

HYDROCAM bolt tensioners

Industrial tightening systems





The SKF brand now stands for more than ever before, and means more to you as a valued customer.

While SKF maintains its leadership as the hallmark of quality bearings throughout the world, new dimensions in technical advances, product support and services have evolved SKF into a truly solutions-oriented supplier, creating greater value for customers.

These solutions encompass ways to bring greater productivity to customers, not only with breakthrough application-specific products, but also through leading-edge design simulation tools and consultancy services, plant asset efficiency maintenance programmes, and the industry's most advanced supply management techniques.

The SKF brand still stands for the very best in rolling bearings, but it now stands for much more.

SKF – the knowledge engineering company

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K SKF – The Knowledge Engineering Company

Introduction

SKF has worked in the field of bolt-tightening by pre-load tension since the 1940's.

At that time, design studies concentrated on the tightening of slewing rings, where the SKF group's subsidiary, RKS, is a leading specialist.

Since the 1940's, SKF has continuously furthered in France its bolt-tightening experience in every industrial sector and in many different types of applications.

Today, SKF, through its "Industrial Tightening Engineering" Department located in France, offers two descriptive documents on the subject of bolt-tightening: the "Bolt-tightening handbook", which discusses the technical aspects of bolt-tightening, and this product catalogue: the "HYDROCAM bolt tensioners – Industrial tightening systems" catalogue.

Well aware that good tightening control is extremely important for safety and economic reasons, SKF offers both expertise and service to solve any problems involving the tightening of bolted assemblies.

Just what is a bolted assembly?

A bolted assembly quite simply means the putting together of at least two parts using one or several bolts. As is shown in **fig. 1**, these bolts can be made up of screws and nuts, studs with nuts on one or both ends, and possibly washers.

In the following document, the word "bolt" includes these three types of screwing components.

Bolted assemblies are the most commonly used connecting systems in mechanics. And although they appear to be quite simple, bolted assemblies do pose several challenges at many levels: design department, assembly workshop, on-site, and maintenance.

Rough dimensioning methods are too often applied at the design stage, which leads to unnecessary oversizing. Such oversizing does not enhance product safety, quite the contrary...

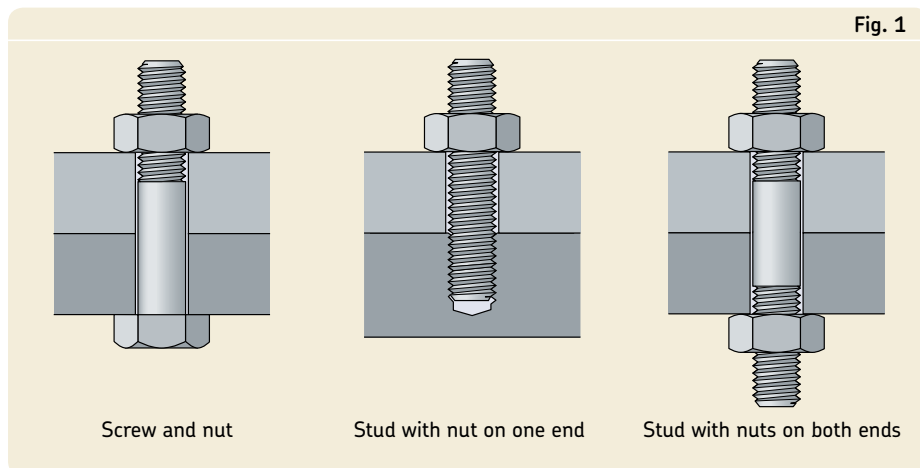
The design and implementation of a bolted assembly requires a very strict methodological approach, for errors can lead to costly and often disastrous failures.

Several studies have shown that incidents encountered on bolted assemblies are most often due to improper design of the assembly (analysis, design, calculation, component choice) or poor implementation (tightening method, tooling, inspection).

Today it is known that of all the various causes of failure (overloading, design flaws, manufacturing defects, and others), the most frequent is improper assembly. Tightening problems, whether insufficient tightening, excessive tightening or heterogenous tightening, alone account for over 30% of all bolted assembly failures.

More specifically, 45% of all fatigue failures are estimated to be due to improper assembly.

Therefore, the importance of the design of the bolted assembly and the means used to tighten it are of utmost importance.



Introduction

The “Bolt-tightening handbook” clearly explains that “optimum tightening means a bolt which is not too tight and not too loose” and shows how to achieve the best tightening.

It reviews all the tightening methods and proves that the best tightening control is provided by the hydraulic tensioner.

This “Product Catalogue” describes all the products and services that SKF offers in order to enable you to better manage your bolted assemblies thanks to HYDROCAM bolt tensioner.

Both of these documents provide indispensable information on optimizing the bolted assemblies that you are designing

and on choosing the best tightening method for your application. They describe the key aspects, which are:

- quality
- accuracy
- homogeneity
- ease of use.

These provide additional advantages such as:

- reliability and safety
- optimized dimensions
- time savings
- cost reduction in use, control and maintenance.

In addition, this catalogue provides other useful information such as standard bolting dimensions, units conversion, and the conversion of torque into tension load...

As an example – did you know that with SKF hydraulic tensioner you can tighten bolts from 5 to 500 mm?

Please do not hesitate to contact SKF for your needs. You may be surprised by all the services SKF can provide in the field of bolted assembly tightening.



Technical information

What makes up the HYDROCAM bolt tensioner?

A standard HYDROCAM tensioner has a hydraulic body which, using a hydraulic fluid, exerts a strong tension load on the bolt through the brace screwed on that bolt. In some tensioner types (HTC R), the body is screwed directly on the bolt to be tightened. The body also rests on the skirt in order to apply the reaction force on the assembly to be tightened.

Prior to screwing the body-brace-skirt unit on the protruding end of the bolt, a socket has to be placed on the nut of the bolt. This nut can then be "turned down" (screwed until the lower surface of the nut comes into contact with the assembly bearing surface), by a tommy bar, while the tensioner applies the tension load.

Brace

The brace is screwed on the protruding end of the bolt, above the nut. It supplies the tension load exerted by the hydraulic body on the bolt (→ fig. 2).

Hydraulic body

Using the fluid under pressure, the hydraulic body creates the tension load on the brace by pushing on the skirt (→ fig. 3).

Skirt

The skirt is placed around the nut on the assembly to be tightened. It transmits the compression force to the assembly by reaction to the tension load applied on the bolt by the hydraulic body (→ fig. 4).

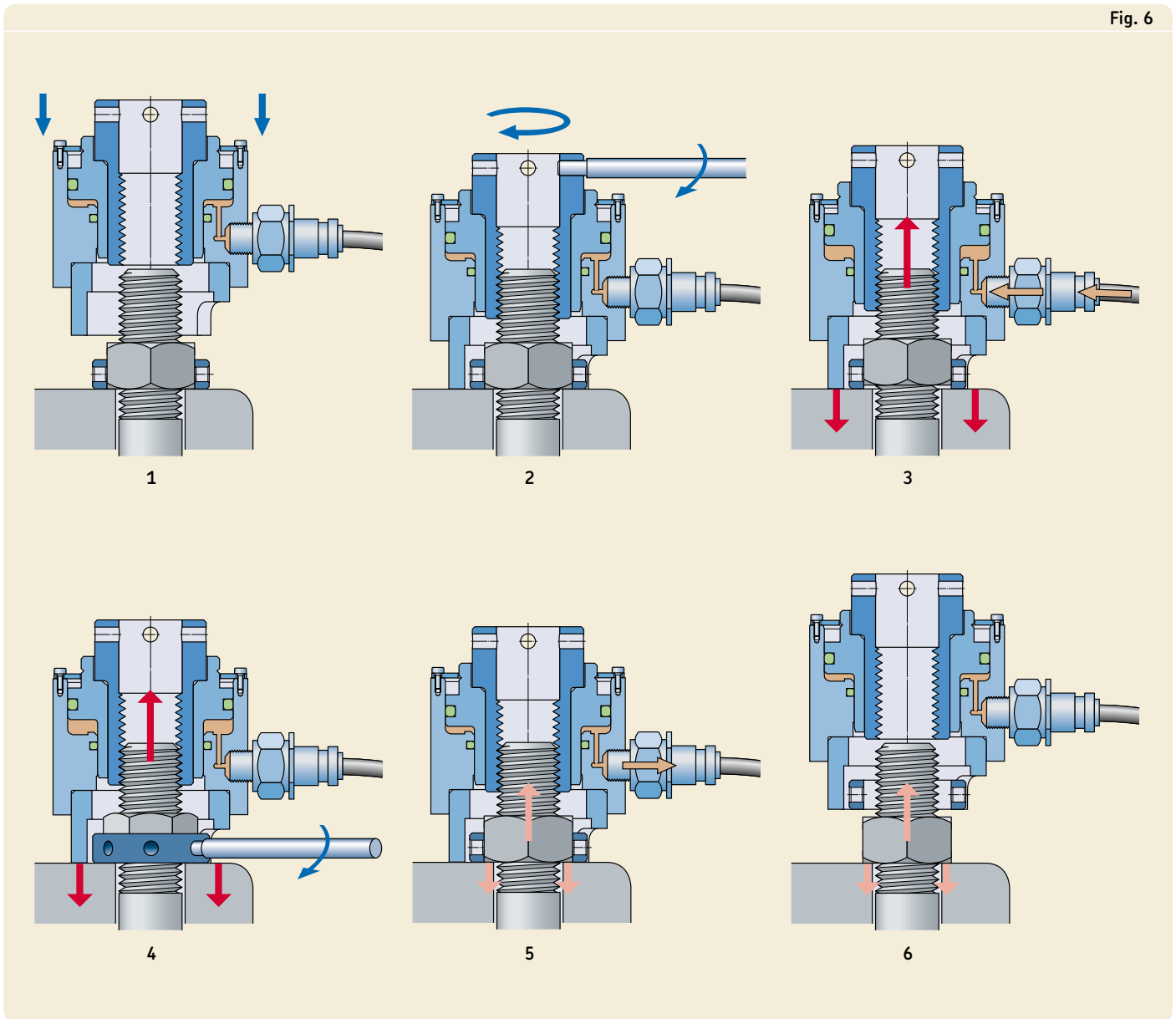
Socket for standard nut (optional)

In the case of assemblies with standard nuts, a socket is placed around the nut to effortlessly bring the nut into contact with the assembly. For this purpose, the outer surface of the socket is drilled with radial axis holes to hold the push rods. Turning down occurs while the tension load is applied by the hydraulic body (→ fig. 5).

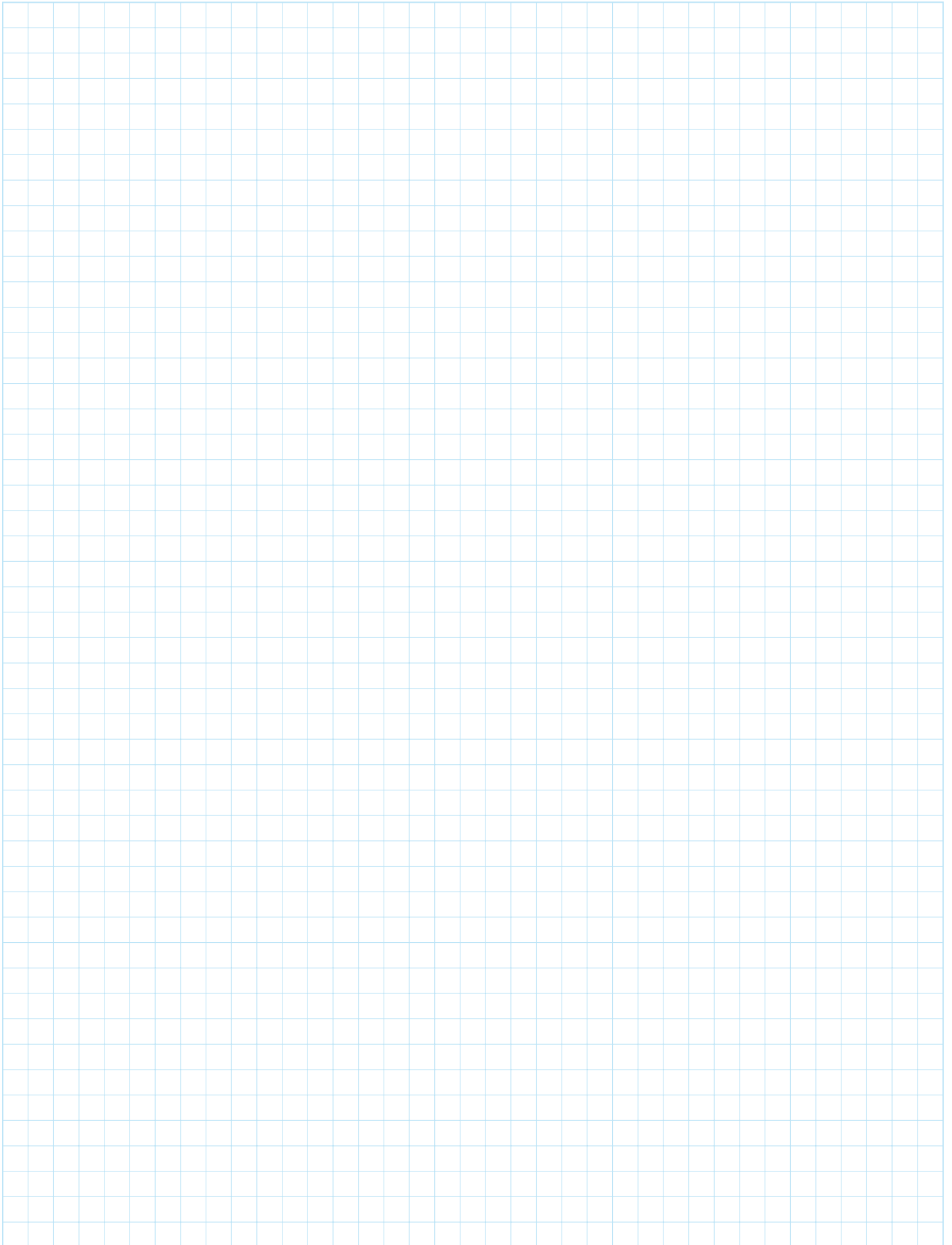


How a HYDROCAM tensioner works (→ fig. 6)

Fig. 6

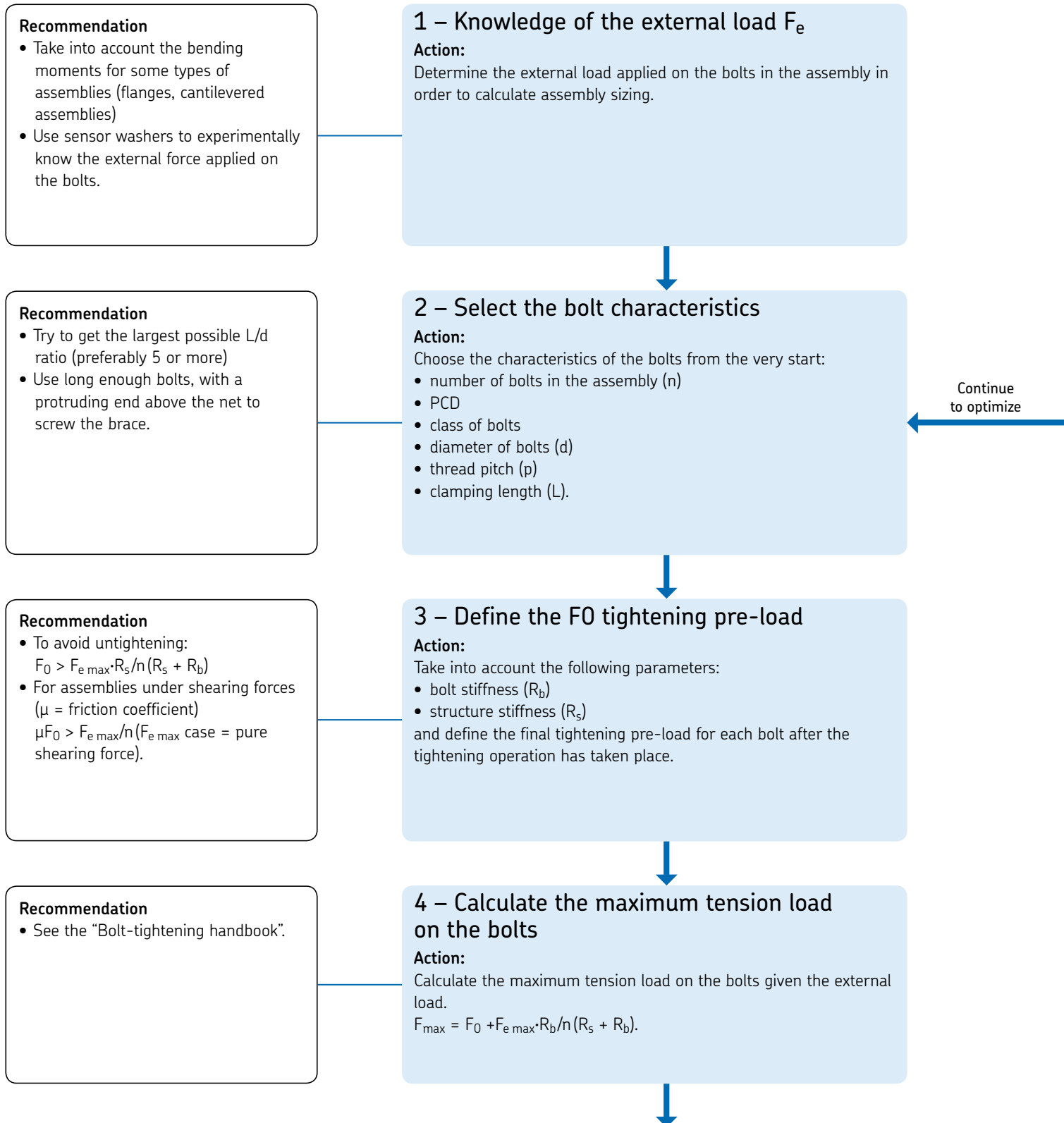


- 1 The turndown socket is placed over the nut and the hydraulic tensioner grasps the bolt.
- 2 The brace/retraction unit is screwed onto the protruding end of the bolt.
- 3 After the hydraulic connections, the tensioner is pressurized and applies the required tractive force on the bolt.
- 4 While the pressure is maintained, the nut is turned down without loading, using the socket and the tommy bar.
- 5 Their pressure is released and the piston is pushed back. The tightening load is now exerted through bolt tension.
- 6 The tensioner and the socket can be removed.



Optimize your bolted assembly

SKF provides recommendations and services for each one of these steps.



5 – Monitor the stress in the bolts

Action:

Calculate the maximum stress borne by the bolts in stressed section S

$$\sigma_{\max} = F_{\max}/S.$$

Recommendation

- For the threaded part of the bolt, use the equivalent section (A_s) as the bolt section
- For the cylindrical parts, use the entire section
- In the event of a central link, take the section variation into account
- See the “Bolt-tightening handbook”.

6 – Optimize bolt size

Action:

Try to increase the length to diameter ratio (L/d). If the maximum stress on the bolt is well within its yield point, the diameter can be reduced.

Recommendation

- The higher the L/d ratio and the higher the tightening stress, the better the fatigue behavior of a bolted assembly is. Tightening stress should be close to the yield point (preferably 80% R_e). See **pages 33 and 34** “Tightening Stress Chart”
- Likewise, in decreasing bolt stiffness, the share of the external load applied to the bolt is also decreased
- Choose the class of bolt material to appropriately resist the maximum load F_{\max} applied on the bolt
- See the “Bolt-tightening handbook”.

Use the following criteria to evaluate the optimization of your assembly

- Tightening stress is as close to 80% of R_e as possible
- Highest possible L/d diameter
- Lowest assembly weight and size as possible
- Appropriate safety margin?
- Tightening techniques have been taken into consideration since the design stages of the project.

Recommendation

See: “Recommendations for the use of HYDROCAM tensioners” **pages 12-14**.

Continue to optimize

The assembly is not optimized

no

yes

Optimized assembly

Please send us your technical data using the fax form on page 90.

or

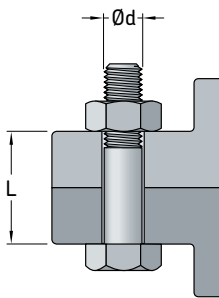
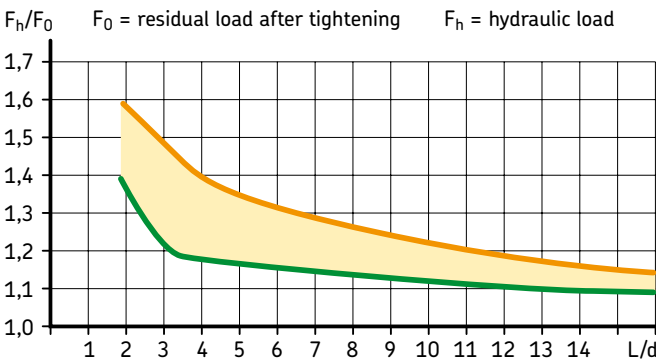
Once the assembly is designed, choose the best HYDROCAM tensioner for your application, using the logic diagram on the following pages.

Choose the best tightening solution: the HYDROCAM hydraulic bolt tensioners

Designing the assembly

See "Optimize your bolted assembly" (pages 8 and 9)

- Note:**
- Use a sensor washer for a direct reading of the residual load (page 80).
 - Accuracy is also increased by measuring bolt elongation. Contact SKF "Bolt Tensioning Department" in France for further information.
 - Ratio F_h/F_0 can also be obtained in some cases by calculation.



- Upper limit: wide pitch thread
- Lower limit: narrow pitch thread

The F_h/F_0 ratio as a function of bolt aspect ratio L/d for commonly used bolting steels

No extra charge for special thread

Your situation

- 1 – Little space around the bolt
- 2 – Homogenous tightening (case of several bolts to be tightened)
- 3 – Tightening time and accuracy

SKF solutions

Choose the right tensioner (pages 36 to 63)

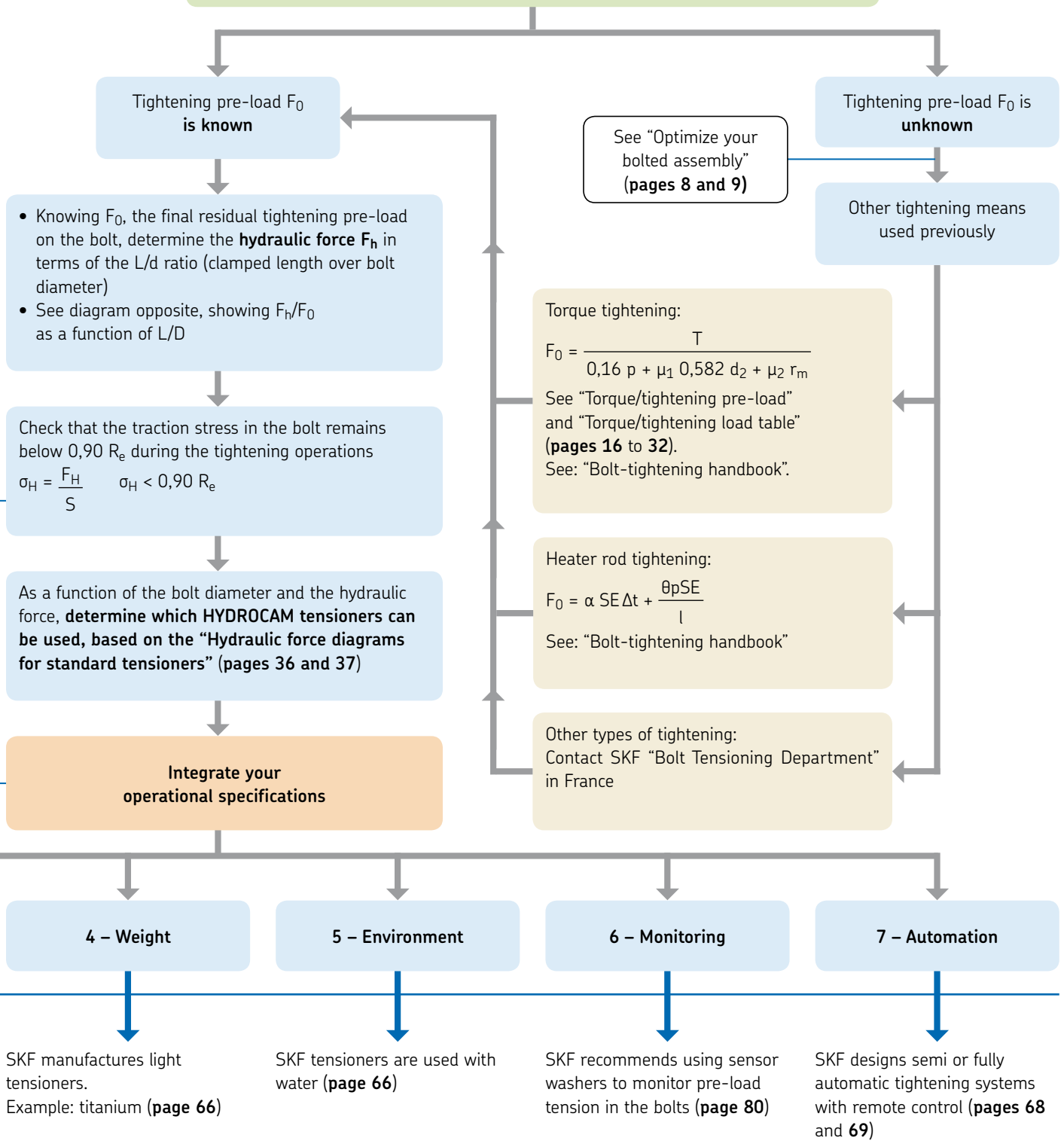
- If you are having problems,
- an adapted tensioner (page 65)
 - a special tensioner (pages 66 and 67)
- Contact SKF "Bolt Tensioning Department" in France

Ideally, for simultaneous tightening, use as many tensioners as bolts to be tightened

- If you can only do partial simultaneous tightening, follow a tightening procedure (see the "Bolt-tightening handbook")
- SKF can help you define a procedure which guarantees minimal dispersion for the number of bolts

- Select a tensioner with automatic piston return. If the most suitable tensioner does not have automatic return, check with SKF "Bolt Tensioning Department" in France about adapting a return system
- For partial simultaneous tightening, use the most tensioners possible to save time and improve accuracy

Tightening the designed assembly



To check the price of your HYDROCAM tensioner, use the fax form on **page 90**

Recommendations for the use of HYDROCAM tensioners

Choose the use of tensioners from the very start of the design phase of your assembly.

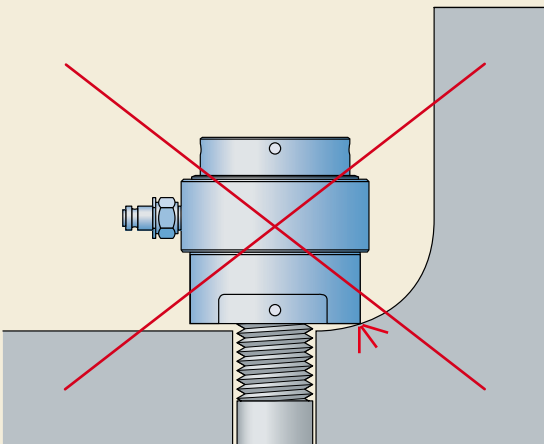
For the very best HYDROCAM tensioner efficiency and usage, please follow the

following recommendations from the very start of the design stage of the bolted assembly.

Failure to observe these basic recommendations can result in problems for which SKF cannot be held liable. To operate the HYDROCAM tensioners, please see the user manual enclosed with the product.

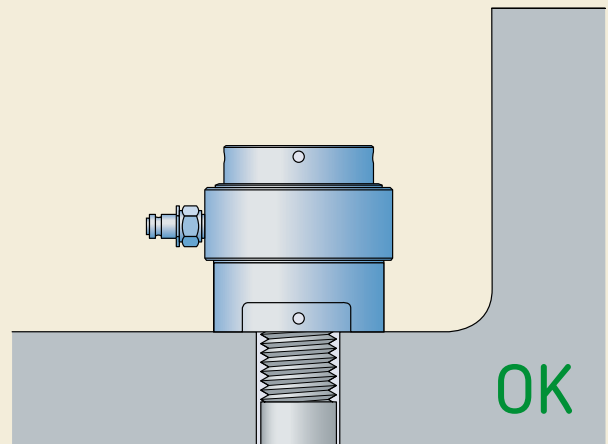
Avoid

Insufficient flat area around the bolt

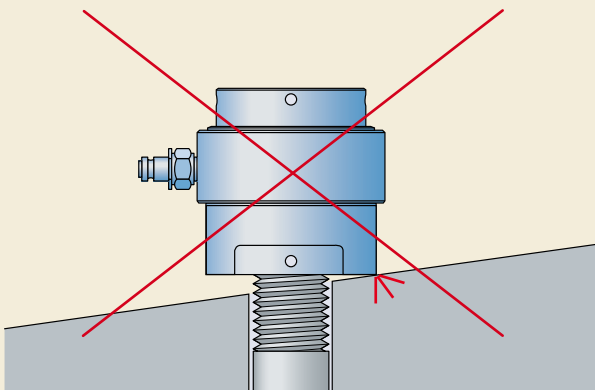


Recommended

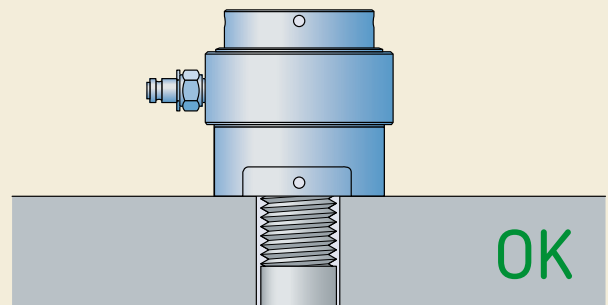
The lower part of the skirt must be in full contact with the assembly



Bearing area is slanted with respect to the bolt axis

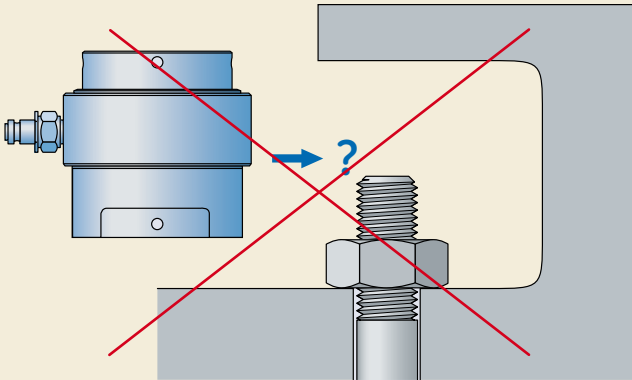


The skirt/assembly contact surface must be perpendicular to the bolt axis



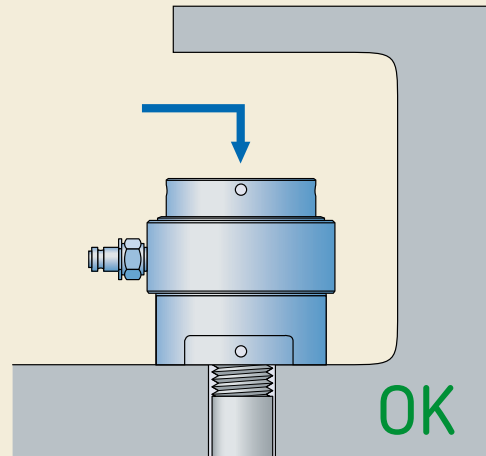
Avoid

Not enough room to fit the tensioner

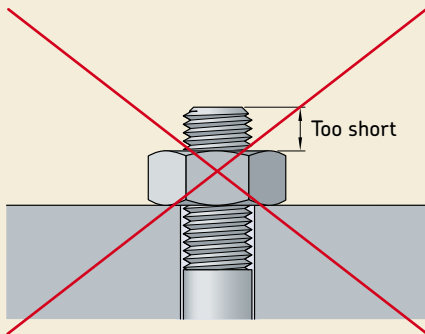


Recommended

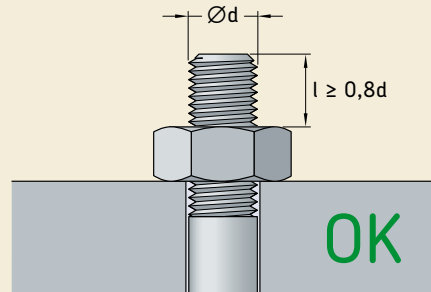
Design enough clearance to install the tensioner



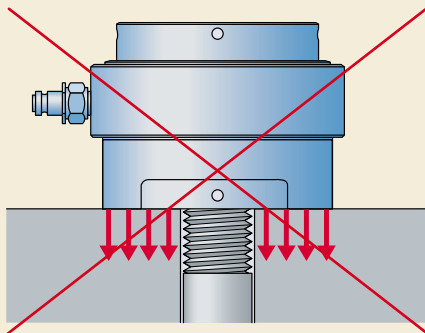
The protruding end of the bolt is too short



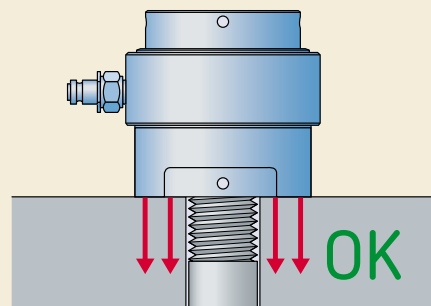
The length of the protruding end must provide for screwing the tensioner brace on a length of at least $l \geq 0,8d$



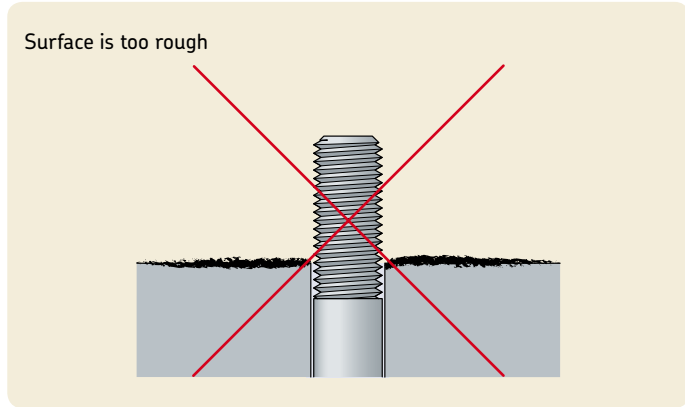
The tensioner is too big for the bolt – not enough pressure



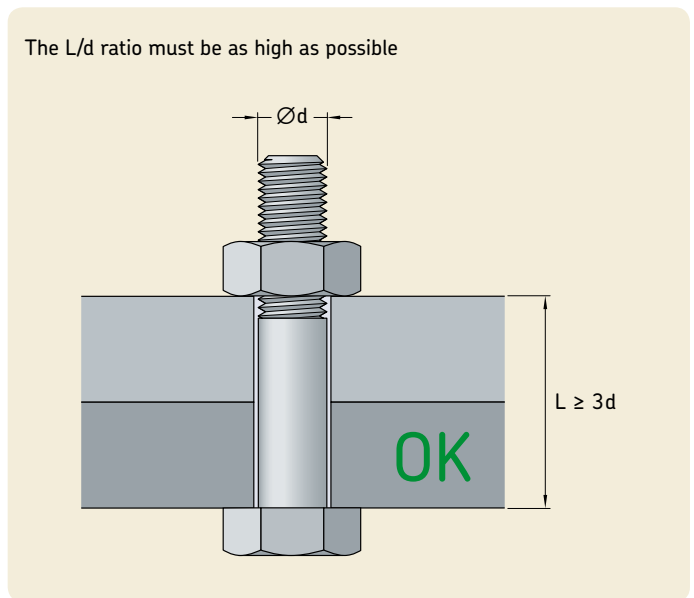
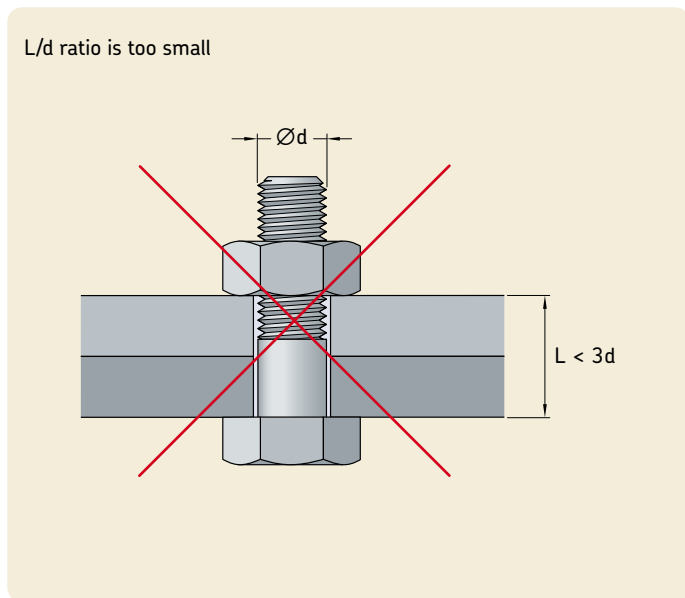
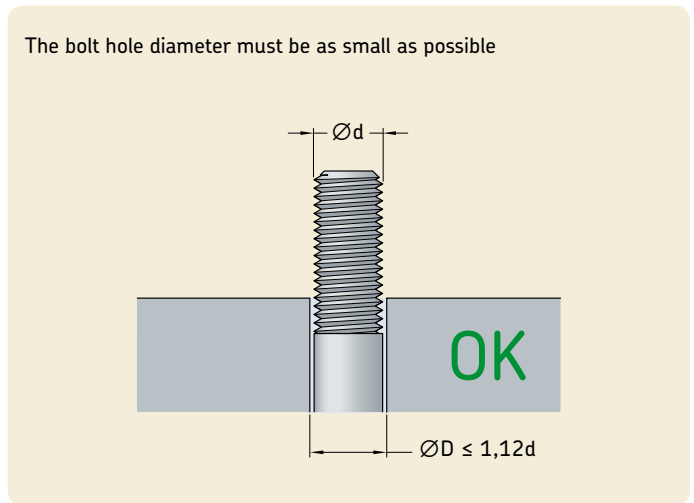
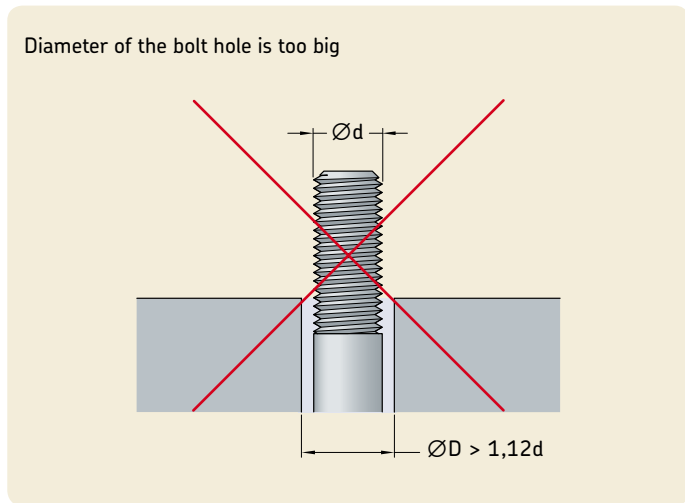
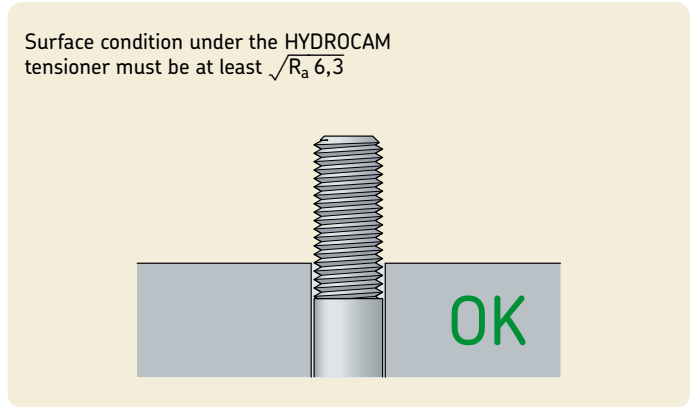
Tensioner diameter must be adapted to the bolt, and must operate under high pressure for the best tensioner and tightening performance



Avoid



Recommended



Units conversion

Metric system – Imperial system

B

Length

Metric units	→	Imperial units
1 millimeter (mm)	=	0,039370 in.
1 centimeter (cm)	=	0,03281 ft.
1 meter (m)	=	39,370 in.
1 meter (m)	=	3,2808 ft.

Imperial units	→	Metric units
1 inch (in.)	=	25,4 mm
1 foot (ft.)	=	30,48 cm
1 inch (in.)	=	0,0254 m
1 foot (ft.)	=	0,3048 m

Force

Metric units	→	Imperial units
1 newton (N)	=	0,22481 lbf.
1 kilonewton (kN)	=	224,81 lbf.

Imperial units	→	Metric units
1 pound force (lbt.)	=	4,4482 N
1 pound force (lbt.)	=	0,22448 kN

Torque

Metric units	→	Imperial units
1 newtonmeter (Nm)	=	0,73756 lbf.ft.
1 newtonmeter (Nm)	=	8,8507 lbf.in.

Imperial units	→	Metric units
1 pound force foot (lbf.ft.)	=	1,3558 Nm
1 pound force foot (lbf.in.)	=	0,113 Nm

Stress – Pressure

Metric units	→	Imperial units
1 bar	=	14,504 psi.
1 megapascal (MPa)	=	145,04 psi.

Imperial units	→	Metric units
1 pound-force per square inch (psi.)	=	0,06895 bar
1 pound-force per square inch (psi.)	=	0,006895 MPa

Reminder: 1 bar = 1 daN/cm²
1 MPa = 1 N/mm²
1 MPa = 10 bar

Remarque: in practice, "1 kg" = 10 MPa.

Example: "90 kilo" steel means that the yield point is 900 MPa.

Torque/tightening load tables

The tables on the following pages show the tightening load applied to a bolt when this bolt has been tightened with a torque wrench. This tightening load is strongly influenced by the friction coefficients from the threads and the nut face in contact with the assembly. Such friction is due to the torque-wrench tightening method itself.

Torque tightening therefore introduces great uncertainty in the actual value of the

bolt's residual tightening pre-load. However, the tables on the following pages do establish an order of magnitude.

If the plan is to tighten an existing assembly with hydraulic tensioners instead of with the torque wrench, tensioners able to supply a tension force similar to torque tightening must be chosen. However, for the sake of precaution, we recommend further calculation of the required tension force based on the optimization of a bolted assembly on **pages 8–9**.

Reading the tables

For a bolt diameter M39, tightened with a torque value of 3 500 Nm, the tightening pre-load is 484 kN for a friction coefficient of 0,15.

If this tightening pre-load were applied to a bolt from class 8-8 (yield point: 640 MPa), the tightening stress in this bolt would be 75% of the yield point (R_e).

However, if the friction coefficient is 0,10, the same torque of 3 500 Nm will generate in this bolt a tightening traction load of 695 kN leading to exceed the elastic limit.

Friction coefficient

- 0,10 (0,08/0,12): phosphate treated or galvanized bolt, good quality lubrication.
- 0,15 (0,13/0,17): black or galvanized bolt, low quality lubrication.
- 0,20 (0,18/0,25): regular bolts, no lubrication.

Torque/tightening load – Metric system

Bolt diameter from 5 to 14 mm	page 17
Bolt diameter from 16 to 39 mm	pages 18-19
Bolt diameter from 42 to 80 mm	pages 20-21
Bolt diameter from 85 to 150 mm	pages 22- 23

Torque/tightening load – Imperial system

Bolt diameter from 1/4 to 3/4 in.	pages 24-25
Bolt diameter from 7/8 to 2 in.	pages 26-27
Bolt diameter from 2 1/4 to 3 3/4 in.	pages 28-29
Bolt diameter from 4 to 5 1/4 in.	pages 30-31
Bolt diameter from 5 1/2 to 6 in.	page 32

Tightening load (kN) – metric system

- As a function of the torque (Nm)
- As a function of the diameter of the standard bolt from 5 to 150 mm
- As a function of the bolt friction coefficient.

B

Ø bolt (mm)	5			8			10			12			14		
Pitch (mm)	1			1,25			1,25			1,5			1,5		
Width across flats (mm)	10			13			17			19			22		
Friction coefficient	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20
Torque (Nm)															
10	12	8	7	9	6	5	7	5	4	6	4		5	4	
20	24	17	13	18	13	10	14	10	8	12	9	7	11	8	6
30	25	25	20	27	19	15	21	15	11	19	13	10	16	11	9
40	47	34	26	35	25	19	28	20	15	25	17	13	22	15	12
50		42	33	44	31	24	35	25	19	31	22	17	27	19	14
60			39	53	38	29	42	30	23	37	26	20	33	23	17
70			46		44	34	49	34	26	43	30	23	38	26	20
80					50	39	56	39	30	49	35	27	43	30	23
90						44	63	44	34	56	39	30	49	34	26
100						49		49	38	62	43	33	54	38	29
120								59	45	74	52	40	65	45	35
140									53	87	61	47	76	53	41
160									61		69	53	87	60	46
180											78	60	98	68	52
200											87	67	108	76	58
250												83		94	72
300														113	87
350															101
400															116

Continued

Technical information

Tightening load (kN) – metric system

Ø bolt (mm)	16			18			20			22			24		
Pitch (mm)	2			2,5			2,5			2,5			3		
Width across flats (mm)	24			27			30			32			36		
Friction coefficient	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20
Torque (Nm)															
10															
20	10														
30	15	10													
40	19	14	10	17											
50	24	17	13	22			19								
60	29	20	16	26	18			23							
70	34	24	18	30	21	16	27	19							
80	39	27	21	35	24	19	31	22			29				
90	44	31	24	39	27	21	35	24	19	33					
100	48	34	26	44	30	23	39	27	21	36	26			32	
120	58	41	31	52	37	28	46	33	25	44	31			39	
140	68	48	37	61	43	33	54	38	29	51	36	27	45	32	
160	77	54	42	70	49	37	62	43	34	58	41	31	52	36	
180	87	61	47	78	55	42	70	49	38	66	46	35	58	41	31
200	97	68	52	87	61	47	77	54	42	73	51	39	64	45	35
250	121	85	65	109	76	58	97	68	52	91	64	49	81	57	44
300	145	102	79	131	91	70	116	82	63	109	77	59	97	68	52
350		119	92	152	107	82	135	95	73	127	89	69	113	79	61
400		136	105	174	122	94	155	109	84	146	102	79	129	91	70
450		153	118		137	105	174	122	94	164	115	88	145	102	79
500			131		152	117	193	136	105	182	128	98	161	113	87
550			144		167	129	213	149	115	200	140	108	177	125	96
600					183	140		163	126	219	153	118	193	136	105
650						152		177	136	237	166	128	210	147	113
700						164		190	147	255	179	137	226	159	122
750						175		304	157		191	147	242	170	131
800								217	168		204	157	258	181	150
850									178		217	167	274	193	158
900									189		230	177	290	204	157
950									199		242	187	306	215	166
1 000									210		255	196		226	175
1 200												236		272	210
1 400														317	244
1 600															279
1 800															314
2 000															
2 500															
3 000															
3 500															
4 000															
4 500															
5 000															
5 500															
6 000															
6 500															
7 000															
7 500															
8 000															

Continued

27			30			33			36			39		
3			3,5			3,5			4			4		
41			46			50			55			60		
0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20
40														
46														
52														
58	40		52											
72	50	39	65											
86	60	46	78	54		71								
101	70	52	91	63		83			75					
115	80	62	104	72	55	95			86					
129	90	69	117	81	62	107	74		97			89		
144	100	77	130	90	69	118	83		107	75		99		
158	110	82	143	99	73	130	91	70	118	82		109		
173	121	93	156	108	83	142	99	76	129	90		119		
187	131	100	169	117	90	154	107	82	139	97	75	129	90	
201	141	108	182	126	97	166	116	89	150	105	81	139	97	
216	151	116	195	135	104	178	124	95	161	112	86	149	104	
230	161	123	208	144	11	189	132	101	172	120	92	159	111	
244	171	131	221	153	118	201	140	108	182	127	98	169	117	90
259	181	139	234	162	124	213	149	114	193	135	104	179	124	95
273	191	147	247	171	131	225	157	120	204	142	109	189	131	101
288	201	154	259	180	138	237	165	127	215	150	115	199	138	106
345	241	185	311	217	166	284	198	152	258	180	138	238	166	127
403	281	216	363	253	194	331	231	177	300	210	161	278	194	148
	321	247	415	289	221	379	264	203	343	240	184	318	221	170
	362	278	467	325	249	426	297	228	386	270	207	357	249	191
	402	309	519	361	277	474	330	253	429	300	230	397	276	212
		386		451	346	592	413	317	537	375	288	497	346	265
				541	415		495	380	644	450	346	596	415	318
					484		578	444		525	403	695	484	371
					553			507		600	461	794	553	424
								570		675	518		622	477
											576		691	530
											633		760	583
											691		829	636
														689
														742
														795
														848

B

Technical information

Tightening load (kN) – metric system

Ø bolt (mm)	42			45			48			52			56		
Pitch (mm)	4,5			4,5			5			5			5,5		
Width across flats (mm)	65			70			75			80			85		
Friction coefficient	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20
Torque (Nm)															
550	101														
600	110														
650	119														
700	128			120											
750	137			128											
800	146	102		137											
850	155	108		145											
900	165	115		154			143								
950	174	121		163			151								
1 000	183	127	98	171	119		159			150					
1 200	219	153	117	205	143		191			180					
1 400	256	178	137	239	166	128	223	155		210	146		197		
1 600	292	204	156	274	190	146	255	177		240	166		225		
1 800	329	229	176	308	214	164	287	199	153	270	187	143	253		
2 000	366	255	196	342	238	182	318	222	170	300	208	159	281	195	
2 500	457	319	244	428	297	228	398	277	212	375	260	199	351	244	187
3 000	548	382	293	513	357	273	478	332	255	450	312	239	421	293	224
3 500	640	446	342	599	416	319	557	388	297	525	364	279	491	342	262
4 000	731	510	391	684	476	364	637	443	340	599	416	319	561	390	299
4 500	823	573	440	770	535	410	716	499	382	674	468	359	632	439	337
5 000	914	637	489	855	594	456	796	554	425	749	520	398	702	488	374
5 500	1 005	701	538	941	654	501	876	609	467	824	572	438	772	537	411
6 000		764	587	1 026	713	547	955	665	510	899	624	478	842	585	449
6 500		828	636	1 112	773	592	1 035	720	552	974	676	518	912	634	486
7 000		892	685		832	638	1 114	776	595	1 049	728	558	983	683	523
7 500		956	733		892	683	1 194	831	637	1 124	780	598	1 053	732	561
8 000			782		951	729	1 274	886	680	1 199	832	637	1 123	781	598
8 500			831		1 011	774		942	722	1 274	884	677	1 193	829	636
9 000			880		1 070	820		997	765	1 349	936	717	1 263	878	673
9 500			929		1 129	866		1 053	807	1 424	988	757	1 334	927	710
10 000			978			911		1 108	850	1 499	1 040	797	1 404	976	748
12 000						1 093		1 330	1 020		1 249	956		1 171	897
14 000									1 190		1 457	1 116		1 366	1 047
16 000									1 360			1 275		1 561	1 196
18 000												1 434		1 756	1 346
20 000															1 496
25 000															
30 000															
35 000															
40 000															
45 000															
50 000															
55 000															
60 000															
65 000															

Continued

60			64			68			72			76			80		
5,5			6			6			6			6			6		
90			95			100			105			110			115		
0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20
240																	
266			251														
333	231		314			299											
399	277		377	262		359			343								
466	323	247	440	305		419	290		400			383					
532	369	283	502	349	267	479	332		458			438			420		
599	415	318	565	392	301	539	373	286	515	356		493			473		
665	462	353	628	436	334	599	415	317	572	396		548	378		525		
732	508	389	691	480	367	659	456	349	629	435	333	603	416		578		
799	554	424	753	523	401	718	498	381	687	475	363	657	454		631	435	
865	600	459	816	567	434	778	539	413	744	515	393	712	492	376	683	471	
932	646	495	879	610	468	838	581	444	801	554	424	767	530	405	736	507	
998	692	530	942	654	501	898	622	476	858	594	454	822	568	434	788	544	415
1 065	739	565	1 005	698	534	958	664	508	915	633	484	876	605	462	841	580	443
1 131	785	601	1 067	741	568	1 018	705	540	973	673	514	931	643	491	893	616	470
1 198	831	636	1 130	785	601	1 078	747	571	1 030	712	545	986	681	520	946	652	498
1 264	877	671	1 193	828	635	1 137	788	603	1 087	752	575	1 041	719	549	998	689	526
1 331	923	707	1 256	872	668	1 197	830	635	1 144	792	605	1 096	757	578	1 051	725	553
1 597	1 108	848	1 507	1 046	802	1 437	996	762	1 373	950	726	1 315	908	694	1 261	870	664
1 863	1 292	989	1 758	1 221	935	1 676	1 162	889	1 602	1 108	847	1 534	1 059	809	1 471	1 015	775
	1 477	1 131	2 009	1 395	1 069	1 916	1 328	1 016	1 831	1 267	968	1 753	1 211	925	1 682	1 160	885
	1 662	1 272	2 260	1 570	1 202	2 155	1 494	1 143	2 060	1 425	1 089	1 972	1 362	1 040	1 892	1 305	996
	1 846	1 413		1 744	1 336		1 660	1 270	2 288	1 583	1 210	2 191	1 514	1 156	2 102	1 450	1 107
		1 767		2 180	1 670		2 075	1 587		1 979	1 513	2 739	1 892	1 445	2 627	1 812	1 383
				2 004				1 905		2 375	1 815	3 287	2 270	1 734	3 153	2 175	1 660
				2 338				2 222				2 118	2 649	2 023	3 678	2 537	1 936
											2 421		3 027	2 312		2 900	2 213
													3 406	2 601		3 262	2 490
														2 890		3 625	2 766
															3 179		3 043
															3 468		3 320
																	3 596

Technical information

Tightening load (kN) – metric system

Ø bolt (mm)	85			90			95			100			110				
Pitch (mm)	6			6			6			6			6				
Width across flats (mm)	120			130			135			145			155				
Friction coefficient	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20		
Torque (Nm)																	
4 500	454																
5 000	505																
5 500	555			516													
6 000	605			563													
6 500	656	452		610			588										
7 000	706	487		657			633										
7 500	757	521		704			679										
8 000	807	556		751	516		724				678						
8 500	858	591	451	798	548		769				720						
9 000	908	626	477	845	580		814				763						
9 500	959	660	504	891	613		859	590		805							
10 000	1 009	695	530	938	645	491	905	621		848				794			
12 000	1 211	834	636	1 126	774	589	1 086	745	567	1 017	697		953				
14 000	1 413	973	742	1 314	903	688	1 267	869	662	1 187	813		1 112	761			
16 000	1 614	1 112	848	1 501	1 032	786	1 448	994	756	1 356	929	707	1 271	869			
18 000	1 816	1 251	954	1 689	1 161	884	1 629	1 118	851	1 526	1 045	795	1 430	978	743		
20 000	2 018	1 390	1 060	1 877	1 290	982	1 809	1 242	946	1 695	1 161	883	1 589	1 086	826		
25 000	2 523	1 738	1 325	2 346	1 612	1 228	2 262	1 553	1 182	2 119	1 452	1 104	1 986	1 358	1 032		
30 000	3 027	2 085	1 590	2 815	1 935	1 474	2 714	1 863	1 418	2 543	1 742	1 325	2 383	1 630	1 238		
35 000	3 532	2 433	1 855	3 284	2 257	1 719	3 167	2 174	1 655	2 967	2 033	1 546	2 780	1 901	1 445		
40 000	4 036	2 780	2 120	3 754	2 579	1 965	3 619	2 484	1 891	3 390	2 323	1 767	3 177	2 173	1 651		
45 000		3 128	2 385	4 223	2 902	2 210	4 071	2 795	2 128	3 814	2 613	1 988	3 574	2 445	1 858		
50 000		3 475	2 650	4 692	3 224	2 456	4 524	3 105	2 364	4 238	2 904	2 208	3 971	2 716	2 064		
55 000		3 823	2 915		3 547	2 702	4 976	3 416	2 600	4 662	3 194	2 429	4 368	2 988	2 270		
60 000		4 170	3 180		3 869	2 947	5 428	3 726	2 837	5 086	3 484	2 650	4 766	3 259	2 477		
65 000			3 445		4 192	3 193		4 037	3 073	5 509	3 775	2 871	5 163	3 531	2 683		
70 000			3 710		4 514	3 438		4 347	3 310	5 933	4 065	3 092	5 560	3 803	2 890		
75 000			3 975		4 836	3 684		4 658	3 546		4 355	3 313	5 957	4 074	3 096		
80 000			4 240			3 930		4 968	3 782		4 646	3 533	6 354	4 346	3 302		
85 000						4 175		5 279	4 019		4 936	3 754	6 751	4 618	3 509		
90 000						4 421			4 255		5 227	3 975	7 148	4 889	3 715		
95 000						4 666			4 492		5 517	4 196		5 161	3 921		
100 000									4 728		5 807	4 417		5 432	4 128		

120			125			130			140			150		
6			6			6			6			6		
170			180			185			200			210		
0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20
1 019														
1 165			1 105											
1 311			1 243			1 210								
1 456	994		1 381			1 345			1 249					
1 820	1 242	943	1 727	1 177		1 681	1 145		1 561					
2 185	1 491	1 132	2 072	1 412	1 071	2 017	1 374		1 873	1 274			1 785	
2 549	1 739	1 320	2 417	1 648	1 250	2 353	1 603	1 215	2 185	1 486			2 083	
2 913	1 988	1 509	2 763	1 883	1 428	2 689	1 832	1 389	2 497	1 699	1 287		2 380	
3 277	2 236	1 697	3 108	2 119	1 607	3 025	2 061	1 563	2 809	1 911	1 448		2 678	1 819
3 641	2 485	1 886	3 453	2 354	1 786	3 361	2 290	1 736	3 122	2 123	1 609		2 975	2 022
4 005	2 733	2 075	3 799	2 589	1 964	3 697	2 519	1 910	3 434	2 336	1 770		3 273	2 224 1 684
4 369	2 982	2 263	4 144	2 825	2 143	4 034	2 748	2 084	3 746	2 548	1 930		3 570	2 426 1 837
4 733	3 230	2 452	4 489	3 060	2 321	4 370	2 977	2 257	4 058	2 760	2 091		3 868	2 628 1 990
5 097	3 479	2 640	4 835	3 295	2 500	4 706	3 206	2 431	4 370	2 973	2 252		4 165	2 830 2 143
5 461	3 727	2 829	5 180	3 531	2 678	5 042	3 435	2 605	4 682	3 185	2 413		4 463	3 032 2 297
5 825	3 976	3 018	5 525	3 766	2 857	5 378	3 664	2 778	4 995	3 397	2 574		4 760	3 235 2 450
6 190	4 224	3 206	5 871	4 002	3 035	5 714	3 893	2 952	5 307	3 610	2 735		5 058	3 437 2 603
6 554	4 473	3 395	6 216	4 237	3 214	6 050	4 122	3 125	5 619	3 822	2 896		5 355	3 639 2 756
6 918	4 721	3 583	6 561	4 472	3 392	6 386	4 351	3 299	5 931	4 034	3 057		5 653	3 841 2 909
7 282	4 970	3 772	6 907	4 708	3 571	6 723	4 580	3 473	6 243	4 246	3 217		5 950	4 043 3 062

B

Technical information

Tightening load (lbs.) – imperial system

Tightening load (lbs.) – imperial system

- As a function of the torque (ft.lb.)
- As a function of the diameter of the standard bolt from 1/4 to 6 in.
- As a function of the bolt friction coefficient.

Ø bolt (in.)	1/4			5/16			3/8			7/16			
Number of threads/inch	20			18			16			14			
Width across flats (in.)	7/16			1/2			9/16			5/8			
Friction coefficient	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	
Torque (ft.lb.)													
5	1 556	1 114	867	1 350	964	750							
10	3 111	2 227	1 735	2 700	1 928	1 499	2 382	1 700	1 322	2 126	1 519		
20	6 223	4 455	3 469	5 400	3 856	2 998	4 764	3 400	2 643	4 252	3 038	2 364	
30		6 682	5 204	8 100	5 783	4 497	7 147	5 100	3 965	6 378	4 558	3 546	
40			6 938		7 711	5 996	9 529	6 800	5 286	8 503	6 077	4 728	
50					9 639	7 495	11 911	8 500	6 608	10 629	7 596	5 910	
60						8 995		10 200	7 930	12 755	9 115	7 092	
70								11 900	9 251	14 881	10 635	8 274	
80									10 573	17 007	12 154	9 456	
90									11 894		13 673	10 638	
100											15 192	11 820	
120												14 183	
140													16 547
160													
180													
200													
250													
300													
350													
400													
450													
500													
550													
600													
650													
700													
3 500													
4 000													

Continued

1/2			9/16			5/8			3/4		
13			12			11			10		
3/4			27/32			15/16			1/18		
0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20
1 808	1 284										
3 615	2 568	1 991	3 230								
5 423	3 852	2 987	4 846	3 435							
7 230	5 136	3 982	6 461	4 580	3 547	5 829					
9 038	6 420	4 978	8 076	5 725	4 434	7 286			6 141		
10 846	7 704	5 974	9 691	6 870	5 320	8 744	6 192		7 369		
12 653	8 988	6 969	11 306	8 014	6 207	10 201	7 224	5 592	8 597	6 060	
14 461	10 272	7 965	12 921	9 159	7 094	11 658	8 256	6 391	9 825	6 926	
16 269	11 556	8 961	14 537	10 304	7 981	13 115	9 288	7 189	11 053	7 792	6 016
18 076	12 840	9 956	16 152	11 449	8 867	14 573	10 320	7 988	12 281	8 657	6 685
21 691	15 408	11 947	19 382	13 739	10 641	17 487	12 383	9 586	14 737	10 389	8 022
	17 976	13 939	22 613	16 029	12 414	20 402	14 447	11 183	17 193	12 120	9 359
	20 544	15 930	25 843	18 319	14 188	23 316	16 511	12 781	19 650	13 852	10 696
		17 921		20 609	15 961	26 231	18 575	14 379	22 106	15 583	12 033
		19 912		22 898	17 735	29 145	20 639	15 976	24 562	17 315	13 370
				28 623	22 168		25 799	19 970	30 703	21 643	16 712
					26 602		30 959	23 964	36 843	25 972	20 055
									27 958	42 984	30 301
									31 953	49 124	34 630
											23 397
											26 740
											30 082
											33 425
											36 767
											40 110
											43 452
											46 795

Technical information

Tightening load (lbs.) – imperial system

Ø bolt (in.)	7/8			1			1 1/8			1 1/4		
	Number of threads/inch 9			8			7			7		
Width across flats (in.)	1 5/16			1 1/2			1 11/16			1 7/8		
Friction coefficient	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20
Torque (ft.lb.)												
80	8 471											
90	9 530											
100	10 589 7 447			9 283								
120	12 707 8 936			11 139								
140	14 825 10 426 8 040			12 996 9 132			11 530					
160	16 943 11 915 9 188			14 853 10 437			13 178					
180	19 061 13 404 10 337			16 709 11 742 9 051			14 825					
200	21 178 14 894 11 485			18 566 13 046 10 057			16 472 11 584					
250	26 473 18 617 14 357			23 207 16 308 12 571			20 590 14 480 11 166			18 754		
300	31 768 22 341 17 228			27 848 19 570 15 085			24 708 17 376 13 400			22 505		
350	37 062 26 064 20 099			32 490 22 831 17 599			28 826 20 272 15 633			26 256 18 375		
400	42 357 29 787 22 971			37 131 26 093 20 113			32 944 23 168 17 866			30 007 20 999		
450	47 652 33 511 25 842			41 773 29 354 22 628			37 062 26 064 20 099			33 758 23 624		
500	52 946 37 234 28 713			46 414 32 616 25 142			41 180 28 960 22 333			37 509 26 249 20 189		
550	58 241 40 958 31 585			51 056 35 878 27 656			45 298 31 856 24 566			41 259 28 874 22 208		
600	44 681 34 456			55 697 39 139 30 170			49 416 34 752 26 799			45 010 31 499 24 227		
650	48 404 37 327			60 338 42 401 32 684			53 534 37 648 29 032			48 761 34 124 26 246		
700	52 128 40 199			64 980 45 662 35 198			57 652 40 544 31 266			52 512 36 749 28 265		
750	55 851 43 070			69 621 48 924 37 713			61 770 43 440 33 499			56 263 39 374 30 284		
800	59 575 45 941			74 263 52 185 40 227			65 888 46 336 35 732			60 014 41 999 32 303		
850	48 813			78 904 55 447 42 741			70 007 49 232 37 965			63 765 44 624 34 321		
900	51 684			83 545 58 709 45 255			74 125 52 128 40 199			67 515 47 249 36 340		
950	54 555			88 187 61 970 47 769			78 243 55 024 42 432			71 266 49 874 38 359		
1 000	57 427			65 232 50 283			82 361 57 920 44 665			75 017 52 499 40 378		
1 200	68 912			78 278 60 340			98 833 69 504 53 598			90 021 62 998 48 454		
1 400				91 325 70 397			11 530 81 088 62 531			105 024 73 498 56 529		
1 600				80 453			92 672 71 464			120 027 83 998 64 605		
1 800				90 510			10 425 80 398			135 031 94 498 72 681		
2 000							89 331			150 034 104 997 80 756		
2 500							11 584 11 166			131 247 100 945		
3 000										157 496 121 134		
3 500										141 324		
4 000										161 513		
4 500												
5 000												
5 500												
6 000												
6 500												
7 000												
7 500												
8 000												
8 500												
9 000												
9 500												
10 000												
12 000												
14 000												

Continued

$1\frac{3}{8}$			$1\frac{1}{2}$			$1\frac{3}{4}$			2		
6			6			5			$4\frac{1}{2}$		
$2\frac{1}{16}$			$2\frac{1}{4}$			$2\frac{5}{8}$			3		
0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20
20 326											
23 713			21 946								
27 101			25 081								
30 489	21 394		28 216								
33 876	23 771	20 140	31 352	21 913							
37 264	26 148	21 971	34 487	24 105		29 471					
40 651	28 525	23 802	37 622	26 296		32 150					
44 039	30 902	25 633	40 757	28 487	21 896	34 829					
47 427	33 279	27 464	43 892	30 679	23 580	37 509			32 919		
50 814	35 656	29 295	47 027	32 870	25 265	40 188	28 124		35 270		
54 202	38 033	31 126	50 162	35 062	26 949	42 867	29 999		37 622		
57 590	40 410	32 956	53 298	37 253	28 633	45 546	31 874		39 973		
60 977	42 787	34 787	56 433	39 444	30 317	48 225	33 749		42 325		
64 365	45 165	36 618	59 568	41 636	32 002	50 904	35 624	27 399	44 676		
67 752	47 542	43 942	62 703	43 827	33 686	53 584	37 499	28 842	47 027	32 870	
81 303	57 050	51 266	75 244	52 592	40 423	64 300	44 999	34 610	56 433	39 444	
94 853	66 558	58 589	87 784	61 358	47 160	75 017	52 499	40 378	65 838	46 018	
108 404	76 067	65 913	100 325	70 123	53 898	85 734	59 999	46 146	75 244	52 592	40 423
121 954	85 575	73 237	112 866	78 888	60 635	96 451	67 498	51 915	84 649	59 166	45 476
135 505	95 083	91 546	125 406	87 654	67 372	107 167	74 998	57 683	94 055	65 740	50 529
169 381	118 854	109 855	156 758	109 567	84 215	133 959	93 748	72 104	117 568	82 175	63 161
	142 625	128 164	188 109	131 481	101 058	160 751	112 497	86 525	141 082	98 611	75 794
	166 396	146 473		153 394	117 901	187 543	131 247	100 945	164 596	115 046	88 426
		164 782		175 308	134 744	214 335	149 996	115 366	188 109	131 481	101 058
				197 221	151 587	241 127	168 746	129 787	211 623	147 916	113 690
					168 430	267 918	187 496	144 208	235 136	164 351	126 323
					185 273		206 245	158 628	258 650	180 786	138 955
					202 116		224 995	173 049	282 164	197 221	151 587
							243 744	187 470	305 677	213 656	164 219
							262 494	201 891	329 191	230 091	176 852
								216 312		246 526	189 484
								230 732		262 961	202 116
								245 153		279 397	214 749
								259 574		295 832	227 381
										312 267	240 013
										328 702	252 645
											303 174
											353 703

Technical information

Tightening load (lbs.) – imperial system

Ø bolt (in.)	2 1/4			2 1/2			2 3/4			3																													
	Number of threads/inch 4 1/2			4			4			4																													
Width across flats (in.)	3 3/8			3 3/4			4 1/8			4 1/2																													
Friction coefficient	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20																											
Torque (ft.lb.)																																							
1 000	42 299																																						
1 200	50 758																																						
1 400	59 218			41 191			53 233																																
1 600	67 678			47 075			60 838																																
1 800	76 138			52 959			68 443			62 769																													
2 000	84 597			58 844			45 111			76 047			52 922			69 743																							
2 500	105 747			73 555			56 388			95 059			66 153			87 179			80 506																				
3 000	126 896			88 265			67 666			114 071			79 383			60 873			104 615			72 539			96 607														
3 500	148 046			102 976			78 944			133 083			92 614			71 018			122 051			84 629			64 770			112 708			77 912								
4 000	169 195			117 687			90 221			152 095			105 845			81 164			139 487			96 719			74 023			128 809			89 042								
4 500	190 344			132 398			101 499			171 107			119 075			91 309			156 923			108 809			83 276			144 911			100 172			76 542					
5 000	211 494			147 109			112 777			190 118			132 306			101 455			174 359			120 899			92 529			161 012			111 303			85 046					
5 500	232 643			161 820			124 054			209 130			145 536			111 600			191 795			132 989			101 782			177 113			122 433			93 551					
6 000	253 792			176 531			135 332			228 142			158 767			121 746			209 230			145 079			111 034			193 214			133 563			102 055					
6 500	274 942			191 242			146 610			247 154			171 998			131 891			226 666			157 168			120 287			209 315			144 693			110 560					
7 000	296 091			205 953			157 887			266 166			185 228			142 037			244 102			169 258			129 540			225 416			155 824			119 065					
7 500	317 241			220 664			169 165			285 178			198 459			152 182			261 538			181 348			138 793			241 518			166 954			127 569					
8 000	338 390			235 374			180 443			304 189			211 689			162 328			278 974			193 438			148 046			257 619			178 084			136 074					
8 500	359 539			250 085			191 720			323 201			224 920			172 473			296 410			205 528			157 299			273 720			189 214			144 579					
9 000	380 689			264 796			202 998			342 213			238 150			182 619			313 846			217 618			166 552			289 821			200 345			153 083					
9 500	401 838			279 507			214 276			361 225			251 381			192 764			331 282			229 708			175 804			305 922			211 475			161 588					
10 000	422 987			294 218			225 553			380 237			264 612			202 909			348 717			241 798			185 057			322 024			222 605			170 092					
12 000				353 062			270 664			456 284			317 534			243 491			418 461			290 157			222 069			386 428			267 126			204 111					
14 000				411 905			315 775			532 332			370 456			284 073			488 204			338 517			259 080			450 833			311 647			238 129					
16 000							360 885						423 379			324 655			557 948			386 876			296 092			515 238			356 168			272 148					
18 000							405 996						476 301			365 237			627 691			435 236			333 103			579 642			400 689			306 166					
20 000							451 107						529 223			405 819						483 595			370 115			644 047			445 210			340 185					
25 000																507 274						604 494			462 643			805 059			556 513			425 231					
30 000																						725 393			555 172						667 816			510 277					
35 000																									647 701						779 118			595 324					
40 000																																					680 370		
45 000																																					765 416		
50 000																																							
55 000																																							
60 000																																							
65 000																																							
70 000																																							
75 000																																							
80 000																																							
85 000																																							
90 000																																							

Continued

3 1/4			3 1/2			3 3/4		
4			4			4		
4 7/8			5 1/4			5 5/8		
0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20
104 694								
119 650								
134 607	92 806		125 671					
149 563	103 118		139 634					
164 519	113 430		153 598			144 036		
179 475	123 741	94 420	167 561	115 265		157 130		
194 432	134 053	102 288	181 524	124 870		170 224		
209 388	144 365	110 157	195 488	134 476		183 318	125 855	
224 344	154 677	118 025	209 451	144 081	109 810	196 412	134 844	
239 301	164 988	125 893	223 415	153 687	117 130	209 506	143 834	
254 257	175 300	133 762	237 378	163 292	124 451	222 601	152 824	
269 213	185 612	141 630	251 341	172 898	131 772	235 695	161 813	123 196
284 169	195 924	149 499	265 305	182 503	139 092	248 789	170 803	130 040
299 126	206 235	157 367	279 268	192 108	146 413	261 883	179 793	136 885
358 951	247 483	188 840	335 122	230 530	175 695	314 260	215 751	164 261
418 776	288 730	220 314	390 975	268 952	204 978	366 636	251 710	191 638
478 601	329 977	251 787	446 829	307 373	234 261	419 013	287 668	219 015
538 426	371 224	283 260	502 683	345 795	263 543	471 389	323 627	246 392
598 252	412 471	314 734	558 536	384 217	292 826	523 766	359 585	273 769
747 814	515 589	393 417	698 171	480 271	366 032	654 708	449 482	342 211
897 377	618 706	472 101	837 805	576 325	439 239	785 649	539 378	410 654
	721 824	550 784	977 439	672 379	512 445	916 591	629 274	479 096
	824 942	629 467	1 117 073	768 434	585 651	1 047 532	719 171	547 538
	928 060	708 151		864 488	658 858	1 178 474	809 067	615 981
		786 834		960 542	732 064	1 309 415	898 963	684 423
		865 518		1 056 596	805 271		988 860	752 865
		944 201		1 152 650	878 477		1 078 756	821 307
					951 684		1 168 652	889 750
					1 024 890		1 258 549	958 192
					1 098 096			1 026 634
								1 095 077
								1 163 519
								1 231 961

Technical information

Tightening load (lbs.) – imperial system

Ø bolt (in.)	4			4 1/4			4 1/2		
Number of threads/inch	4			4			4		
Width across flats (in.)	6			6 3/8			6 3/4		
Friction coefficient	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20
Torque (ft.lb.)									
6 500	160 248								
7 000	172 575								
7 500	184 902			174 665					
8 000	197 228	135 169		186 310					
8 500	209 555	143 617		197 954			187 570		
9 000	221 882	152 065		209 599			198 604		
9 500	234 209	160 513		221 243	151 392		209 637		
10 000	246 536	168 961	128 521	232 887	159 360		220 671		
12 000	295 843	202 753	154 225	279 465	191 232		264 805	180 950	
14 000	345 150	236 545	179 929	326 042	223 104	169 568	308 939	211 108	160 335
16 000	394 457	270 337	205 633	372 620	254 976	193 792	353 073	241 267	183 240
18 000	443 764	304 130	231 337	419 197	286 848	218 016	397 208	271 425	206 146
20 000	493 071	337 922	257 041	465 775	318 720	242 240	441 342	301 583	229 051
25 000	616 339	422 402	321 302	582 218	398 400	302 800	551 677	376 979	286 313
30 000	739 607	506 883	385 562	698 662	478 080	363 360	662 013	452 375	343 576
35 000	862 874	591 363	449 822	815 105	557 760	423 920	772 348	527 771	400 838
40 000	986 142	675 843	514 083	931 549	637 440	484 480	882 684	603 167	458 101
45 000	110 9410	760 324	578 343	1 047 993	717 120	545 040	993 019	678 563	515 364
50 000	123 2678	844 804	642 603	1 164 436	796 800	605 600	1 103 355	753 958	572 626
55 000	135 5945	929 285	706 864	1 280 880	876 480	666 160	1 213 690	829 354	629 889
60 000	147 9213	1 013 765	771 124	1 397 324	956 160	726 720	1 324 026	904 750	687 152
65 000		1 098 246	835 384	1 513 767	1 035 840	787 280	1 434 361	980 146	744 414
70 000		1 182 726	899 645	1 630 211	1 115 520	847 840	1 544 696	1 055 542	801 677
75 000		1 267 207	963 905		1 195 201	908 400	1 655 032	1 130 938	858 940
80 000		1 351 687	1 028 165		1 274 881	968 960	1 765 367	1 206 333	916 202
85 000		1 436 167	1 092 426		1 354 561	1 029 520	1 875 703	1 281 729	973 465
90 000			1 156 686		1 434 241	1 090 080		1 357 125	1 030 728
95 000			1 220 946		1 513 921	1 150 640		1 432 521	1 087 990
100 000			1 285 207		1 593 601	1 211 200		1 507 917	1 145 253

Continued

4 3/4			5			5 1/4		
4			4			4		
7 1/8			7 1/2			7 7/8		
0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20
209 672			239 662			266 933		
251 607			279 605			305 066		
293 541			319 549			343 199		
335 476	228 956		359 493	245 071				
377 410	257 576	195 501						
419 345	286 195	217 223	399 436	272 301		3813 32	259 694	
524 181	357 744	271 529	499 295	340 377	258 197	476 665	324 618	
629 017	429 293	325 835	599 154	408 452	309 836	571 998	389 541	295 335
733 853	500 842	380 141	699 013	476 528	361 475	667 331	454 465	344 557
838 689	572 391	434 446	798 872	544 603	413 115	762 664	519 388	393 780
943 525	643 940	488 752	898 731	612 678	464 754	857 998	584 312	443 002
1 048 362	715 488	543 058	998 590	680 754	516 393	953 331	649 235	492 224
1 153 198	787 037	597 364	1 098 449	748 829	568 033	1 048 664	714 159	541 447
1 258 034	858 586	651 670	1 198 308	816 904	619 672	1 143 997	779 082	590 669
1 362 870	930 135	705 975	1 298 167	884 980	671 311	1 239 330	844 006	639 892
1 467 706	1 001 684	760 281	1 398 026	953 055	722 950	1 334 663	908 929	689 114
1 572 542	1 073 233	814 587	1 497 885	1 021 130	774 590	1 429 996	973 853	738 337
1 677 379	1 144 781	868 893	1 597 744	1 089 206	826 229	1 525 329	1 038 776	787 559
1 782 215	1 216 330	923 199	1 697 604	1 157 281	877 868	1 620 662	1 103 700	836 782
1 887 051	1 287 879	977 504	1 797 463	1 22 5357	929 508	1 715 995	1 1686 23	886 004
1 99 1887	1 359 428	1 03 1810	1 897 322	1 293 432	981 147	1 811 328	1 233 547	935 226
2 096 723	1 430 977	1 08 6116	1 997 181	1 361 507	1 032 786	1 906 661	1 298 470	984 449

Technical information

Tightening load (lbs.) – imperial system

Ø bolt (in.)	5 1/2			5 3/4			6		
Number of threads/inch	4			4			4		
Width across flats (in.)	8 1/4			8 5/8			9		
Friction coefficient	0,10	0,15	0,20	0,10	0,15	0,20	0,10	0,15	0,20
Torque (ft.lb.)									
16 000	291 839			279 711					
18 000	328 318			314 675			302 120		
20 000	364 798	248 202		349 638			335 688		
25 000	455 998	310 253		437 048	297 106		419 611	285 028	
30 000	547 197	372 304	282 130	524 458	356 527		503 533	342 033	
35 000	638 397	434 354	329 152	611 867	415 948	315 065	587 455	399 039	302 135
40 000	729 597	496 405	376 173	699 277	475 370	360 074	671 377	456 045	345 297
45 000	820 796	558 456	423 195	786 687	534 791	405 084	755 299	513 050	388 459
50 000	911 996	620 506	470 217	874 096	594 212	450 093	839 221	570 056	431 621
55 000	1 003 195	682 557	517 239	961 506	653 633	495 102	923 143	627 061	474 783
60 000	1 094 395	744 607	564 260	1 048 915	713 054	540 112	1 007 065	684 067	517 945
65 000	1 185 594	806 658	611 282	1 136 325	772 476	585 121	1 090 987	741 072	561 107
70 000	1 276 794	868 709	658 304	1 223 735	831 897	630 130	1 174 909	798 078	604 269
75 000	1 367 994	930 759	705 325	1 311 144	891 318	675 140	1 258 832	855 084	647 431
80 000	1 459 193	992 810	752 347	1 398 554	950 739	720 149	1 342 754	912 089	690 593
85 000	1 550 393	1 054 861	799 369	1 485 964	1 010 160	765 158	1 426 676	969 095	733 756
90 000	1 641 592	1 116 911	846 390	1 573 373	1 069 582	810 167	1 510 598	1 026 100	776 918
95 000	1 732 792	1 178 962	893 412	1 660 783	1 129 003	855 177	1 594 520	1 083 106	820 080
100 000	1 823 991	1 241 012	940 434	1 748 192	1 188 424	900 186	1 678 442	1 140 111	863 242

Tension load tables

Metric system tension load (kN)

This table shows the tightening loads to apply to a bolt as a function of bolt diameter and class (mechanical properties) in order to obtain a tightening load at 80% of its yield point (R_e).

B

Bolt diameter	Pitch	kN load for tightening to 80% of the yield point		
		Class 8-8	Class 10-9	Class 12-9
mm	mm	$R_e = 640 \text{ MPa}$	$R_e = 900 \text{ MPa}$	$R_e = 1080 \text{ MPa}$
8	1,25	19	26	32
10	1,5	31	44	53
12	1,75	45	63	76
14	2	64	90	108
16	2	80	113	135
18	2,5	105	147	176
20	2,5	125	176	212
22	2,5	155	218	262
24	3	180	254	305
27	3	235	331	397
30	3,5	297	418	502
33	3,5	355	499	599
36	4	418	588	706
39	4	500	703	843
42	4,5	574	807	968
45	4,5	669	940	1 128
48	5	754	1 061	1 273
52	5	900	1 266	1 519
56	5,5	1 039	1 462	1 754
60	5,5	1 209	1 701	2 041
64	6	1 370	1 927	2 312
68	6	1 564	2 200	2 640
72	6	1 771	2 491	2 989
76	6	1 991	2 800	3 360
80	6	2 224	3 128	3 753
85	6	2 533	3 562	4 275
90	6	2 862	4 025	4 830
95	6	3 212	4 517	5 420
100	6	3 581	5 036	6 043
110	6	4 380	6 160	7 392
120	6	5 260	7 397	8 876
125	6	5 730	8 058	9 669
130	6	6 220	8 747	10 496
140	6	7 261	10 210	12 252
150	6	8 381	11 786	14 144

Example: one M39 class 10-9 bolt can be tightened with a residual tightening load of 703 kN to provide an initial tightening

load corresponding to 80% of the bolt's yield point.

Technical information

Imperial system tension load (lbs.)

Bolt diameter		Number of threads* per inch	Pound load for tightening to 80% of the yield point		
in.	mm		Class 8-8 R _e = 95 000 psi.	Class 10-9 R _e = 130 000 psi.	Class 12-9 R _e = 155 000 psi.
5/16	7,94	18	4 047	5 538	6 603
3/8	9,53	16	5 974	8 176	9 748
7/16	11,11	14	8 194	11 212	13 368
1/2	12,70	13	10 926	14 952	17 827
9/16	14,29	12	14 002	19 160	22 845
5/8	15,88	11	17 388	23 794	28 370
3/4	19,05	10	25 702	35 171	41 935
7/8	22,23	9	35 462	48 526	57 858
1	25,40	8	46 513	63 650	75 890
1 1/8	28,58	7	58 620	80 217	95 643
1 1/4	31,75	7	74 341	101 730	121 294
1 3/8	34,93	6	88 648	121 308	144 637
1 1/2	38,10	6	107 767	147 470	175 830
1 3/4	44,45	5	145 709	199 391	237 736
2	50,80	4 1/2	191 586	262 170	312 587
2 1/4	57,15	4 1/2	248 786	340 444	405 915
2 1/2	63,50	4	306 360	419 230	499 851
2 3/4	69,85	4	377 706	516 861	616 257
3	76,20	4	456 514	624 703	744 838
3 1/4	82,55	4	542 783	742 756	885 593
3 1/2	88,90	4	636 514	871 019	1 038 522
3 3/4	95,25	4	737 706	1 009 492	1 203 625
4	101,60	4	846 360	1 158 176	1 380 903
4 1/4	107,95	4	962 475	1 317 071	1 570 354
4 1/2	114,30	4	1 086 052	1 486 176	1 771 979
4 3/4	120,65	4	1 217 090	1 665 492	1 985 779
5	127,00	4	1 355 590	1 855 018	2 211 753
5 1/4	133,35	4	1 501 552	2 054 755	2 449 900
5 1/2	139,70	4	1 654 975	2 264 702	2 700 222
5 3/4	146,05	4	1 815 859	2 484 860	2 962 718
6	152,40	4	1 984 205	2 715 229	3 237 388

* Coarse thread series UNC/UNRC.

Example: one 1 1/2" class 10-9 bolt can be tightened with a residual tightening load of 147 470 lbs. to provide an initial tightening load corresponding to 80% of the bolt's yield point.

Standard product range

In its standard range of hydraulic tensioners, SKF offers no less than 6 different types of tensioners with characteristics which are both different and complementary.

The product range includes multi-purpose, powerful, thin, compact and other types of tensioners, covering a wide range of bolt dimensions from M8 to M160 (5/16 to 6 in.), and able to apply pre-tightening loads ranging from 50 kN to 8 500 kN.

Tensioner dimension has been carefully designed to allow use in the widest range of situations.

The product range has improved and extended over the years, benefiting from SKF extensive experience in the hydraulic tightening field.

Experience gained from responding to customer demand has also contributed to enriching the product range.

This range should therefore meet your tensioner and accessory needs. If however this were not the case, SKF also makes customized tensioners (adapting standard

tensioner parts to your application) and special tensioners (new design of dedicated tensioners).

Specially designed tensioners have enabled us to increase the range of sizes of bolts tightened, covering M5 to M500 (3/16 to 20 in.).

Generally speaking, it is more economical to plan the use of the tensioner from the assembly design stage, and to try to use standard equipment.

This provides significant savings in the cost of tightening bolted assemblies.

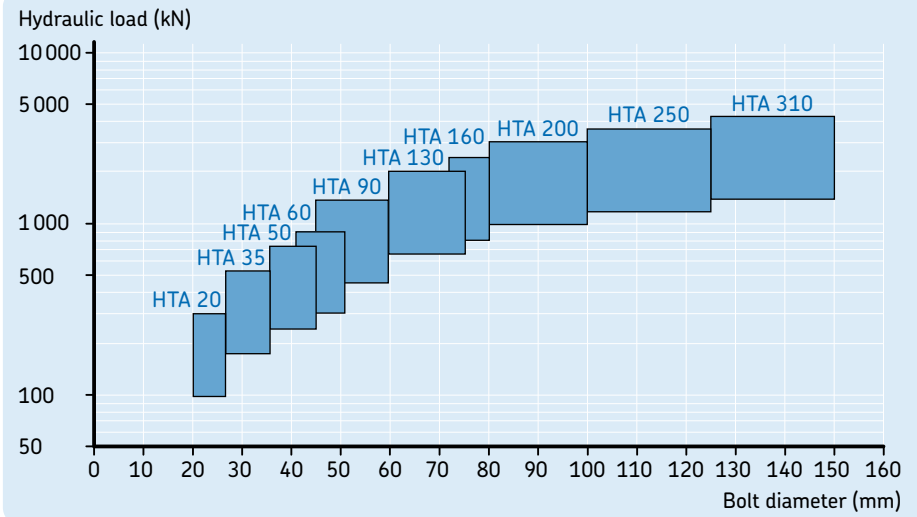


Hydraulic force diagrams for standard tensioners

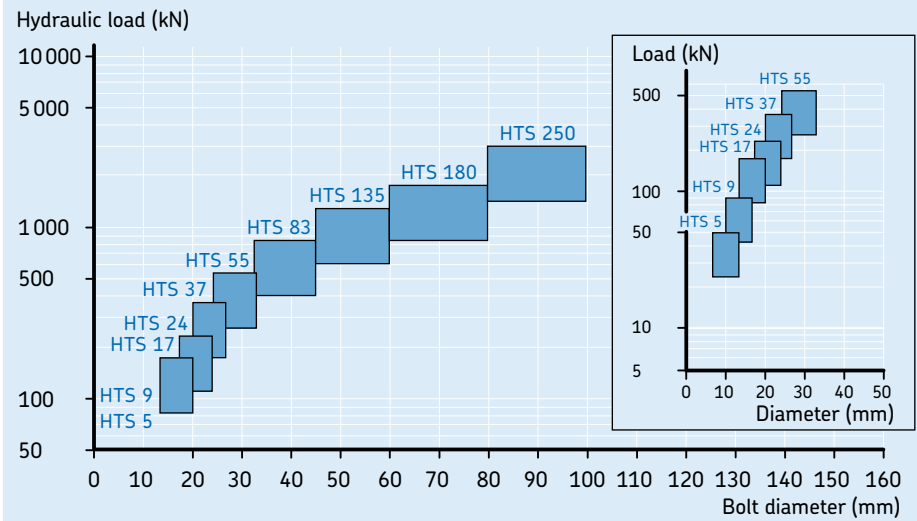
These hydraulic force diagrams help define the type(s) of tensioners which best suit your application, depending on the size of the bolt and the traction load

to apply. In addition, you must verify the other characteristics with respect to your operational constraints (space, weight, time...).

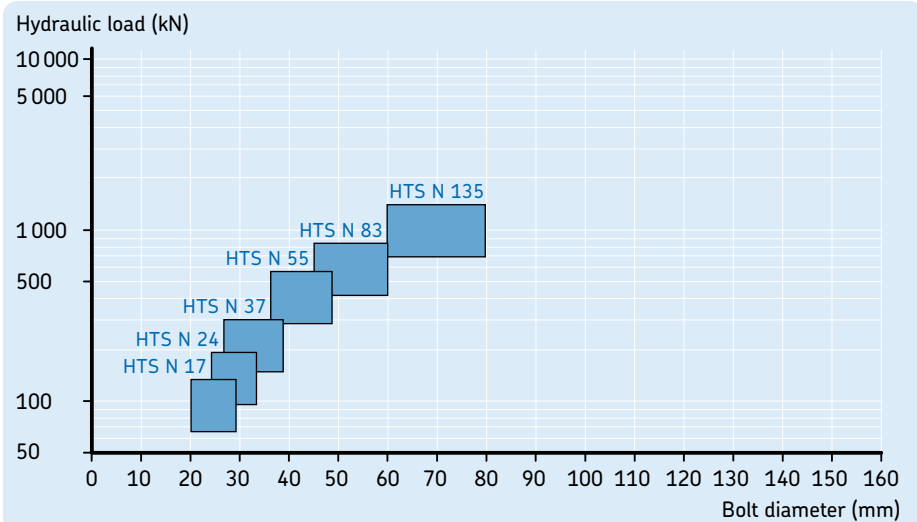
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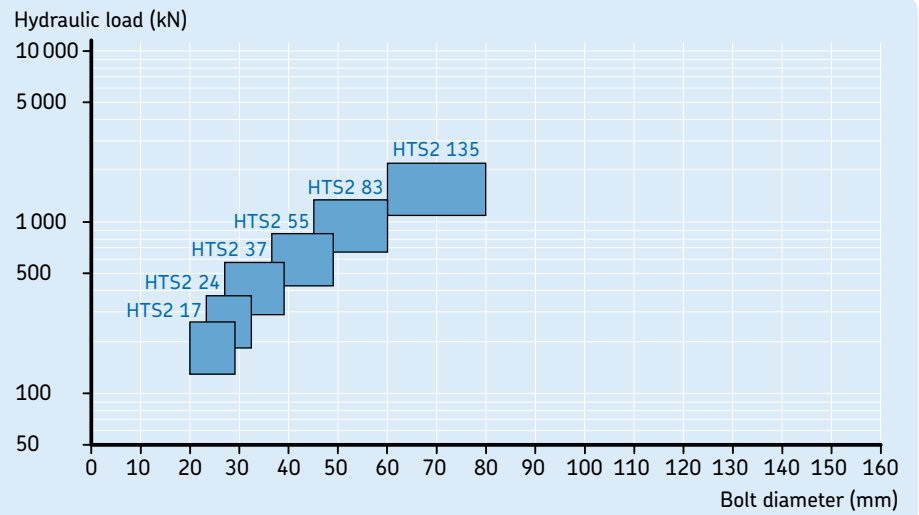
HTS



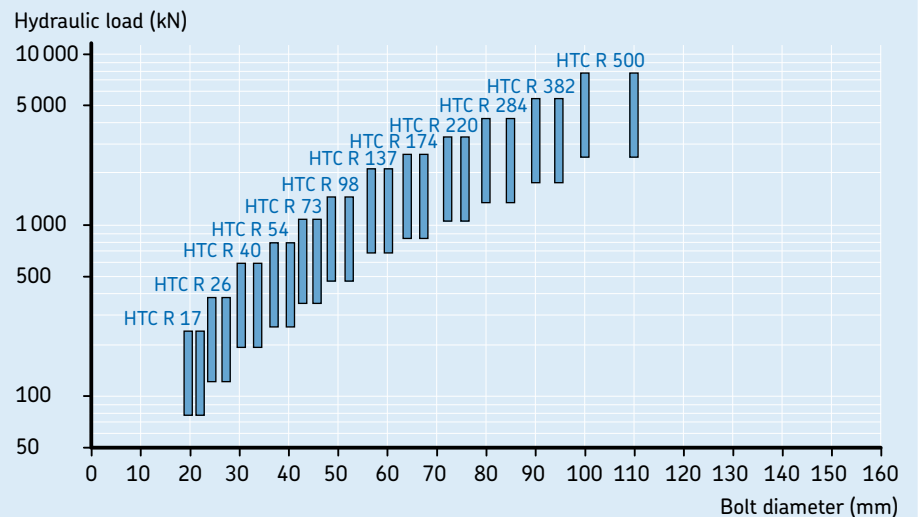
HTS N



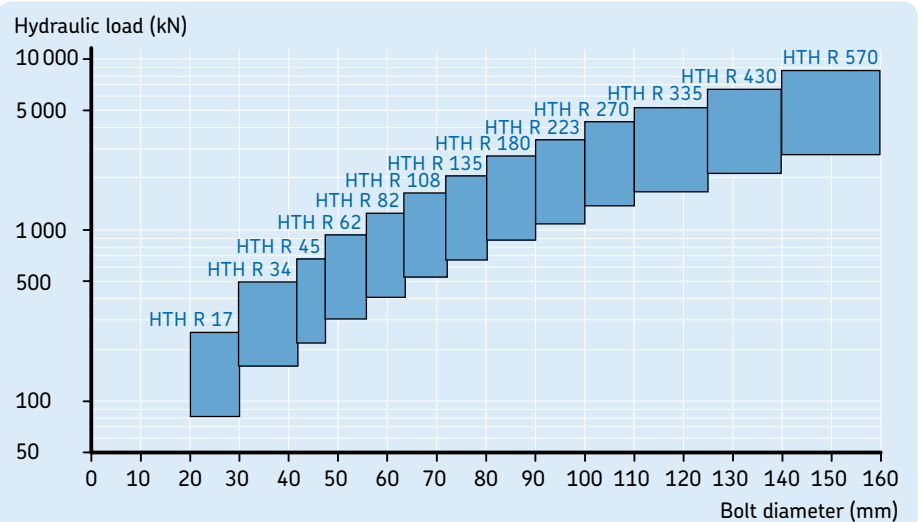
HTS2

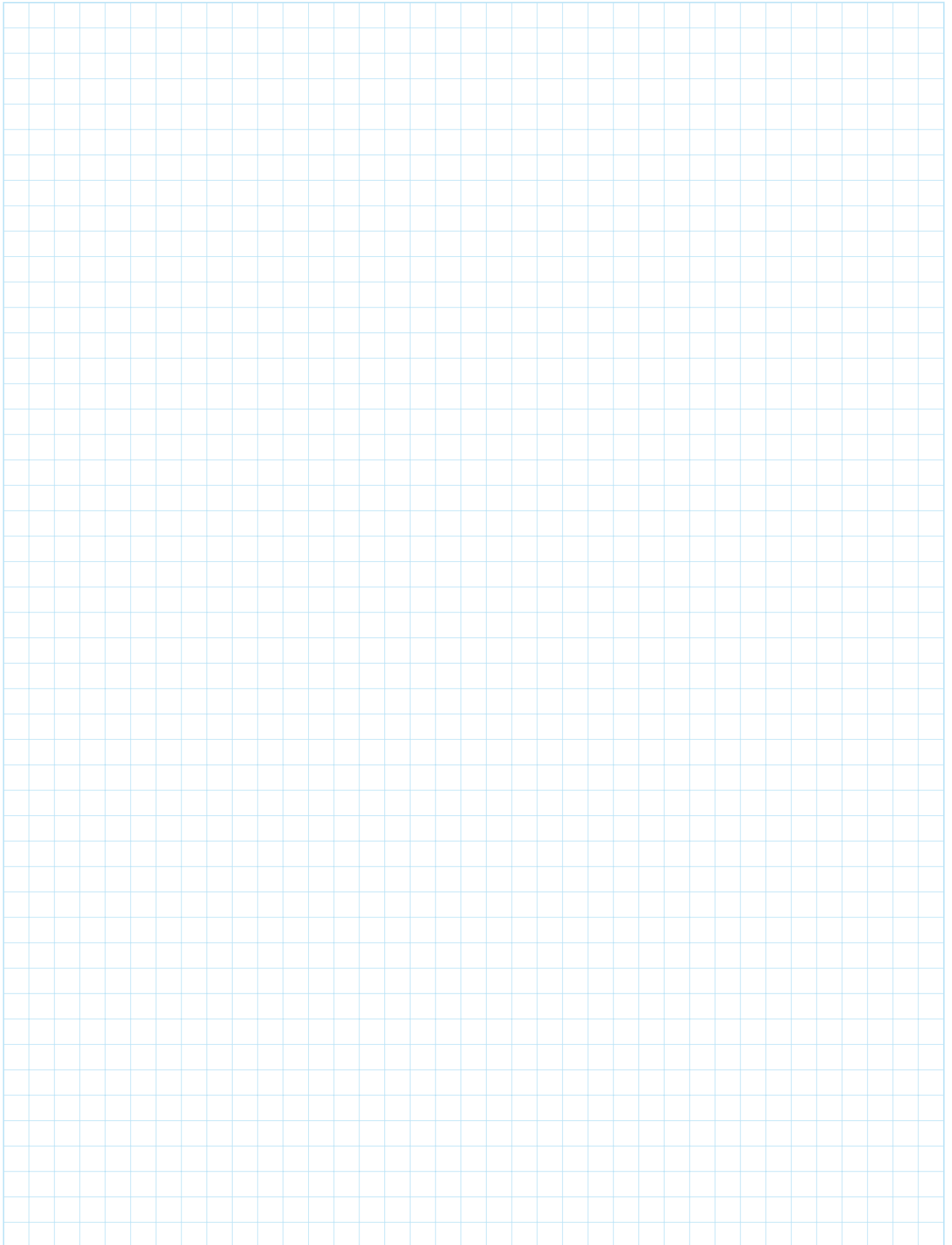


HTC R



HTH R





Standard tensioner characteristics

Summary table

This table summarizes the main features of each tensioner, in order to help you select the standard tensioner for your operational requirements.

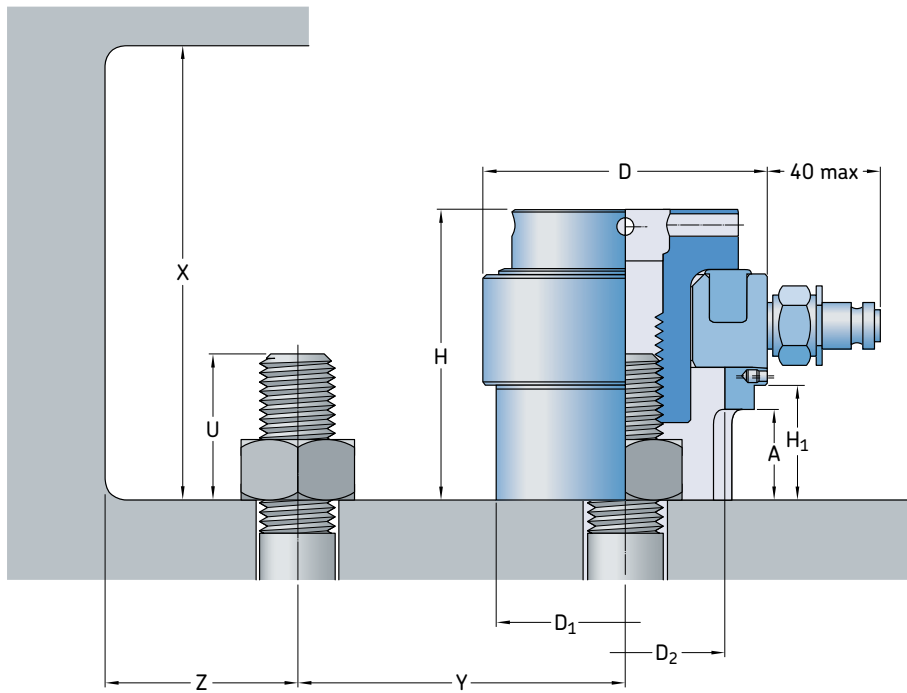


	HTA	HTS	HTS N	HTS 2	HTC R	HTH R
Tightens several diameters¹⁾	Yes	Yes	Yes	Yes	No	Yes
Diameters of the bolts tightened	Small and large	Small and very small	Small	Small and average	Small and large	Large and very large
Space occupied by the tensioner	Normal	Average	Little	Very little	Compact	Very little
Tightening load	High	High	Average	High	Very high	Very high
Stroke arresting device	Optional	Optional	Optional	Optional	Yes	Yes
Automatic return	Non	Optional	Optional	Optional	Yes	Yes
Cost index²⁾	100 (base)	140	160	200	180	250
Special feature	Adaptable	Very small bolt diameters	The same tensioner can tighten several diameters	Fits in very narrow spaces	Compact and powerful	Takes up very little space and very powerful
Catalogue page:						
metric system	40-41	44-45	48-49	52-53	56-57	60-61
imperial system	42-43	46-47	50-51	54-55	58-59	62-63

¹⁾ By changing the brace.

²⁾ Indicative, also takes into account the loads applied.

HTA (metric system)



HTA .. T ..

HTA .. C

HTA .. J

optional

Type	Bolt dimension		Max. pressure
	Diameter	Pitch	
	mm	mm	MPa
HTA 20 M20 × 2,5	M20	2,5	150
HTA 20 M22 × 2,5	M22	2,5	150
HTA 20 M24 × 3	M24	3	150
HTA 20 M27 × 3	M27	3	150
HTA 35 M27 × 3	M27	3	150
HTA 35 M30 × 3,5	M30	3,5	150
HTA 35 M33 × 3,5	M33	3,5	150
HTA 35 M36 × 4	M36	4	150
HTA 50 M36 × 4	M36	4	150
HTA 50 M39 × 4	M39	4	150
HTA 50 M42 × 4,5	M42	4,5	150
HTA 50 M45 × 4,5	M45	4,5	150
HTA 60 M42 × 4,5	M42	4,5	150
HTA 60 M45 × 4,5	M45	4,5	150
HTA 60 M48 × 5	M48	5	150
HTA 60 M52 × 5	M52	5	150
HTA 90 M45 × 4,5	M45	4,5	150
HTA 90 M48 × 5	M48	5	150
HTA 90 M52 × 5	M52	5	150
HTA 90 M56 × 5,5	M56	5,5	150
HTA 90 M60 × 5,5	M60	5,5	150
HTA 130 M60 × 5,5	M60	5	150
HTA 130 M64 × 6	M64	6	150
HTA 130 M68 × 6	M68	6	150
HTA 130 M72 × 6	M72	6	150
HTA 130 M76 × 6	M76	6	150
HTA 160 M72 × 6	M72	6	150
HTA 160 M76 × 6	M76	6	150
HTA 160 M80 × 6	M80	6	150
HTA 200 M80 × 6	M80	6	150
HTA 200 M85 × 6	M85	6	150
HTA 200 M90 × 6	M90	6	150
HTA 200 M95 × 6	M95	6	150
HTA 200 M100 × 6	M100	6	150
HTA 250 M100 × 6	M100	6	150
HTA 250 M110 × 6	M110	6	150
HTA 250 M120 × 6	M120	6	150
HTA 250 M125 × 6	M125	6	150
HTA 310 M125 × 6	M125	6	150
HTA 310 M130 × 6	M130	6	150
HTA 310 M140 × 6	M140	6	150
HTA 310 M150 × 6	M150	6	150

Multi-purpose

The dimensions and the traction load suit this tensioner to many different applications.

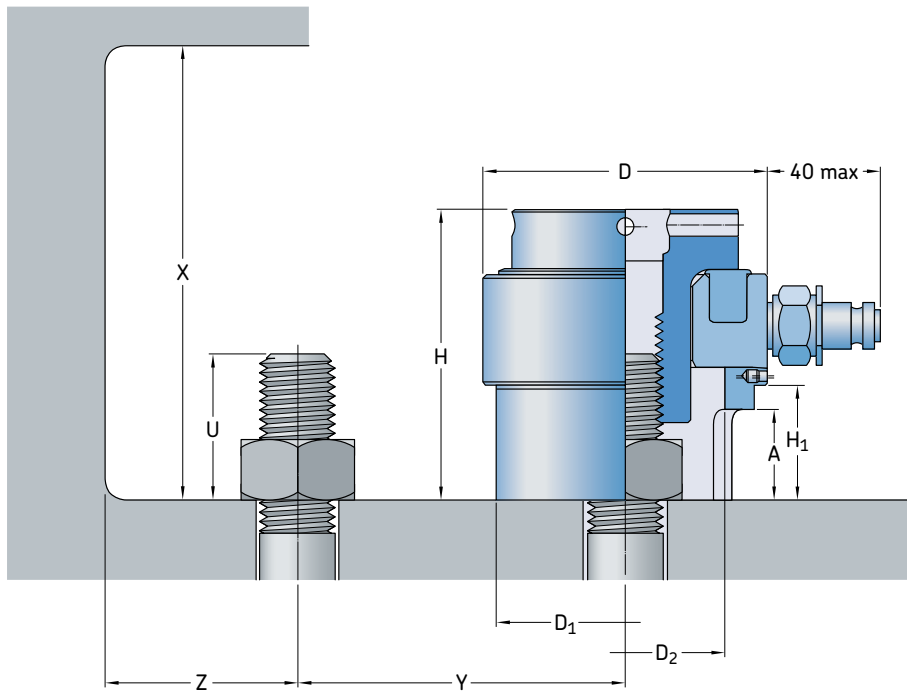
Reference examples:

- Reference example for a complete tensioner for M48 bolts:
HTA 90 M48 × 5
- Reference example for the M48 × 5 brace for the HTA 90 tensioner:
HTA 90T M48 × 5

Hydraulic area	Max. hydraulic load	Piston stroke	Dimensions										Total tensioner weight
			D	H	H ₁	D ₁	D ₂	A	U	X	Y	Z	
cm ²	kN	mm	mm										kg
20	300	8	86	100	30	74	56	26	38	138	56	44,5	3
20	300	8	86	100	30	74	56	26	42	142	57	44,5	3
20	300	8	86	100	30	74	56	26	46	146	59	44,5	3
20	300	8	86	100	30	74	56	26	52	152	62	44,5	3
35	525	8	109	116	40	97	73	31	52	168	73,5	56	4,8
35	525	8	109	116	40	97	73	31	57	173	76,5	56	4,8
35	525	8	109	116	40	97	73	31	63	179	79	56	4,8
35	525	8	109	116	40	97	73	31	69	185	81	56	4,8
50	750	8	128	128	49	116	90	38	69	197	91	65,5	7,5
50	750	8	128	128	49	116	90	38	74	202	94	65,5	7,5
50	750	8	128	128	49	116	90	38	80	208	97	65,5	7,5
50	750	8	128	128	49	116	90	38	86	214	100	65,5	7,5
60	900	8	137	140	54	133	102	40	80	220	91	69,5	9
60	900	8	137	140	54	133	102	40	86	226	92	69,5	9
60	900	8	137	140	54	133	102	40	92	232	94	69,5	9
60	900	8	137	140	54	133	102	40	99	239	96	69,5	9
90	1 350	8	166	154	65	154	114	42	86	240	119	84,5	15,3
90	1 350	8	166	154	65	154	114	42	92	246	122	84,5	15,3
90	1 350	8	166	154	65	154	114	42	99	253	124,5	84,5	15,3
90	1 350	8	166	154	65	154	114	42	107	261	127,5	84,5	15,3
90	1 350	8	166	154	65	154	114	42	114	268	130,5	84,5	25
130	1 950	8	198	179	82	187	137	50	114	293	147	101	25
130	1 950	8	198	179	82	187	137	50	122	301	150	101	25
130	1 950	8	198	179	82	187	137	50	130	309	153	101	25
130	1 950	8	198	179	82	187	137	50	137	316	155,5	101	25
130	1 950	8	198	179	82	187	137	50	145	324	158,5	101	31
160	2 400	10	215	190	86	203	145	50	137	327	163,5	109	31
160	2 400	10	215	190	86	203	145	50	145	335	166,5	109	31
160	2 400	10	215	190	86	203	145	50	152	342	169,5	109	31
200	3 000	10	244	217	106	232	180	60	152	355	184,5	124	31
200	3 000	10	244	217	106	232	180	60	162	365	187,5	124	39
200	3 000	10	244	217	106	232	180	60	171	374	193	124	39
200	3 000	10	244	217	106	232	180	60	181	384	196	124	39
200	3 000	10	244	217	106	232	180	60	190	393	202	124	54
250	3 750	10	284	245	131	272	223	73	190	425	222	144	54
250	3 750	10	284	245	131	272	223	73	209	444	227,5	144	54
250	3 750	10	284	245	131	272	223	73	228	463	236	144	54
250	3 750	10	284	245	131	272	223	73	238	473	242	144	54
310	4 650	10	325	273	156	313	260	86	238	506	262,5	164,5	75
310	4 650	10	325	273	156	313	260	86	247	515	265	164,5	75
310	4 650	10	325	273	156	313	260	86	266	534	274	164,5	75
310	4 650	10	325	273	156	313	260	86	285	553	280	164,5	75



HTA (imperial system)



Multi-purpose

The dimensions and the traction load suit this tensioner to many different applications.

Reference examples:

- Reference example for a complete tensioner for 2 - 4 1/2 in. bolts:
HTA 90 2" - 4 1/2
- Reference example for the 2 - 4 1/2 in. brace for the HTA 90 tensioner:
HTA 90T 2" - 4 1/2



HTA .. T ..

HTA .. C

HTA .. J

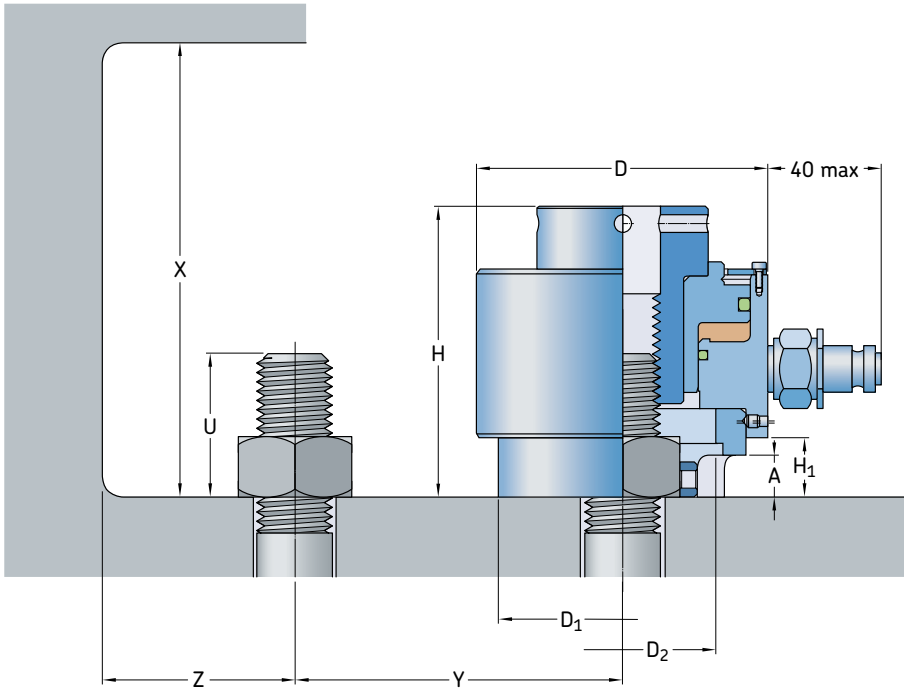
optional

Type	Bolt dimension		Max. pressure
	Ø	Pitch	
	in.	Threads/in. psi.	
HTA 20 3/4" - 10	3/4	10	21 756
HTA 20 7/8" - 9	7/8	9	21 756
HTA 20 1" - 8	1	8	21 756
HTA 35 1" - 8	1	8	21 756
HTA 35 1 1/8" - 7	1 1/8	7	21 756
HTA 35 1 1/4" - 7	1 1/4	7	21 756
HTA 35 1 3/8" - 6	1 3/8	6	21 756
HTA 50 1 3/8" - 6	1 3/8	6	21 756
HTA 50 1 1/2" - 6	1 1/2	6	21 756
HTA 50 1 3/4" - 5	1 3/4	5	21 756
HTA 60 1 1/2" - 6	1 1/2	6	21 756
HTA 60 1 3/4" - 5	1 3/4	5	21 756
HTA 60 2" - 4 1/2	2	4 1/2	21 756
HTA 90 1 3/4" - 5	1 3/4	5	21 756
HTA 90 2" - 4 1/2	2	4 1/2	21 756
HTA 90 2 1/4" - 4 1/2	2 1/4	4 1/2	21 756
HTA 130 2 1/2" - 4	2 1/2	4	21 756
HTA 130 2 3/4" - 4	2 3/4	4	21 756
HTA 130 3" - 4	M68	4	21 756
HTA 160 2 3/4" - 4	2 3/4	4	21 756
HTA 160 3" - 4	3	4	21 756
HTA 160 3 1/4" - 4	3 1/4	4	21 756
HTA 200 3 1/4" - 4	3 1/4	4	21 756
HTA 200 3 1/2" - 4	3 1/2	4	21 756
HTA 200 3 3/4" - 4	3 3/4	4	21 756
HTA 250 3 3/4" - 4	3 3/4	4	21 756
HTA 250 4" - 4	4	4	21 756
HTA 250 4 1/4" - 4	4 1/4	4	21 756
HTA 250 4 1/2" - 4	4 1/2	4	21 756
HTA 250 4 3/4" - 4	4 3/4	4	21 756
HTA 310 5" - 4	5	4	21 756
HTA 310 5 1/4" - 4	5 1/4	4	21 756
HTA 310 5 1/2" - 4	5 1/2	4	21 756
HTA 310 5 3/4" - 4	5 3/4	4	21 756

Hydraulic area	Max. hydraulic load	Piston stroke	Dimensions										Total tensioner weight
			D	H	H ₁	D ₁	D ₂	A	U	X	Y	Z	
in. ²	lbf.	mm	mm										kg
3,10	67 443	8	86	100	30	74	56	26	38	138	56	44,5	3
3,10	67 443	8	86	100	30	74	56	26	42	142	57	44,5	3
3,10	67 443	8	86	100	30	74	56	26	46	146	59	44,5	3
5,43	118 025	8	109	116	40	97	73	31	52	168	73,5	56	4,8
5,43	118 025	8	109	116	40	97	73	31	57	173	76,5	56	4,8
5,43	118 025	8	109	116	40	97	73	31	63	179	79	56	4,8
5,43	118 025	8	109	116	40	97	73	31	69	185	81	56	4,8
7,75	168 606	8	128	128	49	116	90	38	69	197	91	65,5	7,5
7,75	168 606	8	128	128	49	116	90	38	74	202	94	65,5	7,5
7,75	168 606	8	128	128	49	116	90	38	80	208	97	65,5	7,5
9,30	202 328	8	137	140	54	133	102	40	80	220	91	69,5	9
9,30	202 328	8	137	140	54	133	102	40	86	226	92	69,5	9
9,30	202 328	8	137	140	54	133	102	40	92	232	94	69,5	9
13,95	303 492	8	166	154	65	154	114	42	86	240	119	84,5	15,3
13,95	303 492	8	166	154	65	154	114	42	92	246	122	84,5	15,3
13,95	303 492	8	166	154	65	154	114	42	99	253	124,5	84,5	15,3
20,15	438 377	8	198	179	82	187	137	50	114	293	147	101	25
20,15	438 377	8	198	179	82	187	137	50	122	301	150	101	25
20,15	438 377	8	198	179	82	187	137	50	130	309	153	101	25
24,80	539 541	10	215	190	86	203	145	50	137	327	163,5	109	31
24,80	539 541	10	215	190	86	203	145	50	145	335	166,5	109	31
24,80	539 541	10	215	190	86	203	145	50	152	342	169,5	109	31
31,00	674 426	10	244	217	106	232	180	60	152	355	184,5	124	31
31,00	674 426	10	244	217	106	232	180	60	162	365	187,5	124	39
31,00	674 426	10	244	217	106	232	180	60	171	374	193	124	39
38,75	843 032	10	284	245	131	272	223	73	190	425	222	144	54
38,75	843 032	10	284	245	131	272	223	73	209	444	227,5	144	54
38,75	843 032	10	284	245	131	272	223	73	228	463	236	144	54
38,75	843 032	10	284	245	131	272	223	73	238	473	242	144	54
38,75	843 032	10	284	245	131	272	223	73	250	485	244	144	54
48,05	1 045 360	10	325	273	156	313	260	86	238	506	262,5	164,5	75
48,05	1 045 360	10	325	273	156	313	260	86	247	515	265	164,5	75
48,05	1 045 360	10	325	273	156	313	260	86	266	534	274	164,5	75
48,05	1 045 360	10	325	273	156	313	260	86	285	553	280	164,5	75



HTS (metric system)



Small

The HTS tensiometer is specially designed to tighten small bolts (starting with M8). However, it can also tighten large bolts. Its design also tolerates possible geometric faults in the assembly parts.

Reference examples:

- Reference example for a complete tensiometer for M12 bolts:
HTS 9 M12 × 1,75
- Reference example of hydraulic body for the HTS 9 tensiometer:
HTS 9 C
(M48 × 5 much too big !!!)



HTS .. T ..

HTS .. C

HTS .. J

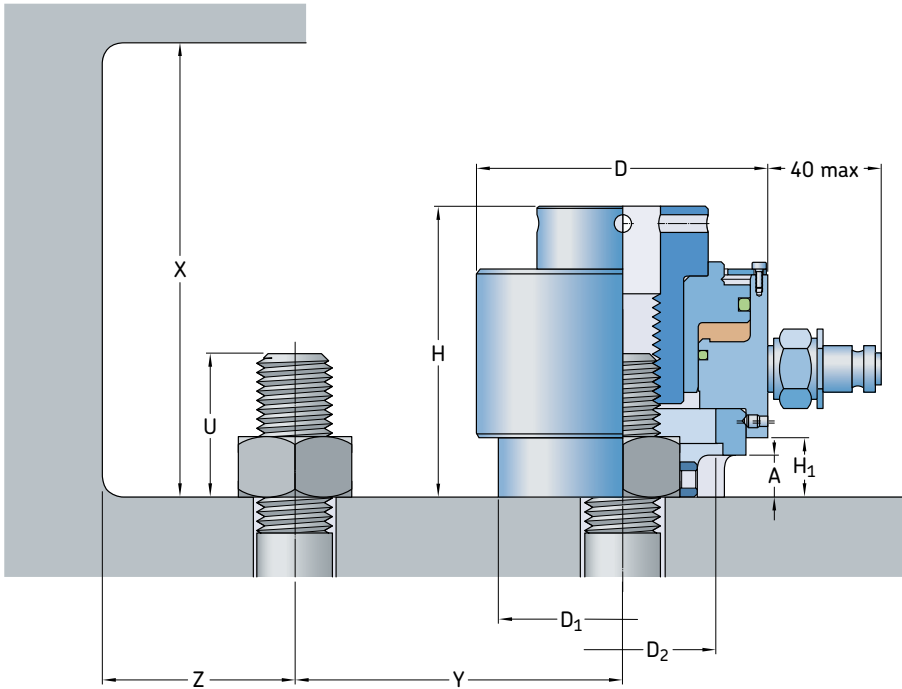
optional

Type	Bolt dimension		Max. pressure
	Diameter	Pitch	
	mm	mm	MPa
HTS 5 M8 × 1,25	M8	1,25	100
HTS 5 M10 × 1,5	M10	1,50	100
HTS 5 M12 × 1,75	M12	1,75	100
HTS 9 M10 × 1,5	M10	1,50	100
HTS 9 M12 × 1,75	M12	1,75	100
HTS 9 M14 × 2	M14	2	100
HTS 9 M16 × 2	M16	2	100
HTS 17 M14 × 2	M14	2	100
HTS 17 M16 × 2	M16	2	100
HTS 17 M18 × 2,5	M18	2,5	100
HTS 17 M20 × 2,5	M20	2,5	100
HTS 24 M18 × 2,5	M18	2,5	100
HTS 24 M20 × 2,5	M20	2,5	100
HTS 24 M22 × 2,5	M22	2,5	100
HTS 24 M24 × 3	M24	3	100
HTS 37 M20 × 2,5	M20	2,5	100
HTS 37 M22 × 2,5	M22	2,5	100
HTS 37 M24 × 3	M24	3	100
HTS 37 M27 × 3	M27	3	100
HTS 55 M24 × 3	M24	3	100
HTS 55 M27 × 3	M27	3	100
HTS 55 M30 × 3,5	M30	3,5	100
HTS 55 M33 × 3,5	M33	3,5	100
HTS 83 M33 × 3,5	M33	3,5	100
HTS 83 M36 × 4	M36	4	100
HTS 83 M39 × 4	M39	4	100
HTS 83 M42 × 4,5	M42	4,5	100
HTS 83 M45 × 4,5	M45	4,5	100
HTS 135 M45 × 4,5	M45	4,5	100
HTS 135 M48 × 5	M48	5	100
HTS 135 M52 × 5	M52	5	100
HTS 135 M56 × 5,5	M56	5,5	100
HTS 180 M56 × 5,5	M56	5,5	100
HTS 180 M60 × 5,5	M60	5,5	100
HTS 180 M64 × 6	M64	6	100
HTS 180 M68 × 6	M68	6	100
HTS 180 M72 × 6	M72	6	100
HTS 180 M76 × 6	M76	6	100
HTS 180 M80 × 6	M80	6	100
HTS 250 M80 × 6	M80	6	120
HTS 250 M85 × 6	M85	6	120
HTS 250 M90 × 6	M90	6	120
HTS 250 M95 × 6	M95	6	120
HTS 250 M100 × 6	M100	6	120

Hydraulic area	Max. hydraulic load	Piston stroke	Dimensions										Total tensioner weight
			D	H	H ₁	D ₁	D ₂	A	U	X	Y	Z	
cm ²	kN	mm	mm										kg
5	50	5	51	58	14,5	40	28,5	14,5	16	74	33	23,5	0,5
5	50	5	51	58	14,5	40	28,5	14,5	20	78	33	23,5	0,5
5	50	5	51	58	14,5	40	28,5	14,5	23	81	33	23,5	0,5
9	90	6	60	68	17,5	48	35	17	20	88	39,5	28,5	1
9	90	6	60	68	17,5	48	35	17	23	91	39,5	28,5	1
9	90	6	60	68	17,5	48	35	17	27	95	39,5	28,5	1
9	90	6	60	68	17,5	48	35	17	31	99	39,5	28,5	1
17	170	6	65	85	16	60	42	16	27	112	46,5	34	1,7
17	170	6	65	85	16	60	42	16	31	116	48	34	1,7
17	170	6	65	85	16	60	42	16	35	120	49,5	34	1,7
17	170	6	65	85	16	60	42	16	38	123	51,5	34	1,7
24	240	6	80	95	20	64	52	14	35	130	56,5	41	2,4
24	240	6	80	95	20	64	52	14	38	133	58,5	41	2,4
24	240	6	80	95	20	64	52	14	42	137	59,5	41	2,4
24	240	6	80	95	20	64	52	14	46	141	62	41	2,4
37	370	6	97	95	20	84	60	18	38	133	67,5	50	3,7
37	370	6	97	95	20	84	60	18	42	137	68,5	50	3,7
37	370	6	97	95	20	84	60	18	46	141	71	50	3,7
37	370	6	97	95	20	84	60	18	52	149	73,5	50	3,7
55	550	7	114	111	26	98	72	24	46	157	79	58	5,3
55	550	7	114	111	26	98	72	24	52	163	81,5	58	5,3
55	550	7	114	111	26	98	72	24	57	168	84,5	58	5,3
55	550	7	114	111	26	98	72	24	63	174	87	58	5,3
83	830	8	145	142	46	122	92	35	63	205	91,5	74	10,4
83	830	8	145	142	46	122	92	35	69	211	94,5	74	10,4
83	830	8	145	142	46	122	92	35	74	216	97	74	10,4
83	830	8	145	142	46	122	92	35	80	222	100	74	10,4
83	830	8	145	142	46	122	92	35	86	228	103	74	10,4
135	1 350	8	180	200	75	155	117	40	86	286	119,5	92	27
135	1 350	8	180	200	75	155	117	40	92	292	122,5	92	27
135	1 350	8	180	200	75	155	117	40	99	299	125	92	27
135	1 350	8	180	200	75	155	117	40	107	307	128	92	27
180	1 800	15	250	265	95	220	156	55	107	372	160,5	127	62
180	1 800	15	250	265	95	220	156	55	114	379	163,5	127	62
180	1 800	15	250	265	95	220	156	55	122	387	166,5	127	62
180	1 800	15	250	265	95	220	156	55	130	395	169	127	62
180	1 800	15	250	265	95	220	156	55	137	402	172	127	62
180	1 800	15	250	265	95	220	156	55	145	410	175	127	62
180	1 800	15	250	265	95	220	156	55	152	417	178	127	62
250	3 000	15	285	310	140	250	194	47	152	462	193	144	91
250	3 000	15	285	310	140	250	194	47	162	472	196	144	91
250	3 000	15	285	310	140	250	194	47	171	481	201,5	144	91
250	3 000	15	285	310	140	250	194	47	181	491	204,5	144	91
250	3 000	15	285	310	140	250	194	47	190	500	210	144	91



HTS (imperial system)



Small

The HTS tensiometer is specially designed to tighten small bolts (starting with M8). However, it can also tighten large bolts. Its design also tolerates possible geometric faults in the assembly parts.

Reference examples:

- Reference example for a complete tensiometer for 7/16 - 14 in. bolts: HTS 9 7/16" - 14
- Reference example of hydraulic body for the HTS 9 tensiometer: HTS 9 C

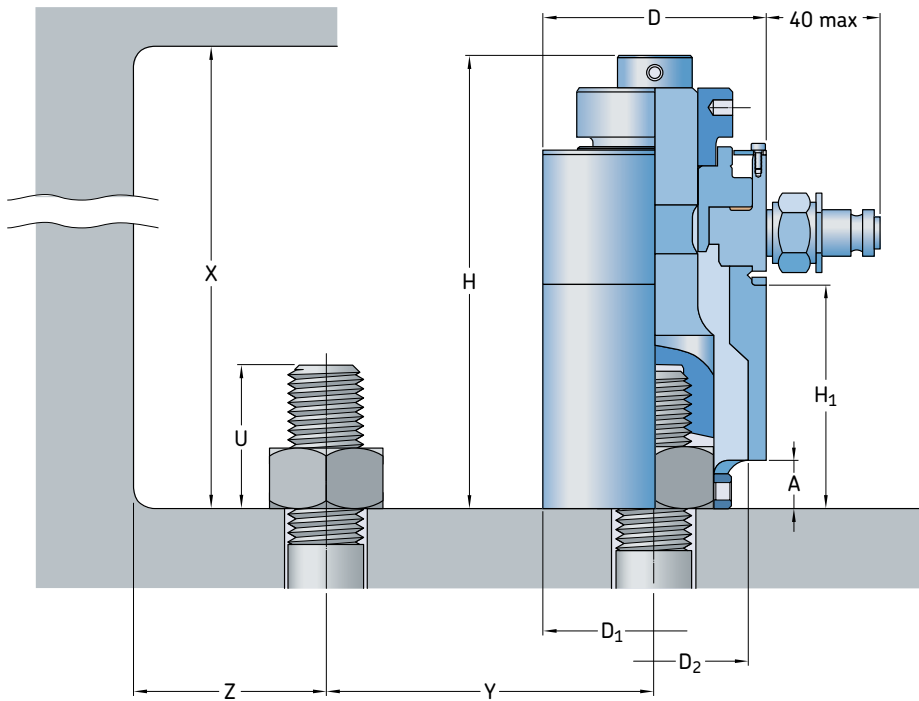


Type	Bolt dimension		Max. pressure
	Ø	Pitch	
	in.	Threads/in.	psi.
HTS 5 5/16" - 18	5/16	18	14 504
HTS 5 3/8" - 16	3/8	16	14 504
HTS 5 7/16" - 14	7/16	14	14 504
HTS 9 3/8" - 16	3/8	16	14 504
HTS 9 7/16" - 14	7/16	14	14 504
HTS 9 1/2" - 13	1/2	13	14 504
HTS 9 9/16" - 12	9/16	12	14 504
HTS 9 5/8" - 11	5/8	11	14 504
HTS 17 9/16" - 12	9/16	12	14 504
HTS 17 5/8" - 11	5/8	11	14 504
HTS 17 3/4" - 10	3/4	10	14 504
HTS 24 3/4" - 10	3/4	10	14 504
HTS 24 7/8" - 9	7/8	9	14 504
HTS 24 1" - 8	1	8	14 504
HTS 37 7/8" - 9	7/8	9	14 504
HTS 37 1" - 8	1	8	14 504
HTS 37 1 1/8" - 7	1 1/8	7	14 504
HTS 55 1" - 8	1	8	14 504
HTS 55 1 1/8" - 7	1 1/8	7	14 504
HTS 55 1 1/4" - 7	1 1/4	7	14 504
HTS 83 1 1/4" - 7	1 1/4	7	14 504
HTS 83 1 3/8" - 6	1 3/8	6	14 504
HTS 83 1 1/2" - 6	1 1/2	6	14 504
HTS 83 1 3/4" - 5	1 3/4	5	14 504
HTS 135 1 3/4" - 5	1 3/4	5	14 504
HTS 135 2" - 4 1/2	2	4 1/2	14 504
HTS 135 2 1/4" - 4 1/2	2 1/4	4 1/2	14 504
HTS 180 2 1/4" - 4 1/2	2 1/4	4 1/2	14 504
HTS 180 2 1/2" - 4	2 1/2	4	14 504
HTS 180 2 3/4" - 4	2 3/4	4	14 504
HTS 180 3" - 4	3	4	14 504
HTS 250 3" - 4	3	4	17 405
HTS 250 3 1/4" - 4	3 1/4	4	17 405
HTS 250 3 1/2" - 4	3 1/2	4	17 405
HTS 250 3 3/4" - 4	3 3/4	4	17 405

Hydraulic area	Max. hydraulic load	Piston stroke	Dimensions										Total tensioner weight
			D	H	H ₁	D ₁	D ₂	A	U	X	Y	Z	
in. ²	lbf.	mm	mm										kg
0,78	11 240	5	51	58	14,5	40	28,5	14,5	16	74	33	23,5	0,5
0,78	11 240	5	51	58	14,5	40	28,5	14,5	20	78	33	23,5	0,5
0,78	11 240	5	51	58	14,5	40	28,5	14,5	23	81	33	23,5	0,5
1,40	20 233	6	60	68	17,5	48	35	17	20	88	39,5	28,5	1
1,40	20 233	6	60	68	17,5	48	35	17	23	91	39,5	28,5	1
1,40	20 233	6	60	68	17,5	48	35	17	27	95	39,5	28,5	1
1,40	20 233	6	60	68	17,5	48	35	17	31	99	39,5	28,5	1
1,40	20 233	6	60	68	17,5	48	35	17	31	99	39,5	28,5	1
2,64	38 217	6	65	85	16	60	42	16	27	112	46,5	34	1,7
2,64	38 217	6	65	85	16	60	42	16	31	116	48	34	1,7
2,64	38 217	6	65	85	16	60	42	16	35	120	49,5	34	1,7
3,72	53 954	6	80	95	20	64	52	14	35	130	56,5	41	2,4
3,72	53 954	6	80	95	20	64	52	14	38	133	58,5	41	2,4
3,72	53 954	6	80	95	20	64	52	14	42	137	59,5	41	2,4
5,74	83 179	6	97	95	20	84	60	18	38	133	67,5	50	3,7
5,74	83 179	6	97	95	20	84	60	18	42	137	68,5	50	3,7
5,74	83 179	6	97	95	20	84	60	18	46	141	71	50	3,7
8,53	123 645	7	114	111	26	98	72	24	46	157	79	58	5,3
8,53	123 645	7	114	111	26	98	72	24	52	163	81,5	58	5,3
8,53	123 645	7	114	111	26	98	72	24	57	168	84,5	58	5,3
12,87	186 591	8	145	142	46	122	92	35	63	205	91,5	74	10,4
12,87	186 591	8	145	142	46	122	92	35	69	211	94,5	74	10,4
12,87	186 591	8	145	142	46	122	92	35	74	216	97	74	10,4
12,87	186 591	8	145	142	46	122	92	35	80	222	100	74	10,4
20,93	303 492	8	180	200	75	155	117	40	86	286	119,5	92	27
20,93	303 492	8	180	200	75	155	117	40	92	292	122,5	92	27
20,93	303 492	8	180	200	75	155	117	40	99	299	125	92	27
27,90	404 655	15	250	265	95	220	156	55	107	372	160,5	127	62
27,90	404 655	15	250	265	95	220	156	55	114	379	163,5	127	62
27,90	404 655	15	250	265	95	220	156	55	122	387	166,5	127	62
27,90	404 655	15	250	265	95	220	156	55	130	395	169	127	62
38,75	674 426	15	285	310	140	250	194	47	152	462	193	144	91
38,75	674 426	15	285	310	140	250	194	47	162	472	196	144	91
38,75	674 426	15	285	310	140	250	194	47	171	481	201,5	144	91
38,75	674 426	15	285	310	140	250	194	47	181	491	204,5	144	91



HTS N (metric system)



Thin

This tensioner is designed to fit into narrow spaces. It is also used when bolts are spaced close together. It particularly suits tightening big bolts with low traction load.

Reference examples:

- Reference example for a complete tensioner for M30 bolts:
HTS N 24 M30 × 3,5
- Reference example for the M30 × 3,5 brace of the HTS N 24 tensioner:
HTS N 24 T M30 × 3,5

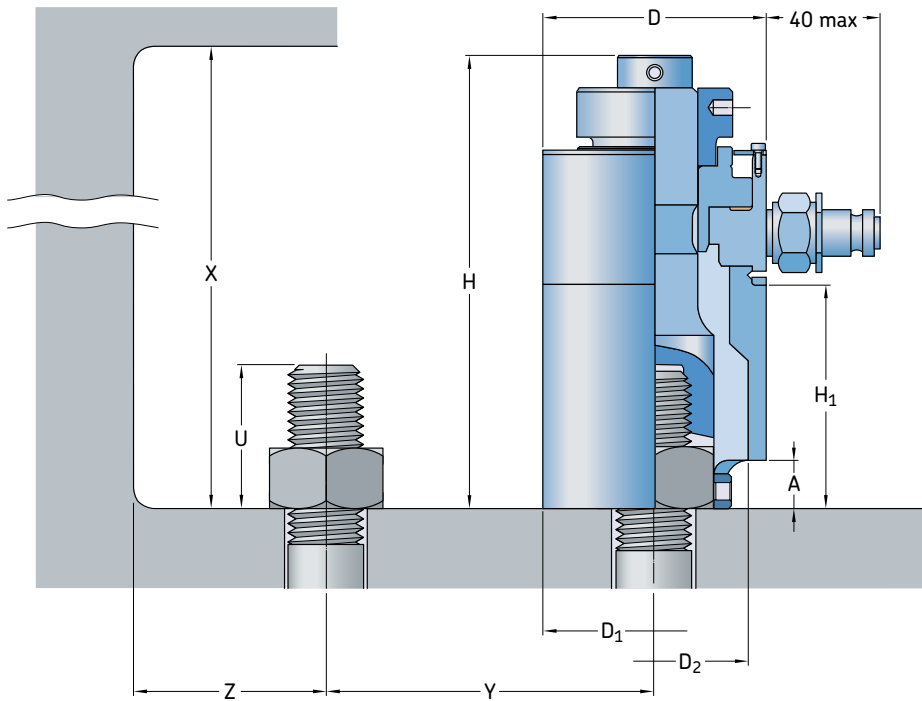


Type	Bolt dimension		Max. pressure
	Diameter	Pitch	
	mm	mm	MPa
HTS N 17 M20 × 2,5	M20	2,5	80
HTS N 17 M22 × 2,5	M22	2,5	80
HTS N 17 M24 × 3	M24	3	80
HTS N 17 M27 × 3	M27	3	80
HTS N 24 M24 × 3	M24	3	80
HTS N 24 M27 × 3	M27	3	80
HTS N 24 M30 × 3,5	M30	3,5	80
HTS N 24 M33 × 3,5	M33	3,5	80
HTS N 37 M27 × 3	M27	3	80
HTS N 37 M30 × 3,5	M30	3,5	80
HTS N 37 M33 × 3,5	M33	3,5	80
HTS N 37 M36 × 4	M36	4	80
HTS N 37 M39 × 4	M39	4	80
HTS N 55 M36 × 4	M36	4	100
HTS N 55 M39 × 4	M39	4	100
HTS N 55 M42 × 4,5	M42	4,5	100
HTS N 55 M45 × 4,5	M45	4,5	100
HTS N 55 M48 × 5	M48	5	100
HTS N 83 M45 × 4,5	M45	4,5	100
HTS N 83 M48 × 5	M48	5	100
HTS N 83 M52 × 5	M52	5	100
HTS N 83 M56 × 5,5	M56	5,5	100
HTS N 83 M60 × 5,5	M60	5,5	100
HTS N 135 M60 × 5,5	M60	5,5	100
HTS N 135 M64 × 6	M64	6	100
HTS N 135 M68 × 6	M68	6	100
HTS N 135 M72 × 6	M72	6	100
HTS N 135 M76 × 6	M76	6	100
HTS N 135 M80 × 6	M80	6	100

Hydraulic area	Max. hydraulic load	Piston stroke	Dimensions										Total tensioner weight
			D	H	H ₁	D ₁	D ₂	A	U	X	Y	Z	
cm ²	kN	mm	mm										kg
17	136	6	65	161	75	65	53	20	38	199	51,5	34	3
17	136	6	65	161	75	65	53	20	42	203	52	34	3
17	136	6	65	161	75	65	53	20	46	207	55	34	3
17	136	6	65	161	75	65	53	20	52	213	57,5	34	3
24	192	6	80	177	78	80	66	20	46	223	62	41	4,6
24	192	6	80	177	78	80	66	20	52	229	65	41	4,6
24	192	6	80	177	78	80	66	20	57	234	68	41	4,6
24	192	6	80	177	78	80	66	20	63	240	70,5	41	4,6
37	296	6	97	206	95	97	76	25	52	258	73,5	50	7,6
37	296	6	97	206	95	97	76	25	57	263	76,5	50	7,6
37	296	6	97	206	95	97	76	25	63	269	79	50	7,6
37	296	6	97	206	95	97	76	25	69	275	81,5	50	7,6
37	296	6	97	206	95	97	76	25	74	280	84,5	50	7,6
55	550	7	114	233	115	114	95	25	69	302	90	58	11,6
55	550	7	114	233	115	114	95	25	74	307	93	58	11,6
55	550	7	114	233	115	114	95	25	78	311	96	58	11,6
55	550	7	114	233	115	114	95	25	86	319	99	58	11,6
55	550	7	114	233	115	114	95	25	92	325	102	58	11,6
83	830	8	145	286	145	145	120	30	86	372	114,5	74	20
83	830	8	145	286	145	145	120	30	92	378	117,5	74	20
83	830	8	145	286	145	145	120	30	99	385	120	74	20
83	830	8	145	286	145	145	120	30	107	393	123	74	20
83	830	8	145	286	145	145	120	30	114	400	126	74	20
135	1 350	8	180	390	200	180	152	50	114	504	143,5	92	50
135	1 350	8	180	390	200	180	152	50	122	512	146,5	92	50
135	1 350	8	180	390	200	180	152	50	133	520	149	92	50
135	1 350	8	180	390	200	180	152	50	137	527	152	92	50
135	1 350	8	180	390	200	180	152	50	145	535	155	92	50
135	1 350	8	180	390	200	180	152	50	152	542	158	92	50

C

HTS N (imperial system)



Thin

This tensioner is designed to fit into narrow spaces. It is also used when bolts are spaced close together. It particularly suits tightening big bolts with low traction load.

Reference examples:

- Reference example for a complete tensioner for 1 1/8 - 7 in. bolts:
HTS N 24 1 1/8" - 7
- Reference example for the 1 1/8 - 7 in. brace of the HTS N 24 tensioner:
HTS N 24 T 1 1/8" - 7

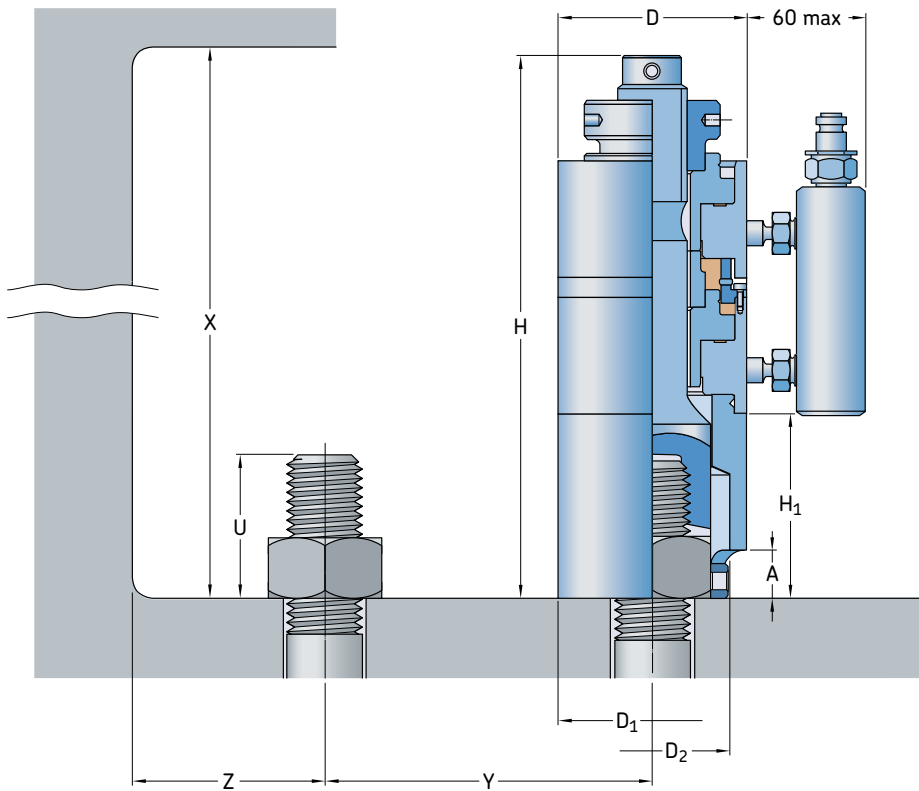


Type	Bolt dimension		Max. pressure
	Ø	Pitch	
	in	Threads/in	psi.
HTS N 17 3/4" - 10	3/4	10	80
HTS N 17 7/8" - 9	7/8	9	80
HTS N 17 1" - 8	1	8	80
HTS N 24 7/8" - 9	7/8	9	80
HTS N 24 1" - 8	1	8	80
HTS N 24 1 1/8" - 7	1 1/8	7	80
HTS N 24 1 1/4" - 7	1 1/4	7	80
HTS N 37 1 1/8" - 7	1 1/8	7	80
HTS N 37 1 1/4" - 7	1 1/4	7	80
HTS N 37 1 3/8" - 6	1 3/8	6	80
HTS N 37 1 1/2" - 6	1 1/2	6	80
HTS N 55 1 3/8" - 6	1 3/8	6	100
HTS N 55 1 1/2" - 6	1 1/2	6	100
HTS N 55 1 3/4" - 5	1 3/4	5	100
HTS N 83 1 3/4" - 5	1 3/4	5	100
HTS N 83 2" - 4 1/2	2	4 1/2	100
HTS N 83 2 1/4" - 4 1/2	2 1/4	4 1/2	100
HTS N 135 2 1/4" - 4 1/2	2 1/4	4 1/2	100
HTS N 135 2 1/2" - 4	2 1/2	4	100
HTS N 135 2 3/4" - 4	2 3/4	4	100
HTS N 135 3" - 4	3	4	100

Hydraulic area	Max. hydraulic load	Piston stroke	Dimensions										Total tensioner weight
			D	H	H ₁	D ₁	D ₂	A	U	X	Y	Z	
in. ²	lbf.	mm	mm										kg
17	136	6	65	161	75	65	53	20	38	199	51,5	34	3
17	136	6	65	161	75	65	53	20	42	203	52	34	3
17	136	6	65	161	75	65	53	20	46	207	55	34	3
24	192	6	80	177	78	80	66	20	46	223	62	41	4,6
24	192	6	80	177	78	80	66	20	52	229	65	41	4,6
24	192	6	80	177	78	80	66	20	57	234	68	41	4,6
24	192	6	80	177	78	80	66	20	63	240	70,5	41	4,6
37	296	6	97	206	95	97	76	25	52	258	73,5	50	7,6
37	296	6	97	206	95	97	76	25	57	263	76,5	50	7,6
37	296	6	97	206	95	97	76	25	63	269	79	50	7,6
37	296	6	97	206	95	97	76	25	69	275	81,5	50	7,6
55	550	7	114	233	115	114	95	25	69	302	90	58	11,6
55	550	7	114	233	115	114	95	25	74	307	93	58	11,6
55	550	7	114	233	115	114	95	25	78	311	96	58	11,6
83	830	8	145	286	145	145	120	30	86	372	114,5	74	20
83	830	8	145	286	145	145	120	30	92	378	117,5	74	20
83	830	8	145	286	145	145	120	30	99	385	120	74	20
135	1 350	8	180	390	200	180	152	50	114	504	143,5	92	50
135	1 350	8	180	390	200	180	152	50	122	512	146,5	92	50
135	1 350	8	180	390	200	180	152	50	133	520	149	92	50
135	1 350	8	180	390	200	180	152	50	137	527	152	92	50



HTS 2 (metric system)



Thin and powerful

Like the HTS N tensioner, HTS 2 takes up very little space. Due to its two-story design, there is greater tightening load for a given diameter as compared with HTS or HTS N.

Reference examples:

- Reference example for a complete tensioner for M36 bolts: HTS 2 37 M36 × 4
- Reference example for the HTS 2 37 tensioner upper screw: HTS 2 37 ES

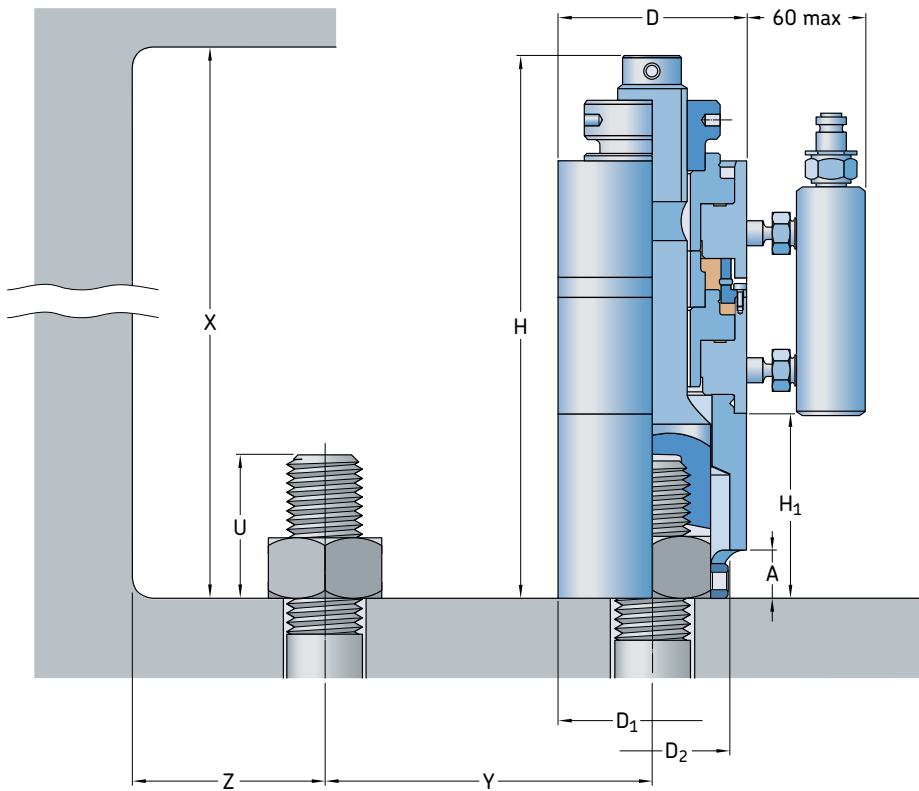


Type	Bolt dimension		Max. pressure
	Diameter	Pitch	
	mm	mm	MPa
HTS 2 17 M20 × 2,5	M20	2,5	80
HTS 2 17 M22 × 2,5	M22	2,5	80
HTS 2 17 M24 × 3	M24	3	80
HTS 2 17 M27 × 3	M27	3	80
HTS 2 24 M24 × 3	M24	3	80
HTS 2 24 M27 × 3	M27	3	80
HTS 2 24 M30 × 3,5	M30	3,5	80
HTS 2 24 M33 × 3,5	M33	3,5	80
HTS 2 37 M27 × 3	M27	3	80
HTS 2 37 M30 × 3,5	M30	3,5	80
HTS 2 37 M33 × 3,5	M33	3,5	80
HTS 2 37 M36 × 4	M36	4	80
HTS 2 37 M39 × 4	M39	4	80
HTS 2 55 M36 × 4	M36	4	80
HTS 2 55 M39 × 4	M39	4	80
HTS 2 55 M42 × 4,5	M42	4,5	80
HTS 2 55 M45 × 4,5	M45	4,5	80
HTS 2 55 M48 × 5	M48	5	80
HTS 2 83 M45 × 4,5	M45	4,5	80
HTS 2 83 M48 × 5	M48	5	80
HTS 2 83 M52 × 5	M52	5	80
HTS 2 83 M56 × 5,5	M56	5,5	80
HTS 2 83 M60 × 5,5	M60	5,5	80
HTS 2 135 M60 × 5,5	M60	5,5	80
HTS 2 135 M64 × 6	M64	6	80
HTS 2 135 M68 × 6	M68	6	80
HTS 2 135 M72 × 6	M72	6	80
HTS 2 135 M76 × 6	M76	6	80
HTS 2 135 M80 × 6	M80	6	80

Hydraulic area	Max. hydraulic load	Piston stroke	Dimensions										Total tensioner weight
			D	H	H ₁	D ₁	D ₂	A	U	X	Y	Z	
cm ²	kN	mm	mm										kg
34	272	6	65	228	75	65	53	20	38	266	51,5	34	4,8
34	272	6	65	228	75	65	53	20	42	270	52,5	34	4,8
34	272	6	65	228	75	65	53	20	46	274	55	34	4,8
34	272	6	65	228	75	65	53	20	52	280	57,5	34	4,8
48	384	6	80	245	78	80	66	20	46	291	62	41	7,6
48	384	6	80	245	78	80	66	20	52	297	65	41	7,6
48	384	6	80	245	78	80	66	20	57	302	68	41	7,6
48	384	6	80	245	78	80	66	20	63	308	70,5	41	7,6
74	592	6	97	277	95	97	76	25	52	329	73,5	50	11,4
74	592	6	97	277	95	97	76	25	57	334	76,5	50	11,4
74	592	6	97	277	95	97	76	25	63	340	79	50	11,4
74	592	6	97	277	95	97	76	25	69	346	81,5	50	11,4
74	592	6	97	277	95	97	76	25	74	351	84,5	50	11,4
110	880	7	114	312	115	114	95	25	69	381	90	58	16,9
110	880	7	114	312	115	114	95	25	74	386	93	58	16,9
110	880	7	114	312	115	114	95	25	80	392	96	58	16,9
110	880	7	114	312	115	114	95	25	86	398	99	58	16,9
110	880	7	114	312	115	114	95	25	92	404	102	58	16,9
166	1 328	8	145	363	145	145	120	30	86	449	114,5	74	30
166	1 328	8	145	363	145	145	120	30	92	455	117,5	74	30
166	1 328	8	145	363	145	145	120	30	99	442	120	74	30
166	1 328	8	145	363	145	145	120	30	107	470	123	74	30
166	1 328	8	145	363	145	145	120	30	114	477	126	74	30
270	2 160	8	180	500	200	180	152	50	114	614	143,5	92	66
270	2 160	8	180	500	200	180	152	50	122	622	146,5	92	66
270	2 160	8	180	500	200	180	152	50	130	630	149	92	66
270	2 160	8	180	500	200	180	152	50	137	637	152	92	66
270	2 160	8	180	500	200	180	152	50	145	645	155	92	66
270	2 160	8	180	500	200	180	152	50	152	652	158	92	66



HTS 2 (imperial system)

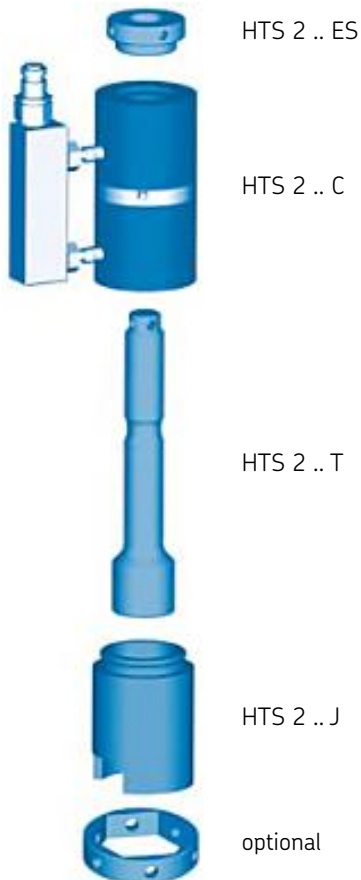


Thin and powerful

Like the HTS N tensioner, HTS 2 takes up very little space. Due to its two-story design, there is greater tightening load for a given diameter as compared with HTS or HTS N.

Reference examples:

- Reference example for a complete tensioner for 1³/₈ – 6 in. bolt:
HTS 2 37 1³/₈" – 6
- Reference example for the HTS 2 37 tensioner upper screw: HTS 2 37 ES

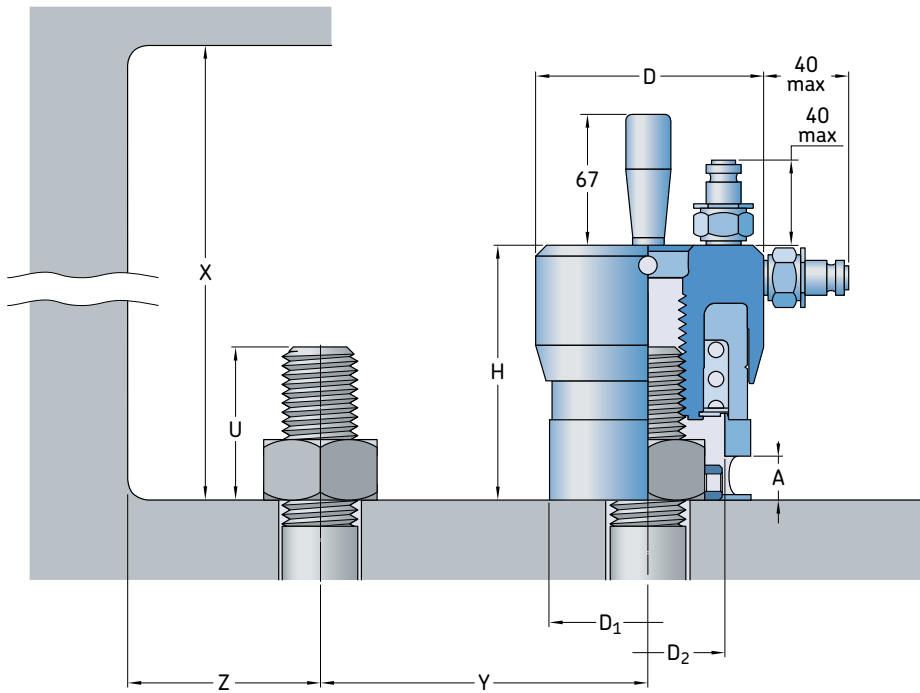


Type	Bolt dimension		Max. pressure
	Ø	Pitch	
	in.	Threads/in. psi.	
HTS 2 17 3/4" – 10	3/4	10	11 603
HTS 2 17 7/8" – 9	7/8	9	11 603
HTS 2 17 1" – 8	1	8	11 603
HTS 2 24 7/8" – 9	7/8	9	11 603
HTS 2 24 1" – 8	1	8	11 603
HTS 2 24 1 1/8" – 7	1 1/8	7	11 603
HTS 2 24 1 1/4" – 7	1 1/4	7	11 603
HTS 2 37 1 1/8" – 7	1 1/8	7	11 603
HTS 2 37 1 1/4" – 7	1 1/4	7	11 603
HTS 2 37 1 3/8" – 6	1 3/8	6	11 603
HTS 2 37 1 1/2" – 6	1 1/2	6	11 603
HTS 2 55 1 3/8" – 6	1 3/8	6	11 603
HTS 2 55 1 1/2" – 6	1 1/2	6	11 603
HTS 2 55 1 3/4" – 5	1 3/4	5	11 603
HTS 2 83 1 3/4" – 5	1 3/4	5	11 603
HTS 2 83 2" – 4 1/2	2	4 1/2	11 603
HTS 2 83 2 1/4" – 4 1/2	2 1/4	4 1/2	11 603
HTS 2 135 2 1/4" – 4 1/2	2 1/4	4 1/2	11 603
HTS 2 135 2 1/2" – 4	2 1/4	4	11 603
HTS 2 135 2 3/4" – 4	2 3/4	4	11 603
HTS 2 135 3" – 4	3	4	11 603

Hydraulic area	Max. hydraulic load	Piston stroke	Dimensions										Total tensioner weight
			D	H	H ₁	D ₁	D ₂	A	U	X	Y	Z	
in. ²	lbf.	mm	mm										kg
2,64	30 574	6	65	228	75	65	53	20	38	266	51,5	34	4,8
2,64	30 574	6	65	228	75	65	53	20	42	270	52,5	34	4,8
2,64	30 574	6	65	228	75	65	53	20	46	274	55	34	4,8
3,72	43 163	6	80	245	78	80	66	20	46	291	62	41	7,6
3,72	43 163	6	80	245	78	80	66	20	52	297	65	41	7,6
3,72	43 163	6	80	245	78	80	66	20	57	302	68	41	7,6
3,72	43 163	6	80	245	78	80	66	20	63	308	70,5	41	7,6
5,74	66 543	6	97	277	95	97	76	25	52	329	73,5	50	11,4
5,74	66 543	6	97	277	95	97	76	25	57	334	76,5	50	11,4
5,74	66 543	6	97	277	95	97	76	25	63	340	79	50	11,4
5,74	66 543	6	97	277	95	97	76	25	69	346	81,5	50	11,4
8,53	98 916	7	114	312	115	114	95	25	69	381	90	58	16,9
8,53	98 916	7	114	312	115	114	95	25	74	386	93	58	16,9
8,53	98 916	7	114	312	115	114	95	25	80	392	96	58	16,9
12,87	149 273	8	145	363	145	145	120	30	86	449	114,5	74	30
12,87	149 273	8	145	363	145	145	120	30	92	455	117,5	74	30
12,87	149 273	8	145	363	145	145	120	30	99	442	120	74	30
20,93	242 793	8	180	500	200	180	152	50	114	614	143,5	92	66
20,93	242 793	8	180	500	200	180	152	50	122	622	146,5	92	66
20,93	242 793	8	180	500	200	180	152	50	130	630	149	92	66
20,93	242 793	8	180	500	200	180	152	50	137	637	152	92	66



HTC R (metric system)



HTC R .. C ..

HTC R .. J

optional

Compact and powerful

HTC R, the most powerful tensioner in the HYDROCAM standard range, can apply very high traction loads. The brace and the body are monolithic. The HTC R tensioner, with its automatic piston return and few parts, is very easy to use and well-suited to simultaneous tightening. Each unit is dedicated to a single bolt diameter.

Reference examples:

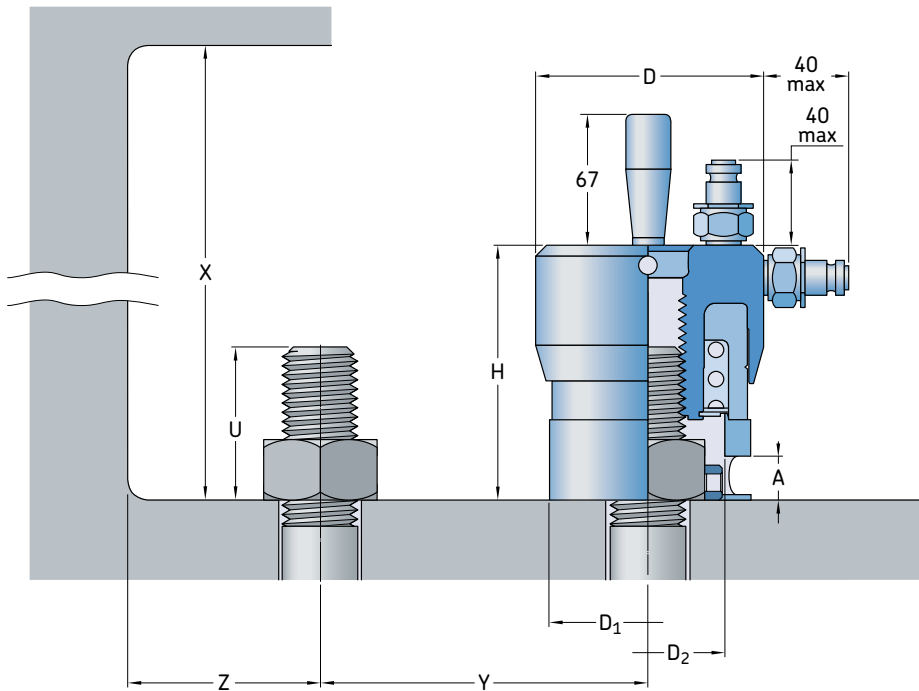
- Reference example for a complete tensioner for M60 bolts:
HTC R 137 M60 × 5,5
- Reference example of HTC R 137 hydraulic body for a M60 × 5,5 bolt:
HTC R 137 C M60 × 5,5

Type	Bolt dimension		Max. pressure	
	Diameter	Pitch		
	mm	mm	MPa	
HTC R 17	M20 × 2,5	M20	2,5	150
HTC R 17	M22 × 2,5	M22	2,5	150
HTC R 26	M24 × 3	M24	3	150
HTC R 26	M27 × 3	M27	3	150
HTC R 40	M30 × 3,5	M30	3,5	150
HTC R 40	M33 × 3,5	M33	3,5	150
HTC R 54	M36 × 4	M36	4	150
HTC R 54	M39 × 4	M39	4	150
HTC R 73	M42 × 4,5	M42	4,5	150
HTC R 73	M45 × 4,5	M45	4,5	150
HTC R 98	M48 × 5	M48	5	150
HTC R 98	M52 × 5	M52	5	150
HTC R 137	M56 × 5,5	M56	5,5	150
HTC R 137	M60 × 5,5	M60	5,5	150
HTC R 174	M64 × 6	M64	6	150
HTC R 174	M68 × 6	M68	6	150
HTC R 220	M72 × 6	M72	6	150
HTC R 220	M76 × 6	M76	6	150
HTC R 284	M80 × 6	M80	6	150
HTC R 284	M85 × 6	M85	6	150
HTC R 362	M90 × 6	M90	6	150
HTC R 362	M95 × 6	M95	6	150
HTC R 500	M100 × 6	M100	6	150
HTC R 500	M110 × 6	M110	6	150

Hydraulic area	Max. hydraulic load	Piston stroke	Dimensions										Total tensioner weight
			D	H	H ₁	D ₁	D ₂	A	U	X	Y	Z	
cm ²	kN	mm	mm										kg
17	255	8	71	93	41	60,5	45,5	14	38	111,5	50	37	2
17	255	8	71	93	41	60,5	45,5	14	42	111,5	50	37	2
26	390	8	83	103	47	73	54	17	46	126	61,5	43	3
26	390	8	83	103	47	73	54	17	52	126	61,5	43	3
40	600	8	103	116,5	52,5	90	67	20	57	145	75,5	53	4,5
40	600	8	103	116,5	52,5	90	67	20	63	145	75,5	53	4,5
54	810	8	117	130	60,5	103	76,5	23	69	163,5	87,6	60	6,2
54	810	8	117	130	60,5	103	76,5	23	74	163,5	87,6	60	6,2
73	1 095	8	134	144	68,5	120	89,5	26	80	183	102	68,5	9,5
73	1 095	8	134	144	68,5	120	89,5	26	86	183	102	68,5	9,5
98	1 470	8	154	159,5	72,5	138	102	29	92	204	116,5	78,5	15
98	1 470	8	154	159,5	72,5	138	102	29	99	204	116,5	78,5	15
137	2 055	8	183	195	90	160	116	32	107	247	133,5	93	24,2
137	2 055	8	183	195	90	160	116	32	114	247	133,5	93	24,2
174	2 610	10	204	225	108	178	127	37	122	285	148	103,5	34
174	2 610	10	204	225	108	178	127	37	130	285	148	103,5	34
220	3 300	10	227	241	114	194	136	42	137	308	162	115	45,5
220	3 300	10	227	241	114	194	136	42	145	308	162	115	45,5
284	4 260	10	255	225	87	217	151	47	152	300	179,5	129	49
284	4 260	10	255	225	87	217	151	47	162	300	179,5	129	49
362	5 430	10	287	240	98	244	168	51	171	323	202	145,5	65
362	5 430	10	287	240	98	244	168	51	181	323	202	145,5	65
500	7 500	10	335	260	113	283	192	56	190	356	233	169,5	99
500	7 500	10	335	260	113	283	192	56	209	356	233	169,5	99



HTC R (imperial system)



HTC R .. C ..

HTC R .. J

optional

Compact and powerful

HTC R, the most powerful tensioner in the HYDROCAM standard range, can apply very high traction loads. The brace and the body are monolithic. The HTC R tensioner, with its automatic piston return and few parts, is very easy to use and well-suited to simultaneous tightening. Each unit is dedicated to a single bolt diameter.

Reference examples:

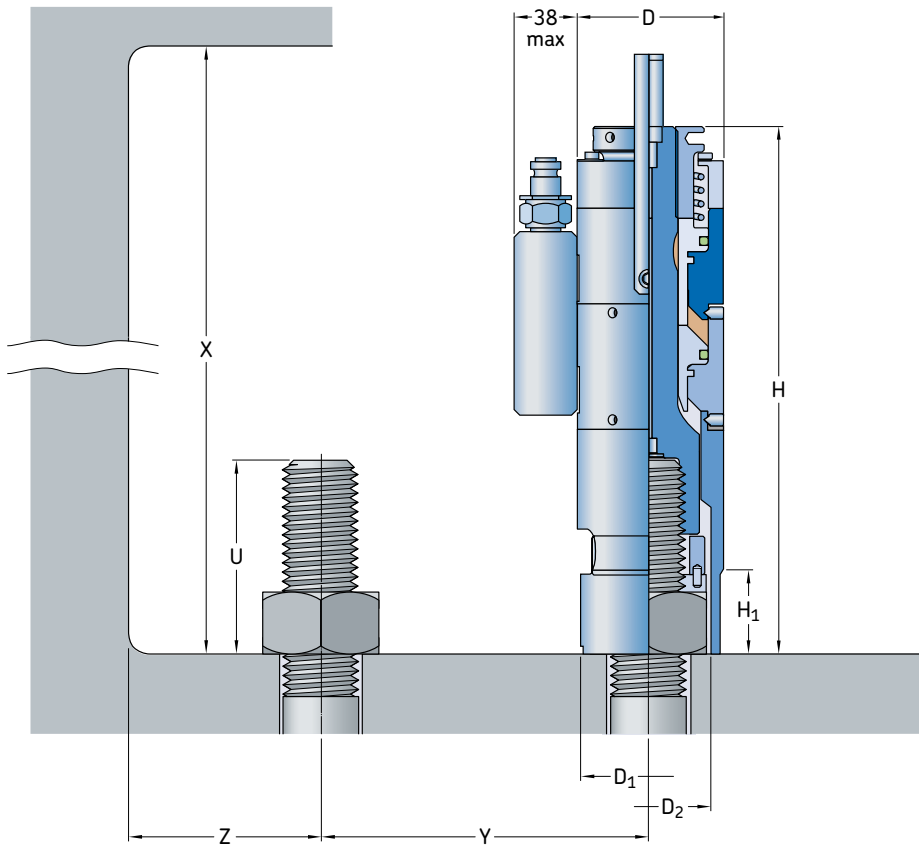
- Reference example for a complete tensioner for 2 1/2 – 4 in. bolts:
HTC R 137 2 1/2" – 4
- Reference example of HTC R 137 hydraulic body for a 2 1/2 – 4 in. bolt:
HTC R 137 C 2 1/2" – 4

Type	Bolt dimension		Max. pressure
	Ø	Pitch	
	in.	Threads/in.psi.	
HTC R 17 3/4" – 10	3/4	10	21 756
HTC R 17 7/8" – 9	7/8	9	21 756
HTC R 26 1" – 8	1	8	21 756
HTC R 26 1 1/8" – 7	1 1/8	7	21 756
HTC R 40 1 1/8" – 7	1 1/8	7	21 756
HTC R 40 1 1/4" – 7	1 1/4	7	21 756
HTC R 54 1 3/8" – 6	1 3/8	6	21 756
HTC R 54 1 1/2" – 6	1 1/2	6	21 756
HTC R 73 1 3/8" – 6	1 3/8	6	21 756
HTC R 73 1 1/2" – 6	1 1/2	6	21 756
HTC R 98 1 3/4" – 5	1 3/4	5	21 756
HTC R 98 2" – 4 1/2	2	4 1/2	21 756
HTC R 137 2 1/4" – 4 1/2	2 1/4	4 1/2	21 756
HTC R 137 2 1/2" – 4	2 1/2	4	21 756
HTC R 174 2 1/2" – 4	2 1/2	4	21 756
HTC R 174 2 3/4" – 4	2 3/4	4	21 756
HTC R 220 2 3/4" – 4	2 3/4	4	21 756
HTC R 220 3" – 4	3	4	21 756
HTC R 284 3 1/4" – 4	3 1/4	4	21 756
HTC R 284 3 1/2" – 4	3 1/2	4	21 756
HTC R 362 3 1/2" – 4	3 1/2	4	21 756
HTC R 362 3 3/4" – 4	3 3/4	4	21 756
HTC R 500 4" – 4	4	4	21 756
HTC R 500 4 1/4" – 4	4 1/4	4	21 756

Hydraulic area	Max. hydraulic load	Piston stroke	Dimensions										Total tensioner weight
			D	H	H ₁	D ₁	D ₂	A	U	X	Y	Z	
in. ²	lbf.	mm	mm										kg
2,64	57 326	8	71	93	41	60,5	45,5	14	38	111,5	50	37	2
2,64	57 326	8	71	93	41	60,5	45,5	14	42	111,5	50	37	2
4,03	87 675	8	83	103	47	73	54	17	46	126	61,5	43	3
4,03	87 675	8	83	103	47	73	54	17	52	126	61,5	43	3
6,20	134 885	8	103	116,5	52,5	90	67	20	57	145	75,5	53	4,5
6,20	134 885	8	103	116,5	52,5	90	67	20	63	145	75,5	53	4,5
8,37	182 095	8	117	130	60,5	103	76,5	23	69	163,5	87,6	60	6,2
8,37	182 095	8	117	130	60,5	103	76,5	23	74	163,5	87,6	60	6,2
11,32	246 165	8	134	144	68,5	120	89,5	26	80	183	102	68,5	9,5
11,32	246 165	8	134	144	68,5	120	89,5	26	86	183	102	68,5	9,5
15,19	330 469	8	154	159,5	72,5	138	102	29	92	204	116,5	78,5	15
15,19	330 469	8	154	159,5	72,5	138	102	29	99	204	116,5	78,5	15
21,24	461 982	8	183	195	90	160	116	32	107	247	133,5	93	24,2
21,24	461 982	8	183	195	90	160	116	32	114	247	133,5	93	24,2
26,97	586 750	10	204	225	108	178	127	37	122	285	148	103,5	34
26,97	586 750	10	204	225	108	178	127	37	130	285	148	103,5	34
34,10	741 868	10	227	241	114	194	136	42	137	308	162	115	45,5
34,10	741 868	10	227	241	114	194	136	42	145	308	162	115	45,5
44,02	957 685	10	255	225	87	217	151	47	152	300	179,5	129	49
44,02	957 685	10	255	225	87	217	151	47	162	300	179,5	129	49
56,11	1 220 711	10	287	240	98	244	168	51	171	323	202	145,5	65
56,11	1 220 711	10	287	240	98	244	168	51	181	323	202	145,5	65
77,50	1 686 064	10	335	260	113	283	192	56	190	356	233	169,5	99
77,50	1 686 064	10	335	260	113	283	192	56	209	356	233	169,5	99



HTH R (metric system)



HTH R .. ES

HTH R .. C

HTH R .. T ..

HTH R .. J

ACC ..

Thin and super-powerful

This full-option tensioner provides maximum power for a minimum of space. Built on two or three stories (depending on the diameters to be tightened), this is the thinnest tensioner in the HYDROCAM standard product range. In most cases, it requires the use of cylindrical nuts. The HTH R also has an automatic piston return mechanism and is very well-suited to simultaneous tightening.

Reference examples:

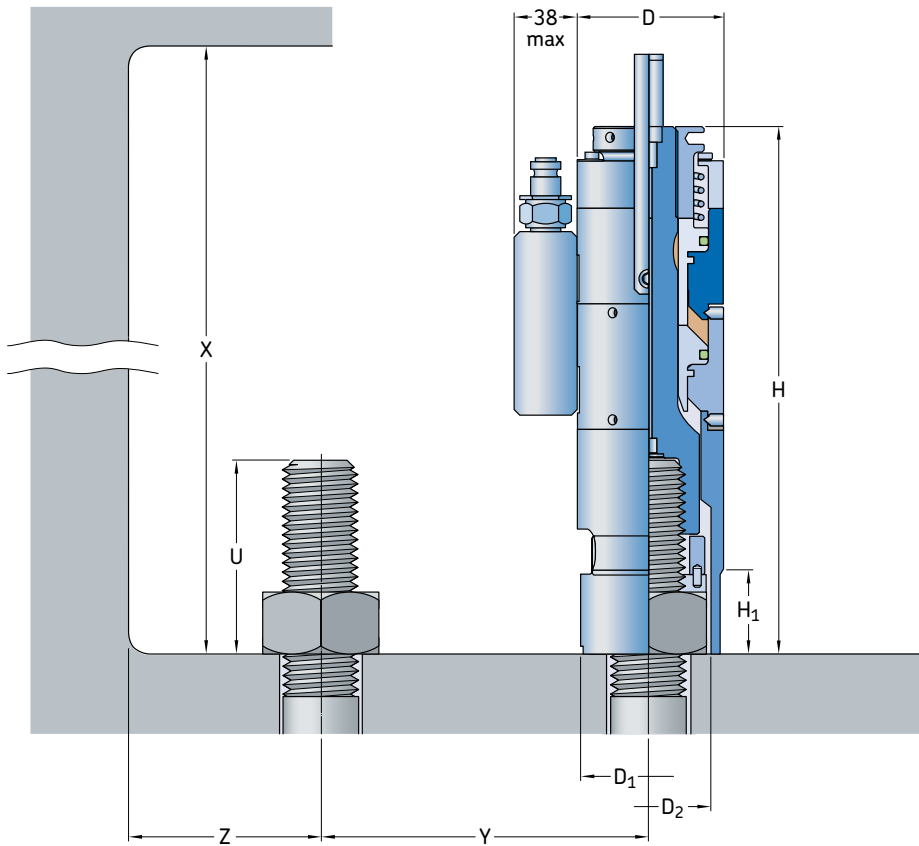
- Reference example for a complete tensioner for M72 bolts:
HTH R 108 M72 × 6
- Reference example for the HTH R 108 tensioner skirt: HTH R 108 J

Type	Bolt dimension		Max. pressure
	Diameter	Pitch	
	mm	mm	MPa
HTH R 17 M20 × 2,5	M20	2,5	150
HTH R 17 M22 × 2,5	M22	2,5	150
HTH R 17 M24 × 3	M24	3	150
HTH R 17 M27 × 3	M27	3	150
HTH R 17 M30 × 3,5	M30	3,5	150
HTH R 34 M30 × 3,5	M30	3,5	150
HTH R 34 M33 × 3,5	M33	3,5	150
HTH R 34 M36 × 4	M36	4	150
HTH R 34 M39 × 4	M39	4	150
HTH R 34 M42 × 4,5	M42	4,5	150
HTH R 45 M42 × 4,5	M42	4,5	150
HTH R 45 M45 × 4,5	M45	4,5	150
HTH R 45 M48 × 5	M48	5	150
HTH R 62 M48 × 5	M48	5	150
HTH R 62 M52 × 5	M52	5	150
HTH R 62 M56 × 5,5	M56	5,5	150
HTH R 82 M56 × 5,5	M56	5,5	150
HTH R 82 M60 × 5,5	M60	5,5	150
HTH R 82 M64 × 6	M64	6	150
HTH R 108 M64 × 6	M64	6	150
HTH R 108 M68 × 6	M68	6	150
HTH R 108 M72 × 6	M72	6	150
HTH R 135 M72 × 6	M72	6	150
HTH R 135 M76 × 6	M76	6	150
HTH R 135 M80 × 6	M80	6	150
HTH R 180 M80 × 6	M80	6	150
HTH R 180 M85 × 6	M85	6	150
HTH R 180 M90 × 6	M90	6	150
HTH R 223 M90 × 6	M90	6	150
HTH R 223 M95 × 6	M95	6	150
HTH R 223 M100 × 6	M100	6	150
HTH R 270 M100 × 6	M100	6	150
HTH R 270 M110 × 6	M110	6	150
HTH R 335 M110 × 6	M110	6	150
HTH R 335 M120 × 6	M120	6	150
HTH R 335 M125 × 6	M125	6	150
HTH R 427 M125 × 6	M125	6	150
HTH R 427 M130 × 6	M130	6	150
HTH R 427 M140 × 6	M140	6	150
HTH R 567 M140 × 6	M140	6	150
HTH R 567 M150 × 6	M150	6	150
HTH R 567 M160 × 6	M160	6	150

Hydraulic area	Max. hydraulic load	Piston stroke	Dimensions									Total tensioner weight
			D	H	H ₁	D ₁	D ₂	U	X	Y	Z	
cm ²	kN	mm	mm									kg
17	255	8	63	180	60	62	45	50	230	55	33	3,5
17	255	8	63	180	60	62	45	55	235	55	33	3,5
17	255	8	63	180	60	62	45	60	240	55	33	3,5
17	255	8	63	180	60	62	45	68	248	55	33	3,5
17	255	8	63	180	60	62	45	73	253	55	33	3,5
34	510	10	73	270	41	70	61	73	343	68	38	7
34	510	10	73	270	41	70	61	77	347	68	38	7
34	510	10	73	270	41	70	61	84	354	68	38	7
34	510	10	73	270	41	70	61	91	361	68	38	7
34	510	10	73	270	41	70	61	98	368	68	38	7
45	675	10	84	290	45	81	68	98	388	77	43,5	10
45	675	10	84	290	45	81	68	101	391	77	43,5	10
45	675	10	84	290	45	81	68	107	397	77	43,5	10
62	930	10	100	315	50	96	81	107	422	91	51,5	14
62	930	10	100	315	50	96	81	109	424	91	51,5	14
62	930	10	100	315	50	96	81	117	432	91	51,5	14
82	1 230	10	110	334	61	108	90	117	451	101	56,5	16
82	1 230	10	110	334	61	108	90	122	456	101	56,5	16
82	1 230	10	110	334	61	108	90	132	466	101	56,5	16
108	1 620	10	122	420	144	118	101	132	552	112	62,5	25
108	1 620	10	122	420	144	118	101	137	557	112	62,5	25
108	1 620	10	122	420	144	118	101	145	565	112	62,5	25
135	2 025	10	136	460	155	134	112	144	604	125	68,5	36
135	2 025	10	136	460	155	134	112	152	612	125	68,5	36
135	2 025	10	136	460	155	134	112	160	620	125	68,5	36
180	2 700	10	147	510	171	144	124	160	670	137	75	47
180	2 700	10	147	510	171	144	124	166	676	137	75	47
180	2 700	10	147	510	171	144	124	176	686	137	75	47
223	3 345	10	160	560	185	157	138	176	736	151	82	59
223	3 345	10	160	560	185	157	138	181	741	151	82	59
223	3 345	10	160	560	185	157	138	190	750	151	82	59
270	4 050	10	180	585	-	175	152	190	775	168	92	79
270	4 050	10	180	585	-	175	152	208	793	168	92	79
335	5 025	10	200	635	-	200	171	208	843	187,5	102	90
335	5 025	10	200	635	-	200	171	236	871	187,5	102	90
335	5 025	10	200	635	-	200	171	245	880	187,5	102	90
427	6 405	10	223	695	-	223	190	245	940	208,5	113,5	150
427	6 405	10	223	695	-	223	190	251	946	208,5	113,5	150
427	6 405	10	223	695	-	223	190	270	965	208,5	113,5	150
567	8 505	10	255	770	-	255	217	270	1040	238	129,5	220
567	8 505	10	255	770	-	255	217	290	1060	238	129,5	220
567	8 505	10	255	770	-	255	217	310	1080	238	129,5	220



HTH R (imperial system)



HTH R .. ES

HTH R .. C

HTH R .. T ..

HTH R .. J

ACC ..

Type	Bolt dimension		Max. pressure
	Ø	Pitch	
	in.	Threads/in. psi.	
HTH R 17 3/4" - 10	3/4	10	21 756
HTH R 17 7/8" - 9	7/8	9	21 756
HTH R 17 1" - 8	1	8	21 756
HTH R 17 1 1/8" - 7	1 1/8	7	21 756
HTH R 34 1 1/8" - 7	1 1/8	7	21 756
HTH R 34 1 1/4" - 7	1 1/4	7	21 756
HTH R 34 1 3/8" - 6	1 3/8	6	21 756
HTH R 34 1 1/2" - 6	1 1/2	6	21 756
HTH R 45 1 1/2" - 6	1 1/2	6	21 756
HTH R 45 1 3/4" - 5	1 3/4	5	21 756
HTH R 62 2" - 4 1/2	2	4 1/2	21 756
HTH R 62 2 1/4" - 4 1/2	2 1/4	4 1/2	21 756
HTH R 82 2 1/4" - 4 1/2	2 1/4	4 1/2	21 756
HTH R 82 2 1/2" - 4	2 1/2	4	21 756
HTH R 108 2 1/2" - 4	2 1/2	4	21 756
HTH R 108 2 3/4" - 4	2 3/4	4	21 756
HTH R 135 2 3/4" - 4	2 3/4	4	21 756
HTH R 135 3" - 4	3	4	21 756
HTH R 180 3 1/4" - 4	3 1/4	4	21 756
HTH R 180 3 1/2" - 4	3 1/2	4	21 756
HTH R 223 3 1/2" - 4	3 1/2	4	21 756
HTH R 223 3 3/4" - 4	3 3/4	4	21 756
HTH R 270 4" - 4	4	4	21 756
HTH R 270 4 1/4" - 4	4 1/4	4	21 756
HTH R 335 4 1/2" - 4	4 1/2	4	21 756
HTH R 335 4 3/4" - 4	4 3/4	4	21 756
HTH R 427 5" - 4	5	4	21 756
HTH R 427 5 1/4" - 4	5 1/4	4	21 756
HTH R 427 5 1/2" - 4	5 1/2	4	21 756
HTH R 567 5 1/2" - 4	5 1/2	4	21 756
HTH R 567 5 3/4" - 4	5 3/4	4	21 756
HTH R 567 6" - 4	6	4	21 756

Thin and super-powerful

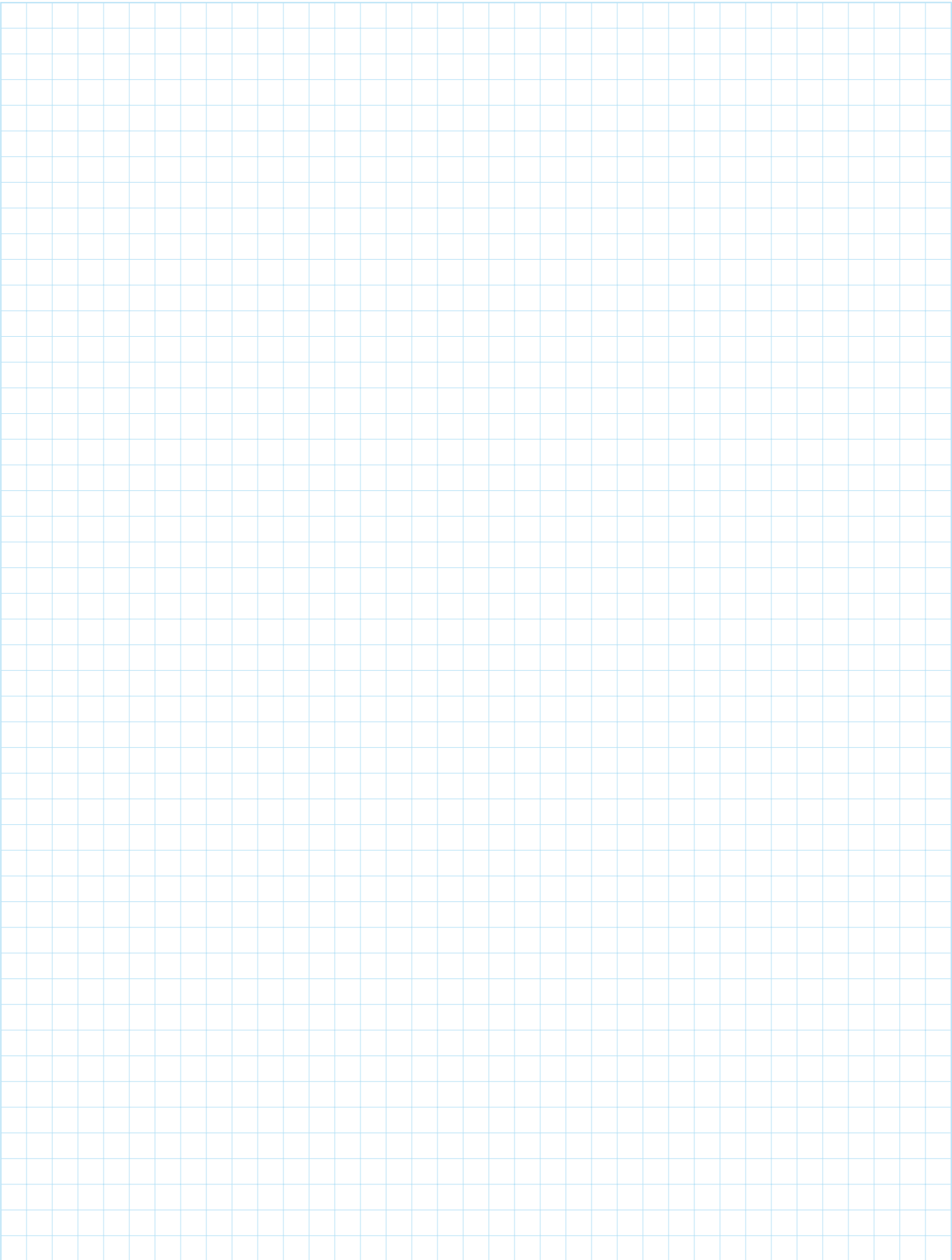
This full-option tensioner provides maximum power for a minimum of space. Built on two or three stories (depending on the diameters to be tightened), this is the thinnest tensioner in the HYDROCAM standard product range. In most cases, it requires the use of cylindrical nuts. The HTH R also has an automatic piston return mechanism and is very well-suited to simultaneous tightening.

Reference examples:

- Reference example for a complete tensioner for 2 1/2 - 4 in. bolts: HTH R 108 2 1/2" - 4
- Reference example for the HTH R 108 tensioner skirt: HTH R 108 J

Hydraulic area	Max. hydraulic load	Piston stroke	Dimensions									Total tensioner weight
			D	H	H ₁	D ₁	D ₂	U	X	Y	Z	
in. ²	lbf.	mm	mm									kg
2,64	57 326	8	63	180	60	62	45	50	230	55	33	3,5
2,64	57 326	8	63	180	60	62	45	55	235	55	33	3,5
2,64	57 326	8	63	180	60	62	45	60	240	55	33	3,5
2,64	57 326	8	63	180	60	62	45	68	248	55	33	3,5
5,27	114 652	10	73	270	41	70	61	73	343	68	38	7
5,27	114 652	10	73	270	41	70	61	77	347	68	38	7
5,27	114 652	10	73	270	41	70	61	84	354	68	38	7
5,27	114 652	10	73	270	41	70	61	91	361	68	38	7
6,98	151 746	10	84	290	45	81	68	98	388	77	43,5	10
6,98	151 746	10	84	290	45	81	68	101	391	77	43,5	10
9,61	209 072	10	100	315	50	96	81	107	422	91	51,5	14
9,61	209 072	10	100	315	50	96	81	109	424	91	51,5	14
12,71	276 515	10	110	334	61	108	90	117	451	101	56,5	16
12,71	276 515	10	110	334	61	108	90	122	456	101	56,5	16
16,74	364 190	10	122	420	144	118	101	132	552	112	62,5	25
16,74	364 190	10	122	420	144	118	101	137	557	112	62,5	25
20,93	455 237	10	136	460	155	134	112	144	604	125	68,5	36
20,93	455 237	10	136	460	155	134	112	152	612	125	68,5	36
27,90	606 983	10	147	510	171	144	124	160	670	137	75	47
27,90	606 983	10	147	510	171	144	124	166	676	137	75	47
34,57	751 985	10	160	560	185	157	138	176	736	151	82	59
34,57	751 985	10	160	560	185	157	138	181	741	151	82	59
41,85	910 475	10	180	585	-	175	152	190	775	168	92	79
41,85	910 475	10	180	585	-	175	152	208	793	168	92	79
51,93	1 129 663	10	200	635	-	200	171	208	843	187,5	102	90
51,93	1 129 663	10	200	635	-	200	171	236	871	187,5	102	90
66,19	1 439 899	10	223	695	-	223	190	245	940	208,5	113,5	150
66,19	1 439 899	10	223	695	-	223	190	251	946	208,5	113,5	150
66,19	1 439 899	10	223	695	-	223	190	270	965	208,5	113,5	150
87,89	1 911 997	10	255	770	-	255	217	270	1040	238	129,5	220
87,89	1 911 997	10	255	770	-	255	217	290	1060	238	129,5	220
87,89	1 911 997	10	255	770	-	255	217	310	1080	238	129,5	220

C



Special products

Customized standard tensioners

Do you have a specific assembly? SKF adapts the tensioner to your application.

A HYDROCAM standard tensioner has been selected for your application... but there may be one feature of your bolted assembly which prevents the tensioner from being used.

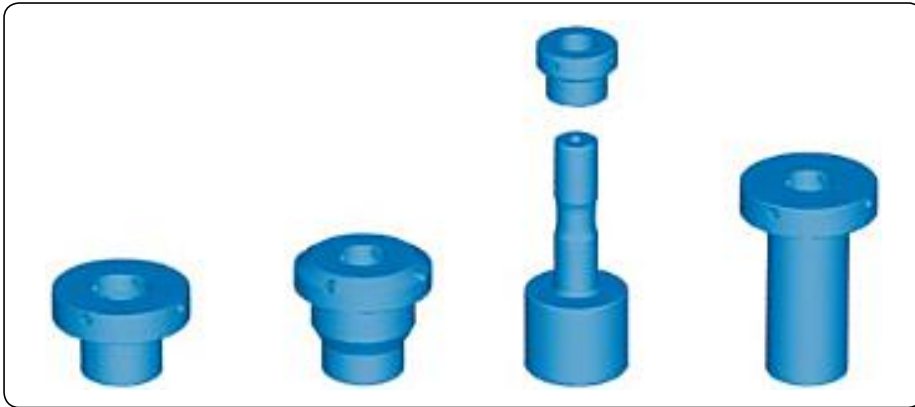
SKF can easily adapt the following components of the tensioner to fit your size and accessibility constraints:

- the brace
- the skirt
- the socket
- the reaction nut.

The examples of customized parts shown below portray only a small portion of what can be done – the possibilities are endless.

If your application presents special characteristics which preclude using a standard or a customized standard tensioner, please turn to the page “Special tensioners”, on **pages 66 and 67**.

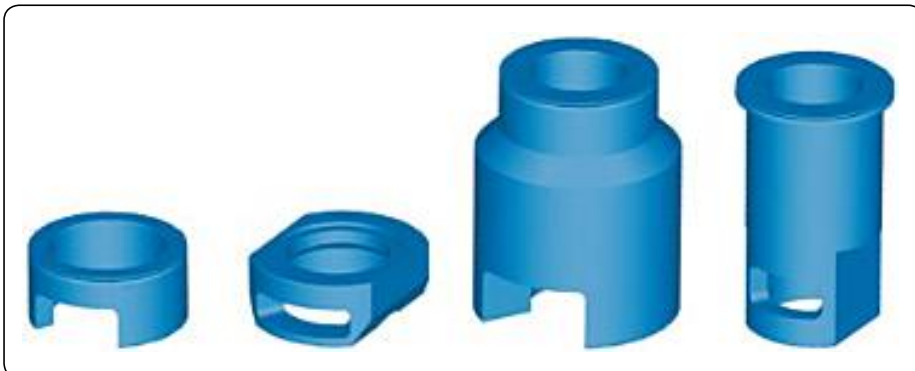
Customized braces



Standard body



Customized skirts



Customized sockets



Special tensioners

You have a specific application which requires a design study. SKF designs, computes, optimizes and manufactures the hydraulic tensioner to meet your needs.

SKF offers tailor-made design of the various tensioner components, in compliance with your application requirements. The operating principle remains the same, however new functions can be added.

A brief overview of SKF expertise follows:

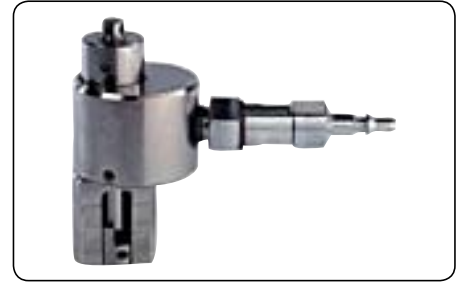
- The general shape, size and number of components can vary as needed, to fit the accessibility, size restrictions and handling constraints.
- The choice of the materials and heat treatments is adapted to meet the mechanical and weight specifications of an application. SKF tensioners can also be manufactured in lighter materials such as titanium.
- The tensioner environment can require the use of specific hydraulic fluids. HYDROCAM tensioners can be designed to work with all types of hydraulic connectors.
- Turning down operations can be motorized and fully automated.
- In cases requiring high accuracy, SKF can supply sensor washers or devices to measure bolt elongation.
- For improved tightening uniformity over several bolts, we recommend either total (preferably) or partial simultaneous tightening.

...

Let us know your needs – we will meet them!

Stainless steel tensioner

- Works with water
- Compact
- No pollution of the assembly
- Environmentally friendly



Monolithic 8-tensioner ring

- Simultaneous, homogenous tightening
- Quick, simple use



Titanium tensioner

- Works with water
- Ultra-light
- Easy handling
- Designed to be handled by a diver in an underwater environment



Compact tensioner

- Tightens hard-to-reach bolts
- Controls turning-down operations



Micro tensioner

- Compact
- Tightens very small bolts (M5)
- Highly accurate (a few microns of screw elongation)



Tensioner for automatic multiple stud tensioner machines, nuclear reactor vessel opening and closing operations

- Remote-controlled
- Highly efficient application of high tightening pre-loads
- Excellent efficiency



Tensioners for very large diameter bolts

- Tighten very large diameter bolts
- Automatic piston return
- Retaining sleeve or clamping jaws



Tensioner for 500 mm diameter bolts

D

Special machines and control systems

Your application requires remote control tightening which is simultaneous, controlled, accurate and totally safe. SKF researches your application and adds hydraulic tensioners to instrumentation and control systems.

In adding HYDROCAM hydraulic tensioners to an instrument, regulation and control system, you automate and protect your tightening. You can also ensure homogenous tightening by using a simultaneous tightening procedure, and

improve accuracy by using measurement and control devices. The handling phases can be automated and included in the machine operating process, resulting in reliable, accurate and rapid tightening operations.

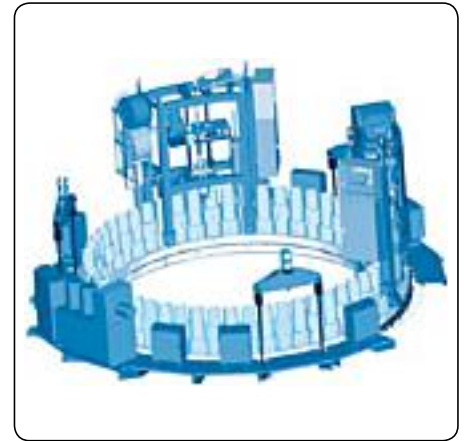
The following lists a brief sampling of some of the automated functions commonly found in special tightening machines:

- pressure increase for controlled tensioners
- turning down operations for the nuts to be tightened
- automatic piston return

- stud screwing and unscrewing
- piston stroke control
- measurement of bolt elongation
- continuous measurement of the tightening load.



Remote control of a tightening machine working in a risk area



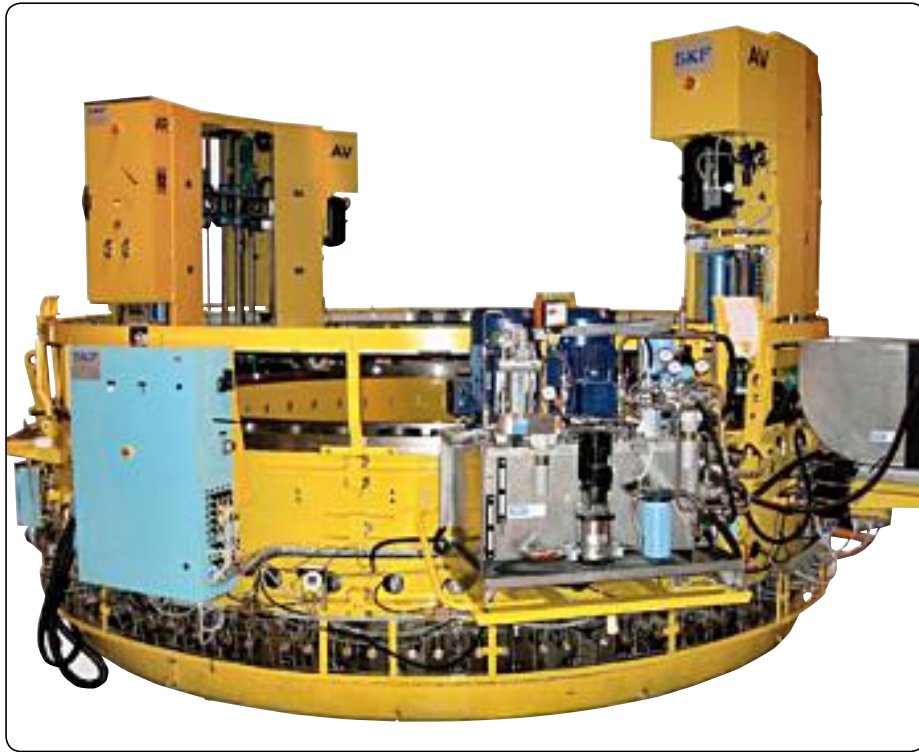
CAD of the MST (Multiple Stud Tensioner) or MSDG (Stud Tightening and Untightening Machine)

Central feed individual tensioner simultaneous tightening



On-site assembly of the MST





*MST Machine for closing and opening operations of PWR 1300 MW reactor vessel
This machine is provided with 54 hydraulic bolt tensioners, two double-head robots and uses demineralized water as hydraulic fluid and its remote control system has a high level of automation.*

MST Machine: Remote Control Panel



Automatic MST Machine holding 54 vessel studs lowering down to the reactor vessel for closing operation



Machine to tighten simultaneously the fastening bolts of the blade slewing bearings on wind turbine

Tensioner accessories

High pressure hoses

High pressure hoses are supplied with high pressure self-sealing quick-coupling connectors, in unit lengths up to 300 m. Two types of hose depending on the pressure used:

HFC: operating pressure: 150 MPa;
bursting pressure: 450 MPa
TFC: operating pressure: 300 MPa;
bursting pressure: 550 MPa

Designation example:

- HFC 1: 1 m long hose, operating pressure 150 MPa
- MFC 2: 2 m long hose, operating pressure 80 MPa

*Ref: MFC, HFC or TFC
(specify length)*



High pressure quick-coupling connectors

The self-sealing quick-coupling connectors on the HYDROCAM tightening and pressure supply equipment are heavy-duty and easy to use. There are three types of quick-coupling connectors depending on the pressure used: HBC 10; HBC 15; HBC 30.

Designation example:

- HBC 15 N/M: quick-coupling male connector, operating pressure: 150 MPa
HBC 30 N/F: quick-coupling female connector, operating pressure: 300 MPa

*Ref: HBC .. N/M or N/F
(specify pressure)*



Distribution blocks

The distribution blocks can simultaneously connect several hydraulic tensioners. They are equipped with high pressure self-sealing quick-coupling connectors. You select the number of outlets.

Designation example:

- HDB 1-2: distribution block one inlet – two outlets
HDB 1-3: distribution block one inlet – three outlets

*Ref: HDB1-..
(specify number of outlets)*



Oil can

Hydraulic oil is supplied in 5 l cans. All HYDROCAM tools are delivered fully oiled and ready to use.

Ref: HCO 5L



Air-driven hydraulic generating set GHP 20300

This air-driven hydraulic generating set, equipped with an air/oil pressure intensifier, supplies adjustable pressure of 300 MPa, calibrated by the air inlet. For air supply of 0,6 MPa (6 bar), the hydraulic flowrate at 100 MPa is 0,2 l/min. This unit has a class 1 manometer, a 5 l tank and

2 hydraulic outlets with quick-coupling, self-sealing connectors.

Dimensions: W 340 × D 320 × H 540 mm.
Weight: 34 kg.

Ref: GHP 20300



Air-driven hydraulic generating set GHP 10200

This air-driven hydraulic generating set, equipped with an air/oil pressure intensifier, supplies adjustable pressure of 160 MPa (200 MPa on request), calibrated by an air inlet. For air supply of 0,6 MPa (6 bar), the hydraulic flowrate at 100 MPa is 0,2 l/min. This hydraulic set has a class 1 manometer,

a 5 l tank, and 2 hydraulic outlets with quick-coupling self-sealing connectors.

Dimensions: W 340 × D 320 × H 440 mm.
Weight: 26 kg.

Ref: GHP 10200



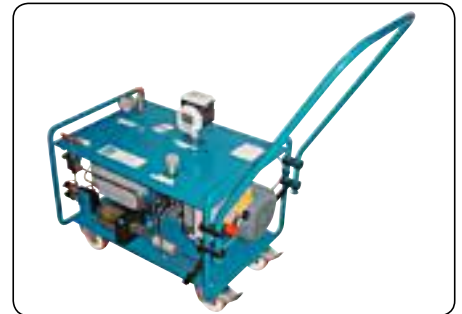
Electro hydraulic generating set GHE 10200

This electro hydraulic generating set, equipped with a 3 kW electric motor, 380/400 OR 220/230 volt and a pressure intensifier, supplies pressure to generate high pressure (from 100 MPa up to request). The hydraulic flowrate is 12 l/min at 10 MPa, 1,2 l/min at 100 MPa and 0,6 l/min at 200 MPa. This hydraulic set

is provided with a class 1 manometer (hydraulic sensor in option), a 9 l tank, and 2 hydraulic outlets. It is installed on a 4 wheel trolley provided with a handling bar.

Dimensions: W 720 × D 480 × H 620 mm.
Weight: 85 kg.

Ref: GHE 10200



Electro-hydraulic generating set GHE 10201

This electro-hydraulic set is provided with: two electric driven pumps supplied by 220/380 V Tri, power 1,5 kW for pressurization and 0,37 kW for filtering and cooling, one radiator with electric fan, one pressure intensifier to develop a maximum pressure of 200 MPa, a 30 l tank with oil level indicator, a digital pressure sensor, a set of filters and temperature probe.

Hydraulic flow rates at output are 3 l/min at 15 MPa and 0,3 l/min at 150 MPa.
Dimensions: W 700 × D 600 × H 500 mm,
Cadre métallique avec bac de rétention.
Weight: 140 kg.
2 HP output and 1 LP.

Réf : GHE 10201



Electro-hydraulic generating set GHE 10202

This electro-hydraulic set is provided with an electric driven pump supplied by 220/380 V Tri, power 4 kW for pressurization, an air cooling circuit with radiator and electric fan, one pressure intensifier to develop a maximum pressure of 150 MPa, a 30 l tank with oil level indicator, a HP dial gauge, a LP dial gauge, set of filters. Hydraulic flow rates at output

are 11 l/min at 15 MPa and 1 l/min at 150 MPa.

Metallic four-wheel cart for easy handling
Dimensions: W 520 × D 430 × H 530 mm;
Weight: 80 kg (with cart)
W 1000 × D 490 × H 910 mm; Weight: 55 kg (without cart)
2 HP output and 1 LP.

Ref : GHE 10202



Tensioner accessories

Sealing kit for HYDROCAM bolt tightener hydraulic bodies

The composite sealing kit for the HYDROCAM bolt tightener hydraulic bodies good high pressure performance, great wear resistance and a low drag friction coefficient, providing efficiency on the order of 98%. These high performance characteristics contribute to high quality bolted assemblies. Sealing kits for standard tensioners are in stock. The reference refers to the hydraulic body.

Designation examples:

- HAK 20: sealing kit for HTA 20 C standard hydraulic body
- HSK 50: sealing kit for HTS 50 C standard hydraulic body.

Ref: HAK, HSK, HCK or HHK...
(the hydraulic section of the tensioner)



Tommy bar

Tommy bars are used to screw the braces and turn down the nut by rotating the hydraulic tensioner socket. Tommy bar diameters depend on the tensioner model they are used with.

Designation examples:

- BR 6-8: pin with 6 mm diameter at one end and 8 mm at the other end.
- BR 10-12: pin with 10 mm diameter at one end and 12 mm at the other end.

Ref: BR ..- ..
(specify dimensions, see table page 73)



Double stage manual pump

The double stage manual pump is equipped with a manometer and a 3 m high pressure hose with a self-sealing quick-coupling connector.

It has a 2,3 l tank and applies pressure up to 150 MPa (1 500 bar).

At low pressure, the volume for each piston stroke is 17,5 cm³.

At high pressure, it is 1,25 cm³.

Weight: 14 kg.

Comes in a steel carrying case.

Ref: PH 1500



Single stage small manual pump

This small single stage manual pump is equipped with a manometer and a 1,5 m high pressure hose with a self-sealing quick-coupling connection. It has a 250 cm³ tank and applies pressure of 100 MPa (1 000 bar).

Volume per piston stroke is 0,5 cm³.

Weight: 3,5 kg.

Comes in a steel carrying case.

Ref: PH 1000 S



Single stage manual pump

This single stage manual pump is equipped with a manometer and a 1,5 m high pressure hose with a self-sealing quick-coupling connection. It has a 700 cm³ tank and applies pressure of 100 MPa (1 000 bar).

Volume per piston stroke is 1 cm³.

Weight: 6 kg.

Comes in a steel carrying case.

Ref: PH 1001



Sockets

The sockets enable easy turning down (or up) of the hexagonal nuts during hydraulic tensioner tightening (or untightening). The standard socket is a hexagonal bore which fits the application nuts.

Designation example:

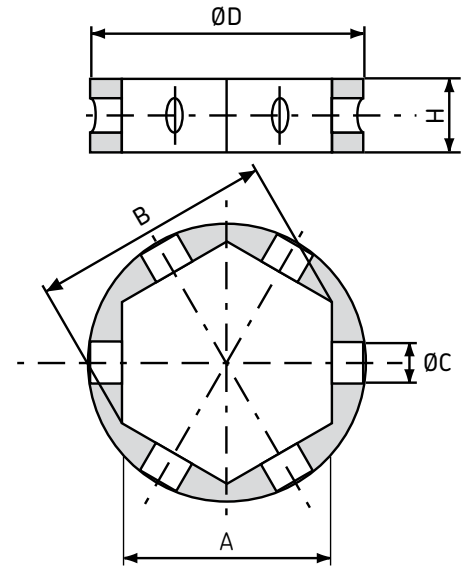
- ACC M39: socket for M39 bolt diameter
- ACC 1 1/4": socket for 1 1/4 in. bolt

The range of standard sockets covers bolt dimensions from M8 to M150 (5/16 to 6 in.). See table below.

In some applications, the nuts may be cylindrical or have special shapes. For cylindrical nuts, sockets are not required.



Ref: ACC .. (specify bolt diameter)



For special shape nuts, SKF manufactures custom-made sockets.

Stud	Outside diameter	Width across flats	Width across points	Height	Tommy bar
	Ø D	A	B	H	Ø C
M8	27	13	15,0	8	4
M10	27	17	19,6	10	6
M12	27	19	21,9	10	6
M14	34	22	25,4	12	6
M16	34	24	27,7	12	6
M18	41	27	31,2	12	6
M20	41	30	34,6	12	6
M22	44	32	36,9	12	6
M24	48	36	41,6	12	6
M27	52	41	47,3	16	8
M30	60	46	53,1	16	8
M33	65	50	57,7	16	8
M36	68	55	63,5	16	8
M39	75	60	69,3	20	10
M42	82	65	75,1	20	10
M45	88	70	80,8	20	10
M48	94	75	86,6	20	10
M52	100	80	92,4	20	10
M56	105	85	98,2	20	10
M60	111	90	103,9	20	10
M64	117	95	109,7	24	12
M68	123	100	115,5	24	12
M72	129	105	121,3	24	12
M76	134	110	127,1	24	12
M80	142	115	132,8	28	14
M85	148	120	138,6	28	14
M90	159	130	150,1	28	14
M95	165	135	155,9	28	14
M100	177	145	167,5	28	14
M110	189	155	179,0	28	14
M120	208	170	196,3	28	14
M125	220	180	207,9	28	14
M130	226	185	213,6	28	14
M140	243	200	231,0	28	14
M150	254	210	242,5	28	14

Applications

The HYDROCAM range provides you with the tensioner which meets your technical and economic criteria.

Civil Engineering

Safety – Performance

The tightening operations for the clamp bolts on the primary load-bearing cables of suspended bridges are performed with HYDROCAM HTA tensioners, known for their flexibility and ease-of-use.

For these and other crucial tasks, where access is difficult and conditions are severe, the tightening tool must guarantee good performance, resistance, efficiency and easy handling.



Public works machinery

Critical tightening level and homogeneity

The safety of the bolted assemblies – on crane slewing rings for example – largely depends on the high tightening level and on the uniformity of the applied tightening load.

HYDROCAM tensioners such as HTH R, HTC R, HTS 2 or N require little space and apply extremely high, uniform tightening loads in each bolt.

The low drag friction coefficients of the seals which equip the hydraulic body ensure high quality assembly and excellent homogeneity.



Wind turbines

Rapid service

The use of double-acting HTC R HYDROCAM tensions with automatic piston return means fast performance of all the tightening operations on wind turbines, without interrupting production.

This guarantees the performance and reliability of these heavy-wear machines, ensuring ongoing electricity production.



Nuclear industry

Safety – Lower dosimetry

Bolted assemblies in the nuclear industry are subject to extremely strict quality rules to ensure safety.

Hydrocam HTA and HTS standard tensioners, operating with oil or water, alone or simultaneously, meet the demanding nuclear industry requirements for tightening operations.

In addition to standard tensioners, specialized HYDROCAM tensioners using automatic feed and control equipment, can be used for remote, rapid tightening of specific assemblies. This reduces contamination and dosimetry risks for the operators.



Aeronautics

Precision – Weight reduction

In the aeronautics industry, customized HTS HYDROCAM tensioners, used alone or simultaneously, tighten very small bolts with high accuracy, reducing the time required for assembly operations. HYDROCAM tensioners take full advantage of the mechanical properties of the main assembly materials used in aeronautics, reducing weight. If necessary, water-based tensioners can be supplied.



F

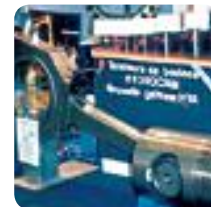
Diesel Engines

Reduced flywheel mass

Bolted assemblies in engines have to withstand heavy mechanical stresses, particularly dynamic.

With the use of customized HTA or HTC R HYDROCAM tensioners, you can take full advantage of the mechanical characteristics of the materials in the primary assemblies, leading to reduced volumes and masses, in particular flywheel masses.

Engine performance and operating costs are clearly improved.



Company resources and organization at the client's service

The ITE Department of SKF in France is totally client-oriented. It disposes of the resources and the organization it needs to meet its customers' needs...



Located in spacious, well-designed premises in France, Paris area



Customer-focused approach combining quality, performance and friendliness



The Design Department works on the cutting edge (CAD, analytical software and finite element structural analysis)



A team of engineers which combines understanding, expertise, experience and a forward-thinking attitude to analyze clients' needs and provide the best solutions



Hydraulic test beds (using oil and water), for low-pressure tests (0-300 bar), and high pressure tests (300-3 000 bar)



Control and verification instrumentation to measure hardness, dimensions, surface condition, geometrical defects...



Mechanical test beds to measure loads, stresses and strains, to determine equipment performance and lifetime



Well-equipped production and assembly workshops

... and in addition

- SKF's quality organization has been acknowledged by ISO 9001/2000 certification
- a powerful network of partners, subcontractors and suppliers, carefully selected and regularly audited
- and the entire SKF network, capable of meeting customer demand anywhere in the world.

Services provided by Bolt Tensioning Department of SKF

Work alone no longer! Bolt Tensioning Department of SKF located in France offers its partnership for all your tightening applications.

Assistance in designing bolted assemblies

You have to design new bolted assemblies or revise the design of existing assemblies.

SKF's vast experience on a wide range of applications has led to the creation of a complete set of theoretical and practical tooling and hardware which can solve nearly any problem encountered in the field of bolted assembly tightening.

SKF can therefore offer its assistance from the very start of the design stage.

This saves you precious time and frees you to concentrate on the design aspects which are at the core of your business.

In addition, you reap all the advantages which result from optimized bolted assembly design: saved space, less weight, increased safety, easier assembly and maintenance.

Assistance in selecting the best tightening method

You are dealing with tightening or loosening problems on an existing bolted assembly.

SKF has faced such problems daily, and has a wide range of solutions.

Turn to SKF for assistance in selecting the most effective tightening method for your needs, given your space constraints, loads, time, environment, cost and other issues.

Expertise and experiments

You would sometimes like to have an expert opinion, or conduct an experiment on bolted assemblies.

Thanks to the wide variety of problems solved with their clients, SKF has gained in-depth expertise in the field. SKF has long been conducting on-going experiments, and has developed specifications, procedures, protocols and instructions...

SKF can help you define, calculate, measure and analyze the static and dynamic loads applied on the bolts in your assemblies, both on stand-by and in service.

SKF offers its services in every area where error or the wrong direction can have serious consequences on costs and schedules.

Checks and tests

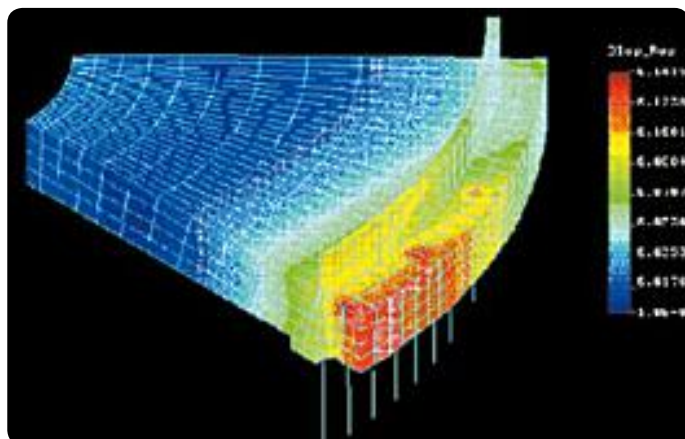
You most certainly conduct many checks and tests on your application, however the skilled operators and the proper tooling can be very demanding. This can lead to very complex situations which cannot always be solved in-house.

SKF offers the full range of tooling it has developed over the years, and can provide you with – or design – the specific, effective and practical solution for your problem.

SKF teams are expert users of this equipment, and can modify, adapt or redesign existing tooling to meet your needs.

In a word – rapid, effective service in the testing field.

Optimizing the number of rounds required for the partial simultaneous tightening of a 96-bolt flange, using 8 tensioners



On-site intervention, tightening the man hole hatch on the primary cooling system of a steam generator



Training

Although the field of bolted assemblies is highly complex and vast, it is relatively rarely included in the curricula followed by engineers and technicians.

Based on its long-standing experience, SKF has developed training programs which can be very useful for your teams dealing with bolted assemblies.

SKF can also offer tailor-made programs to meet the specific requirements you have identified.

Technical support/on-site assistance

There is no lack of jobs to be done in your workshops and on your sites. However, you may not always have skilled employees on hand to do the job where and when it needs to be done.

SKF can send skilled technicians to your workshops and site, to provide you with the help you need.

On-site, in addition to working with the tightening tools, SKF can perform many other tasks, such as:

- repairing and reconditioning the parts to be tightened (cleaning, grinding, adjustment, control...)
- repair and preparation of sealing surfaces
- replacement of assembly parts
- cutting bolts to be replaced
- checking the tightening loads using the most appropriate means, and others.

SKF also provides rental equipment for temporary, short-term use.

Installation and commissioning

You have purchased new bolt tightening equipment. Perhaps your staff is not yet familiar with the equipment, or you prefer or are not able to assign a task force to implementing it.

SKF offers installation and commissioning services, and can also operate the equipment for you each time you need to use it.

Maintenance and repair/in the workshop and on-site

You may not have a repair shop able to maintain and repair the tightening equipment.

SKF can do this work for you, preferably in their own workshops if the material can be sent back, or on-site, if working conditions are conducive to performing maintenance, overhaul and repair on the site.

Industrial partnerships

You are looking for an industrial partner capable of supplying you with regular or periodic service in one or several of the previously described areas.

SKF offers you a partnership arrangement in which SKF commits to supplying the required services in a time frame and way which are to be defined. SKF offers total flexibility to come up with the formula which best meets the client's needs.

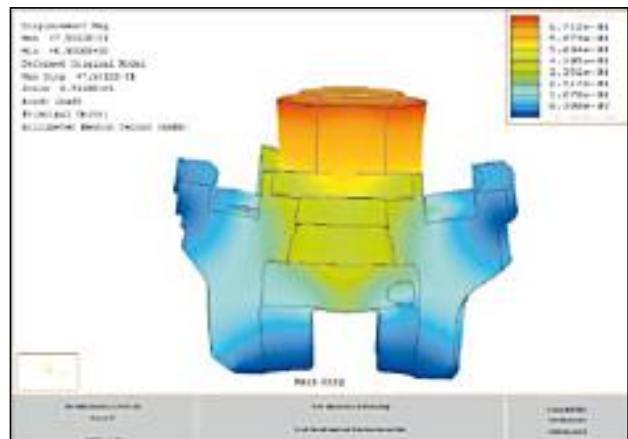


Training on hydraulic tensioner tightening techniques

Kit demonstrating the use of HYDROCAM tensioners with the BoltSafe sensor washer



Display of assembly strain during bolt tightening using HYDROCAM tensioners



The BoltSafe sensor washer

What is the tightening pre-load in my bolt?

Your bolted assembly is a critical part of your application, and reliability is crucial. The BoltSafe sensor washer, designed by the Scan Sense company, provides you with the information you need on the reliable operation of your application.

BoltSafe washers are integrated into your application, where they are as easy to use as any normal washer. Using a handheld reader or a PC connected to your application's BoltSafe networks, you can accurately monitor the tightening pre-load of each BoltSafe washer equipped bolt in your application. This way, you can easily check if the prescribed tightening load remains throughout operations. You ensure operational safety and the reliability at low cost.

What is the accuracy?

BoltSafe washers are an excellent means of monitoring, for they are capable of detecting any load variation in the bolt.

The accuracy of the measurement of the absolute load in the bolt depends on several factors. First of all, HYDROCAM tensioners must be used to guarantee measurement accuracy, particularly in the case where the washer is placed directly under the nut. Indeed, after turning down the nut and releasing the pressure of the tensioner, solely the axial tightening pre-load is

applied on the washer, whereas, with torque tightening, torsion stresses are induced in the

BoltSafe washer. In addition, torque tightening misaligns the washer with respect to the bolt, which significantly impairs measurement accuracy.

Accurate load measurement also depends on assembly quality, such as the perpendicularity of the bearing faces with respect to bolt axis, surface flatness, absence of holes, gouges and roughness on the assembled parts in contact with the BoltSafe washer faces.

HYDROCAM tensioner tightening with the BoltSafe CMS tightening measurement washer



How does it work?

The BoltSafe washer operating concept is based on the fact that material's ability (depending on its structural quality) to conduct a magnetic field is an almost linear function of the stress inside the material. Each washer contains an electronic chip which processes the measurement and transforms it into a digital signal. The chip provides unique identification of the BoltSafe washer and integrates it in the BoltSafe washer network.

Optimum tightening with BoltSafe washers and HYDROCAM tensioners

In the case of tightening of a flange or a bolted assembly, the use of HYDROCAM tensioners on each bolt is sufficiently efficient to avoid the need for a BoltSafe

sensor washer on each bolt. A few BoltSafe washers are sufficient. The HYDROCAM tensioner ensures the homogeneity and the repeatability of the tightening, and the washer provides knowledge of the bolts' pre-load with increased accuracy.

If the number of tensioners used is lower than the number of bolts in the assembly, the number of BoltSafe washers on the bolts should be increased.

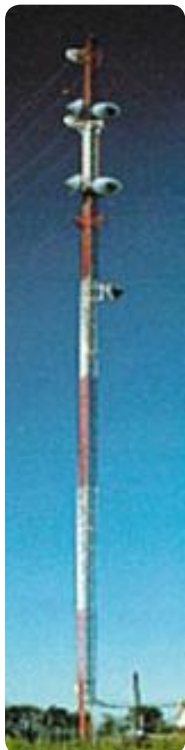
This way, the BoltSafe washer network will more easily detect variations in the pre-load on the bolts when the specific procedure is applied to a partial simultaneous tightening (see simultaneous tightening in the "Bolt-tightening handbook").

Lastly, efficient monitoring of load in operation will depend on the positioning of the BoltSafe washers, which must be carefully chosen.

Where is the BoltSafe washer used?

BoltSafe washers are already used in every kind of bolted assembly which is subjected to load variations due to vibrations, changes in temperature, pressure, external loads or any other mechanical influence. In these and other situations, BoltSafe washers can monitor the tightening level.

Add your application to the growing list using BoltSafe washers for accurate measurement.



Monitoring

The tightening level of your application can be monitored in several different ways depending on the number of BoltSafe washers and on the security and monitoring program in place for your application.

Monitoring individual BoltSafe washers

If a number of BoltSafe washers are individually installed throughout your application, each washer can be read with a simple SM-100 handheld reader, which can read two types of BoltSafe washers:

- the BoltSafe CMS washer (Continuous Monitoring System) connected to the SM-100 by a cable
- the BoltSafe PMS washer (Periodic Monitoring System) which is read through a probe in contact with an electronic interface in the washer.

There is also a SM-200 reader similar to the SM-100 reader, yet with an additional storage function to store the information from 255 BoltSafe washers. This information can be downloaded to a PC using BS-2000 software.

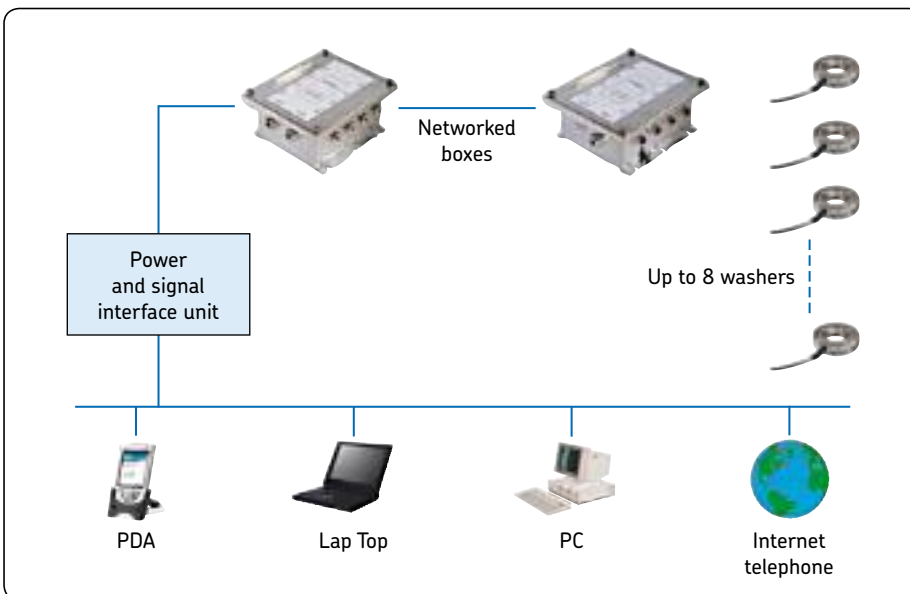
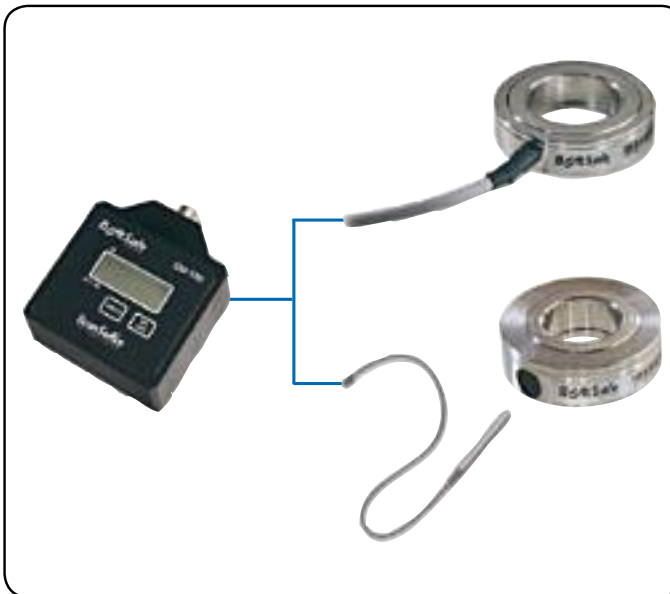
With this monitoring system, the operator must come close to each BoltSafe washer to read the measurement.

Monitoring a network of BoltSafe washers

The BoltSafe washers in your application can also be connected to a central station, the CM-1000, which displays the tightening load level on each washer. In this case, a pocket computer (Palm Top) or a portable computer (Lap Top) is used to interrogate, identify and store the measurement from each one of the BoltSafe washers in the network. This reader can then be directly connected to a PC to download the data using BS-2000 software.

With this monitoring system, the operator reads the BoltSafe washer information from a single spot, close to the application.

Equipment description	Reference
Handled reader with memory	SM-200
BoltSafe network adapter	CM-1000
BoltSafe analysis and display software	BS-2000





The BS-2000 software processes the data from the BoltSafe washers



The BS-2000 program

The BS-2000 program was specially designed to provide the user with user-friendly interface enabling him to instantaneously review residual pre-tension directly on the screen. The program is easy to use and to understand. It uses the structures, icons and drag-and-drop functionality from the standard Windows environment.

Residual pre-tension data can be analyzed in three different ways (list, bar chart and histogram) and can be saved to files or printed.

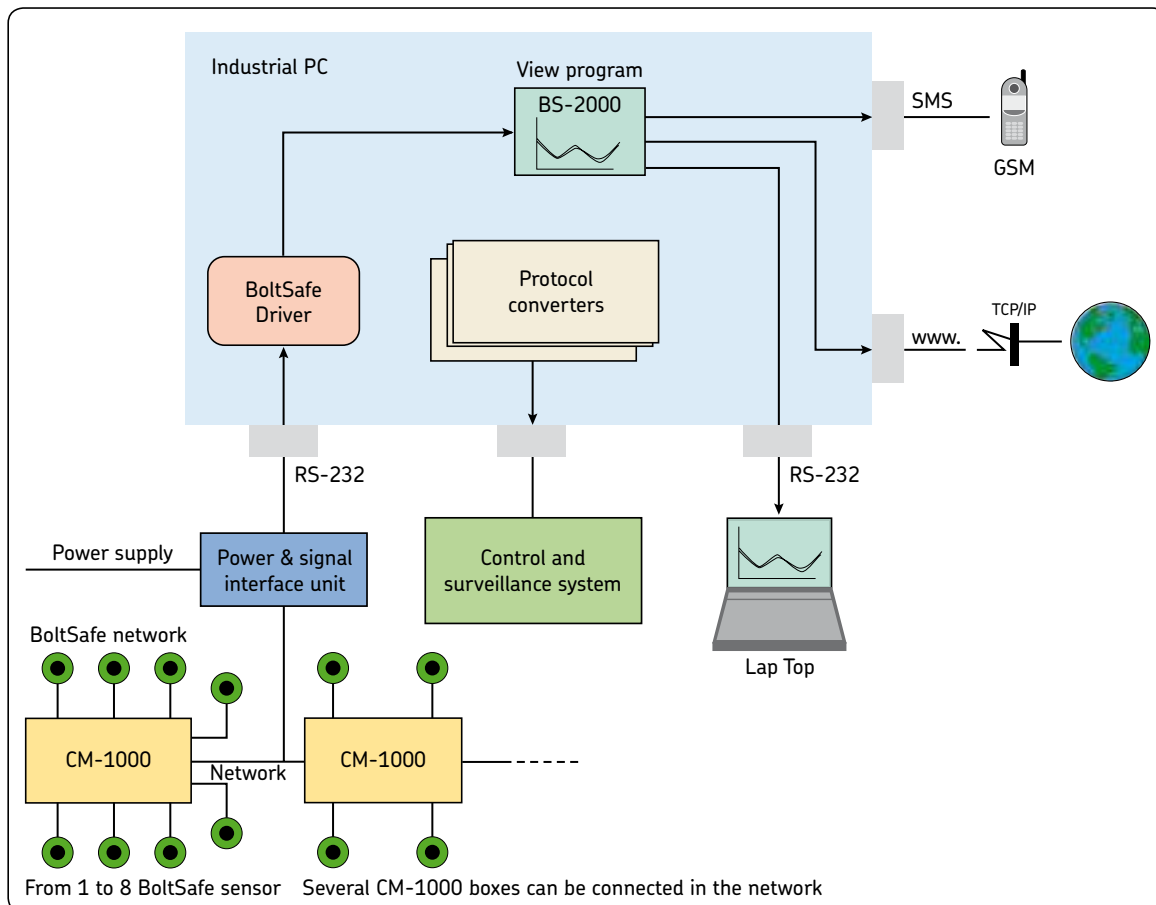
BS-2000 software can also be concurrently used to upload data recorded in the SM-200 reader or from a hand-held reader.

In the case of remote surveillance, software functions can be added to provide access to the monitored BoltSafe network by all control systems.

Remote monitoring of the BoltSafe network

The BoltSafe washer network in a strategic application can be an integral part of a company's security and monitoring system. The objective is to detect and warn of any abnormal situation reflected by variations in the tightening pre-load in the bolts in the application.

In this monitoring arrangement, the BoltSafe washers are connected to inter-connected CM-1000 stations. A single network station is then connected to a PC (RS-232 connection) and to the BS-2000 program, where warning levels can be programmed to warn the overall surveillance system. Or, the PC can be remotely polled and can provide information from afar.

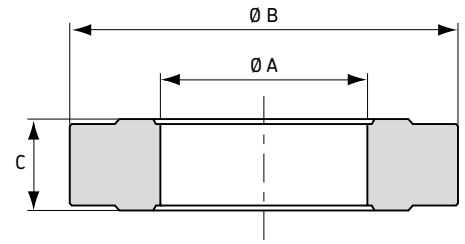


The BoltSafe sensor washer

The BoltSafe CMS washer

Standard range

The BoltSafe CMS (Continuous Monitoring System) washer is connected to a SM-100 or CM-1000 station via cable.



Metric system

Bolt description	Bolt diameter	Inside diameter		Outside diameter		Thickness	Weight	Maximum tightening load Class 10.9
		A	B	C				
	mm						g	kN
M20	20	20,4	37	14	73	166		
M22	22	22,4	40	14	85	208		
M24	24	24,4	44	14	104	239		
M27	27	27,4	50	14	137	315		
M30	30	30,6	56	17	214	385		
M33	33	33,6	58	17	218	480		
M36	36	36,6	66	17	295	560		
M39	39	39,6	68	17	300	670		
M42	42	42,6	75	20	445	772		
M45	45	45,6	80	20	506	905		
M48	48	48,6	86	20	591	1 018		
M52	52	52,6	92	20	669	1 221		
M56	56	56,6	100	20	798	1 408		
M60	60	60,8	108	23	1 083	1 647		
M64	64	64,8	114	23	1 196	1 794		

Imperial system

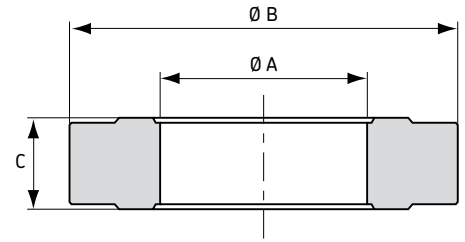
Bolt description	Bolt diameter	Inside diameter		Outside diameter		Thickness	Weight	Maximum tightening load Class 10.9
		A	B	C				
	mm						g	kN
7/8"	22,2	22,6	47	14	133	214		
1"	25,4	25,8	52	14	160	280		
1 1/8"	28,6	29	57,1	14	191	354		
1 1/4"	31,8	32,3	63	17	286	437		
1 3/8"	34,9	35,5	69	17	343	529		
1 1/2"	38,1	38,7	74	17	391	629		
1 5/8"	41,3	41,9	80	20	543	739		
1 3/4"	44,5	45,1	85	20	608	857		
1 7/8"	47,6	48,2	91	20	698	983		
2"	50,8	51,4	98	20	816	1 119		
2 1/4"	57,2	57,8	108,8	23	1 156	1 416		
2 1/2"	63,5	64,3	116,6	23	1 289	1 748		

The BoltSafe PMS washer

Standard range

The BoltSafe PMS (Periodic Monitoring System) washer.

Measurement is read through a probe in contact with an electronic interface in the washer.



Metric system

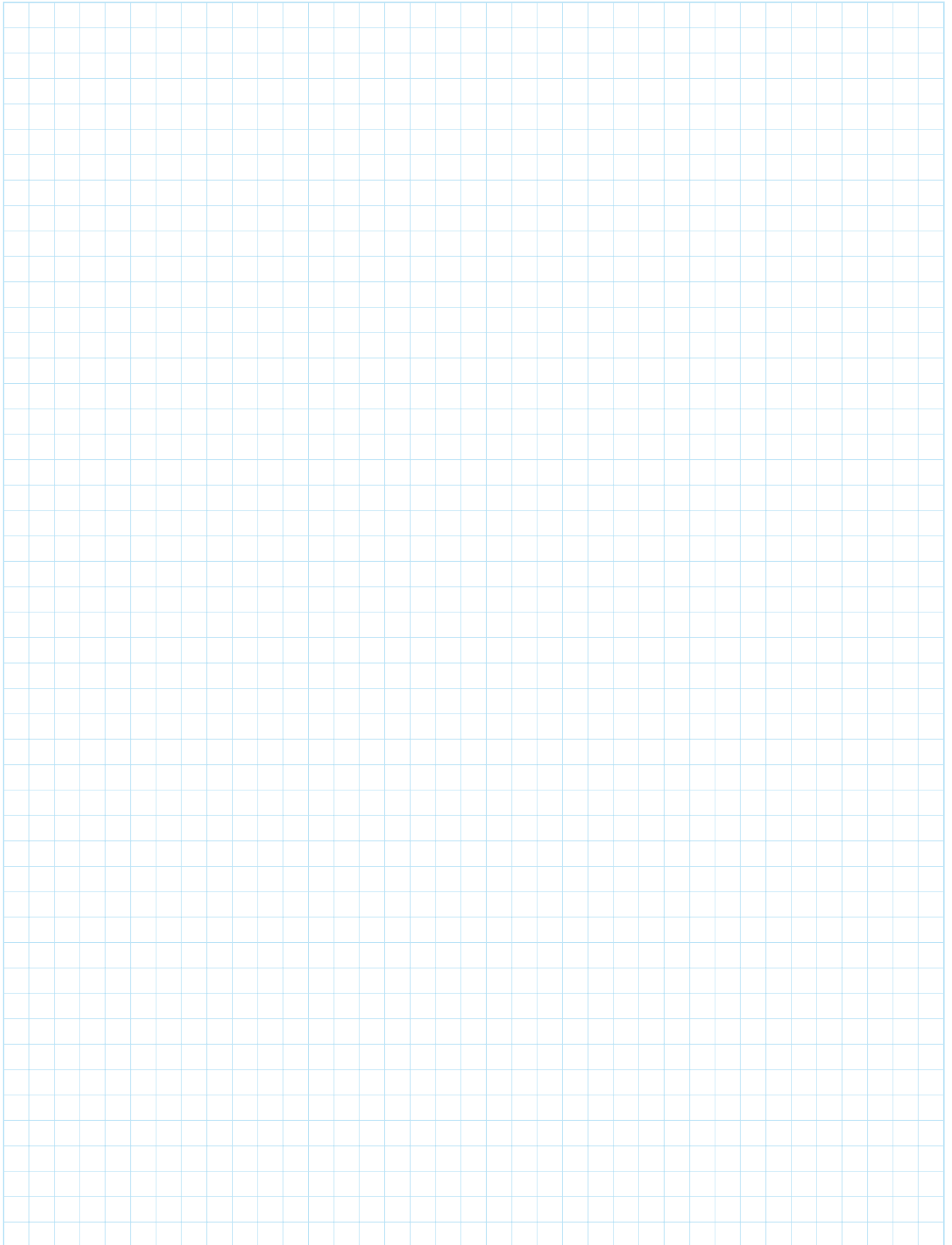
Bolt description	Bolt diameter	Inside diameter A	Outside diameter B	Thickness C	Weight	Maximum tightening load* Class 10.9
	mm				g	kN
M30	30	30,6	64,3	20	372	385
M33	33	33,6	68,4	20	413	480
M36	36	36,6	72,8	20	462	560
M39	39	39,6	78	20	528	670
M42	42	42,6	83	20	593	772
M45	45	45,6	87,6	20	655	905
M48	48	48,6	92	20	716	1 018
M52	52	52,6	97,2	20	784	1 221
M56	56	56,6	102	20	845	1 408
M60	60	60,8	108	23	1 083	1 647
M64	64	64,8	114	23	1 196	1 794

* Corresponding to 80% of the yield point of a class 10.9 bolt.

Imperial system

Bolt description	Bolt diameter	Inside diameter A	Outside diameter B	Thickness C	Weight	Maximum tightening load* Class 10.9
	mm				g	kN
1 1/4"	31,8	32,3	67	20	401	437
1 3/8"	34,9	35,5	73	20	474	529
1 1/2"	38,1	38,7	78	20	535	629
1 5/8"	41,3	41,9	84	20	619	739
1 3/4"	44,5	45,1	86	20	628	857
1 7/8"	47,6	48,2	91	20	698	983
2"	50,8	51,4	98	20	816	1 119
2 1/4"	57,2	57,8	108,8	23	1 156	1 416
2 1/2"	63,5	64,3	116,6	23	1 289	1 748

* Corresponding to 80% of the yield point of a class 10.9 bolt.



Glossary of terms

Automatic return

A mechanical device on certain tensioners which returns the piston to its original position when tensioner pressure stops.

Bolt class

Category of bolts defined by the mechanical characteristics of failure limit and yield point.

Example: Class 12-9 bolt

The first figure indicates one hundredth of the failure limit in MPa.

The second figure indicates the coefficient in 10ths that would have to be applied to this failure limit in order to find the yield point.

- Failure limit:
1 200 MPa ($12 = 1\ 200 \times 1/100$)
- Yield point:
1 080 MPa ($1\ 080 = 9/10 \times 1\ 200$).

Bolt stiffness

The theoretically constant ratio between the tensile strength applied on a bolt and the elongation due to this strength. Bolt stiffness depends on the area, the modulus of elasticity and the tightened length.

Elongation

The stretching of the bolt by tensile stress.

Equivalent bar area

Cylinder section modeling the threaded part of a bolt, subjected to uniform tension. The calculation of cylinder diameter is based on thread diameter and pitch.

External load

Force applied on the bolted assembly from operation of the application.

Failure limit

Maximum possible stress causing the failure of the bolt.

Hydraulic area

Piston area subjected to hydraulic pressure.

Hydraulic load

Force transmitted during tightening operation, by the hydraulic tensioner to the bolt, produced by the hydraulic pressure from the hydraulic area of the tensioner.

Pre-stressing

Stress applied to the bolt when it is tightened, and the result of the relation between the residual load and the equivalent bolt area. Prestress does not take into account the stress from the external load.

Residual load

Force or pre-tension applied on the bolt when the nut has been turned down and the hydraulic pressure has been released.

Stud

A bolt which is threaded on both ends over a certain length. Most often, the central part remains smooth and is generally smaller than the threaded sections.

Tensile stress

The relation between the tensile strength exerted on the bolt and its unit area.

Tightened length

Distance between the bearing face under the nut and the bearing face under the bolt head or under the other nut head if it is a stud.

Yield point

The maximum stress point possible in a bolt in order to undergo no elongation when the tensile stress stops. Beyond this stress limit, the bolt sustains permanent strain.

Conclusion

This catalogue illustrates SKF expertise in the industrial tightening field. This catalogue is aimed at helping bolted assembly designers from the very start of the design stage for bolt-tightening applications. The information, the recommendations and the description of the total product range, with its diverse and varied product characteristics, provide the reader with everything he needs to define the equipment which best meets the needs of his application.

The crucial message is that tightening is one of the most critical steps in a bolted assembly, and must be thoroughly studied.

Every bolted assembly must be tightened just right. There is no such thing as "too little or too much tightening".

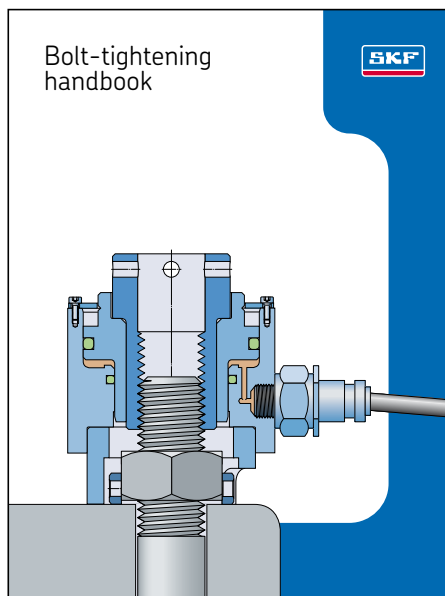
And ITE department of SKF in France can help you define and implement what is just right for you.

ITE department can:

- help you optimize your assemblies
- help you choose the tensioner(s) adapted to your application
- design custom tensioners for your needs
- manufacture special tightening machines.

Industrial tightening is our profession.

We can help you concentrate on yours.



SKF HYDROCAM Bolt Tensioners

Bolt tensioning department of SKF, located in France, develops and manufactures the entire range of hydraulic bolt tensioners.

The quality system has been ISO 9001/2000 certified.

Bolt-tightening products and services provided by SKF Bolt Tensioning Department.

HYDROCAM bolt tensioners

- Complete standard range including six different types covering a large range of bolt sizes: M8 to M160 and loads of 50 kN to 8 500 kN
- standard tensioners adaptable according to application interface
- special tensioners designed for dedicated applications, extending the range of bolt sizes from M5 to M500.

Accessories

- Manual pumps delivering various pressure ranges: 700, 1 000 or 1 500 bar
- air-driven hydraulic power units delivering various pressure ranges: 700, 1 000, 1 500, 2 000 or 3 000 bar
- electrically driven hydraulic power units delivering various pressure ranges: 700, 1 000, 1 500 or 2 000 bar
- high-pressure hoses of all lengths; distribution blocks
- pressure intensifiers.

Simultaneous tightening machines and systems (with optional automation)

Standard and customised automatic remote-control systems

Services

- Assistance in design of bolted joints
- assistance in selecting most appropriate tightening method
- expertise and experimentation
- industrial partnerships
- checks and tests
- training
- technical assistance/on-site intervention
- installation and commissioning
- maintenance and repairs in our workshop or on site,
- distance monitoring.



Fax / / (date; yyyy,mm,dd)

From:

Company _____

Address _____

Name _____

Tel. N° _____

Fax N° _____

I would like information on HYDROCAM tensioners:

Send to

SKF France

Département Techniques de Serrage Industriel
30-32, avenue des Trois-Peuples
F-78180 Montigny-le-Bretonneux

Fax: 33 1 30 12 69 79

Tel.: 33 1 30 12 69 76

Information on the HYDROCAM tensioner(s)

Application: existing being validated

Equipment: _____

Parts to be tightened: _____

Bolt characteristics

(specify numbers)

Bolt thread diameter (d): _____

Pitch: _____

Protruding end (u): _____

Extending length (l): _____

Nut(s): _____

– width across flats (f): _____

– height (h): _____

Washer(s): _____

– \varnothing outside (A): _____

– Thickness (e): _____

Bolt material: _____

Yield point: _____

Class: _____

Bolt distribution

(supply diagram if possible)

Distribution diameter: _____

Number of screws: _____

Distance between 2 bolts: _____

Optimizing the bolted assembly

(dimensions and number of bolts)

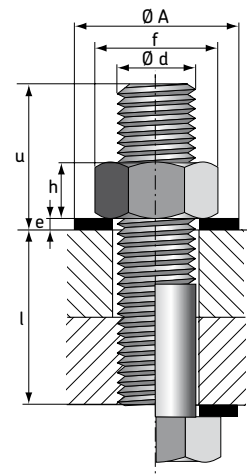
yes no

External load: _____

static dynamic

Application point: _____

(diagram if possible)



Current tightening method (specify units)

Torque (wrench) _____

– torque applied: _____

– elongation: _____

Heating rod _____

– temperature: _____

– screwing angle: _____

Other methods _____

Hydraulic tensioner tightening

Residual pre-load (per bolt) _____

Hydraulic load (per bolt) _____

Simultaneous tension: yes no

How much: _____

Existing:

Feed to provide for:

manual pump

air-driven generating set

electro hydraulic generating set

Space available for the tensioner

Height (X): _____

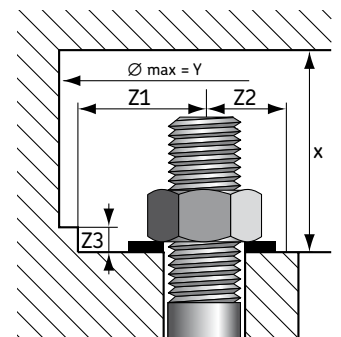
Diameter (Y): _____

Local obstruction (Z1): _____

(Z2): _____

(Z3): _____

Drawings enclosed: _____



SKF – the knowledge engineering company

From the company that invented the self-aligning ball bearing more than 100 years ago, SKF has evolved into a knowledge engineering company that is able to draw on five technology platforms to create unique solutions for its customers. These platforms include bearings, bearing units and seals, of course, but extend to other areas including: lubricants and lubrication systems, critical for long bearing life in many applications; mechatronics that combine mechanical and electronics knowledge into systems for more effective linear motion and sensorized solutions; and a full range of services, from design and logistics support to conditioning monitoring and reliability systems.

Though the scope has broadened, SKF continues to maintain the world's leadership in the design, manufacture and marketing of rolling bearings, as well as complementary products such as radial seals. SKF also holds an increasingly important position in the market for linear motion products, high-precision aerospace bearings, machine tool spindles and plant maintenance services.

The SKF Group is globally certified to ISO 14001, the international standard for environmental management, as well as OHSAS 18001, the health and safety management standard. Individual divisions have been approved for quality certification in accordance with ISO 9001 and other customer specific requirements.

With over 100 manufacturing sites worldwide and sales companies in 70 countries, SKF is a truly international corporation. In addition, our distributors and dealers in some 15 000 locations around the world, an e-business marketplace and a global distribution system put SKF close to customers for the supply of both products and services. In essence, SKF solutions are available wherever and whenever customers need them. Overall, the SKF brand and the corporation are stronger than ever. As the knowledge engineering company, we stand ready to serve you with world-class product competencies, intellectual resources, and the vision to help you succeed.

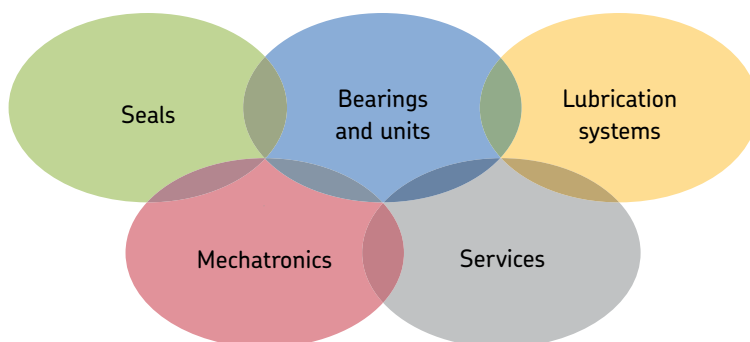


© Airbus – photo: e'im company, H. Goussé

Evolving by-wire technology

SKF has a unique expertise in fast-growing by-wire technology, from fly-by-wire, to drive-by-wire, to work-by-wire. SKF pioneered practical fly-by-wire technology and is a close working partner with all aerospace industry leaders. As an example, virtually all aircraft of the Airbus design use SKF by-wire systems for cockpit flight control.

SKF is also a leader in automotive by-wire technology, and has partnered with automotive engineers to develop two concept cars, which employ SKF mechatronics for steering and braking. Further by-wire development has led SKF to produce an all-electric forklift truck, which uses mechatronics rather than hydraulics for all controls.





Harnessing wind power

The growing industry of wind-generated electric power provides a source of clean, green electricity. SKF is working closely with global industry leaders to develop efficient and trouble-free turbines, providing a wide range of large, highly specialized bearings and condition monitoring systems to extend equipment life of wind farms located in even the most remote and inhospitable environments.



Working in extreme environments

In frigid winters, especially in northern countries, extreme sub-zero temperatures can cause bearings in railway axleboxes to seize due to lubrication starvation. SKF created a new family of synthetic lubricants formulated to retain their lubrication viscosity even at these extreme temperatures. SKF knowledge enables manufacturers and end user customers to overcome the performance issues resulting from extreme temperatures, whether hot or cold. For example, SKF products are at work in diverse environments such as baking ovens and instant freezing in food processing plants.



Developing a cleaner cleaner

The electric motor and its bearings are the heart of many household appliances. SKF works closely with appliance manufacturers to improve their products' performance, cut costs, reduce weight, and reduce energy consumption. A recent example of this cooperation is a new generation of vacuum cleaners with substantially more suction. SKF knowledge in the area of small bearing technology is also applied to manufacturers of power tools and office equipment.



Maintaining a 350 km/h R&D lab

In addition to SKF's renowned research and development facilities in Europe and the United States, Formula One car racing provides a unique environment for SKF to push the limits of bearing technology. For over 50 years, SKF products, engineering and knowledge have helped make Scuderia Ferrari a formidable force in F1 racing. (The average racing Ferrari utilizes more than 150 SKF components.) Lessons learned here are applied to the products we provide to auto-makers and the aftermarket worldwide.



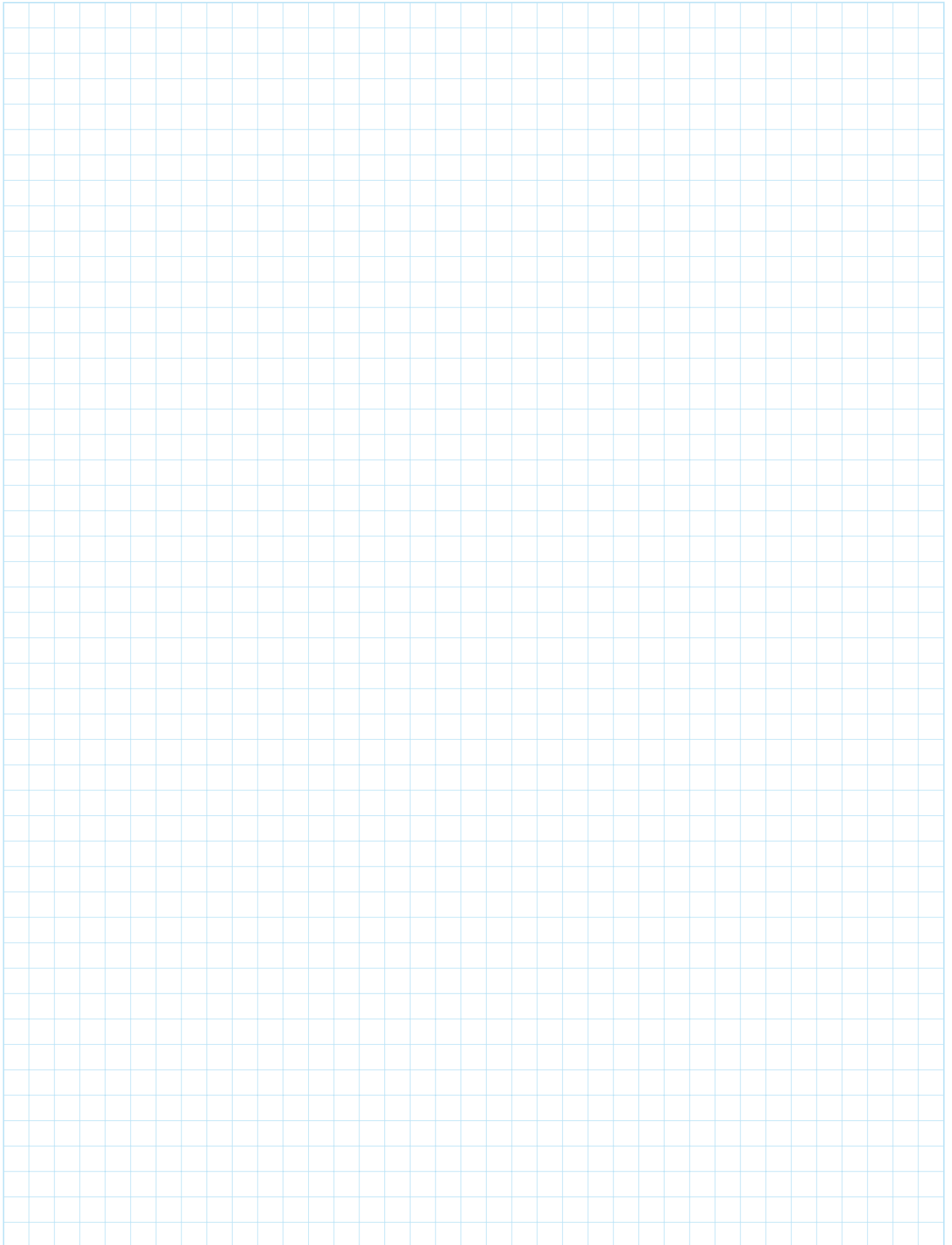
Delivering Asset Efficiency Optimization

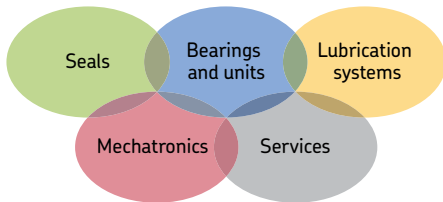
Through SKF Reliability Systems, SKF provides a comprehensive range of asset efficiency products and services, from condition monitoring hardware and software to maintenance strategies, engineering assistance and machine reliability programmes. To optimize efficiency and boost productivity, some industrial facilities opt for an Integrated Maintenance Solution, in which SKF delivers all services under one fixed-fee, performance-based contract.



Planning for sustainable growth

By their very nature, bearings make a positive contribution to the natural environment, enabling machinery to operate more efficiently, consume less power, and require less lubrication. By raising the performance bar for our own products, SKF is enabling a new generation of high-efficiency products and equipment. With an eye to the future and the world we will leave to our children, the SKF Group policy on environment, health and safety, as well as the manufacturing techniques, are planned and implemented to help protect and preserve the earth's limited natural resources. We remain committed to sustainable, environmentally responsible growth.





The Power of Knowledge Engineering

Drawing on five areas of competence and application-specific expertise amassed over more than 100 years, SKF brings innovative solutions to OEMs and production facilities in every major industry worldwide. These five competence areas include bearings and units, seals, lubrication systems, mechatronics (combining mechanics and electronics into intelligent systems), and a wide range of services, from 3-D computer modelling to advanced condition monitoring and reliability and asset management systems. A global presence provides SKF customers uniform quality standards and worldwide product availability.

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