ΚΟΧΛΙΕΣ ΣΥΣΦΙΓΞΗΣ (threaded fasteners)

Table 13.2 Dimensions of Selected Metric Standard Screw Threads[1] (preferred combinations of diameter and pitch; other standard options are available)

	Coarse Thread Series				Fine Thread Series			
Major Diam. d, mm	Pitch p, mm	Minor Diam. d_r, mm	Minor Diam. Area A_r, mm^2	Tensile Stress Area[2], mm^2	Pitch p, mm	Minor Diam. d_r, mm	Minor Diam. Area A_r, mm^2	Tensile Stress Area[2], mm^2
3.0	0.50	2.459	4.75	5.18				
3.5	0.60	2.850	6.38	6.98				
4.0	0.70	3.242	8.25	9.05				
5.0	0.80	4.134	13.4	14.6				
6.0	1.00	4.917	19.0	20.7				
8.0	1.25	6.647	34.7	37.6	1.00	6.917	38.0	40.0
10.0	1.50	8.376	55.1	59.5	1.25	8.647	58.7	62.5
12.0	1.75	10.106	80.2	86.3	1.25	10.647	89.0	93.6
14.0	2.00	11.835	110	118	1.50	12.376	120	127
16.0	2.00	13.835	150	160	1.50	14.376	162	170
18.0	2.50	15.294	184	197	1.50	16.376	211	219
20.0	2.50	17.294	235	250	1.50	18.376	265	275
22.0	2.50	19.294	292	309	1.50	20.376	326	337
24.0	3.00	20.752	338	360	2.00	21.835	374	389
27.0	3.00	23.752	443	468	2.00	24.835	484	501
30.0	3.50	26.211	540	571	2.00	27.835	609	628

10.7 Bolt Tightening and Initial Tension

For most applications, screws and nut-bolt assemblies should ideally be tightened to produce an initial tensile force F_i nearly equal to the full "proof load," which is defined as the maximum tensile force that does not produce a normally measurable permanent set. (This is a little less than the tensile force producing a 0.2 percent offset elongation associated with standard tests to determine S_y.) On this basis initial tensions are commonly specified in accordance with the equation

$$F_i = K_i A_t S_p \qquad \textbf{(10.11)}$$

where A_t is the tensile stress area of the thread (Tables 10.1 and 10.2), S_p is the "proof strength" of the material (Tables 10.4 and 10.5), and K_i is a constant, usually specified in the range of 0.75 to 1.0. For ordinary applications involving static loading, let $K_i \approx 0.9$, or

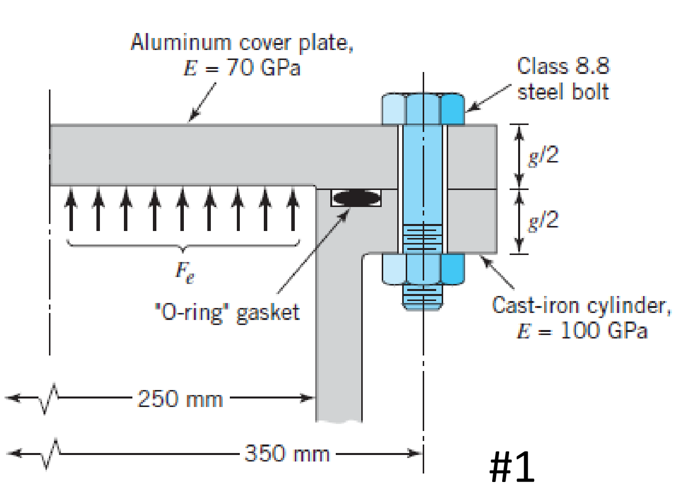
$$F_i = 0.9 A_t S_p \qquad \textbf{(10.11a)}$$

SAE Class	Diameter d (mm)	Proof Load (Strength)[a] S_p (MPa)	Yield Strength[b] S_y (MPa)	Tensile Strength S_u (MPa)
4.6	5 thru 36	225	240	400
4.8	1.6 thru 16	310	—	420
5.8	5 thru 24	380	—	520
8.8	17 thru 36	600	660	830
9.8	1.6 thru 16	650	—	900
10.9	6 thru 36	830	940	1040
12.9	1.6 thru 36	970	1100	1220

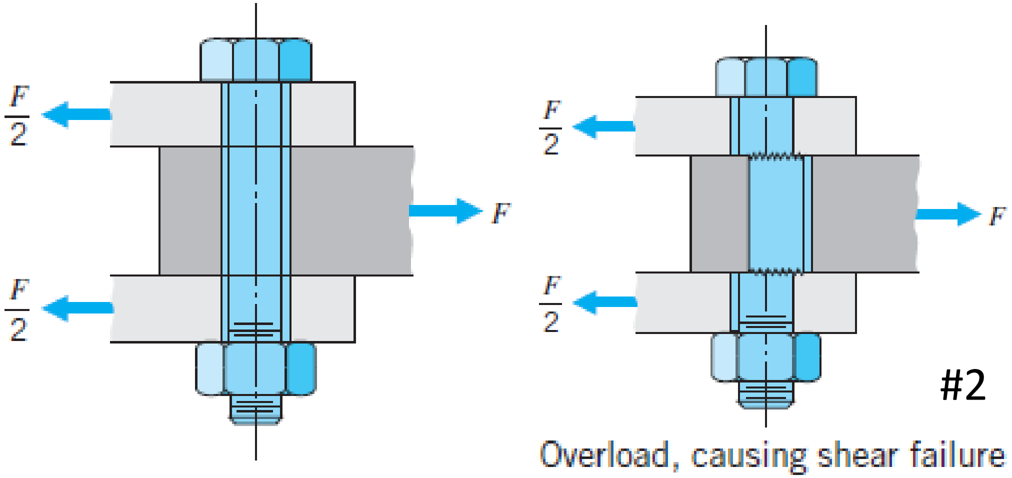
Table 16.5: Strength of various metric series steel bolts.

Metric grade	Head marking	Range of crest diameters, mm	Ultimate tensile strength S_u, MPa	Yield strength S_y, MPa	Proof strength S_p, MPa
4.6	4.6	M5 – M36	400	240	225
4.8	4.8	M1.6 – M16	420	340[a]	310
5.8	5.8	M5 – M24	520	415[a]	380
8.8	8.8	M17 – M36	830	660	600
9.8	9.8	M1.6 – M16	900	720[a]	650
10.9	10.9	M6 – M36	1040	940	830
12.9	12.9	M1.6 – M36	1220	1100	970

[a] Yield strengths are approximate and are not included in the standard.



#1



#2

Overload, causing shear failure

Briefly, the rationale behind so high an initial tension is the following.

1. For loads tending to separate rigid members (as in Figure #1), the bolt load cannot be increased very much unless the members do actually separate, and the higher the initial bolt tension, the less likely the members are to separate.
2. For loads tending to shear the bolt (as in Figure #2), the higher the initial tension the greater the friction forces resisting the relative motion in shear.

Further implications of the initial bolt tension for fatigue loading will be discussed in a next Section.

Relating Bolt Torque to Bolt Tension

Having learned that a high preload is very desirable in important bolted connections, we must next consider means of ensuring that the preload is actually developed when the parts are assembled.

torque coefficient K

$$\boxed{T = KF_i d}$$

Bolt Condition	K
Nonplated, black finish	0.30
Zinc-plated	0.20
Lubricated	0.18
Cadmium-plated	0.16
With Bowman Anti-Seize	0.12
With Bowman-Grip nuts	0.09

The coefficient of friction depends upon the surface smoothness, accuracy, and degree of lubrication.

Remember, this is only an approximate relationship, dependent on "average" conditions of thread friction.

In view of these guidelines, it is recommended for both static and fatigue loading that the following be used for preload:

$$F_i = \begin{cases} 0.75F_p & \text{for nonpermanent connections, reused fasteners} \\ 0.90F_p & \text{for permanent connections} \end{cases} \qquad (8\text{–}31)$$

where F_p is the proof load, obtained from the equation

$$F_p = A_t S_p \qquad (8\text{–}32)$$

Here S_p is the proof strength obtained from Tables

For other materials, an approximate value is $S_p = 0.85S_y$.

Metric Mechanical-Property Classes for Steel Bolts, Screws, and Studs

Property Class	Size Range, Inclusive	Minimum Proof Strength,* MPa	Minimum Tensile Strength,* MPa	Minimum Yield Strength,* MPa	Material	Head Marking
4.6	M5–M36	225	400	240	Low or medium carbon	
4.8	M1.6–M16	310	420	340	Low or medium carbon	
5.8	M5–M24	380	520	420	Low or medium carbon	
8.8	M16–M36	600	830	660	Medium carbon, Q&T	
9.8	M1.6–M16	650	900	720	Medium carbon, Q&T	

Table 8–12 is included to provide some information on the relative values of the stiffnesses encountered. The grip contains only two members, both of steel, and no washers. The ratios C and $1 - C$ are the coefficients of P in Eqs.

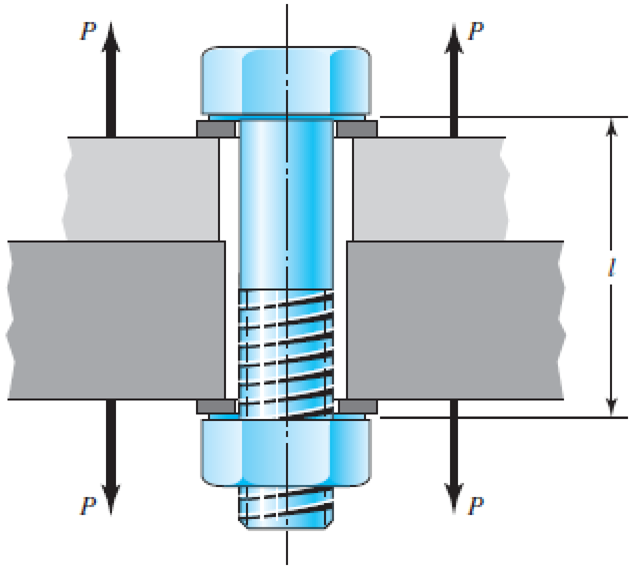
They describe the proportion of the external load taken by the bolt and by the members, respectively. In all cases, the members take over 80 percent of the external load. Think how important this is when fatigue loading is present. Note also that making the grip longer causes the members to take an even greater percentage of the external load.

Bolt Grip, in	Stiffnesses, M lbf/in k_b	k_m	C	$1 - C$
2	2.57	12.69	0.168	0.832
3	1.79	11.33	0.136	0.864
4	1.37	10.63	0.114	0.886

Computation of Bolt and Member Stiffnesses. Steel members clamped using a $\frac{1}{2}$ in-13 NC steel bolt. $C = \dfrac{k_b}{k_b + k_m}$

Tension Joints—The External Load

A bolted connection loaded in tension by the forces P. Note the use of two washers. Note how the threads extend into the body of the connection. This is usual and is desired. l is the grip of the connection.



Let us now consider what happens when an external tensile load P, as in Fig. I is applied to a bolted connection. It is to be assumed, of course, that the clamping force, which we will call the *preload* F_i, has been correctly applied by tightening the nut *before* P is applied. The nomenclature used is:

F_i = preload

P_{total} = Total external tensile load applied to the joint

P = external tensile load per bolt

If N bolts equally share the total external load, then

$$P = P_{total}/N$$

P = external tensile load per bolt

P_b = portion of P taken by bolt

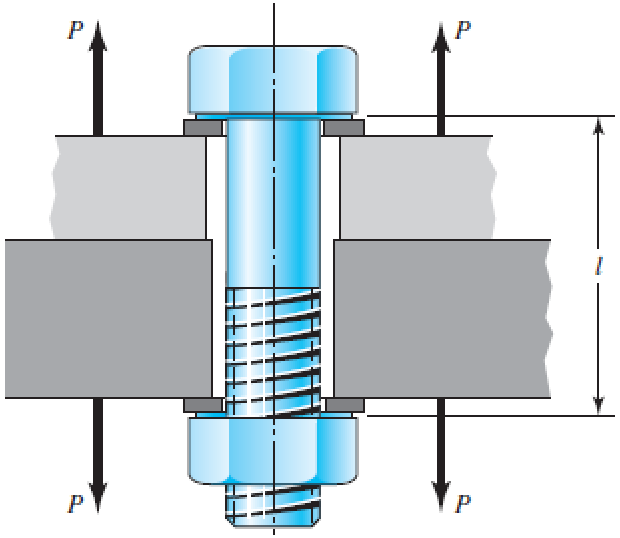
P_m = portion of P taken by members

$F_b = P_b + F_i$ = resultant bolt load

$F_m = P_m - F_i$ = resultant load on members

C = fraction of external load P carried by bolt

$1 - C$ = fraction of external load P carried by members



The load P is tension, and it causes the connection to stretch, or elongate, through some distance δ. We can relate this elongation to the stiffnesses by recalling that k is the force divided by the deflection. Thus

$$\delta = \frac{P_b}{k_b} \qquad \text{and} \qquad \delta = \frac{P_m}{k_m} \tag{b}$$

or

$$P_m = P_b \frac{k_m}{k_b} \tag{c}$$

Since $P = P_b + P_m$, we have

$$P_b = \frac{k_b P}{k_b + k_m} = CP \qquad (d)$$

and

$$P_m = P - P_b = (1 - C)P \qquad (e)$$

where

$$C = \frac{k_b}{k_b + k_m} \qquad (f)$$

is called the *stiffness constant of the joint*. The resultant bolt load is

$$F_b = P_b + F_i = CP + F_i$$

and the resultant load on the connected members is

$$F_m = P_m - F_i = (1 - C)P - F_i$$

Of course, these results are valid only as long as some clamping load remains in the members; this is indicated by the qualifier in the equations.

Statically Loaded Tension Joint with Preload

tensile stress in the bolt can be found as in Ex. 8–3 as

$$\sigma_b = \frac{F_b}{A_t} = \frac{CP + F_i}{A_t} \qquad (a)$$

Thus, the yielding factor of safety guarding against the static stress exceeding the proof strength is

$$n_p = \frac{S_p}{\sigma_b} = \frac{S_p}{(CP + F_i)/A_t} \qquad (b)$$

or

$$n_p = \frac{S_p A_t}{CP + F_i} \qquad (8\text{–}28)$$

Since it is common to load a bolt close to the proof strength, the yielding factor of safety is often not much greater than unity.

Statically Loaded Tension Joint with Preload

Another indicator of yielding that is sometimes used is a *load factor,* which is applied only to the load P as a guard against overloading. Applying such a load factor, n_L, to the load P in Eq. (a), and equating it to the proof strength gives

$$\frac{Cn_LP + F_i}{A_t} = S_p \qquad \text{(c)}$$

Solving for the load factor gives

$$n_L = \frac{S_pA_t - F_i}{CP} \qquad \text{(8–29)}$$

Statically Loaded Tension Joint with Preload

It is also essential for a safe joint that the external load be smaller than that needed to cause the joint to separate. If separation does occur, then the entire external load will be imposed on the bolt. Let P_0 be the value of the external load that would cause joint separation. At separation, $F_m = 0$ in Eq. (8–25), and so

$$(1 - C)P_0 - F_i = 0 \qquad (d)$$

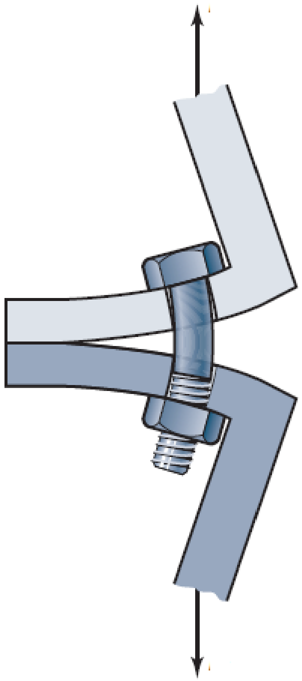
Let the factor of safety against joint separation be

$$n_0 = \frac{P_0}{P} \qquad (e)$$

Substituting $P_0 = n_0 P$ in Eq. (d), we find

$$n_0 = \frac{F_i}{P(1 - C)} \qquad (8\text{–}30)$$

as a load factor guarding against joint separation.



Separation of joint.

Tension Loaded Bolted Joints: Static Factors of Safety

Axial Stress:

$$\sigma_b = \frac{F_b}{A_t} = \frac{CP + F_i}{A_t}$$

Yielding Factor of Safety:

$$\boxed{n_p = \frac{S_p}{\sigma_b} = \frac{S_p}{(CP + F_i)/A_t} = \frac{S_p A_t}{CP + F_i}}$$

Load Factor:

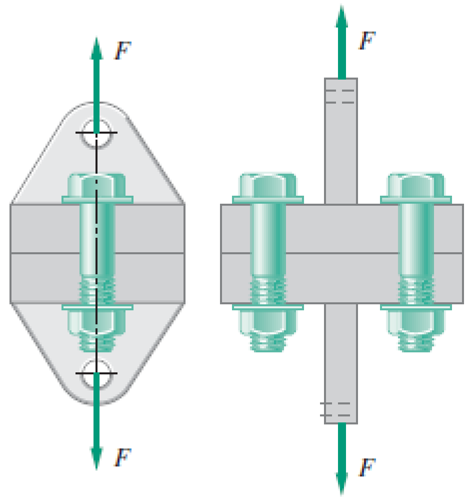
$$\frac{C n_L P + F_i}{A_t} = S_p$$

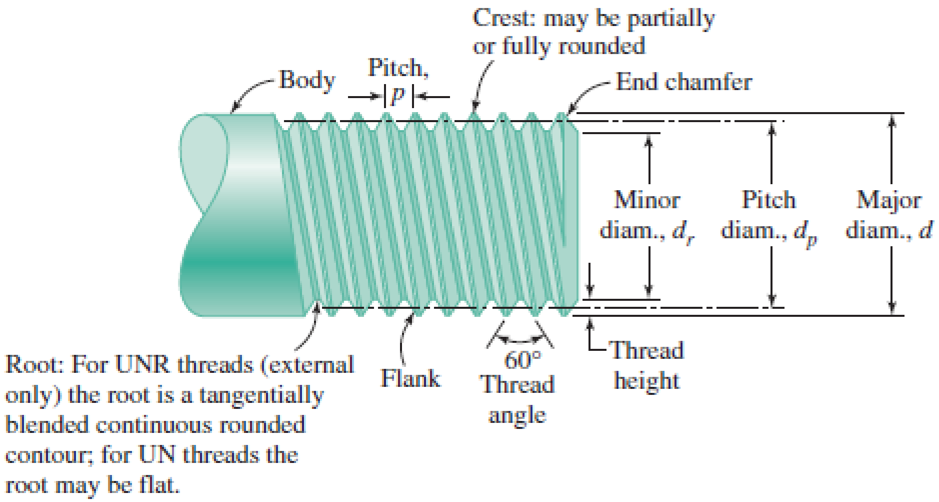
$$\boxed{n_L = \frac{S_p A_t - F_i}{CP}}$$

Joint Separation Factor:

$$\boxed{n_0 = \frac{F_i}{P(1 - C)}}$$

The bolted joint shown in Figure E13.2 is required to support an external force of $F = 10$ kN. For a preliminary design, class 4.6 bolts are specified and initial estimates indicate that $k_m = 4k_b$ can be expected. The maximum root stress is required to be less than 65 percent of the minimum yield strength of the bolt and the joint cannot separate. Determine the minimum required bolt preload to assure that the joint does not separate and the type of bolt to be used





A set of six M8 bolts are used to provide a clamping force of 20 kN between two components in a machine. If the joint is subjected to an additional load of 18 kN after the initial preload of 8.5 kN per bolt has been applied, determine the stress in the bolts. The stiffness of the clamped components can be assumed to be three times that of the bolt material. The proof stress of the low carbon steel bolt material is 310 MPa.

Table A–17

Preferred Sizes and Renard (R-Series) Numbers (When a choice can be made, use one of these sizes; however, not all parts or items are available in all the sizes shown in the table.)

Fraction of Inches

$\frac{1}{64}$, $\frac{1}{32}$, $\frac{1}{16}$, $\frac{3}{32}$, $\frac{1}{8}$, $\frac{5}{32}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{7}{16}$, $\frac{1}{2}$, $\frac{9}{16}$, $\frac{5}{8}$, $\frac{11}{16}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2, $2\frac{1}{4}$, $2\frac{1}{2}$, $2\frac{3}{4}$, 3, $3\frac{1}{4}$, $3\frac{1}{2}$, $3\frac{3}{4}$, 4, $4\frac{1}{4}$, $4\frac{1}{2}$, $4\frac{3}{4}$, 5, $5\frac{1}{4}$, $5\frac{1}{2}$, $5\frac{3}{4}$, 6, $6\frac{1}{2}$, 7, $7\frac{1}{2}$, 8, $8\frac{1}{2}$, 9, $9\frac{1}{2}$, 10, $10\frac{1}{2}$, 11, $11\frac{1}{2}$, 12, $12\frac{1}{2}$, 13, $13\frac{1}{2}$, 14, $14\frac{1}{2}$, 15, $15\frac{1}{2}$, 16, $16\frac{1}{2}$, 17, $17\frac{1}{2}$, 18, $18\frac{1}{2}$, 19, $19\frac{1}{2}$, 20

Decimal Inches

0.010, 0.012, 0.016, 0.020, 0.025, 0.032, 0.040, 0.05, 0.06, 0.08, 0.10, 0.12, 0.16, 0.20, 0.24, 0.30, 0.40, 0.50, 0.60, 0.80, 1.00, 1.20, 1.40, 1.60, 1.80, 2.0, 2.4, 2.6, 2.8, 3.0, 3.2, 3.4, 3.6, 3.8, 4.0, 4.2, 4.4, 4.6, 4.8, 5.0, 5.2, 5.4, 5.6, 5.8, 6.0, 7.0, 7.5, 8.5, 9.0, 9.5, 10.0, 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5, 20

Millimeters

0.05, 0.06, 0.08, 0.10, 0.12, 0.16, 0.20, 0.25, 0.30, 0.40, 0.50, 0.60, 0.70, 0.80, 0.90, 1.0, 1.1, 1.2, 1.4, 1.5, 1.6, 1.8, 2.0, 2.2, 2.5, 2.8, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 8.0, 9.0, 10, 11, 12, 14, 16, 18, 20, 22, 25, 28, 30, 32, 35, 40, 45, 50, 60, 80, 100, 120, 140, 160, 180, 200, 250, 300

Renard Numbers*

1st choice, R5: 1, 1.6, 2.5, 4, 6.3, 10

2d choice, R10: 1.25, 2, 3.15, 5, 8

3d choice, R20: 1.12, 1.4, 1.8, 2.24, 2.8, 3.55, 4.5, 5.6, 7.1, 9

4th choice, R40: 1.06, 1.18, 1.32, 1.5, 1.7, 1.9, 2.12, 2.36, 2.65, 3, 3.35, 3.75, 4.25, 4.75, 5.3, 6, 6.7, 7.5, 8.5, 9.5

*May be multiplied or divided by powers of 10.

Fatigue Loading of Tension Joints

- Fatigue methods of Ch. 6 are directly applicable
- Distribution of typical bolt failures is
  - 15% under the head
  - 20% at the end of the thread
  - 65% in the thread at the nut face

- **Fatigue stress-concentration factors** for threads and fillet are given in **Table 8–16**

Table 8–16

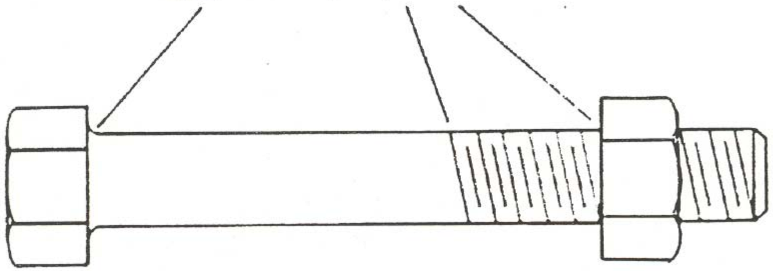
Fatigue Stress-Concentration Factors K_f for Threaded Elements

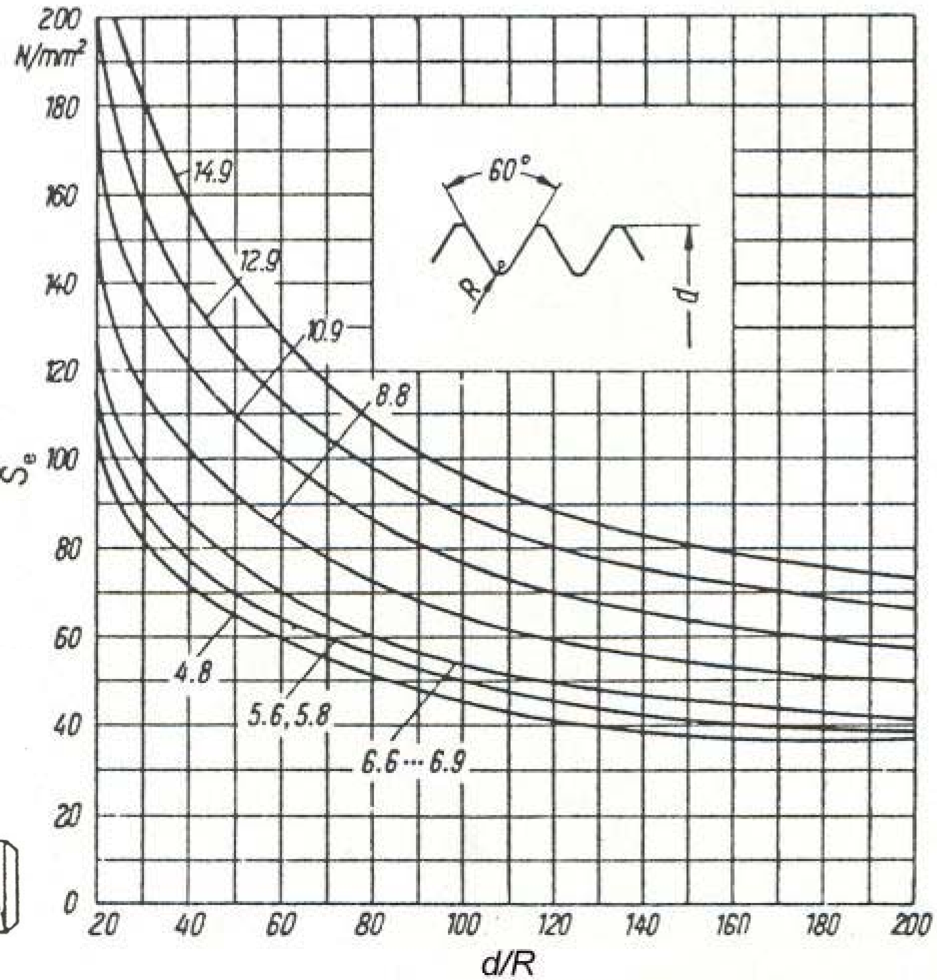
SAE Grade	Metric Grade	Rolled Threads	Cut Threads
0 to 2	3.6 to 5.8	2.2	2.8
4 to 8	6.6 to 10.9	3.0	3.8

Συντελεστές συγκέντρωσης τάσεων k_f

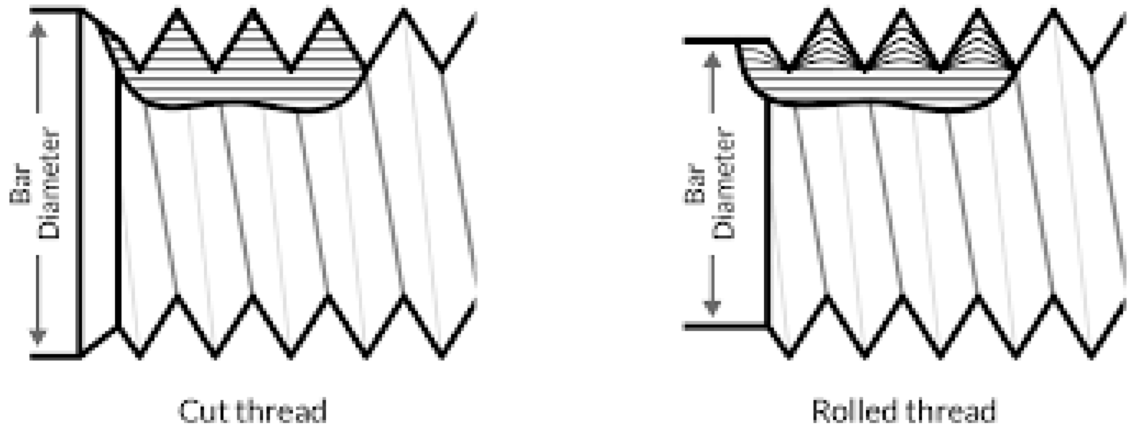
Όταν ένας κοχλίας υπόκειται σε δυναμική καταπόνηση, πρέπει να υπολογίζεται λαμβάνοντας υπ' όψη τον συντελεστή συγκέντρωσης τάσεων.

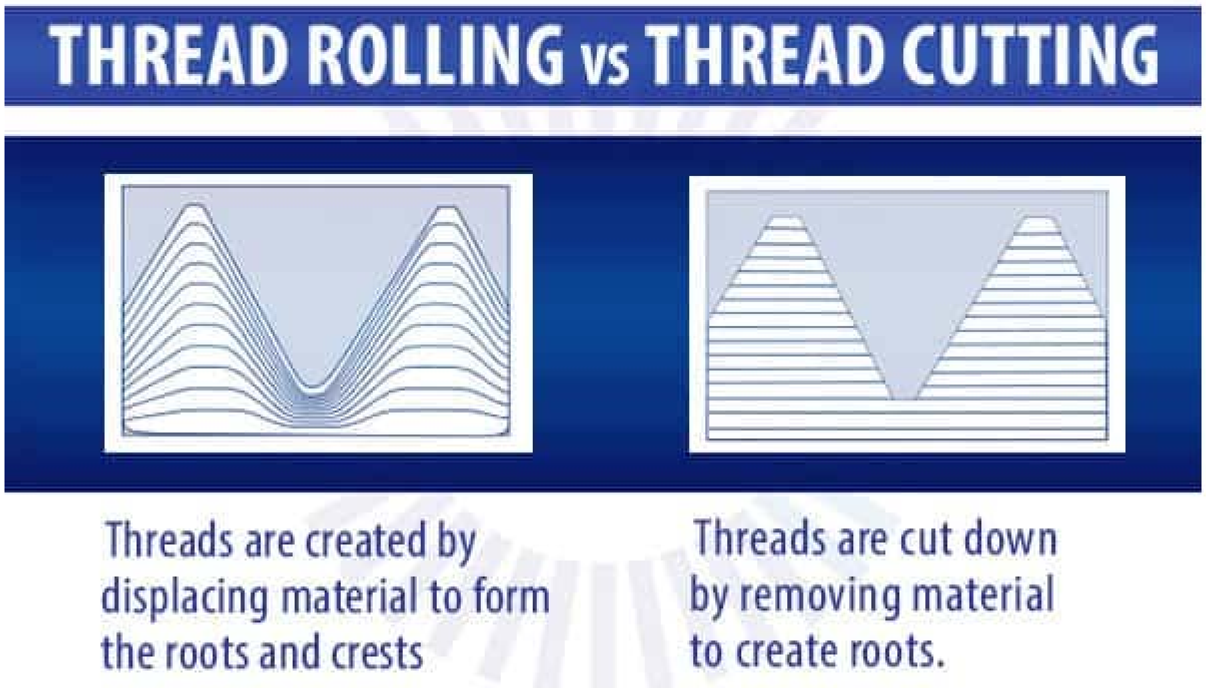
Τα κρίσιμα σημεία για αστοχία είναι:
(α) το σημείο αλλαγής της διαμέτρου κάτω από την κεφαλή του κοχλία
(β) το σημείο αρχής του σπειρώματος
(γ) κατά μήκος του σπειρώματος μέσα στο περικόχλιο.
Ο συντελεστής συγκ. τάσεων εξαρτάται από το λόγο d/R (R ακτίνα καμπυλότητας στο σπείρωμα)





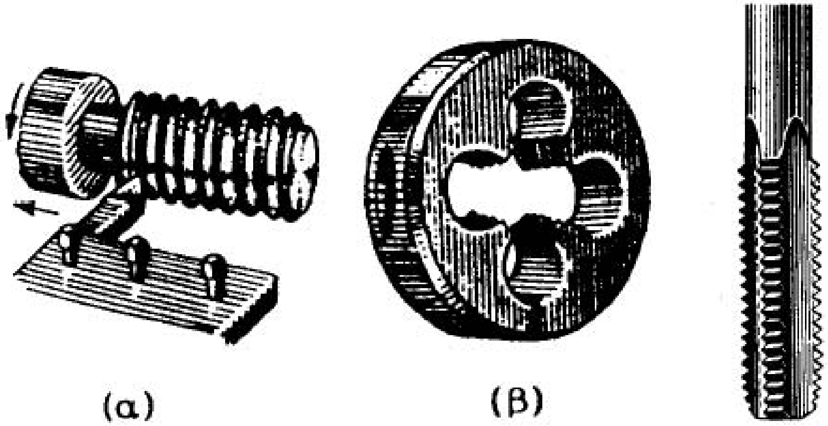
Διάγραμμα διαρκούς δυναμικής αντοχής σe για χαλύβδινους κοχλίες διαφόρων κατηγοριών
Το σe εμπεριέχει το συντελεστή συγκέντρωσης τάσεων


Bar Diameter
Cut thread
Bar Diameter
Rolled thread

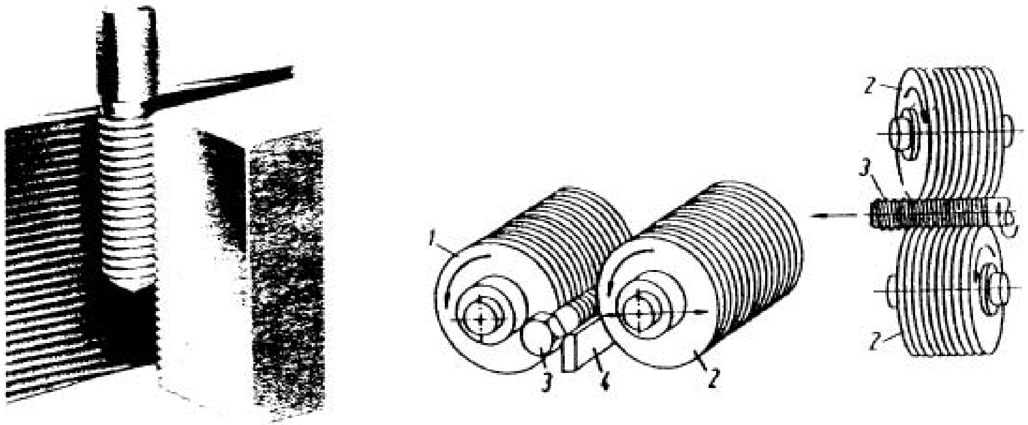

THREAD ROLLING vs THREAD CUTTING
Threads are created by displacing material to form the roots and crests
Threads are cut down by removing material to create roots.

Κατασκευή Σπειρώματος

- Κοπή και αφαίρεση υλικού



- Διαμόρφωση με έλαση



Endurance Strength for Bolts

- Bolts are standardized, so endurance strengths are known by experimentation, including all modifiers discussed in chapter 6. See Table 8–17.
- Fatigue stress-concentration factor K_f should not be applied to the nominal bolt stresses.
- Ch. 6 methods can be used for cut threads.

Table 8–17

Fully Corrected Endurance Strengths for Bolts and Screws with Rolled Threads*

Grade or Class	Size Range	Endurance Strength
SAE 5	$\frac{1}{4}$–1 in	18.6 kpsi
	$1\frac{1}{8}$–$1\frac{1}{2}$ in	16.3 kpsi
SAE 7	$\frac{1}{4}$–$1\frac{1}{2}$ in	20.6 kpsi
SAE 8	$\frac{1}{4}$–$1\frac{1}{2}$ in	23.2 kpsi
ISO 8.8	M16–M36	129 MPa
ISO 9.8	M1.6–M16	140 MPa
ISO 10.9	M5–M36	162 MPa
ISO 12.9	M1.6–M36	190 MPa

*Repeatedly applied, axial loading, fully corrected.

Use of rolled threads is the predominant method of thread-forming in screw fasteners. In thread-rolling, the amount of cold work and strain-strengthening is unknown to the designer; therefore, fully corrected (including K_f) axial endurance strength is reported in Table 8–17. Since K_f is included as an endurance strength reducer in Table 8–17, it should not be applied as a stress increaser when using values from this table. For cut threads, the methods of Chap. 6 are useful. Anticipate that the endurance strengths will be considerably lower.

Table 8–16

Fatigue Stress-Concentration Factors K_f for Threaded Elements

SAE Grade	Metric Grade	Rolled Threads	Cut Threads
0 to 2	3.6 to 5.8	2.2	2.8
4 to 8	6.6 to 10.9	3.0	3.8

Table 8–17

Fully Corrected Endurance Strengths for Bolts and Screws with Rolled Threads*

Grade or Class	Size Range	Endurance Strength
ISO 8.8	M16–M36	129 MPa
ISO 9.8	M1.6–M16	140 MPa
ISO 10.9	M5–M36	162 MPa
ISO 12.9	M1.6–M36	190 MPa

*Repeatedly applied, axial loading, fully corrected, including K_f as a strength reducer.

Fatigue Stresses

- With an external load on a per bolt basis fluctuating between P_{min} and P_{max},

$$F_{b\min} = CP_{\min} + F_i \qquad (a)$$

$$F_{b\max} = CP_{\max} + F_i \qquad (b)$$

$$\sigma_a = \frac{(F_{b\max} - F_{b\min})/2}{A_t} = \frac{(CP_{\max} + F_i) - (CP_{\min} + F_i)}{2A_t}$$

$$\sigma_a = \frac{C\,(P_{\max} - P_{\min})}{2A_t}$$

$$\sigma_m = \frac{(F_{b\max} + F_{b\min})/2}{A_t} = \frac{(CP_{\max} + F_i) + (CP_{\min} + F_i)}{2A_t}$$

$$\sigma_m = \frac{C\,(P_{\max} + P_{\min})}{2A_t} + \frac{F_i}{A_t}$$

Yield Check with Fatigue Stresses

- As always, maximum stress must be checked for static yielding, using Sp instead of Sy.
- In fatigue loading situations, since σ_a and σ_m are already calculated, it may be convenient to check yielding with

$$\boxed{n_p = \frac{S_p}{\sigma_m + \sigma_a}} \qquad (8\text{–}51)$$

- This is equivalent to the yielding factor of safety from Eq. (8–28).

(8–28)

$$\boxed{n_p = \frac{S_p}{\sigma_b} = \frac{S_p}{(CP + F_i)/A_t} = \frac{S_p A_t}{CP + F_i}}$$

For a general case with a constant preload, and an external load on a per bolt basis fluctuating between $P_{\min}$ and $P_{\max}$, a bolt will experience fluctuating forces such that

$$F_{b\min} = CP_{\min} + F_i \qquad (a)$$

$$F_{b\max} = CP_{\max} + F_i \qquad (b)$$

Fatigue Factor of Safety

- Fatigue factor of safety based on Goodman line and constant preload load line,

$$n_f = \frac{S_e(S_{ut} - \sigma_i)}{S_{ut}\sigma_a + S_e(\sigma_m - \sigma_i)}$$

- Other failure theories can be used, following the same approach.

Repeated Load Special Case

- Fatigue factor of safety equations for repeated loading, constant preload load line, with various failure curves:

Goodman:

$$n_f = \frac{S_e(S_{ut} - \sigma_i)}{\sigma_a(S_{ut} + S_e)} \tag{8–45}$$

Gerber:

$$n_f = \frac{1}{2\sigma_a S_e}\left[S_{ut}\sqrt{S_{ut}^2 + 4S_e(S_e + \sigma_i)} - S_{ut}^2 - 2\sigma_i S_e\right] \tag{8–46}$$

ASME-elliptic:

$$n_f = \frac{S_e}{\sigma_a(S_p^2 + S_e^2)}\left(S_p\sqrt{S_p^2 + S_e^2 - \sigma_i^2} - \sigma_i S_e\right) \tag{8–47}$$

Often, the type of fatigue loading encountered in the analysis of bolted joints is one in which the externally applied load fluctuates between zero and some maximum force P.

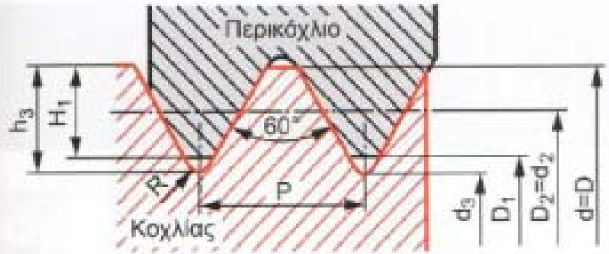
For a bolted assembly with eight bolts, the stiffness of each bolt is $k_b = 1.0$ MN/mm and the stiffness of the members is $k_m = 2.6$ MN/mm per bolt. The bolts are preloaded to 75 percent of proof strength. Assume the external load is equally distributed to all the bolts. The bolts are M6 $\times$ 1 class 5.8 with rolled threads. A fluctuating external load is applied to the entire joint with $P_{\text{max}} = 60$ kN and $P_{\text{min}} = 20$ kN.

(*a*) Determine the yielding factor of safety.

(*b*) Determine the overload factor of safety.

(*c*) Determine the factor of safety based on joint separation.

(*d*) Determine the fatigue factor of safety using the Goodman criterion.



Ονομαστική διάμετρος	d=D
Βήμα σπειρώματος	P
Γωνία σπειρώματος	60°
Μέση διάμετρος σπειρώματος	$d_2=D_2=d-0{,}6495\cdot P$
Εσωτερική διάμετρος: Κοχλία	$d_3=d-1{,}2269\cdot P$
Περικόχλιου	$D_1=d-1{,}0825\cdot P$
Βάθος σπειρώματος: Κοχλία	$h_3=0{,}6134\cdot P$
Περικόχλιου	$H_1=0{,}5413\cdot P$
Ακτίνα καμπυλότητας	$R=0{,}1443\cdot P$
Διατομή σπειρώματος	$A_s=\frac{\pi}{4}\cdot(\frac{d_2+d_3}{2})$

Ονομασία	Βήμα	Μέση διάμετρος	Εσωτερική διάμετρος (πυρήνα)		Βάθος σπειρώματος		Καμπυλότητα	Διάμετρος οπής	Διατομή
			Κοχλία	Περικοχλίου	Κοχλία	Περικοχλίου			
d=D	P	$D_2=d_2$	d_3	D_1	h_3	H_1	R	–	A_s
M 1	0,25	0,838	0,693	0,729	0,153	0,135	0,036	1,2	0,46
M 1,2	0,25	1,038	0,893	0,929	0,153	0,135	0,036	1,4	0,73
M 1,6	0,35	1,373	1,170	1,221	0,215	0,189	0,051	1,8	1,27
M 2	0,4	1,740	1,509	1,567	0,245	0,217	0,058	2,4	2,07
M 2,5	0,45	2,208	1,948	2,013	0,276	0,244	0,065	2,9	3,39
M 3	0,5	2,675	2,387	2,459	0,307	0,271	0,072	3,4	5,03
M 4	0,7	3,545	3,141	3,242	0,429	0,379	0,101	4,5	8,73
M 5	0,8	4,480	4,019	4,134	0,491	0,433	0,115	5,5	14,2
M 6	1	5,350	4,773	4,917	0,613	0,541	0,144	6,6	20,1
M 8	1,25	7,188	6,466	6,647	0,767	0,677	0,180	9	36,6
M 10	1,5	9,026	8,160	8,376	0,920	0,812	0,217	11	58,0
M 12	1,75	10,863	9,853	10,106	1,074	0,947	0,253	13,5	84,3
M 16	2	14,701	13,546	13,835	1,227	1,083	0,289	17,5	157
M 20	2,5	18,376	16,933	17,294	1,534	1,353	0,361	22	245
M 24	3	22,051	20,319	20,752	1,840	1,624	0,433	26	353
M 30	3,5	27,727	25,706	26,211	2,147	2,894	0,505	33	561
M 36	4	33,402	31,093	31,670	2,454	2,165	0,577	39	817
M 42	4,5	39,077	36,479	37,129	2,760	2,436	0,650	45	1120
M 48	5	44,752	41,866	42,587	3,067	2,706	0,722	52	1470
M 56	5,5	52,428	49,252	50,046	3,374	2,977	0,794	62	2030
M 64	6	60,103	56,639	57,505	3,681	3,248	0,866	70	2680

Πίνακας 6.3 Τριγωνικό μετρικό σπείρωμα κατά ISO – DIN 13-1 (διαστάσεις σε mm)

An M30 $\times$ 3.5 ISO 8.8 bolt is used in a joint at recommended preload, and the joint is subject to a repeated tensile fatigue load of $P = 65$ kN per bolt. The joint constant is $C = 0.28$. Find the static load factors and the factor of safety guarding against a fatigue failure based on the Gerber fatigue criterion.