

Bolt torque calculation for flanges

How to enable and manage the optional bolt torque calculation available for flanges.

Online version: <https://nextgen.sant-ambrogio.it/KB811869>

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When designing a flange, it is possible to enable the calculation - which remains optional - of the tightening torque required for the bolts.

Regardless of the calculation code adopted, be it American or European, the methods for calculating the tightening torque are those of ASME PCC-1

For flanges that support this calculation, simply enable it by checking the appropriate option in the "General" category of the component:

Slip-on flange "M1 (24" - 150#) POS.57"

Change active component: M1 (24" - 150#) POS.57 M1 (24" - 150#) POS.60

Category	Parameter	Value	Unit	Lock	Info
Essentials	Name / Position	M1 (24" - 150#) POS.57			
General	Flange material	SA-105 - Forgings			Database Edit
Design conditions	Overpressure due to static head - internal	0.11	MPa	Lock	Info
Geometry	Overpressure due to static head - Hydraulic test	0.15	MPa	Lock	Info
Bolts	Overpressure due to static head - external	0	MPa	Lock	Info
Torque	Overpressure due to static head - Hydraulic test - external	0	MPa	Lock	Info
Gasket	Is surrounded by a jacket or external chamber, perform test at external pressure too	<input checked="" type="checkbox"/>		Lock	
Standard flange	Calculate bolt torque according to ASME PCC-1	<input checked="" type="checkbox"/>			
Welds	Design mode	<input type="checkbox"/>			
Liquid level	Check minimum hub thickness as cylindrical shell	<input type="checkbox"/>			

A new "Torque" category will then be displayed, in which to set the calculation method and its geometric and operational parameters:

Slip-on flange "M1 (24" - 150#) POS.57"

Change active component: M1 (24" - 150#) POS.57 M1 (24" - 150#) POS.60

Category	Parameter	Value	Unit	Lock	Info
Essentials	Target torque calculation method	ASME PCC-1 Appendix K-2 (former Appendix J)			
General	Bolt preload	F 206793	N	Lock	
Design conditions	Bolt hole diameter	dh 35	mm	Lock	
Geometry	Nut washer face diameter	dw 47.625	mm	Lock	
Bolts	Coefficient of friction between the bolt nut (or bolt head) and the flange (or washer)	μ_n 0.2			
Torque	Coefficient of friction between bolt/nut threads	μ_t 0.2			
Gasket	Pitch of the threads	L 3.175	mm		
Standard flange	Effective pitch diameter (or mean thread contact diameter)	d2 29.68778	mm	Lock	
Welds	Thread flank angle	α 30	°		

The calculation report will finally show the procedure. This calculation does not require any validation and is available for both standard flanges and code-calculated flanges.

Standard Slip-on flange - M1 (24" - 150#) POS.57			
<i>According to: Asme VIII Div. 1 Ed. 2021, UG-44(a) - Metric Units</i>			
Flange material	SA-105 - Forgings - UNS: K03504		
Shell material	SA-240 - Plate - UNS: S31803		
Bolting material	SA-193 B7 - Bolting (≤64) - UNS: G41400		
Gasket	GOROTEX DF		
Calculation performed as a standard flange:			Yes
Flange standard / specification:			ASME B16.5 2013
Flange rating		=	150
Nominal size:			24"
Number of bolts		=	20
Bolt type:			ANSI_TEMA 1-1/4"
Material group		=	1.1
Calculation temperature		T =	200.00 °C
Internal pressure		Pd =	0.60 MPa
Overpressure due to static head		Ph =	0.11 MPa
Calculation pressure		P =	0.71 MPa
Maximum pressure at temperature allowed by the specifications		Pmax =	1.38 MPa
			P ≤ Pmax (0.71 MPa ≤ 1.38 MPa): Ok
Bolt torque calculation according to ASME PCC-1 2022 Appendix K-2			
Number of bolts		n =	20
Target bolt tensile load		F =	206 793 N
Bolt hole diameter		dh =	35.00 mm
Nut washer face diameter		dw =	47.63 mm
Effective bearing diameter of the nut face		$D_e = (d_h + d_w) / 2 =$	41.31 mm
Coefficient of friction between the bolt nut (or bolt head) and the flange (or washer)		$\mu_n =$	0.200
Coefficient of friction between bolt/nut threads		$\mu_t =$	0.200
Pitch of the threads		p =	3.18 mm
Effective pitch diameter (or mean thread contact diameter)		d2 =	29.69 mm
Thread flank angle		$\beta =$	30.00 °
Target torque		$T = \frac{F}{2} \left[\frac{p}{\pi} + \frac{\mu_t d_2}{\cos(\beta)} + D_e \mu_n \right] =$	1 667.7 N·m
Tensile stress area of the thread (Appendix H)		As =	645.2 mm²
Percentage utilization factor for material yield strength		P% = 100·F/(As·Sy) =	44.21101 %