MACHINE DESIGN, VOL.11(2019) NO.4, ISSN 1821-1259 PP. 155-160

DOI: 10.24867/MD.11.2019.4.155-160
Research paper

TIGHTENS AS REQUIRED AND RESPONSIBLE ELEMENTS OF EQUIPMENT

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Received (05.09.2019); ***Revised*** (09.12.2019); ***Accepted*** (11.12.2019)

Abstract: *The tiles represent the mechanical element, which is widely used in mechanical engineering, and orders its wide application in shipbuilding. These elements are standardized where they are specially standardized, dimensions and loads, as well as the technical conditions for design, delivery and marking. The work will show sections of the tent, as well as an example of labeling.*

Key words: *tanks, tightens, tension.*

1. INTRODUCTION

Tensile nuts-clips, used for adjustment) tightening) of wires and steel ropes or other parts like masts, pillars, wagon supports, etc. Ties are made of two screws and joint nuts. The screws with a different direction of slit thread engage in a common nut and thus spatulate or seal the parts. The tanks are standardized, the basic standard is JUS C. H4. 072 (Din 82004), since the tanks have the highest application in shipbuilding, it is also necessary to specify the ship standard SB 8696. A ship is a floating agent, moving by water using a kennel, sail or propeller, which is driven by a device or engine. It serves to carry passengers or cargo or some other special purpose. Our national Serbian standard is marked with the SRPS letter followed by the numerical standard mark. If the standard is homogenized with European standards then it is designated SRPSEN.

Subject of the standard
This standard C: H4.072 determines the shape, dimensions, material, mass and loading of the tower primarily intended for deck equipment on ships, but can be used in other areas of mechanical engineering.

Tanks can be carried out in different forms according to the above standard, they are made in five forms:

- Form A, double-eyelid,
- Form B for two forks,
- Form C of an intestine with two round eyes,
- Form D fork with fork and round eye,
- Form E fork with fork and long eye.

Attachment parts of the tension (marked with numbers 2, 3, 4,5, 6, and 7) with pictures corresponding to the specific features of the material for the fabrication of anchors.
Very important are the working conditions of the machine parts and the construction (aggressiveness of the working atmosphere, the influence of temperature cycles and maximum temperatures, as well as the relative movement of parts), the most important are the input parameters that define the choice of materials. In addition to the basic material and additional materials, it is mandatory to select the material.

2. BASIC CHARACTERISTICS AND SHAPES OF PARTS FOR THE PRODUCTION OF OVERCHARGES

Construction, forged, pressed and rolled parts. The cost of the forged parts is considerably higher than the cast, so the forging should be prescribed only for those parts requiring high strength and durability.
Free forging and forging in molds is distinguished by hammer and press. The basis of the experience has come up with some rules to be followed when constructing forged parts:
Make sure the elongation for forging is more than bending, stepwise transitions are cheaper than conical.
When bending, prescribe permitted radius for avoidance, voltage, and set.
Pρ_min = δ / 2 for some ρ_min = 3 δ for very hard materials
Here is the thickness of the pieces.
Take care of standard blacksmith tools and accessories.
Due to the price of forging, consider the possibility of replacing forging. Welding and mechanical processing, especially in the case of a small number of pieces, avoid sudden cross-sections, since this makes it difficult to manufacture, the surfaces to be processed need to be pushed for easier processing.
Slopes 1-10 and 1-6 for the upper mold should be provided for the forging in molds. The drawing of the forgery is made on the basis of the workshop drawings taking into account the processing accessories. The drawing factor for the additives should be 1: 1.
In Figure 1, the following pictures show examples of good and badly constructed parts

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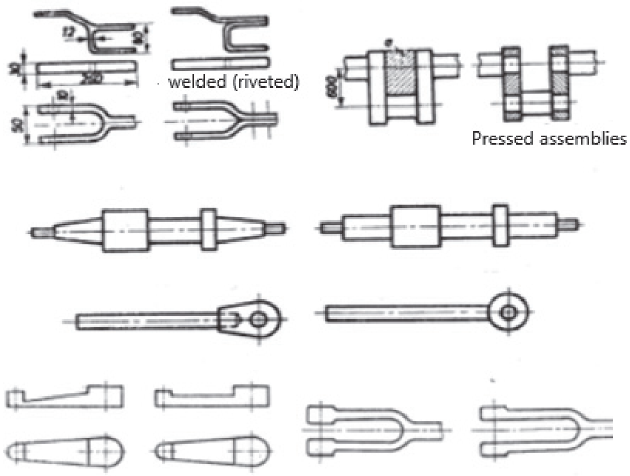

Fig.1. Good and badly designed parts

Pressure can be carried out in a warm and cold state. The cold pressing is performed on parts of thin walls, usually on sheets.
Due to the considerably low speed of pressing, large specific pressures should be provided, which is usually achieved by hydraulic presses in plastic deformation in a cold state and by pressing it by screwing. In recent years, more and more parts are being massively produced in the automotive and aerospace industries. These processes allow for high quality surfaces, complex quality and minimal surface treatment.
Rolling is performed in hot and cold state by imprinting on rolling, very complex forms of high dynamic and surface strength can be achieved.

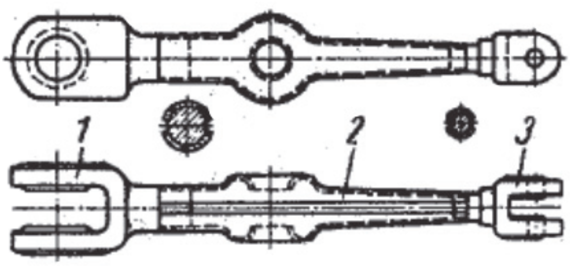

Fig.2. Weighing rods are semi-finished products for further processing

Figure 2 shows an example of the lever elements of the similar embodiment of the clips A and B. The semi-finished product can be further refined by welding and forging as well as the final machining.
Tighten nuts are made of seamless steel carbon steel tubes of guaranteed chemical composition. 1212 according to JUS C: B5 .021 / 64 standard.
In the case of a small number of pieces, round steel Č.0645 is used. General structural steel with 0.40% Carbon σM = 700-850 MP.
Attachment parts of the overpass (2-7) are made of materials specified in the standards JUS C.H4 073, JUS C.H4 074, JUS C.H4 075. Recommended steel is CH.1530 of the guaranteed chemical composition, especially if it is noted that the clamp can be ordered according to the requirement where several combinations such as hook design are considered.

3. DISPLAY THE SHAPE OF THE OVERHANG

Many materials used in constructions have the characteristic of elasticity. The body made of this material under the influence of external forces is deformed, but after the removal of these forces, the body occupies its original position which was before the deformation. The ability of the body to take its original position after removing external forces is called elasticity. From this trait it follows that the elastic bodies suffer from elastic deformations that elude as soon as the causes / external forces that caused them cease.
Depending on the position of the external forces towards the axis of the body (rods), 4 basic types of deformations are distinguished, that is, 4 basic forms of stress states, since the stresses in the body are dependent on deformations, these types are: longitudinal deformation (tensile and pressure, shearing, twisting and bending). If the external forces lie in the axis of the rod and their direction of action is turned into a field, then we have a case of tightening characteristic for the tent.
Form A with two long eye pictures 3. Displays all parts of the overhang: the casing1, the left side of the tensioner 2 with the display B1, as shown in Table 1, which refers to the length of the long-eye material.
Number 3 on the right side represents a completely long eye with right and left thread d1, from Table 1 the size a, c and size d4 can be found. For naive size and permissible load.

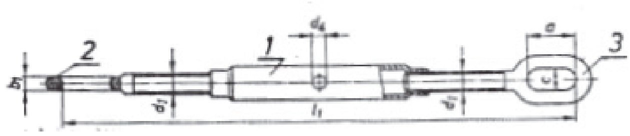

Fig.3. A-type A-shaped shape with two long eyes

Figure 4 shows 4 tiles, shape B with forks, shape C with two round eyes and shape D with fork and round eye as well as shape E with fork and long eye.

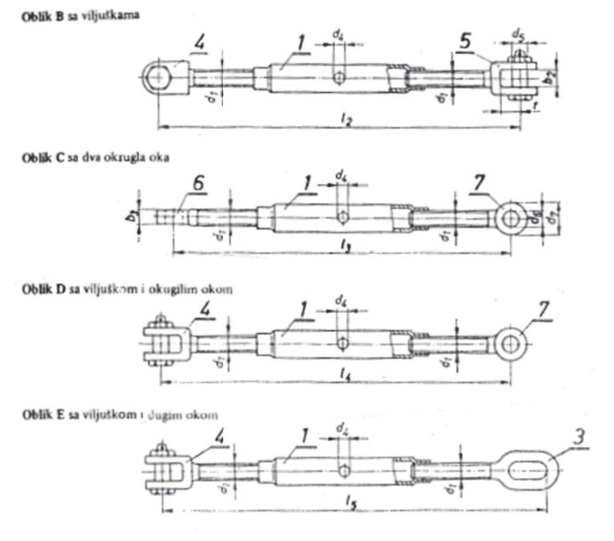

Fig.4. 4 tiles, shape B with forks, shape C with two round eyes and shape D with fork and round eye as well as shape E with fork and long eye

Table 1. The nominal sizes of the overcharges

Nominal size	Permissible loadKN	b_2	b_3	Right, left thread d_1*)	d_4	d_5 $h1_3$	d_7	l_2 $_{max}$	L_3 max	L_4 Max	L_5 max	t	Adjustabili t_y
0.4	4	12	10	M12	12	10	22	387	371	379	404	15	140
0.6	6.3	16	12	M16	12	12	28	426	412	419	464	18	150
1	10	19	16	M18	12	16	35	481	457	469	509	23	165
1.6	16	23	20	M22	14	20	45	529	499	514	564	28	170
2	20	26	22	M24	14	22	50	573	529	556	603	31	190
2.5	25	29	25	M27	14	24	55	617	581	599	662	34	200
3	32	32	28	M30	18	27	60	660	620	640	700	36	210
4	40	35	30	M33	18	30	65	704	660	682	764	39	225
5	50	39	35	M36	18	36	75	766	706	736	816	46	235
6	63	45	40	M42	22	39	85	842	782	812	902	51	260
8	80	49	45	M45	22	45	95	936	866	901	996	56	295
10	100	58	50	M52	22	48	110	1020	950	985	1035	63	315
12	125	125	55	M56	26	52	120	1111	1041	1072	1191	70	345
16	160	70	60	M64	26	60	130	1192	1112	1152	1292	75	365
20	200	74	65	M72x6	26	68	140	1196	1196	1236	1381	80	370
25	250	80	70	M76x6	33	72	150	1278	1278	1323	1483	87	415
32	320	90	80	M80x6	33	80	170	1370	1470	1420	1600	97	445

Form B is a slightly more complicated design because it is necessary to install the appropriate screw of the respective dimensions and install the fuse, to secure the release and pulling bolts. From Table 2, you can find all the parts and sizes that are needed.

Table 2. Nominal sizes and permissible overload loads

Nominal size	Right, left thread d_1*)	d_2xs min	d_3 min	d_4	e	l_6
0.4	M12	25x4	18	12	12	180
0.6	M16	30x4.5	23	12	16	200
1	M18	31.8x4.5	25	12	18	220
1.6	M22	38x5.6	30	14	22	240
2	M24	42.5x6.3	33	14	24	260
2.5	M27	44.5x6.3	37	18	27	280
3	M30	51x6.3	41	18	30	300
4	M33	57x8	46	18	33	320
5	M36	63.5x8	50	22	36	340
6	M42	70x8.8	57	22	42	380
8	M45	76.1x10	63	22	45	420
10	M52	83.9x10	72	22	52	450
12	M56	88.9x11	78	26	56	500
16	M64	108x12.5	90	26	64	540
20	M72x6	127x12.5	100	26	72	580
25	M76x6	152.4x14.2	104	33	76	620
32	M80x6	152.4x16	112	33	80	660

Figure 4 Form B forks with forks, 2 round eye tens, D-shaped tensile with villa and round eye, and E-shaped tensioner fork and long eye

Figure 5 shows the housing (tensioning nut) with the necessary markings, the right and left thread of the tensioning nuts are visible.

The length of the tensioning nut (l6) is determined according to the thread length on the trunk of the connecting parts (l3) according to the thread standards in the tolerance field 7H, the class of construction C according to the standards JUS M.BO.221 and JUS M.BO.230.

In Table 3, the necessary data can be found for making a tension nut. It is necessary to create a technology sheet for the products we want to work on. Often there are customer requests (contracting authorities), then changes in dimensions and shapes occur.

Often there is a change in the manufacturing technology if it is welding, materials must be chosen which can be welded with high quality. These are Č.0345, Č.0445, Č.0545.

Material selection should be made according to the base material. The tensioning devices can be made from full round materials especially if a higher safety factor is required. For the standard tanks, a safety factor 2 is predicted, which is determined by testing on crushers, prepared tools.

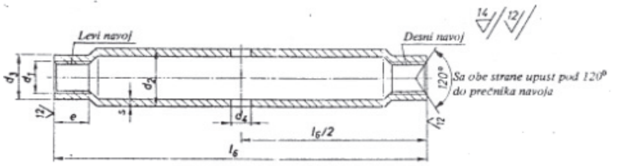

Fig.5. Tube-tightening screw nut

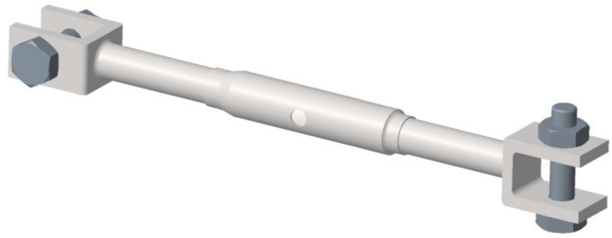

Fig.6. Manufactured view of tension nut

Table 2. The nominal sizes and dimensions of the tension nuts

Nominal size	Right, left thread, d_1*)	d_2xs min	d_3 min	d_4	e	l_6
0.4	M12	25x4	18	12	12	180
0.6	M16	30x4.5	23	12	16	200
1	M18	31.8x4.5	25	14	16	220
1.6	M22	38x5.6	30	14	18	240
2	M24	42.5x6.3	33	14	22	260
2.5	M27	44.5x6.3	37	18	24	280
3	M30	51x6.3	41	18	27	300
4	M33	57x8	46	18	30	320
5	M36	63.5x8	50	22	33	340
6	M42	70x8.8	57	22	36	380
8	M45	76.1x10	63	22	42	420
10	M52	83.9x10	72	22	45	450
12	M56	88.9x11	78	26	52	500
16	M64	108x12.5	90	26	56	540
20	M72x6	127x12.5	100	26	64	580
25	M76x6	152.4x14.2	104	33	72	620
32	M80x6	152.4x16	112	33	76	660

4. CONCLUSIONS

The tanks are very demanding responsible machine elements that have wide application
Large and wide range of loads (4-320 KN) with safety factor 2.
When making, choose the most optimal production technology. It is obligatory to do a technological elaborate with a selection of the best order of technological operations
If standard or non-standard tension is required, it is necessary to approve basic and additional materials and to draw up a workshop drawing as well as drawings for the use of material for higher loads with a higher security factor. Perform all processing stages according to the specified standards and requirements of the contracting authority.

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EXAMPLE-TASK

Determine the diameter and length of the threaded joint, the diameter of the body in section I-I and the key hole (OK). Draw a folding drawing of the strap and detailed drawings of the screw and the body of the strap.

Solution of the task

1. When tightening the tension, the threaded spindles and the body of the tie are exposed by the longitudinal force (F) and the twisting moment (M_o) as shown in Figure 7.
In order to take into account and twist, when calculating the diameter of the threaded spindle, force increases by (20-30%) (20% adopted), so Fa = 30 kN.
Permissible tensile strain

$$\sigma_{zd} = \sigma\frac{v}{v} = \frac{24}{3.5} = 6.86\frac{kN}{cm^2}$$

$$A_1\frac{F_a}{\sigma_{zd}} = \frac{25}{6.86} = 3.64cm^2$$

so the surface of the core of the threaded spindle
Table 1 adopted the thread T, 30 + 6 with geometric dimensions:
d = 27 mm, d_1 = 23.5 mm, H1 = 2.5 mm, φ = 4.06 °

2. The length of the screw thread of one bolt shall be determined from the equation for the number of threads:

$$Z=\frac{F}{\pi \cdot d_2 \cdot H_1 \cdot p_d} = \frac{25}{3.14 \cdot 2.7 \cdot 0.25 \cdot 1} = 11.79 \approx 12$$

Length of threaded joint m = z · P = 12 · = 72 mm

3. The torque needed to rotate the tension when tightening the rope

$$M_o + 2F\frac{d_g}{2}tg(\varphi + \rho') = 2 \cdot 25 \cdot \frac{2.7}{2} \cdot 0.196$$
$$= 13.24\ kN \cdot \text{cm}$$

Wherein:
tgρ'= 1.034; μ=0.124; ρ'=7.073°.

Datas for task

Maximum tensile force	F [kN]	10	16	20	25	30......50
type of thread		Md		Md x P		Tr
Screw material		Č.0345		Č.0445		Č.0545
The material of the body		ČL 0345		ČL 0445		ČL 0545
Friction coefficient in thread	μ	0.12	0.13	0.14	0.15	
Class of manufacture		rough,		medium,		fine
hand force	F_r [kN]	0.1	0.12		0.20	
Allowed surface pressure	p_d [kN/cm²]	0.6	0.7	0.8	0.9	1.0 ....1.5

4. The keyhole can be determined using the torque equation

$$Mo = Fr \cdot l$$

l is Length of the handle

$$L=\frac{M_0}{F_r} = \frac{13.24}{0.12} = 110 \text{ cm.}$$

Since the normal key length is
L = (15-21) d = (15-21) · 30 = (450-630) mm,
Tightening the tie should be carried out by 2 workers
The key opening S = 46 mm is approved, corresponding to the rated diameter of the screw diameter of 30 mm.

5. Section II is defined by two diameters:
d0 = 1.1 d = 1.1 · 30 = 33 and ds1
Cone

$$K=\frac{d_s - d_{s1}}{L} = \frac{46 - d_{s1}}{30} = \frac{1}{5}$$

$$d_s = 46 - \frac{30}{5} = 40 \text{ mm}, \quad \varphi = \frac{d_0}{d_{s1}} = \frac{33}{40} = 0.825=$$

The cross-sectional area of the body is tightened in section I-I:

$$A=\frac{\pi \cdot d_{s1}}{4}(1-\varphi^2) = \frac{3.14 \cdot 40^2}{4}\left[1 - (\frac{3.3}{4})^2\right] = 4 \text{ cm}^2.$$

Polar Resistance Cutting Torque:

$$W_0 = 0.2 d_{s1}^3 (1 - \varphi^4) = 0.2 \cdot 4^3(1 - 0.825^4 = 6.87\ cm^3$$

$$\sigma_z = \frac{F}{A} = \frac{25}{4} = 6.25\ kN/cm^2,$$

$$\tau_{\rceil} = \frac{M_u}{W_0} = \frac{M_{0/2}}{W_0} = \frac{13.24}{2 \cdot 6.87} = 0.96\ kN/cm^2$$

$$\sigma_z = \frac{F}{A} = \frac{25}{4} = 6.25\ kN/cm^2,$$

$$\tau_{\square} = \frac{M_u}{W_0} = \frac{M_{0/2}}{W_0} = \frac{13.24}{2 \cdot 6.87} = 0.96\ kN/cm^2$$

$$A1 = \frac{F_a}{\sigma_{zd}} = \frac{25}{6.86} = 3.64cm^2$$

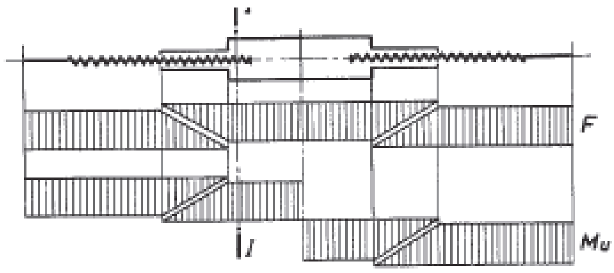

Fig.7. Schema of the tightening load

Strain in section I-I:

$$\sigma_z = \frac{F}{A} = \frac{25}{4} = 6.25\ kN/cm^2,$$

$$\tau_{\rceil} = \frac{M_u}{W_0} = \frac{M_{0/2}}{W_0} = \frac{13.24}{2 \cdot 6.87} = 0.96\ kN/cm^2$$

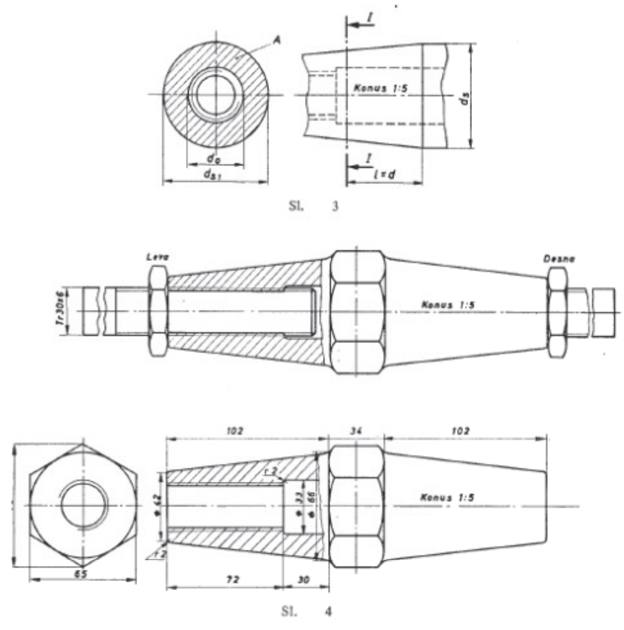

Fig.8. Nuts

The degree of security

$$\upsilon_\sigma = \frac{\sigma_v}{\sigma_z} = \frac{24}{6.25} = 3.84,$$

$$\upsilon_\tau = \frac{\tau_v}{\tau_u} = \frac{0.85\sigma_v}{0.96} = \frac{0.85 \cdot 24}{0.96} = 21.25,$$

$$\upsilon = \frac{\upsilon\sigma\ \upsilon\tau\ \cdot}{\sqrt{\upsilon\sigma^2 + \upsilon\tau^2}} = \frac{3.84 \cdot 21.25}{\sqrt{3.84^2 + 21.25^2}} = 3.78,$$ satisfies

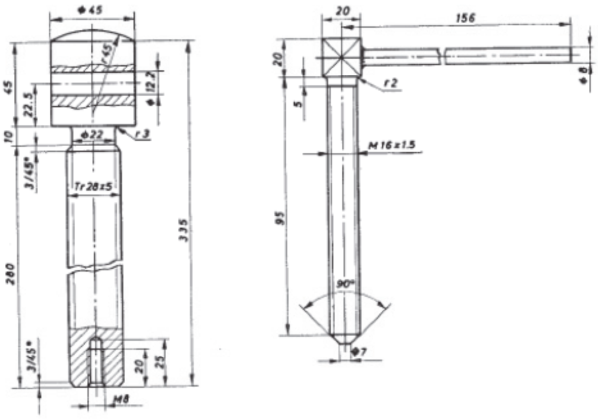

Fig.9. Handle