Select bolt size based on the flanges pressure class and dimensions.Number of Bolts: Refer to the standards for the required number of bolts to ensure a secure connection.Bolt Placement: Calculate the BCD to ensure proper bolt placement and even distribution of pressure.Design the Raised Face (RF):Seal Integrity: Ensure the raised face height is sufficient to create a tight seal under high-pressure conditions.For a high-pressure application with the following conditions:Maximum Pressure: 1000 psiTemperature Range: -20F to 600FMaterial: Stainless steelSelect Pressure Class: For 1000 psi, a Class 600 flange is appropriate.Determine Flange Dimensions: Refer to ASME B16.5 tables for Class 600 stainless steel flanges.Outer Diameter (OD): 12 inchesInner Diameter (ID): 10 inchesBolt Circle Diameter (BCD): 11 inchesBolt Hole Diameter: 0.875 inchesThickness: 1.875 inchesRaised Face (RF) Height: 0.25 inchesMaterial Selection: High-pressure applications often require specialized materials. Ensure the selected material meets all operational requirements.Precision in Measurement: Accurate measurements are crucial to prevent leaks and ensure safety. Use precise tools and double-check all dimensions.Compliance with Standards: Always refer to the latest standards to ensure compliance and safety.Calculating flange dimensions for high-pressure applications requires careful consideration of operating conditions, material properties, and standardized guidelines. By following the steps outlined in this guide, you can ensure that your flanges are designed to withstand high pressures, maintain system integrity, and provide reliable performance. At [Your Company Name], we offer a range of high-quality flanges designed for high-pressure applications. Contact us today to learn more about our products and how they can meet your project needs.For More Info: the bolt diameter, material thickness, and up to two additional parent material thicknesses to determine the proper bolt length. The following formula is used to calculate a bolt length. BL = (D*2) + (a + b + c...) Where BL is the proper bolt length D is the diameter of the bolt a, b, and c are the material thicknesses of the main material and any additional packing/plies respectively To calculate a bolt length, multiply the bolt diameter by 2, then add in any additional material thicknesses. The correct bolt length that should be used in an assembly is roughly 2 times the diameter of the bolt, plus the thickness of the material. As can be seen in the formula above, most often there are additional plates or packers in the bolt assembly. The thicknesses of these should also be added to the calculation. The following example shows the steps and information needed to calculate the bold length for an assembly. First, determine the diameter of the bolt to be used. In this example, the diameter is measured to be 2 inches. Next, determine the thickness of the main material being bolted. In this case, that is 5 inches. Next, add in any additional thickness of packing/plies. For this example, there are two packing nuts that have a combined thickness of .250. Finally, calculate the bolt length using the formula above: BL = (D*2) + (a + b + c) BL = (2*2) + (5+.250) BL = 9.25In this article, I have covered Flange Bolt Dimension Chart and Stud Size Dimensions for stud and bolt used in piping. The diameter and length of the stud and bolt are covered in flange standard ASME B16.5 & B16.47. You will use a bolt and stud to connect flanges. The image shown below indicates the nomenclature used in the dimension chart. Size in Inch Size in mm No of Bolts Bolt Size UNC RF Stud Length ISO Stud Size Machine Bolt Length Class 150 Flange 1/2 15 4 1/2 55 M14 50 3/4 20 4 1/2 65 M14 50 1 25 4 1/2 65 M14 55 1 1/4 32 4 1/2 70 M14 55 1 1/2 40 4 1/2 70 M14 65 2 50 4 5/8 85 M16 70 2 1/2 65 4 5/8 90 M16 75 3 80 4 5/8 90 M16 75 3 1/2 90 8 5/8 90 M16 75 4 100 8 5/8 90 M16 75 5 125 8 3/4 95 M20 85 6 150 8 3/4 100 M20 85 8 200 8 3/4 110 M20 90 10 250 12 7/8 115 M24 100 12 300 12 7/8 120 M24 100 14 350 12 1 135 M27 115 16 400 16 1 135 M27 115 18 450 16 1 1/8 145 M30 125 20 500 20 1 1/8 160 M30 140 24 600 20 1 1/4 170 M33 150 Size in Inch Size in mm No of Bolts Bolt Size UNC RF Stud Length ISO Stud Size Machine Bolt Length Class 300 Flange 1/2 15 4 1/2 65 M14 55 3/4 20 4 5/8 75 M16 65 1 25 4 5/8 75 M16 65 1 1/4 32 4 5/8 85 M16 70 1 1/2 40 4 3/4 90 M20 75 2 50 8 5/8 90 M16 75 2 1/2 65 8 3/4 100 M20 85 3 80 8 3/4 110 M20 90 3 1/2 90 8 3/4 110 M20 95 4 100 8 3/4 115 M20 95 5 125 8 3/4 120 M20 110 6 150 12 3/4 120 M20 110 8 200 12 7/8 140 M24 120 10 250 16 1 160 M27 140 12 300 16 1 1/8 170 M30 145 14 350 20 1 1/8 180 M30 160 16 400 20 1 1/4 190 M33 165 18 450 24 1 1/4 195 M33 170 20 500 24 1 1/4 205 M33 185 24 600 24 1 1/2 230 M39 205 Flange and Olet Quiz Test yourself, Take This Quiz Unlock New Skills with Our Best Selling Online Courses Best Selling How to be an Expert in Piping Components Learn about Pipes, Fittings, Olets, Gaskets, Flanges, Bolting materials, valves, orifice flanges, Spectacle Blind, steam traps, and more. 20% Discount Piping Components and Types of Valve Bundle Learn about Types of Piping Components and Types of Valves in this Course Bundle. Size in Inch Size in mm No of Bolts Bolt Size UNC RF Stud Length ISO Stud Size Class 400 Flange 1/2 15 4 1/2 75 M14 3/4 20 4 5/8 90 M16 1 25 4 5/8 90 M16 1 1/4 32 4 5/8 95 M16 1 1/2 40 4 3/4 110 M20 2 50 8 5/8 110 M16 2 1/2 65 8 3/4 120 M20 3 80 8 3/4 125 M20 3 1/2 90 8 7/8 140 M24 4 100 8 7/8 140 M24 5 125 8 7/8 145 M24 6 150 12 7/8 150 M24 8 200 12 1 170 M27 10 250 16 1 1/8 190 M30 12 300 16 1 1/4 205 M33 14 350 20 1 1/4 210 M33 16 400 20 1 3/8 220 M36 18 450 24 1 3/8 230 M36 20 500 24 1 1/2 240 M39 24 600 24 1 3/4 265 M45 Unlock New Skills with Our Best Selling Online Courses Best Selling How to Read P&ID, PFD and BFD Used in Process Plant Learn How to Read Piping and Instrument Diagram-P&ID, Process Flow Diagram and Block Flow Diagram used in Process Plant. 23% Discount P&ID, Piping Components and Types of Valve Bundle Learn to Read P&ID drawing, Types of Piping Components and Types of Valves in this Course Bundle. Size in Inch Size in mm No of Bolts Bolt Size UNC RF Stud Length ISO Stud Size Class 600 Flange 1/2 15 4 1/2 75 M14 3/4 20 4 5/8 90 M16 1 25 4 5/8 90 M16 1 1/4 32 4 5/8 95 M16 1 1/2 40 4 3/4 110 M20 2 50 8 5/8 110 M16 2 1/2 65 8 3/4 120 M20 3 80 8 3/4 125 M20 3 1/2 90 8 7/8 140 M24 4 100 8 7/8 145 M24 5 125 8 1 165 M27 6 150 12 1 170 M27 8 200 12 1 1/8 190 M30 10 250 16 1 1/4 215 M33 12 300 20 1 1/4 220 M33 14 350 20 1 3/8 235 M36 16 400 20 1 1/2 255 M39 18 450 20 1 5/8 275 M42 20 500 24 1 5/8 285 M42 24 600 24 1 7/8 330 M48 Size in Inch Size in mm No of Bolts Bolt Size UNC RF Stud Length ISO Stud Size Class 900 Flange 1/2 15 4 3/4 110 M20 3/4 20 4 3/4 115 M20 1 25 4 7/8 125 M24 1 1/4 32 4 7/8 125 M24 1 1/2 40 4 1 140 M27 2 50 8 7/8 145 M24 2 1/2 65 8 1 160 M27 3 80 8 7/8 145 M24 4 100 8 1 1/8 170 M30 5 125 8 1 1/4 190 M33 6 150 12 1 1/8 190 M30 8 200 12 1 3/8 220 M36 10 250 16 1 3/8 235 M36 12 300 20 1 3/8 255 M36 14 350 20 1 1/2 275 M39 16 400 20 1 5/8 285 M42 18 450 20 1 7/8 325 M48 20 500 20 2 350 M52 24 600 20 2 1/2 440 M64 Unlock New Skills with Our Best Selling Online Courses 23% Discount Pumps and Compressors Bundle Learn Principles, Operation and Design of Centrifugal Pump and Compressor in this Course Bundle. 33% Discount P&ID and Process Control Bundle Learn about P&ID and Process Control of Process Plants in this Course Bundle. Size in Inch Size in mm No of Bolts Bolt Size UNC RF Stud Length ISO Stud Size Class 1500 Flange 1/2 15 4 3/4 110 M20 3/4 20 4 3/4 115 M20 1 25 4 7/8 125 M24 1 1/4 32 4 7/8 125 M24 1 1/2 40 4 1 140 M27 2 50 8 7/8 145 M24 2 1/2 65 8 1 160 M27 3 80 8 1 1/8 180 M30 4 100 8 1 1/4 195 M33 5 125 8 1 1/2 250 M39 6 150 12 1 3/8 260 M36 8 200 12 1 5/8 290 M42 10 250 12 1 7/8 335 M48 12 300 16 2 375 M52 14 350 16 2 1/4 405 M56 16 400 16 2 1/2 445 M64 18 450 16 2 3/4 495 M72 20 500 16 3 540 M76 24 600 16 3 1/2 615 M90 Size in Inch Size in mm No of Bolts Bolt Size UNC RF Stud Length ISO Stud Size Class 2500 Flange 1/2 15 4 3/4 120 M20 3/4 20 4 3/4 125 M20 1 25 4 7/8 140 M24 1 1/4 32 4 1 150 M27 1 1/2 40 4 1 1/8 170 M30 2 50 8 1 180 M27 2 1/2 65 8 1 1/8 195 M30 3 80 8 1 1/4 220 M33 4 100 8 1 1/2 255 M39 5 125 8 1 3/4 300 M45 6 150 8 2 345 M52 8 200 12 2 380 M52 10 250 12 2 1/2 490 M64 12 300 12 2 3/4 540 M72 Are You Piping Components Master? About Author Varun Patel, B.E Mechanical, PMP 19+ years of experience in the oil and gas sector, specializing in project management, contracts, project control, project coordination, QA/QC and inspection of large-scale Greenfield and Brownfield Projects such as Refinery, Petrochemical, Wellhead production, and Process platform. Proven track record of delivering large-scale projects while ensuring adherence to safety and quality standards. Skilled in leading and mentoring cross-functional teams and resolving technical issues to achieve successful project outcomes. LinkedIn YouTube X Facebook Telegram Fig 1. Typical Flange designs A flange is a means of joining two conduits such as nozzles, pipelines, piping, tubing, etc. that contain flowing and/or pressurised fluid(s). It is usual to ensure that a flanged joint is stronger than the pipe or nozzle to which it is attached, i.e. it is not a focus for weakness, because it would otherwise leak before it fails structurally. Standard flanges are designed to remain pressure-tight even if yield stress is exceeded. Flange Types The principle flange designs are show in Fig 1. Whilst these flanges are, in theory, interchangeable, each type is normally associated with a preferred application.For example: Welding Neck (integral) flanges are mostly used in pipelines and for the most demanding applications in terms of mechanical and hydrostatic loading. Socket (loose) flanges are usually found on small-bore (3"), high-pressure, high-flow, multi-phase piping systems where external flange loading is minimal. The socket design provides a smooth-bore through the joint significantly reducing erosion potential from multi-phase fluids. Slip-On (loose) flanges are for similar applications as the Socket design, except that they are more susceptible to erosion, corrosion, shock loading and vibration. These flanges tend to be used in low-cost, low-demand applications. Lapped (loose) flanges are for applications where the flange and pipe are not to be welded together. A stub-end is inserted in the flange and the stub-end is butt welded to the pipe. This facility is handy where the flange and pipe are manufactured from different materials. These flanges tend to be reserved for low pressure applications and those where external loads are negligible. Swivel Ring flanges are used for loose or integral flanges whose bolting ring must rotate to allow for stud-bolt alignment during assembly. Raised Faces are used for a number of reasons: 1) Easier gasket positioning and visibility 2) Facilitate high pressure (RTJ) gaskets 3) It is easier to install a leak detection facility (Fig 2) The standard thickness of the raised face is 0.06in (1.5mm) for all flange ratings up to and including 300lb and 0.25in (6.35mm) for all other flange ratings. The raised face is not included in Flanges' strength calculations. I.e. the length of the flange (L) does not include the raised face thickness. Gaskets There are many different gasket designs for flanges but the two most popular are RTJ and 'Spiral Wound'. RTJ gaskets normally comprise soft iron or stainless steel and spiral wound gaskets usually comprise a stainless steel mesh with a suitable filler material. Fig 2. Typical Leak Detection for RTJ RTJ gaskets are for high-pressure systems and come in a number of designs and materials but they all work similarly in that they seal on the corners of the ring section as opposed to flat gaskets, which seal on their faces. When flanges are installed in areas where inspection is difficult (e.g. subsea) it is useful to install an outwardly visible leak detection facility (Fig 2). A plunger manufactured from copper will ensure it remains free of marine growth. Flat gaskets are normally used for piping, as opposed to pipeline, systems where the loading conditions are less arduous than typical RTJ applications. Flat gaskets can comprise anything from polymer or vegetable fibre to soft metal (iron, copper, aluminium, etc.). The most common flat gasket is the Spiral wound type. Refer to CalQlata's Flange Gaskets technical help page for more information on these items. Design Gasket size and material will define the bolt loading requirements based either on pressure sealing requirements or external mechanical loading such as bending moments, torsion and/or axial tension. Flange bolt loading for gasket seating (pressure sealing) and that required for external forces are not added together. Flange bolt loading will constitute the highest requirement, i.e. either that for gasket seating or for external loading, whichever is the greater. It is important to ensure that the gasket material is selected accordingly. Flange Stresses A flange is loaded in three ways: 1) Bolting load 2) Internal pressure 3) External forces and moments As the bolting load must be sufficient to restrain the internal pressure and the external forces and moments, the bolt load will always define the size and strength of the flange. Fig 3. Flange Loads and Stresses The highest stresses induced in a flange are usually at the intersection between the hub OD and the back of the flange as a result of the bending moment induced between the bolts and the gasket (Fig 3: M = W x h). Because the highest stresses in a bolted flange are highly localised and dissipate over a very short distance, it is acceptable that the calculated longitudinal stress (S) is allowed to exceed yield. The tangential (S) and radial (S) stresses, however, are pressure carrying and therefore limited to yield stress. Standards Standard flanges are designed to accommodate standard piping for insertion and/or welding, the most recognised international standard for which is API 5L and the most recognised international standards for flanges are API 605 and ANSI B16-5. The most widely recognised international design (calculation) code for these flanges is ASME VIII. CalQlata's flange calculator is therefore predominantly based upon these design standards/codes. Design Code ASME VIII is the most widely known and internationally recognised design code for pipeline flange calculations and ANSI B 16-5 is the most widely known design code for piping systems. As ASME and ANSI are now conjoined, ASME/ANSI has become the most appropriate design code for all pipeline and piping systems. Whilst API also provides a design specification (sizing details) for their pipeline flanges, it is similar to the ANSI design but does not provide a comprehensive calculation facility. Almost all design calculation codes and standards today tend to be based upon the ASME code. It is for this reason that CalQlata has based its flange calculator on: ASME VIII, Division 1, Appendices 2, P and S Flange Cladding Where flanges are clad with a different material to its main body, e.g. Inconel, Monel, 316, Duplex, etc., the cladding material should not be included in the flange calculations as they will have a different elastic properties to those of the main body of the flange and will therefore react differently to loads imposed on the flange itself. Flanges Calculator Technical Help The Flanges calculator includes a database of flange sizes and a calculation facility to determine their suitability according to the ASME VIII design code. The input data follows CalQlata's symbology and the output data follows that provided in the ASME VIII design code. The output data is complete according to Sub-Section 2-3 'Notation' of the design code to help you to verify the flange calculator's results. For this reason; where input and output data are for exactly the same property or dimension, their symbols may differ, e.g. whilst the inside diameter of the flange is designated thus '' in the input data, it is designated thus 'B' in the output data. The two unit systems accommodated in this calculator are metric (mm and N) and Imperial (ins and lbf). Calculation Tips If you are finding it difficult to reduce your stresses to an acceptable level, it is probably because the allowable bolting stress () is too high. The ASME design code assumes you will be applying the allowable bolting stress during assembly. If this proves too arduous for your flange, you could increase its thickness (t), reduce the allowable bolt stress or (slightly) reduce the bolt size. Conversely, if insufficient stresses are applied during installation, the flange could become loose over time due to material relaxation and ultimately leak. Reducing the seating stress (y) and Gasket factor (m) also helps with reducing flange stresses. For example; try using Monel or Inconel instead of stainless steels such as AISI 304 and 316. The maximum bolt load (W), which is used for calculating the flange stresses is selected from the highest of the various load cases: 'W', 'W', 'W', 'W'. By comparing 'W' with the others, you will see which of them is causing the problem. For Lapped flanges, see Accuracy below. Flange Database The flange database includes the following: Designs: Lapped, Socket, Slip-On and Welding Neck Specifications: ANSI, API, BS and MSS Bore Sizes: " to 48" Pressure Ratings: 150lb to 2500lb Input Data Each time a different flange design/size is selected from the database, the following input data is updated automatically: outside diameter () butt diameter () inside diameter ()# thickness (t) length (L) hub diameter () raised face diameter () number of bolts (n) pitch circle diameter (PCD) bolt-hole diameter () # Note: inside diameter () is not updated for welding neck flanges as this is a variable and not included in the design code. All other dimensions and properties (as listed below) will remain unchanged as you switch between flange sizes. Therefore you must take care to ensure that you manually update bolting, gasket and piping/nozzle details as required. Whilst different allowable material stresses are accommodated for ambient and design temperatures (and respectively), ASME normally recommends that carbon steels begin to lose strength above 650F (340C) and alloy steels above 100F (38C). Bolting dimensions ... Major thread diameter () Minor thread diameter () Thread pitch (P) ... can be obtained from CalQlata's ThreadsThreads and Threads+ programs. Gasket dimensions: Gasket pitch diameter () is the diameter through the middle of its manufactured width ('N'). Basic gasket width (b) is the width in direct contact with the flange under full compression. For RTJ gaskets this is normally taken as width 8 (ASME VIII, Division 1, Appendix 2, Table 2-5.2) Both of which will need to be established manually unless you can import them from CalQlata's Flange Gaskets calculator. The following gasket related input data can be found in; ASME VIII, Division 1, Appendix 2, Table 2-5.1 or CalQlata's flange gaskets technical help page Gasket factor (m) ranges from 1.0 for the softest (rubber) materials to 6.5 for stainless steel Seating stress (y) ranges from 0.2ksi for the softest (rubber) materials to 26ksi for stainless steel Except for special designs and materials, internal pressure (p) should not exceed the pressures in the following table: Up to 650F (340C), carbon steel flanges should not exceed the pressure for each designated rating between -28 to 38C Alloy steels flanges should not exceed the pressure for each designated rating at the listed temperatures N/mm(psi) 150lb 300lb 400lb 600lb 900lb 1500lb 2500lb -28 to 38C(-18 to 100F) 1.96(284) 5.11(741) 6.81(988) 10.21(1481) 15.32(2222) 25.53(3703) 42.55(6171) 50C(122F) 1.92(278) 5.01(727) 6.68(969) 10.02(1453) 15.02(2178) 25.04(3632) 41.73(6052) 100C(212F) 1.77(257) 4.64(673) 6.18(896) 9.28(1346) 13.91(2017) 23.19(3363) 38.65(5606) 150C(302F) 1.58(229) 4.52(656) 6.03(875) 9.05(1313) 13.57(1968) 22.61(3279) 37.69(5466) 200C(392F) 1.4(203) 4.38(635) 5.84(847) 8.76(1271) 13.15(1907) 21.91(3178) 36.52(5297) 250C(482F) 1.21(175) 4.17(605) 5.56(806) 8.34(1210) 12.52(1816) 20.86(3025) 34.77(5043) 300C(572F) 1.02(148) 3.87(561) 5.16(748) 7.75(1124) 11.62(1685) 19.37(2809) 32.28(4682) 350C(662F) 0.84(122) 3.7(537) 4.93(715) 7.39(1072) 11.09(1608) 18.48(2680) 30.8(4467) 375C(707F) 0.74(107) 3.65(529) 4.86(705) 7.29(1057) 10.94(1587) 18.23(2644) 30.39(4408) 400C(752F) 0.65(94) 3.45(500) 4.6(667) 6.9(1001) 10.35(1501) 17.25(2502) 28.75(4170) 425C(797F) 0.56(81) 2.88(418) 3.83(555) 5.75(834) 8.63(1252) 14.38(2086) 23.96(3475) 450C(842F) 0.47(68) 2.0(290) 2.67(387) 4.01(582) 6.01(872) 10.02(1453) 16.69(2421) 475C(887F) 0.37(54) 1.35(196) 1.81(263) 2.71(393) 4.06(589) 6.77(982) 11.29(1637) 500C(932F) 0.28(41) 0.88(128) 1.17(170) 1.76(255) 2.64(383) 4.4(638) 7.33(1063) 525C(977F) 0.19(28) 0.52(75) 0.69(100) 1.04(151) 1.55(225) 2.59(376) 4.32(627) 540C(1004F) 0.13(19) 0.33(48) 0.43(62) 0.65(94) 0.98(142) 1.63(236) 2.72(395) Special Designs You can overwrite (modify) any database input value you wish and the calculation will be corrected incorporating your modified value. However, if you change the flange to a different size or type the modified value will be lost. Slip-On flange calculations can be used for Socket flanges greater than 3" as the calculations are identical and the Slip-On flange database includes sizes up to 48". You simply need to include the inner lip and the raised face in your final design drawings/specification. Output Data The output data list and symbology is similar to that shown in ASME VIII, Division 1, Appendix 2, 2-3 Notation. The calculations for Lapped, Socket and Slip-On flanges are 'loose' in accordance with ASME VIII. The calculations for Welding Neck flanges are 'integral' in accordance with ASME VIII. Note the values for 'N' and 'w' (ASME VIII, Division 1, Appendix 2, Table 2-5.2) will automatically be set to zero in this calculator unless gasket information has been imported from CalQlata's Flange Gaskets calculator A calculation result for a swivel ring that is based upon the same ID as the hub OD () is provided at the bottom of the output data page. If this stress is too high, you simply increase the flange thickness (t) until it becomes acceptable. If your flange does not have a swivel ring, then ignore this result. Effective gasket seating width 'b' (ASME VIII, Division 1, Appendix 2, Table 2-5.2) is calculated in the flanges calculator based upon the basic gasket width 'b' that you enter or import from CalQlata's Flange Gaskets calculator. Imported Data The flange calculator imports the following data from CalQlata's Flange Gaskets calculator: '' (gasket pitch diameter) 'b' (basic gasket width) 'N' (gasket width) 'w' (flange nubbin width) Applicability These calculations apply to the designs included in the calculator's database, and to any dimensional modifications you make to them. Flanges only applies to circular flanges of the types shown in Fig 1 Accuracy The accuracy of these calculations is in accordance with the above mentioned Design Code However, care should be taken with allowable stresses for Lapped flanges in that they do not provide the same level of support as the Socket and Slip-On designs as the flange is not welded to the pipe. Therefore, CalQlata would recommend that the allowable bolt and flange stresses in Lapped flanges are kept to within 90% of the yield stress for the material concerned. Notes Flange gaskets normally comprise softer grade nickel based alloys allowing you to reduce the variables 'm' and 'y' by about 15% Whilst ASME recommends that the effective gasket width (b) is the gasket width divided by 8 for all RTJ gaskets, those manufactured from soft (pure) iron can (and CalQlata believes should) be divided by 6. Moreover, 'w' which ASME uses to define 'b' for RTJ flanges is actually a nubbin width and not a gasket width ('N'). As there is no nubbin in RTJ ring grooves, CalQlata's flange gaskets calculator bases 'b' for RTJ gaskets on 'N' and not on 'w'. Further Reading You will find further reading on this subject in reference publications(47, 48 & 49) s = free threads (equals 1/3 time bolt diameter) n = nut height (equals nominal bolt diameter) h = flange (plate) thickness rf = height of raised face g = gasket thickness The height of a nut for a StudBolt is the same as the diameter of the threadrodStuds are measured parallel to the axis (L) from the first to the thread without the chamfers (points). S = free threads equals 1/3 time bolt diaHex bolts are measured from under the head to the top of de boltRelated Post(s) s = free threads (equals 1/3 time bolt diameter) n = nut height (equals nominal bolt diameter) h = flange (plate) thickness rf = height of raised face g = gasket thickness The height of a nut for a StudBolt is the same as the diameter of the threadrodStuds are measured parallel to the axis (L) from the first to the thread without the chamfers (points). S = free threads equals 1/3 time bolt diaHex bolts are measured from under the head to the top of de boltRelated Post(s) Description Key details about the DIN EN 1515 standard and related flange specifications:DIN EN 1515 specifies the dimensions of hexagon bolts and studs for use with flanged joints. It gives dimensions for bolt diameters M12 to M64.EN 10921 defines the requirements for steel flanges and flanged joints with PN (pressuretemperature rating) designations from PN 2.5 to PN 100. It covers multiple flange types like welding neck, slipon, socket weld, etc.The PN rating indicates the maximum allowable pressure in bar at a temperature of 20C. Common ratings are PN2.5, PN6, PN10, PN16, PN25, PN40, PN63, PN100.For a given flange size and PN rating, EN 10921 specifies the required number of bolts and the bolt circle diameter. More bolts are required for higher PN ratings to handle the increased force.For example, a DN150 welding neck flange in PN10 requires 8 M20 bolts on a 190 mm bolt circle. The same flange in PN25 requires 12 M20 bolts on a 220 mm bolt circle.The bolts are used to join the mating flanges together. Hexagon head bolts are most common, along with stud bolts in some high temperature applications. The bolt length depends on the flange and gasket thickness.So in summary, DIN EN 1515 provides bolt dimensions, EN 10921 defines flange specs and required bolt sizes/numbers for different PN ratings. These standards help ensure safe reliably flanged joints.General StandardsDIN EN 15151Flanges and their joints Bolting Part 1: Selection of boltingJan00DIN EN 15152Flanges and their joints Bolting Part 2: Classification of bolt materials for steel flanges, PN designatedMar02DIN EN 15153Flanges and their joints Bolting Part 3: Classification of bolt materials for steel flanges, Class designatedDec05DIN EN 15154Flanges and their joints Bolting Part 4: Selection of bolting for equipment subject to the Pressure Equipment Directive 2014/68/EUDec22DIN EN 15911Flanges and their joints Design rules for gasketed circular flange connections Part 1: CalculationApr14DIN EN 15911 Beiblat 1Flanges and their joints Design rules for gasketed circular flange connections Background informationOct01DIN EN 15912Flanges and their joints Design rules for gasketed circular flange connections Part 2: Gasket ParametersSep08DIN CEN/TS 15913Flanges and their joints Design rules for gasketed circular flange connections Part 3: Calculation method for metal to metal contact type flanged jointOct07DIN EN 15914Flanges and their joints Part 4: Qualification of personnel competency in the assembly of the bolted connections of critical service pressurized systemsDec13Materials&Mechanical PropertiesDIN EN 10269Steels and nickel alloys for fasteners with specified elevated and/or low temperature propertiesFeb14DIN EN ISO 8981Mechanical properties of fasteners made of carbon steel and alloy steel Part 1: Bolts, screws and studs with specified property classes Coarse thread and fine pitch thread (ISO 8981:2013)May13DIN EN ISO 8982Fasteners Mechanical properties of fasteners made of carbon steel and alloy steel Part 2: Nuts with specified property classes (ISO 8982:2022)Feb23DIN EN ISO 8983Fasteners Mechanical properties of fasteners made of carbon steel and alloy steel Part 3: Flat washers with specified property classes (ISO 8983:2018 + Amd 1:2020)Nov21FlangesDIN EN 10921Flanges and their joints Circular flanges for pipes, valves, fittings and accessories, PN designated Part 1: Steel flangesDec18DIN EN 10922Flanges and their joints Circular flanges for pipes, valves, fittings and accessories, PN designated Part 2: Cast iron flangesJun97DIN EN 10923Flanges and their joints Circular flanges for pipes, valves, fittings and accessories, PN designated Part 3: Copper alloy flangesOct04DIN EN 10924Flanges and their joints Circular flanges for pipes, valves, fittings and accessories, PN designated Part 4: Aluminium alloy flangesAug02GasketsDIN EN 15141Flanges and their joints Dimensions of gaskets for PNdesignated flanges Part 1: Nonmetallic flat gaskets with or without insertsAug97DIN EN 15142Flanges and their joints Gaskets for PNdesignated flanges Part 2: Spiral wound gaskets for use with steel flangesMar21DIN EN 15143Flanges and their joints Dimensions of gaskets for PNdesignated flanges Part 3: Nonmetallic PTFE envelope gasketsAug97DIN EN 15144Flanges and their joints Dimensions of gaskets for PNdesignated flanges Part 4: Corrugated flat or grooved metallic and filled metallic gaskets for use with steel flangesAug97DIN EN 15146Flanges and their joints Dimensions of gaskets for PNdesignated flanges Part 6: Covered serrated metal gaskets for use with steel flangesMar04DIN EN 15147Flanges and their joints Gaskets for PNdesignated flanges Part 7: Covered metal jacketed gaskets for use with steel flangesAug04DIN EN 15148Flanges and their joints Dimensions of gaskets for PNdesignated flanges Part 8: Polymeric ORing gaskets for grooved flangesFeb05BoltsDIN EN ISO 4014Fasteners Hexagon head bolts Product gradesA andB (ISO4014:2022)Oct22DIN EN ISO 4016Fasteners Hexagon head bolts Product grade C (ISO 4016:2022)Oct22DIN EN ISO 4017Fasteners Hexagon head screws Product grades A and B (ISO 4017:2022)Oct22DIN EN ISO 4018Fasteners Hexagon head screws Product grade C (ISO 4018:2022)Oct22StudsDIN 939Studs Metal end 1.25dFeb95NutsDIN EN ISO 4032Hexagon regular nuts (style 1) Product grades A and B (ISO 4032:2012)Apr13DIN EN ISO 4034Hexagon regular nuts (style 1) Product grade C (ISO 4034:2012)Apr13WashersDIN EN ISO 7089Plain washers Normal series, Product grade A (ISO 7089:2000)Nov00DIN EN ISO 7091Plain washers Normal series Product grade C (ISO 7091:2000)Apr19 Submitted By: Domagoj Brozovic (domagoj) Submitted On: 20 Oct 2023 File Size: 702.17 Kb Downloads: 13 File Version: 1.0 File Author: DB File Rating (4/3) Full download access to any calculation is available to users with a paid or awarded subscription (XLC Pro). 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Flange bolting calculation. How to calculate bolt length for flanges. How to determine bolt size for flanges.

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