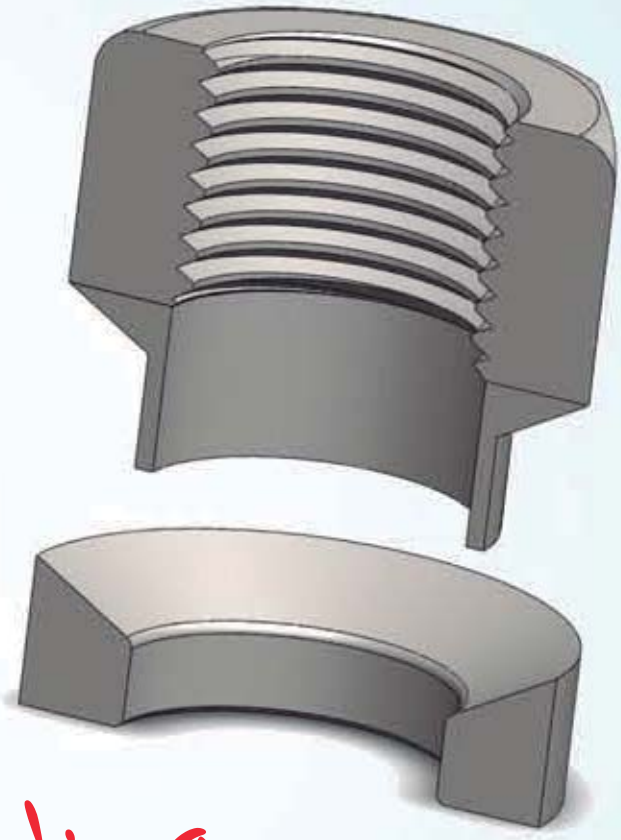


www.tsfttsh.com

patent pending

guaranteed
preload systems

TH - SH - TSH

Minimum guaranteed preload
80% of bolt yield stress

if fastened as specified by the manufacturer

TSF®

Systems to guarantee 80% preload TH, SH and TSH

Bolted joints are essential for engineering applications as diverse as wind turbines, oil rigs, combustion engines, automobiles, cranes, aerospace, nuclear, marine, rail, etc., that must endure the most severe working conditions during its effective lifetime.

These conditions vary constantly, the efforts are not uniform, nor are the temperatures, weather conditions, marine or on land, etc., So that bolts and nuts are designed to withstand the maximum loads that may occur in the application, whether continuous or occasional, regular or extreme situations, during the lifetime of the product in which they are mounted.

These joints are calculated with the load conditions in sophisticated software programs. Components are also tested in laboratories or in testing to failure.
The most commonly used screws are hex heads that are preloaded by applying a torque via pneumatic, hydraulic, electric or manual tools.

During this process, the bolt preloads and stretches, causing it to act like a spring that presses the pieces together, so the torque applied is of vital importance. This torque will cause the preload applied to the screw to be equal to that calculated for the binding, otherwise the joint will not work properly and end up deteriorating or breaking.
When preload is applied with tensioner devices, the bolt or stud is directly stretched to achieve the closing and preloading of the joint. Here raises as a problem the loss of preload when the pressure exerted by the tensioning device ceases, which can exceed 40% of the initially applied, causing the joints to be provided with only 60% or less of the total capacity of the fastening element, being usual stabilizing the preload between 40% and 55% of its total capacity.
Preload losses are mainly caused by the following reasons:

- Plastic or elastic deformation of flanges;
- Permanent plastic or elastic deformation of threads;
- Relaxation between components, flanges, threads, etc..;
- Geometric tolerances from stamping or machining of the binding components, parallelism, perpendicularity, etc..;
- Roughness in machining;
- Elasticity or stiffness of the joint.

Lloyd's Register

TSF®

patent pending

TH

Tension Holder

guaranteed **preload systems**

Minimum guaranteed preload

75% of bolt yield stress

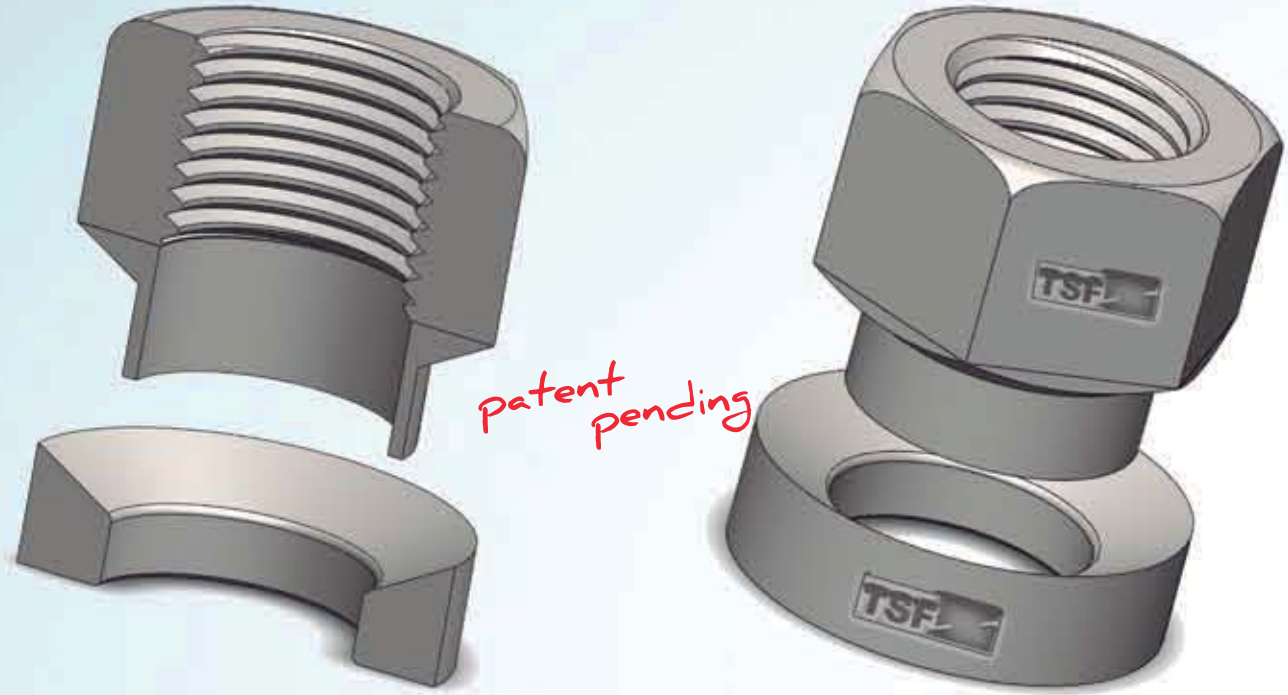
Less than 5% dispersion

if fastened as specified by the manufacturer

TH TENSION HOLDER. GUARANTEED PRELOAD SYSTEMS.

TSF has designed, developed and patented the TH nut system with the following objectives:
- Provide joints with high requirements in preload;
- Provide joints with both requirements of preload and untightening;
- Provide joints with low demand in preload and high requirement in untightening;
- Control of stress applied to the joints of soft components maintaining high preloads on bolt, stud or similar.

These objectives are achieved through pilot nut and washer interrelated with a variable contact angle for its different applications.



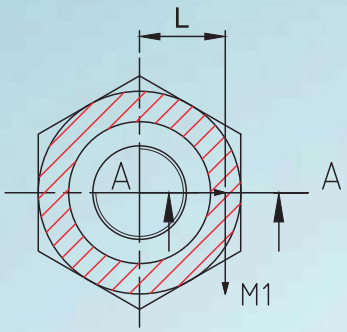
The TH nut preload system is specially designed to fit in standard and commercial tensioners.
No special tools or pulling systems required.

SPECIFIC SYSTEM FOR PULLED UNIONS TO **GUARANTEE 75% PRELOAD WITH LESS THAN 5% DISPERSION**

INNOVATION
- Depending on the joint characteristics, we define the location of the contact zone for optimizing the pressure and the cone strength distribution.
- Interesting for different industrial sectors as: Automotive, Wind Power, Nuclear, Aerospace, Marine Industry etc...
- Certified by Lloyd ' s Register.
- Manufactured in different materials and coatings according to each required performance.

ADVANTAGES
- Reduced number of fastening elements with respect to torque control (25-35% less)
- It can be designed as standard sized parts or according to different designs adapted to any specific application from M-12 up to M-150.
- It is suitable for assembly with standard pullers equipment.
- Low Dispersion.
- High stability of the preload.
- Low load distribution factor for the fastening element. Lower fatigue range.
- Insensitivity to bending moments
- Simultaneous assembly of fastening elements. Elimination of elastic interaction of close elements.
- Benefits of elongation, without the disadvantages of friction.
- Multiple reuse of the element. Ease preload reset by assembly process repetition.
- Self-locking result.
- Same assembly protocol for all metric sizes.
- Depending on each union characteristic a different assembly protocol will be followed.
- Every specific union would be object of its own engineering analysis according to each customer application.
- Maintenance costs are drastically reduced.

HIGHER UNTIGHTENING RESISTANCE INCREASING THE MOMENT

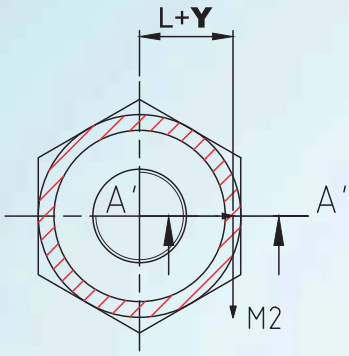


$$M1 = F1 \times L$$

F1: Preload

1 - Standard nut flat base:

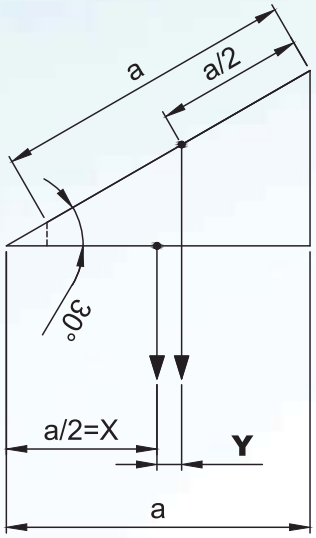
M2 > M1



$$M2 = F1 \times (L+Y)$$

F1: Preload

2 - TH nut conical base:

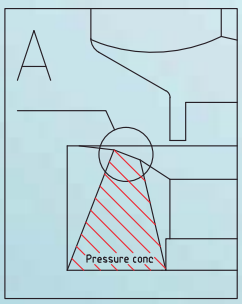


SECTION: A-A; A'-A'

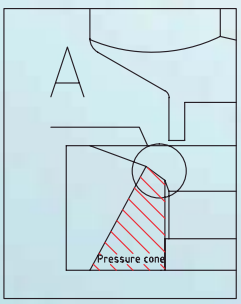
COMPARISON OF STANDARD NUT - TH WITH THE SAME PRELOAD

HIGHER UNTIGHTENING RESISTANCE BECAUSE HIGHER PRELOAD VALUES ACHIEVED

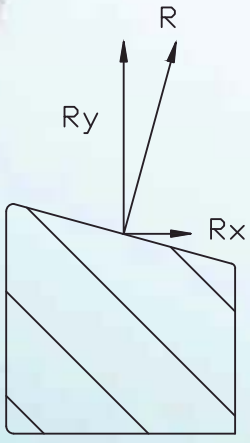
Lloyd's Register



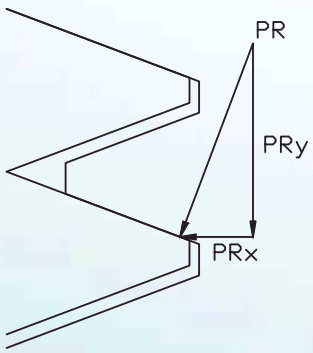
Pressure Cone



Pressure Cone

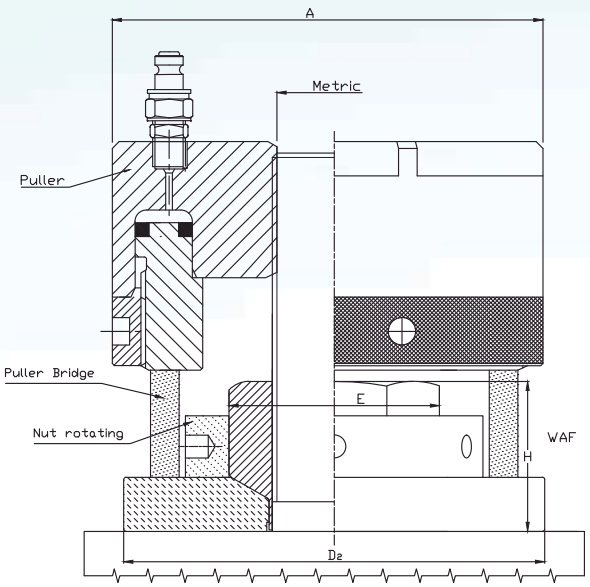


Decomposition of preload reaction in normal and axial stresses at TH washer.

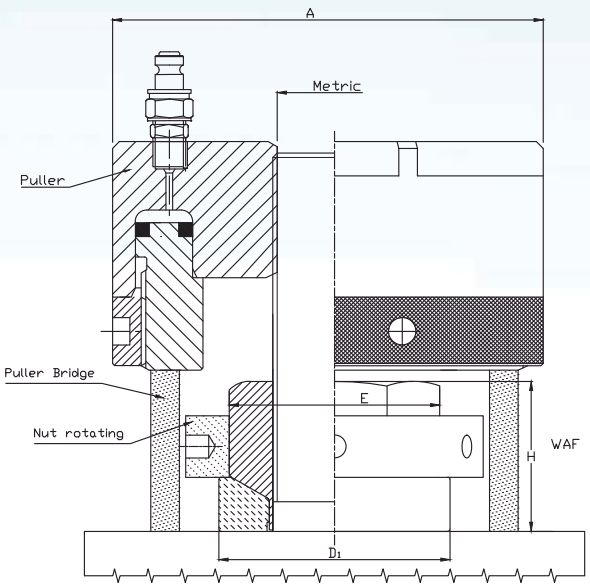


Decomposition of preload in normal and axial stresses at stud thread.

TH Standard



TH Standard assembly over its own washer

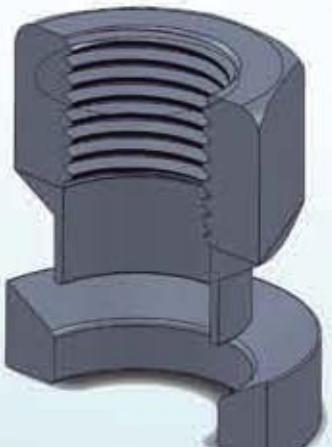


TH Standard assembly over flange

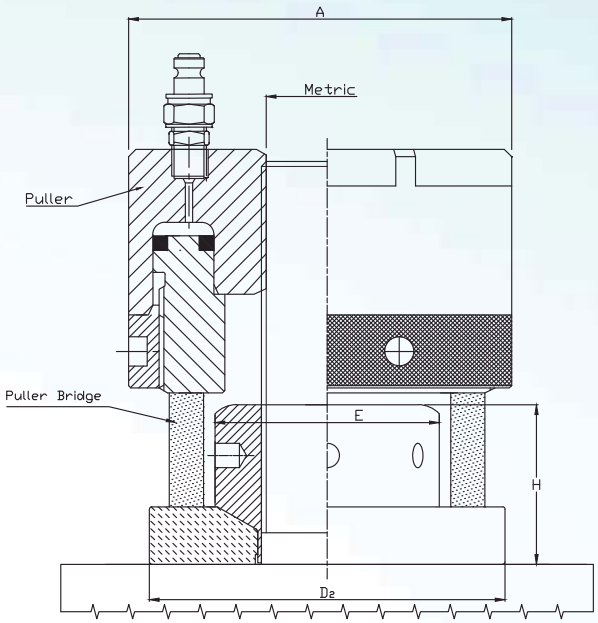
TH	Nut body			Puller		
	E (mm)	D1(mm)	H(mm)	Preload (kN)	TH Preload minimun (kN)	A(mm)
M16x2	24	27	19	180	135	73
M20x2,5	30	34	21,5	230	173	73
M22x2,5	32	36	24,5	285	214	102
M24x3	36	41	27	332	249	102
M27x3	41	46	31	431	324	102
M30x3,5	46	51	35,5	527	396	132
M33x3,5	50	55	38,5	652	489	132
M36x4	55	60	43	768	576	132
M39x4	60	66	46	917	688	163
M42x4,5	65	72	50,5	1053	790	163
M45x4,5	70	78	53,5	1232	924	163
M48x5	75	84	55	1382	1036	163
M52x5	80	90	62	1654	1241	192
M56x5,5	85	97	65,5	1908	1431	192
M60x5,5	90	101	70,5	2218	1664	231
M64X6	95	105	73	2519	1889	231
M68x6	100	110	78	2876	2157	231

**D2: It will depends of the size puller bridge.

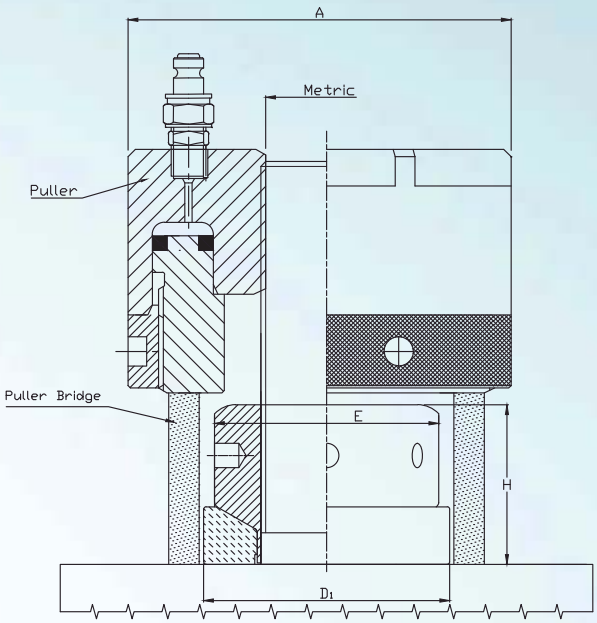
The dimensions shown on the tables may be modified, as every specific union would be object of its own engineering analysis.



TH Round



TH Round assembly over its own washer

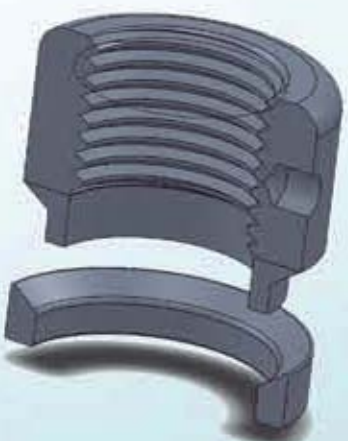


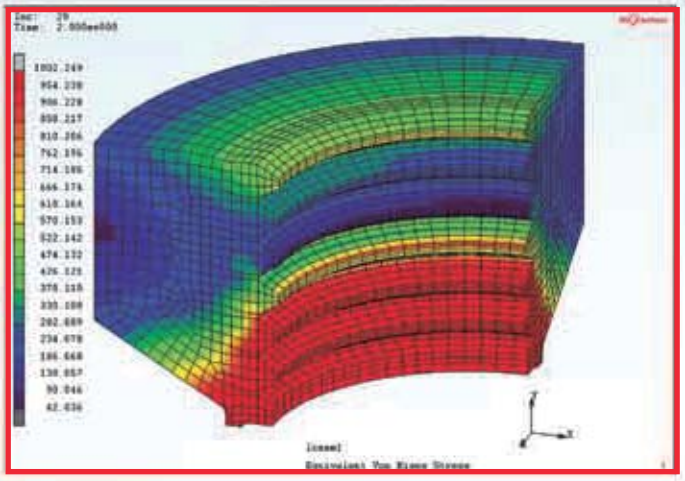
TH Round assembly over flange

TH	Nut body				Puller		
	E_{min} (mm)	WAF	D_1(mm)	H(mm)	Preload (kN)	TH Preload minimun (kN)	A(mm)
M16x2	26,75	24	30	19	180	135	73
M20x2,5	32,95	30	37	21,5	230	173	73
M22x2,5	35,03	32	39	24,5	285	214	102
M24x3	39,55	36	44	27	332	249	102
M27x3	45,2	41	50	31	431	324	102
M30x3,5	50,85	46	56	35,5	527	396	132
M33x3,5	55,37	50	60	38,5	652	489	132
M36x4	60,79	55	66	43	768	576	132
M39x4	66,44	60	72	46	917	688	163
M42x4,5	71,3	65	78	50,5	1053	790	163
M45x4,5	76,95	70	85	53,5	1232	924	163
M48x5	82,6	75	92	55	1382	1036	163
M52x5	88,25	80	98	62	1654	1241	192
M56x5,5	93,56	85	105	65,5	1908	1431	192
M60x5,5	99,21	90	110	70,5	2218	1664	231
M64X6	104,86	95	115	73	2519	1889	231
M68x6	110,51	100	120	78	2876	2157	231

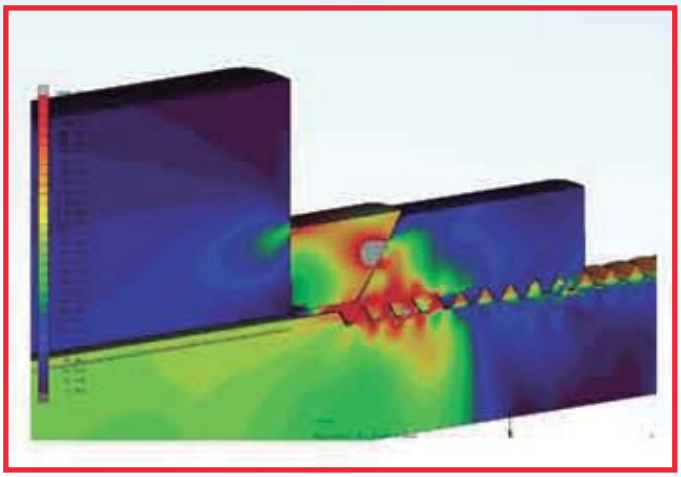
**D2: It will depends of the size puller bridge.

The dimensions shown on the tables may be modified, as every specific union would be object of its own engineering analysis.

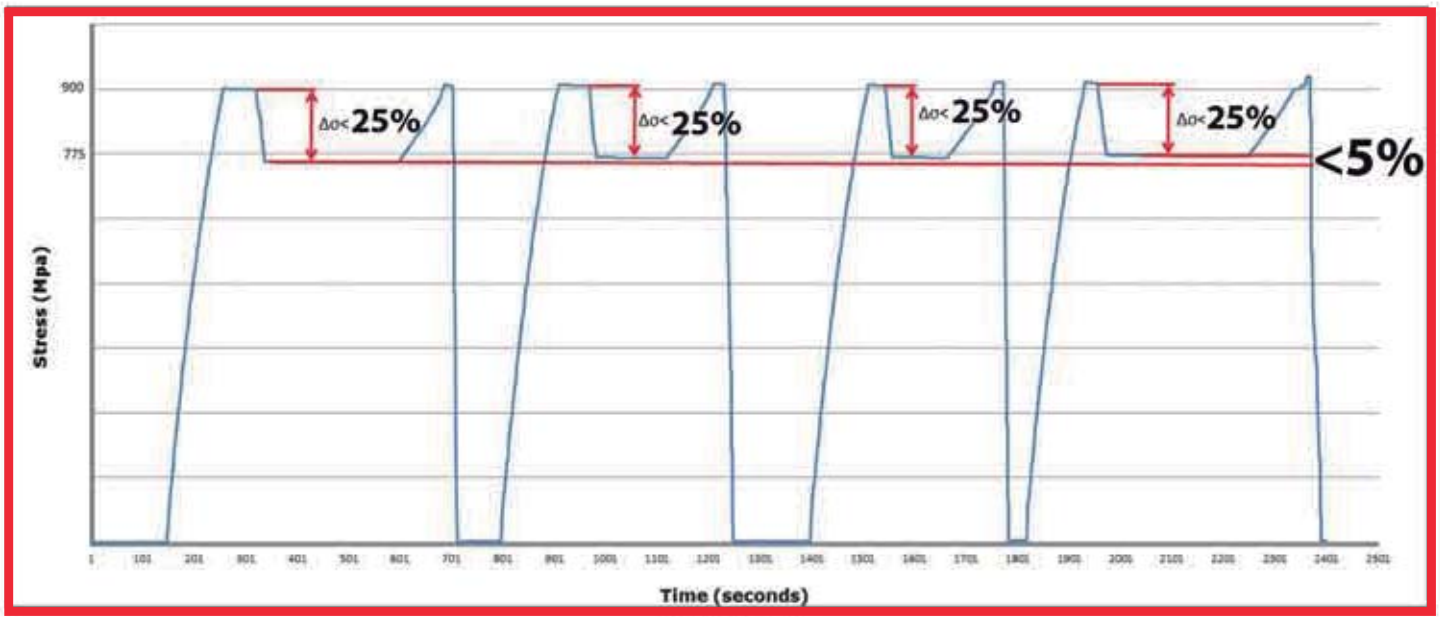




Stress in TH nut at stud preload.



General view of the equivalent Von Mises stresses in load



Mechanical behavior of TH system.

TSF®

Lloyd's Register


Lloyd's Register España, S.A.

General Certificate

patent pending

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www.tsfftsh.com

patent pending

guaranteed
preload systems

TSH - SH

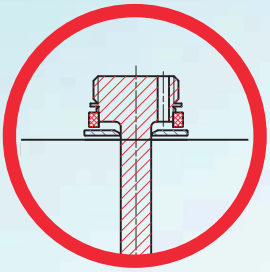
Minimum guaranteed preload
80% of bolt yield stress

if fastened as specified by the manufacturer

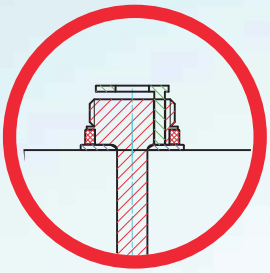
TSF®

TSF®

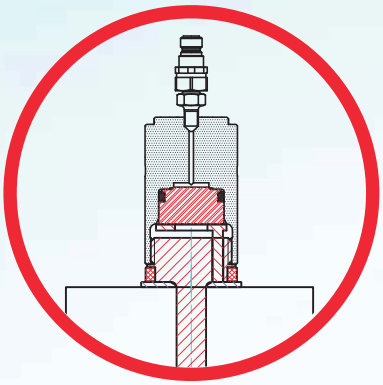
System to guarantee 80% preload TSH
Less than 5% dispersion



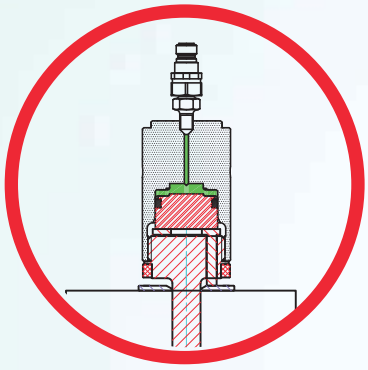
1 The base washer, lock bushing and TSH4 are introduced in the assembly.



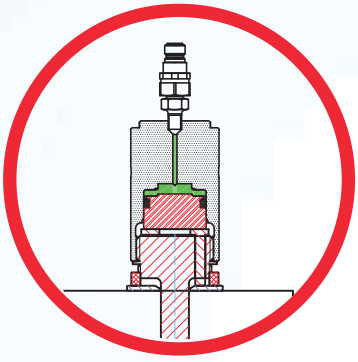
2 Strength transmitters are introduced through the TSH4 head



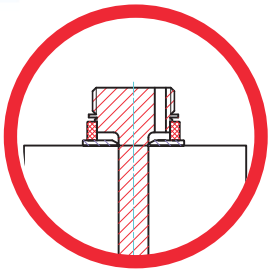
3 Assemble the puller on the TSH4 head



4 Preload is applied through the hydraulic puller and the TSH4 elongates



5 Adjust the lock bushing between the TSH4 head and the base washer to lock the elongation obtained and maintain the preload



6 Disassemble the puller and strength transmitters from the TSH4

guaranteed
preload systems

patent pending

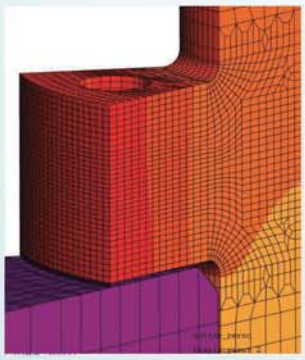
- Reduced number of fixation elements with respect to torque control.
- Quick reaching of preload.
- Low dispersion.
- High stability of the preload.
- Low load distribution factor for the fixation element. Lower fatigue range.
- Achieving preload by the use of pressure tables.
- Insensitivity to bending moments.
- No twisting of the fixation element.
- Ease of assembly and disassembly.
- Simultaneous Assembly of fixation elements. Elimination of elastic interaction of close elements.
- Same assembly protocol for all metric sizes.
- Benefits of elongation, without the disadvantages of friction.
- Ease of verification of preload sustention.
  It enables maintenance actions, if necessary, based on accurate preload readings.
- Multiple reuse of the element. Ease preload reset by assembly process repetition.
- Insensitive to the type of fixation thread or its lead due to lack of friction in the tightening process.
  Potential increment of the preload capacity.

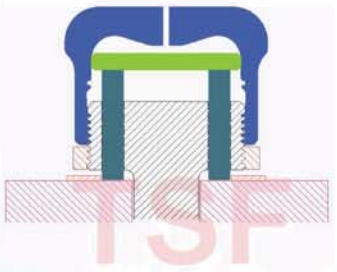
TSH1

TSH3

TSH2

TSH4

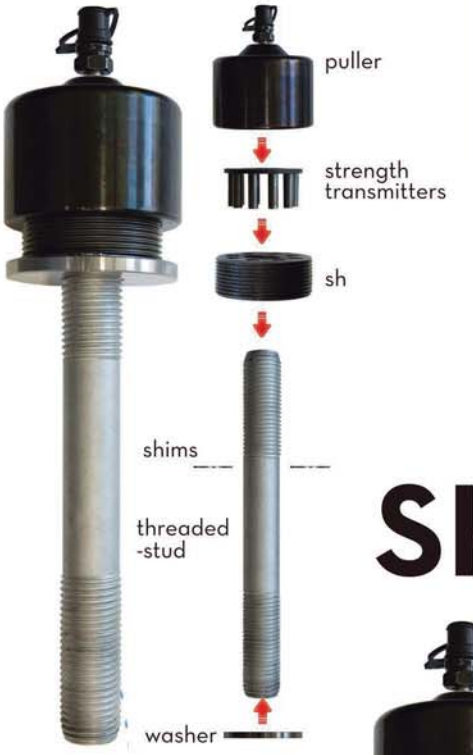


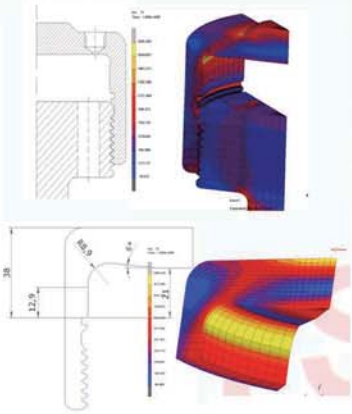


guaranteed
preload systems

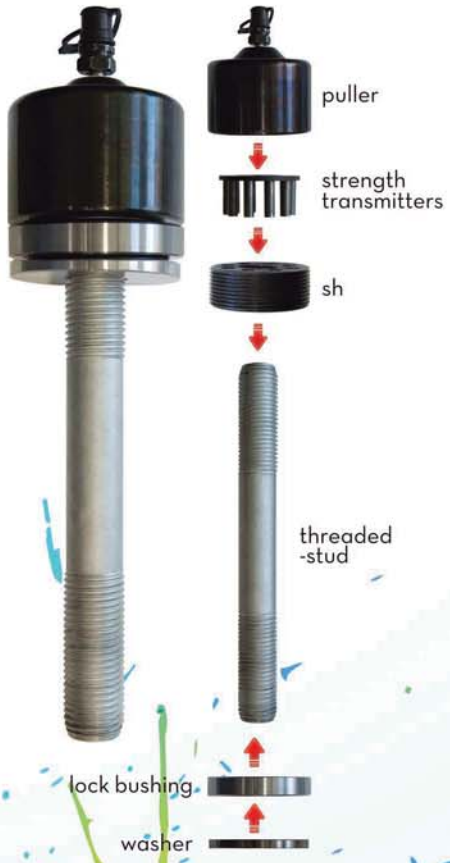
patent pending

SH1





SH2



- Reduced number of fixation elements with respect to torque control.
- Quick reaching of preload.
- Low dispersion.
- High stability of the preload.
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- Achieving preload by the use of pressure tables.
- Insensitivity to bending moments.
- No twisting of the fixation element.
- Ease of assembly and disassembly.
- Simultaneous Assembly of fixation elements. Elimination of elastic interaction of close elements.
- Same assembly protocol for all metric sizes.
- Benefits of elongation, without the disadvantages of friction.
- Ease of verification of preload sustention. It enables maintenance actions, if necessary, based on accurate preload readings.
- Multiple reuse of the element. Ease preload reset by assembly process repetition.
- Insensitive to the type of fixation thread or its lead due to lack of friction in the tightening process. Potential increment of the preload capacity.

Systems to ensure the preload SH and TSH

Bolted joints are essential for engineering applications as diverse as wind turbines, oil rigs, combustion engines, automobiles, cranes, aerospace, nuclear, marine, rail, etc., that must endure the most severe working conditions during its effective lifetime.

These conditions vary constantly, the efforts are not uniform, nor are the temperatures, weather conditions, marine or on land, etc., So that bolts and nuts are designed to withstand the maximum loads that may occur in the application, whether continuous or occasional, regular or extreme situations, during the lifetime of the product in which they are mounted.

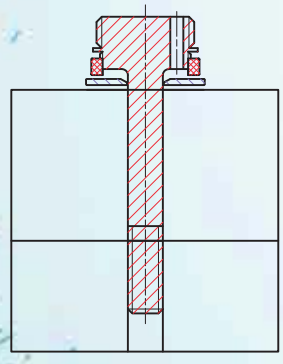
These joints are calculated with the load conditions in sophisticated software programs. Components are also tested in laboratories or in testing to failure.

The most commonly used screws are hex heads that are preloaded by applying a torque via pneumatic, hydraulic, electric or manual tools.

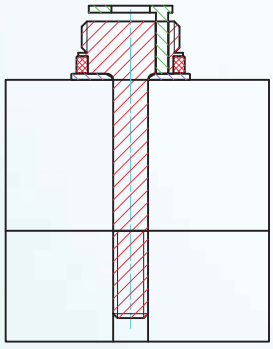
During this process, the bolt preloads and stretches, causing it to act like a spring that presses the pieces together, so the torque applied is of vital importance. This torque will cause the preload applied to the screw to be equal to that calculated for the binding, otherwise the joint will not work properly and end up deteriorating or breaking.

In the application of torque causes the friction to be involved, this friction between parts of the joint generates dispersions in the transformation of the torque to preload. This dispersion can be minimized by the lubrication of the joint components: bolts, screws, nuts, washers, etc., but still and under normal conditions, the dispersion can be up to 25% of the nominal preload calculated.

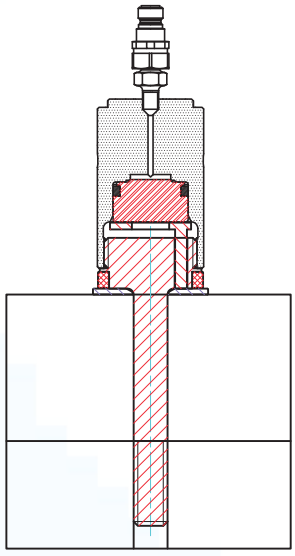
NUTS - LOCK BUSHING



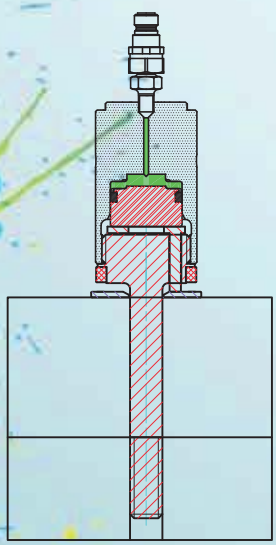
1 The base washer, lock bushing and TSH4 are introduced in the assembly.



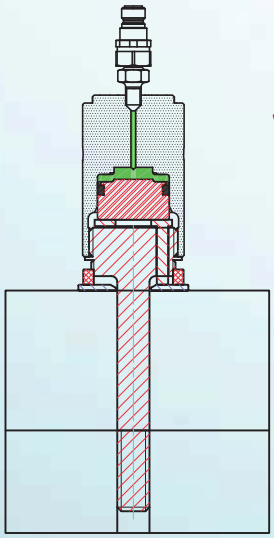
2 Strength transmitters are introduced through the TSH4 head



3 Assemble the puller on the TSH4 head

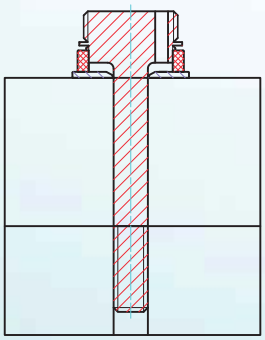


4 Preload is applied through the hydraulic puller and the TSH4 elongates



5 Adjust the lock bushing between the TSH4 head and the base washer to lock the elongation obtained and maintain the preload

patent pending



6 Disassemble the puller and strength transmitters from the TSH4

We can deduce that if we are able to control the dispersion of the preload, we will increase the security and integrity of the bolted joints.

TSF has patented a solution to ensure the preloads and control the dispersion in the joints obtaining preload variations below 5%. These systems to ensure the preloads are called SH and TSH in its different variants.
Systems to ensure preloads SH and TSH distinguish for their simplicity and ease of use, improving preload application performance by torque or through puller already existing in the market.

In our patented systems to ensure the preload SH and TSH, it is generated in a hydraulic puller designed specifically, defragmented and delivered to the joint by strength transmitters across the parts involved in such joint.
The preload is controlled by the pressure applied to the puller 95%, 90%, 85%, etc., of the elastic limit for each screw and supported by shims or locking bush, according to the variant used of SH and TSH. As the friction is not involved in obtaining the preload, only the relaxation will affect between the components of the joint.

Due to the design of our SH and TSH we can, doing the correspondent protocol, know the absolute elongation of the joint, that is, the total elongation minus the loss due to relaxation of the components of such joint. Through standard metrology systems (caliper, palmer, etc.,) we can obtain the absolute elongation value and therefore, know the preload of each of the bolts, also at the same time; we have unitary traceability of all the bolts constituting the joint. As we have explained, to know the bolt preload is not necessary to use current sophisticated systems such as ultrasound, etc., although, due to the geometrical characteristics of our SH and TSH, those can also be used.

Once assembled the joint and with traditional metrology media, we can in time, check again the elongation to control and verify the sustainability of the preload, allowing us to take maintenance actions if needed, based on precise measurements of the elongation.

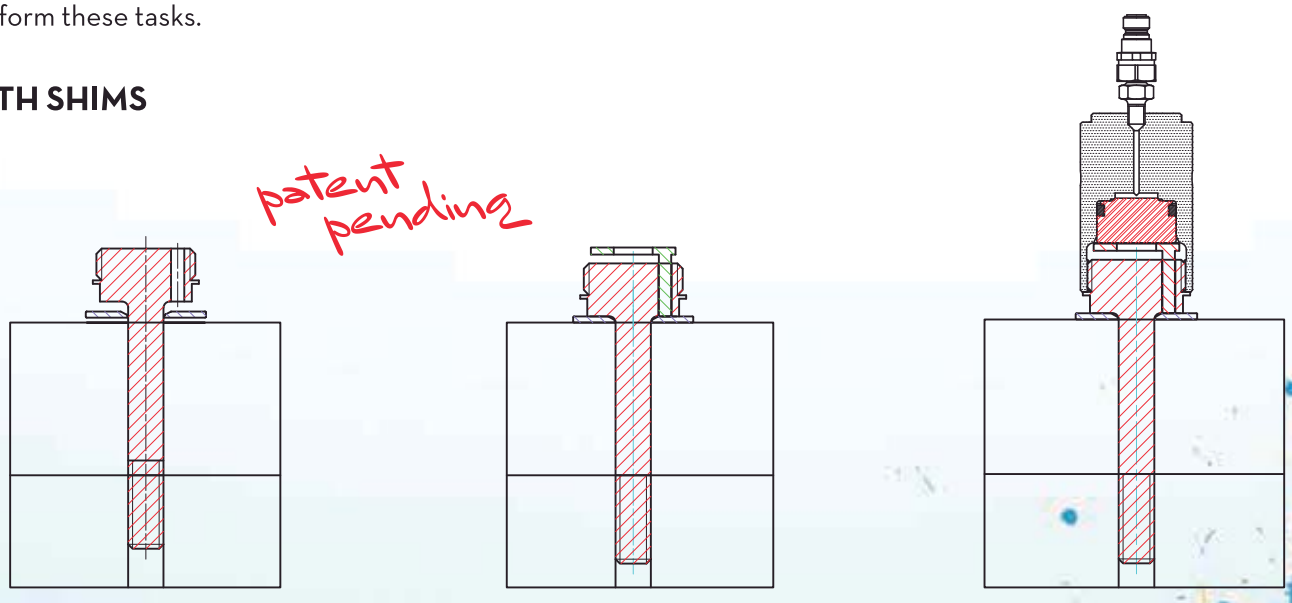
When pulling with our systems to ensure the preload SH and TSH, we eliminate the twist in the tying up element and we achieve insensitivity to bending moments, so as pitch and type of thread of the bolt by not intervening friction in tightening the union.

Is noted in the SH and TSH systems to ensure the preload, the ease of assembly and disassembly of the system and the quick achievement of preload and its reset using the same protocol, which at the same time is the same one for all types of bolts in their different metric sizes; this ease of use allows multiple reuses of the parts that constitute the joint. The preload is defined in pressure-preload tables specifically for each metric size and quality of materials.

By not intervening in the SH and TSH systems the friction, we get a potential increase in preload, high stability and low dispersion, which allows us to place fewer tying up elements than in joints assembled by torque control, or we can also use the same number of tying up elements, reducing the metric size of the bolts to use, obtaining the corresponding savings in machining, assembly time, maintenance, etc.

The field maintenance is drastically reduced due to the security of preload achieved, but whenever needed to do it, it is very easy because no special hardware is required for it, a manual hydraulic pump and a puller are enough to perform these tasks.

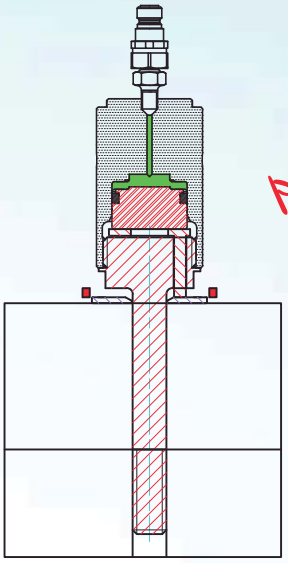
WITH SHIMS



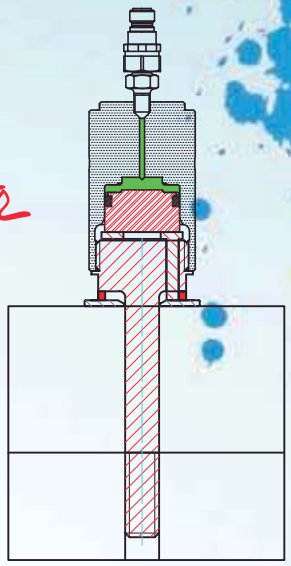
1 The base washer and TSH4 are introduced in the assembly

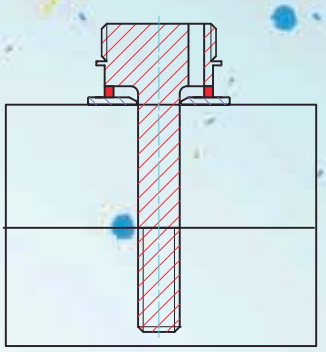
2 Strength transmitters are introduced through the TSH4 head

3 Assemble the puller on the TSH4 head



patent pending





4 Preload is applied through the hydraulic puller and the TSH4 elongates. The shims approximate to the assembly.

5 Adjust the shims between the TSH4 head and the base washer to lock the elongation obtained and maintain the preload.

6 Disassemble the puller and strength transmitters from the TSH4.

RENEWABLE WIND / SOLAR

We supply fasteners from M2 to M100 on cold, hot forging or machined, as well as all kinds of fasteners according to customer requirements.
All these items are manufactured to DIN, ISO, etc. According with ISO 898-1 and ISO 898-2 in addition to the specifications agreed with the customer.
All products are validated in internal laboratories certified A2LA or accredited external laboratories.
We have large stocks of hardware of different standards in grades 8.8, 10.9 and 12.9 that are provided in any type of surface coating.

CAPITAL GOODS

Petrochemical, nuclear, civil engineering, rail, naval...

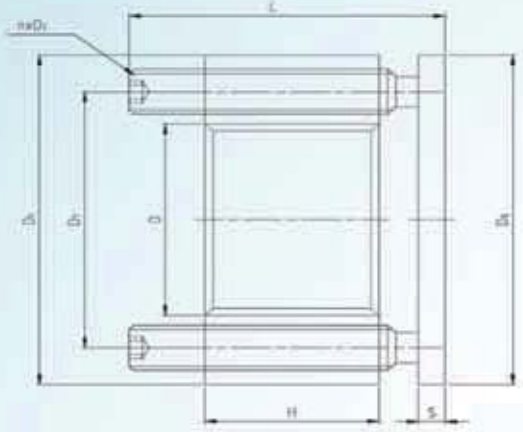
TSF®

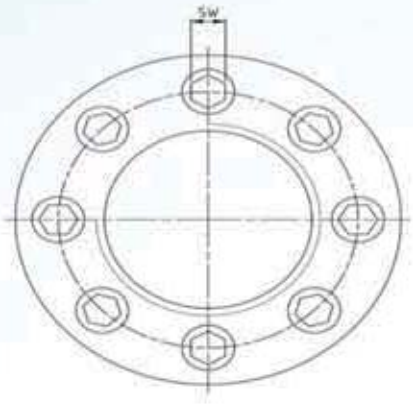
UH

UNIVERSAL HOLDER

UH - Universal Holder

Class 8





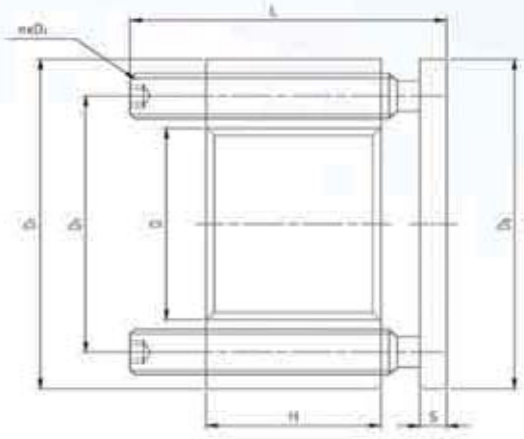
U.H.	Nut body			Height	Jackbolt			Washer		Preload		Torque		Weight
	D.	H	D.	Tot. L (mm)	D. (mm)	n	SW	D. (mm)	S	Nominal F. (kN)	Max. F.	Nominal M. (Nm)	Max M.	(Kg)
M16x2	35	17	25	33	M6	4	3	33	3	71,18	91,65	14	18	0,11
M20x2,5	39	17	29	34	M6	6	3	39	4	107,25	136,50	14	18	0,14
M22x2,5	42	17	31	34	M6	6	3	42	4	107,25	136,50	14	18	0,16
M24x3	45	17	33	34	M6	8	3	44	4	141,38	182,33	14	18	0,19
M27x3	51	25	39	45	M8x1	6	4	51	5	208,65	277,88	36	48	0,35
M30x3,5	54	25	42	45	M8x1	6	4	54	5	208,65	277,88	36	48	0,37
M33x3,5	60	25	45	45	M8x1	8	4	60	5	277,88	370,50	36	48	0,48
M36x4	67	33	51	57	M10x1,25	6	5	67	5	334,43	445,58	72	96	0,76
M39x4	71	33	54	57	M10x1,25	8	5	71	5	445,58	594,75	72	96	0,90
M42x4,5	76	33	57	57	M10x1,25	8	5	74	5	445,58	594,75	72	96	1,01
M45x4,5	84	39	63	68	M12x1,25	8	6	82	6	682,50	911,63	131	175	1,23
M48x5	86	39	66	68	M12x1,25	8	6	86	6	682,50	911,63	131	175	1,50
M52x5	92	39	70	68	M12x1,25	8	6	91	6	682,50	911,63	131	175	1,64
M56x5,5	99	39	74	68	M12x1,25	10	6	95	6	853,13	1131,00	131	175	1,96
M60x5,5	103	39	78	68	M12x1,25	10	6	101	6	853,13	1131,00	131	175	2,04
M64X6	114	54	87	92	M16x1,5	10	8	113	8	1238,25	1647,75	315	420	3,65
M68x6	118	54	91	92	M16x1,5	10	8	118	8	1238,25	1647,75	315	420	3,85
M72x6	121	57	95	92	M16x1,5	8	8	121	8	1238,25	1647,75	315	420	4,00
M76x6	133	57	100	92	M16x1,5	12	8	128	8	1852,50	2466,75	315	420	5,10
M80x6	133	57	103	92	M16x1,5	12	8	128	8	1852,50	2466,75	315	420	4,80
M85x5	138	57	108	92	M16x1,5	12	8	138	8	1852,50	2466,75	315	420	5,10
M90x6	146	60	113	99	M16x1,5	16	8	138	8	2466,75	3295,50	315	420	6,00
M100x6	158	62	123	101	M16x1,5	16	8	152	10	2466,75	3295,50	315	420	7,00
M110x6	178	80	139	125	M20x1,5	12	10	173	10	3071,25	4095,00	645	860	11,40
M120x6	190	82	149	125	M20x1,5	16	10	180	10	4095,00	5460,00	645	860	13,00
M125x6	195	82	154	125	M20x1,5	16	10	191	10	4095,00	5460,00	645	860	13,50
M130x6	206	95	159	140	M20x1,5	18	10	203	10	4582,50	6142,50	645	860	17,50
M140x6	216	95	169	140	M20x1,5	20	10	216	10	5118,75	6825,00	645	860	18,70
M150x6	226	95	179	142	M20x1,5	20	10	226	12	5118,75	6825,00	645	860	20,00
M160x6	235	108	189	162	M20x1,5	24	10	235	12	6142,50	8190,00	645	860	24,10

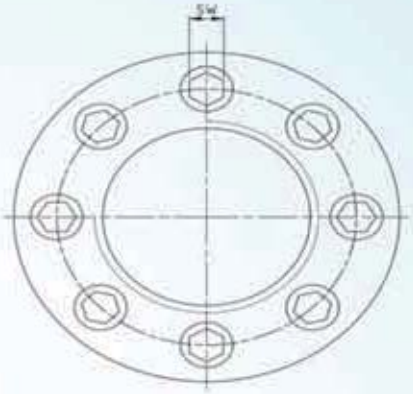
UNIVERSAL PRELOAD SYSTEM

Preloading system that achieves the preload on main stud through torque tightening procedure of smaller satellite studs.

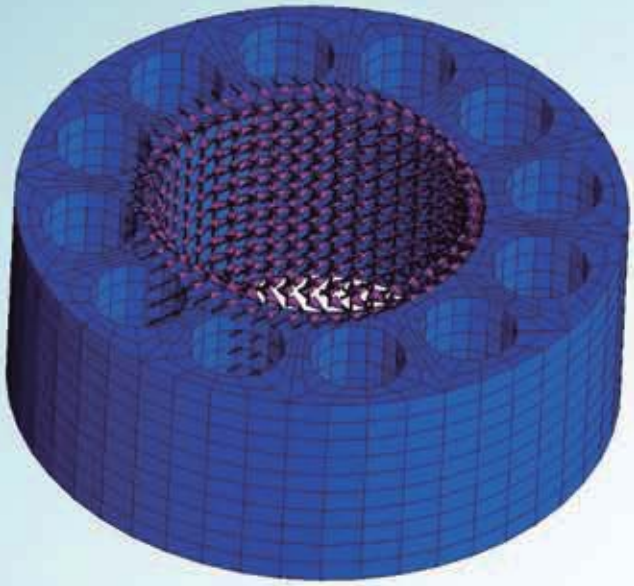
UH - Universal Holder

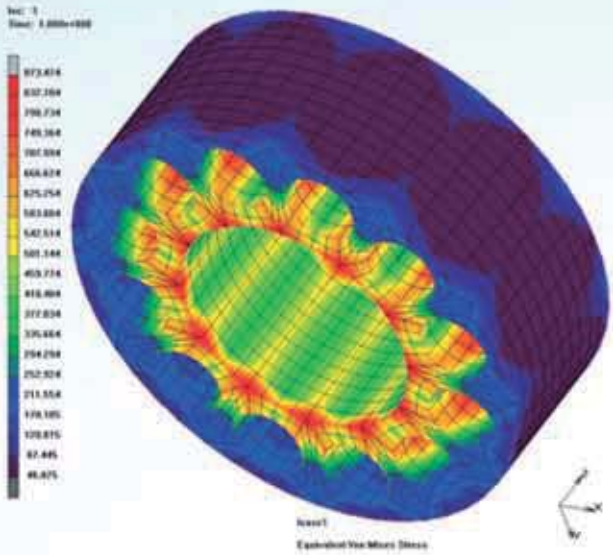
Class 10

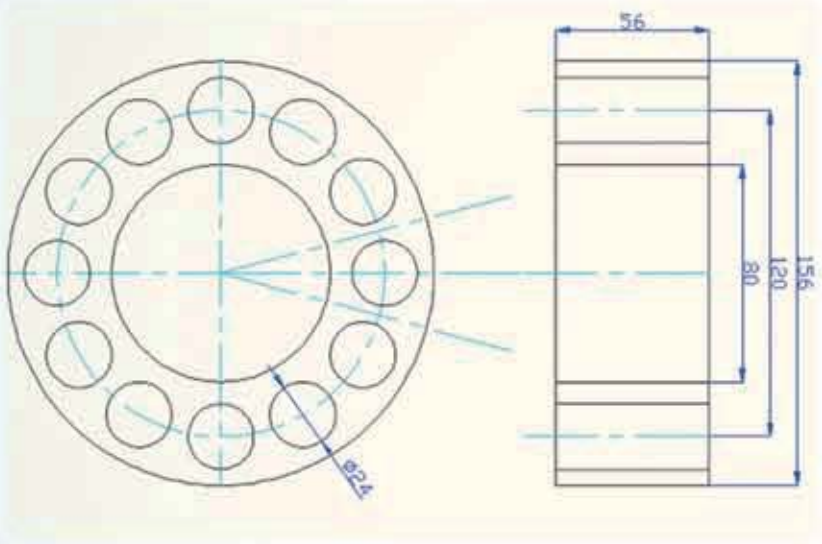




U.H.	Nut body			Height	Jackbolt			Washer		Preload		Torque		Weight
	D.	H	D.	Tot. L (mm)	D. (mm)	n	SW	D. (mm)	S	Nominal F. (kN)	Max. F.	Nominal M. (Nm)	Max M.	(Kg)
M16x2	35	17	25	33	M6	6	3	33	3	107,25	136,50	14	18	0,12
M20x2,5	39	18	29	34	M6	8	3	39	4	141,38	180,38	14	18	0,15
M22x2,5	42	18	31	34	M6	8	3	42	4	141,38	180,38	14	18	0,17
M24x3	48	25	36	44	M8x1	6	4	48	4	209,63	277,88	36	48	0,30
M27x3	52	25	39	45	M8x1	8	4	51	5	277,88	370,50	36	48	0,37
M30x3,5	55	25	42	45	M8x1	8	4	54	5	277,88	370,50	36	48	0,38
M33x3,5	64	33	48	57	M10x1,25	8	5	64	5	443,63	594,75	72	96	0,72
M36x4	67	33	51	57	M10x1,25	8	5	67	5	443,63	594,75	72	96	0,79
M39x4	73	33	54	57	M10x1,25	10	5	71	5	555,75	741,00	72	96	0,97
M42x4,5	77	33	57	57	M10x1,25	12	5	74	5	667,88	892,13	72	96	1,10
M45x4,5	85	39	63	68	M12x1,25	10	6	82	6	853,13	1140,75	131	175	1,26
M48x5	86	39	66	68	M12x1,25	10	6	86	6	853,13	1140,75	131	175	1,54
M52x5	95	39	70	68	M12x1,25	12	6	91	6	1023,75	1365,00	131	175	1,80
M56x5,5	99	39	74	68	M12x1,25	12	6	95	6	1023,75	1365,00	131	175	1,93
M60x5,5	110	60	83	99	M16x1,5	10	8	107	8	1540,50	2047,50	315	420	3,90
M64X6	114	60	87	99	M16x1,5	10	8	113	8	1540,50	2047,50	315	420	4,10
M68x6	118	60	91	99	M16x1,5	12	8	118	8	1852,50	2466,75	315	420	4,30
M72x6	122	60	95	99	M16x1,5	12	8	121	8	1852,50	2466,75	315	420	4,50
M76x6	133	62	102	99	M16x1,5	16	8	128	8	2466,75	3285,75	315	420	5,60
M80x6	134	62	103	99	M16x1,5	16	8	128	8	2466,75	3285,75	315	420	5,40
M85x5	140	62	108	99	M16x1,5	16	8	138	8	2466,75	3285,75	315	420	5,80
M90x6	159	82	119	125	M20x1,5	12	10	152	10	3071,25	4095,00	645	860	10,30
M100x6	169	82	129	125	M20x1,5	14	10	161	10	3578,25	4777,50	645	860	11,10
M110x6	179	82	139	125	M20x1,5	16	10	173	10	4095,00	5460,00	645	860	12,10
M120x6	190	82	149	125	M20x1,5	18	10	180	10	4582,50	6142,50	645	860	13,10
M125x6	195	82	154	125	M20x1,5	18	10	191	10	4582,50	6142,50	645	860	13,70
M130x6	206	95	159	140	M20x1,5	20	10	203	10	5118,75	6825,00	645	860	17,60
M140x6	216	95	169	140	M20x1,5	22	10	216	10	5606,25	7507,50	645	860	18,80
M150x6	226	95	179	142	M20x1,5	22	10	226	12	5606,25	7507,50	645	860	20,10
M160x6	236	108	189	162	M20x1,5	24	10	235	12	6142,50	8190,00	645	860	24,50







ENGINEERING

CALCULATION AND DEVELOPMENT

Calculation and development of bolted joints for automotive, aeolian, construction, equipment, etc.
For the calculation of the unions, the engineering of TSF has a powerful simulation tool using finite elements.
The program used is the prestigious MSC.MARC.
The customer is offered the solution with our design and geometry and the certification of such unions in government agencies.
TSF could calculate, design and manufacture any part adapted to each customer requirements.

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