METHODS OF INSTALLATION OF WIRE ROPE AND BINDER WHEN SECURING LOADS

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Abstract: The article shows the suitability of fastening tools in the process of securing cargo in railway transport and the methods of their installation. Fastening tools for safe transportation of cargo are studied, measures and proposals for their selection are developed. In addition, the technical characteristics of the main models of fastening elements are analyzed, and proposals are made for the installation of tensioners and fasteners to eliminate the shortcomings of the existing system.

Introduction.

When securing cargo, wire (metal cables) tensioners and ties are widely used to prevent cargo movement, keep it stable, and ensure the safety of the vehicle.

The function of wire tensioners and ties: to prevent the cargo from sliding, tipping, or falling; to stabilize the center of gravity of the cargo; to counteract the inertial forces that arise when the vehicle is moving [1].

Types of wire ropes and ties: flat wire tie (filler) - for light and medium loads; steel cable - for heavy loads and containers; adjustable tensioner (tensioner) - allows you to regulate the tension; clip (karabiner) tie - for quick fastening and loosening.

Installation methods: direct lashing - the wire lashing is passed through the middle of the load and attached to the platform rings or crane hooks; the two ends of the wire are secured with a hose clamp; X-shaped (diagonal) lashing - the wires are passed through the four corners of the load in a cross (X) diagonal direction, this method provides greater protection against lateral movement of the load; loop lashing - the wire lashing is passed around the load in a loop and attached to the clamp at both ends, often used for drum or rolled loads; multi-point lashing - a separate wire lashing is pulled on each side of the load [2].

Each tie is tightened to a predetermined force (this force is controlled by a tensioner). Wire ties must be made of rustproof material. Ties must have a load-bearing capacity appropriate to the weight of the load. Soft protective pads are used to prevent damage to the surface during fastening. Wire ties are constantly checked - there must be no rust, cracks, deformation. Each fastening point must comply with standards.

The main part.

Method 1. The tensioner and the tie are made of a continuous wire rope. One end of the wire (Figure 1) is wound 2 times around the wagon (cargo) coupling device and is tightened by twisting it at least 2 times around the rope. The other end of the wire is passed sequentially through the cargo and wagon coupling devices, forming the required amount of rope in the tensioner or tie. The last end of the rope is tightened in the wagon or cargo coupling device in the above manner, that is, it is wrapped around one or more tensioner ropes. The length of the wire ends left for tightening must be at least 500 mm. When tightening, the direction of the wire ends should be chosen so that the fastening force does not weaken during the subsequent turning of the tensioner. The tensioner or tie ropes are tightened by pulling and twisting using a metal beam or other device [3].

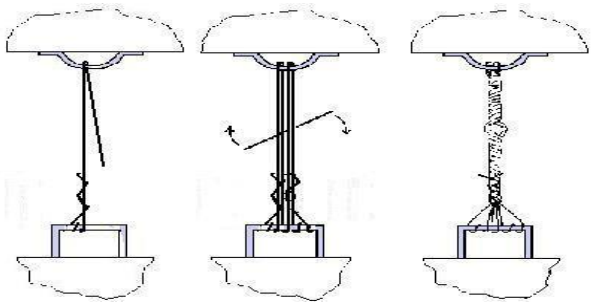

Figure 1. Installing the tensioner and fasteners according to method 1

Method 2. The tensioner and the tie are made of a continuous wire rope. The wire rope is passed through the wagon (load) tie, folded over it and formed into two equal lengths of rope (Figure 2). Then it is sequentially passed through the tie of this load and wagon, forming the required amount of rope on the tensioner or tie. The last wagon (load) tie is turned around 2 times, then the wire ends are individually wrapped around one or more tensioner (tie) ropes. The length of the wire ends left for reinforcement must be at least 500 mm. The requirements for reinforcing the wire ends and tightening the tensioner or tie by twisting are the same as in Method 1 [4].

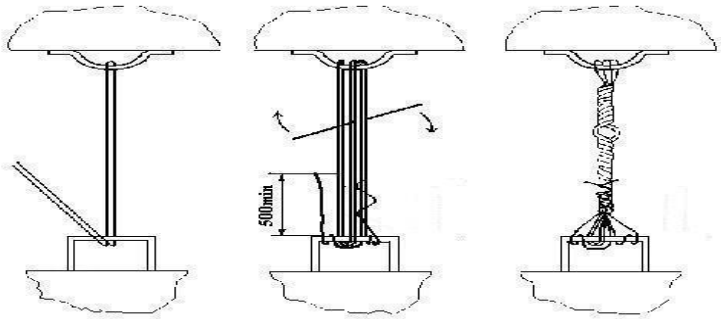

Figure 2. Installing the tensioner and fasteners according to method 2

Method 3. The tensioner and the tie are made using two continuous wire strands (Figure 3). They are passed through the tie, folded, and one end of at least 500 mm in length is left for reinforcement. Each strand is wound 2 times around the wagon (load) tie and secured by twisting it at least 2 times. After the required amount of strand is formed on the tensioner or tie, the end is wound 2 more times around the wagon (load) tie. Then each wire end is individually wrapped around one or more tensioner (tie) strands. The length of the wire ends left for reinforcement must be at least 500 mm. The requirements for reinforcing the wire ends and tightening the tensioner or tie by twisting are the same as in Method 1 [5].

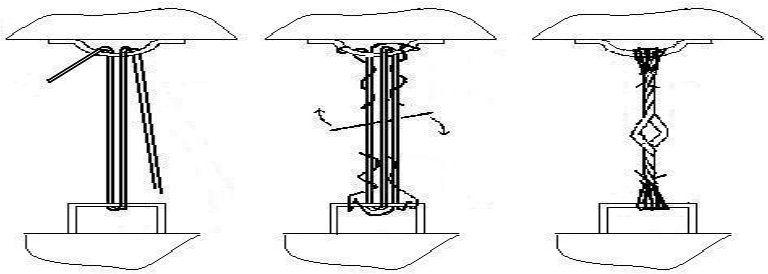

Figure 3. Installing the tensioner and fasteners according to method 3

The tightening of the towbar and ties must be uniform along their entire length. The tightening device must be installed at the central point between the wagon and the load fastening devices (or the wagon fastening device and the bending point on the load, the bending points on the load).

If the length of the towbar or tie is more than 1.5 meters, it is allowed to tighten it in 2 places, but it is not allowed to loosen the previously tightened parts.

The ties must be screwed into the opposite webs in at least 2 places.

In towbars and ties where there are folds in the webs on the load, the sections with a length of more than 300 mm between the folds must be additionally screwed into [6].

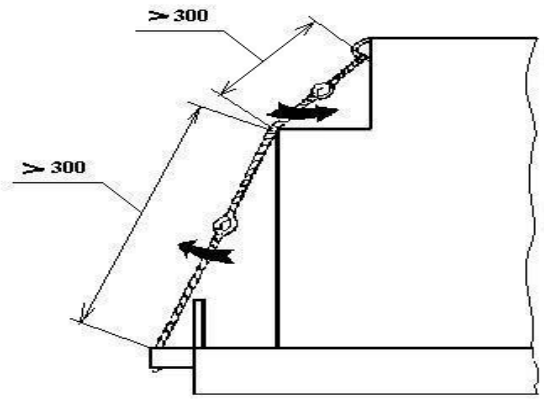

Figure 4. Procedure for tightening the fasteners when there is a bend

When calculating tensioners, ties, compression devices and fastening elements, the number of wire strands, the working cross-sectional area and the permissible load are determined without taking into account the reinforcement ends (Figure 5). The number of strands in tensioners, ties and compression devices must be even [7].

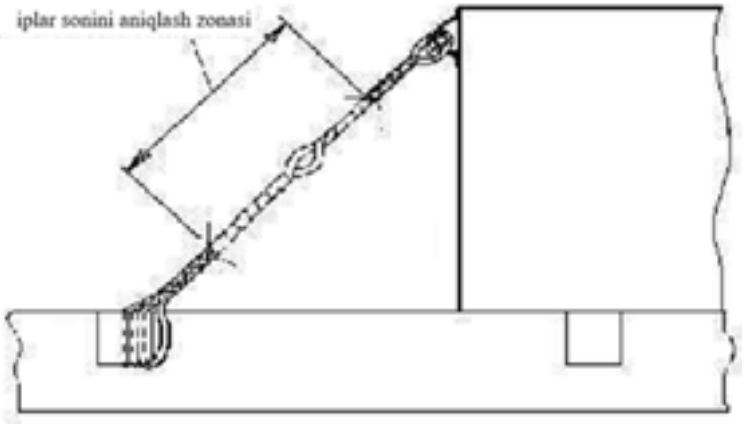

Figure 5. Determining the number of wire strands in tensioners, binders, and compression devices

When the wire diameter is 6 mm or more, the number of wire strands of the tensioner, tie, fastening and clamping devices should not exceed 8. When the wagon is fastened with a load capable of relatively elastic oscillation (for example, spring-loaded), contact between the tensioner and fasteners is not allowed. When using wire fastening devices, it is allowed to replace the specified wire diameter with another diameter, provided that the strength of the fastening device is ensured in accordance with Table 1 [8].

Table 1.

Compatibility of wire fasteners with cross-sectional area

The amount of 6 mm diameter wire ropes that need to be replaced	The corresponding number of wire strands of different diameters								
	4,0	4,5	5,0	5,5	6,3	6,5	7,0	7,5	8,0
2	6	4	4	4	2	2	2	2	2
4	-	8	6	6	4	4	4	4	4
6	-	-	8	8	6	6	6	4	4
8	-	-	-	-	8	8	6	6	6

For the methods of placing and securing cargo provided for in these technical conditions (TU), as well as in NTU and MTU, it is allowed to replace wire and combined tensioners, ties and fasteners with cable tensioners, ties and fasteners.

The cable parts of cable pullers, tie-downs and combination pullers are made from a continuous piece of cable, using cable clamps and tensioning devices – turnbuckles [9].

For the manufacture of cable tensioners, ties and fasteners, double-stranded steel cables with a diameter of at least 5 mm and a breaking strength of not less than 1320 kgf are used. The technical characteristics of the cable used must comply with international or national standards. The diameter of the cable used instead of tensioners, ties and fasteners made of wire with a diameter of 6 mm is accepted in accordance with Table 2.

Table 2.

Replacing tensioners, ties and fasteners made of 6 mm diameter wire with tensioners, ties and fasteners made of steel cables

The amount of 6 mm diameter wire ropes that need to be replaced with rope	Minimum wire diameter for tensioners, ties and fasteners made of steel wire ropes, mm
2	5
4	6,4
6	8,0
8	9,1

The diameter of the cable (wing) is determined as its largest cross-sectional dimension. The connection of the cable branches is carried out using cable clamps (Figure 6). The technical characteristics of the cable clamps must comply with the requirements of international or national standards.

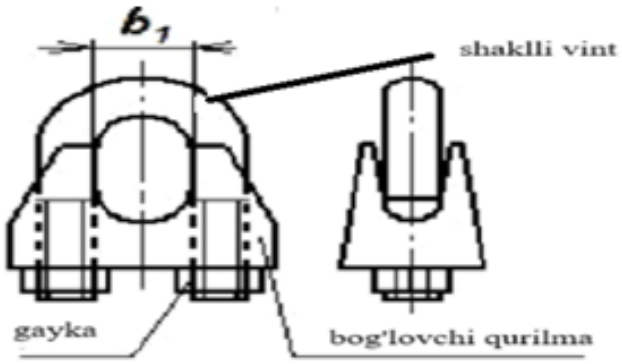

Figure 6. Cable clamp

Table 3.
Choosing the diameter and number of ropes

Wire rope (wing) diameter, mm	Minimum number of clamps, pcs.	Clamping force, N m / kgf m
5	3	2,0/0,2
6,5	3	3,5/0,4
8	4	4,4/0,5
10	4	6,6/0,7
12	4	14,8/1,5
13	4	24,3/2,4
14	4	24,3/2,4
16	4	36,0/3,6
19	5	50,0/5,0
22	5	79,0/7,9

Cable clamps are selected according to the diameter of the cable (span) used. The dimension b_1 should be 1.0 - 1.5 mm larger than the cable diameter. The number of cable clamps to be installed depends on the cable diameter and is determined in accordance with Table 3.

The surface of the cable clamps should not have any cracks, lines or cracks. The clamps should also have clearly visible markings. It is not allowed to change the shape of the clamps by welding, heating or bending. Cable tensioners (connectors) should be of the closed type only (Figure 7). ring - ring, clamp - clamp, clamp - clamp, clamp - ring.

The technical characteristics of the fasteners must comply with the requirements of international or national standards.

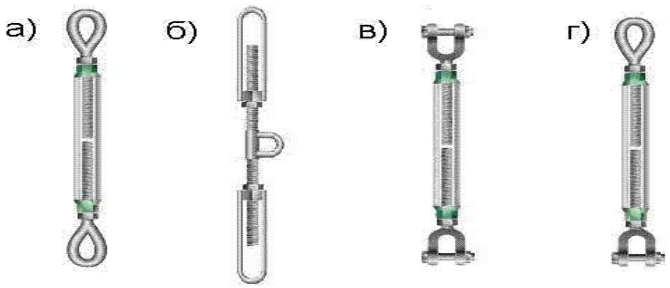

Figure 7. Connection design options:
a – ring (hole) – ring (hole); b – clamp – clamp; c – clamp – clamp;
d – ring (hole) – clamp

The fasteners used must have locknuts that prevent spontaneous loosening.

When installing cable tensioners and ties, the selection of ties is carried out based on their permissible working load, which should not be less than the breaking strength of the cable used in this tensioner or tie.

The cables (wings) should not have broken wires. The ends of the cables should not spread out. To prevent this, before cutting the cable, it is tied with a polymer tape at least 40 mm long and cut in the middle.

When fastening cable tensioners to the fastening devices of the wagon or to cargo devices with sharp edges, to prevent the tensioners from fraying, tensioners reinforced with shoes are used or a thick elastic gasket material is additionally placed between the tensioner and the sharp edge of the fastening device.

Cable clamps should be installed evenly distributed along the connection section of the cable branches (Figure 8).

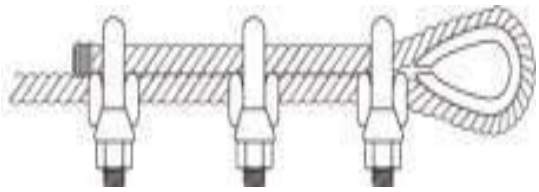

Figure 8. Installing cable clamps

When installing cable clamps, their nuts are initially tightened with a torque 20-30% lower than the values given in Table 22. The final tightening is carried out after the tightening and tying process using a tie.

When forming the tie and ties, the ties should initially be maximally loosened.

Cable tie and ties are installed using the following methods (Figure 9).

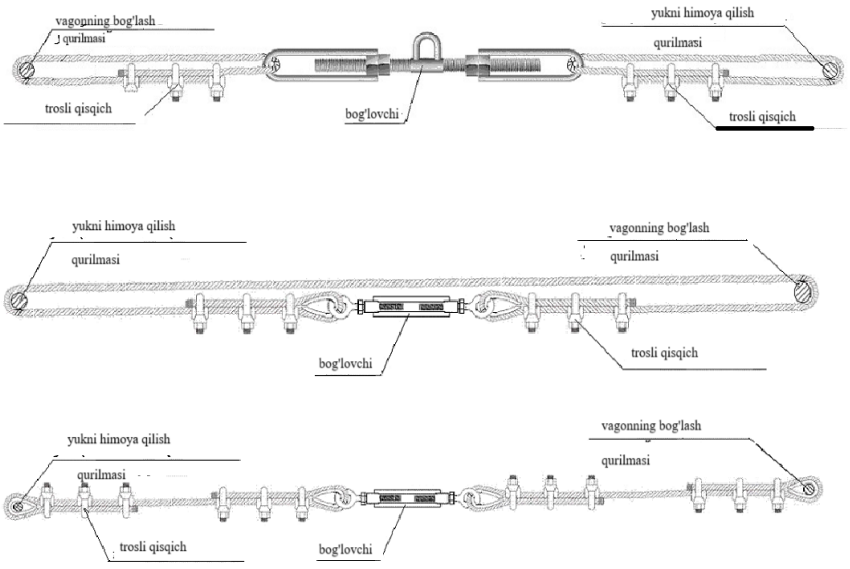

Figure 9. Cable ties and ties

Straps (Figure 1.20) are formed from a continuous wire strand. The strands of the strap are twisted to the point of tension using a crowbar or other device. The strength of the strap should not be less than the strength of the components of the fastening tool to which it is attached.

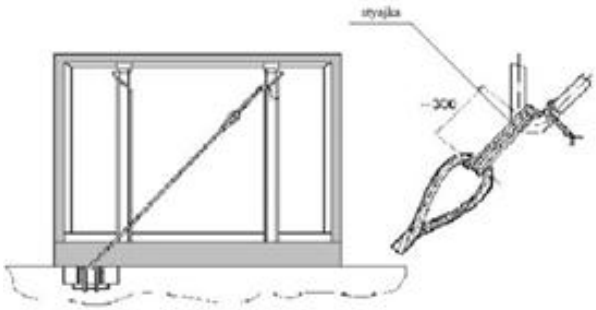

Figure 10. Method of fastening wire ends inside the clamp

The lashing is formed from a continuous wire rope. The number of wire ropes in the lashing is determined by calculation or experiment. The wire ropes in the lashing should be tightly packed together and arranged in a plane perpendicular to the longitudinal axis of the bundle. The ends of the wire ropes are twisted together at least five times and tightened until all the lashing threads are tightened (Figure 11).

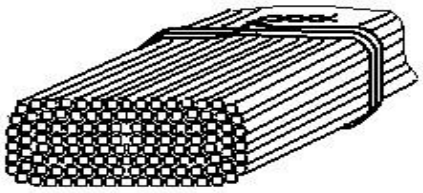

Figure 11. Installing the tie

Wooden fasteners. Wooden fasteners are made of wood materials of grade no lower than the third in accordance with the requirements of GOST 8486 and GOST 2695. Birch, aspen, linden and beech wood are allowed to be used only for the manufacture of additional supports and pads that work in compression and to which supports, support beams and other fastening elements are not attached. These types of wood are prohibited from being used in the manufacture of supports, support beams and reinforcing beams. In addition, it is not allowed to manufacture supports and reinforcing beams from any type of dried or rotten wood. The dimensions of wooden fasteners (additional supports, pads, support and reinforcing beams) are indicated in these technical specifications (TSh) in the following order: height × width × length or height × width.

Use of additional supports and pads. Additional supports and pads are used for the following purposes: To increase the load bearing surface on the wagon floor, to ensure the stability of the load row, to enable mechanized loading and unloading, to protect the load and wagon bearing surface from damage, to create a basis for installing reinforcing and supporting beams.

If the above conditions are met without the use of additional supports and pads, their installation is not mandatory. The height of the additional supports and pads must be at least 25 mm. Their width must be at least 80 mm, and the width to height ratio must be at least 1.5.

Conclusion. The length of the additional supports placed transversely on the wagon should be equal to the width of the wagon body, and the length of the pads should not be less than the width of the load. The transverse pads used to separate the load row are placed on top of each other and are placed at a distance of at least 500 mm from the load end and at least 300 mm from the side supports.

References:

1. Bozorov R.Sh., Saidivaliev Sh.U., Shermatov E.S., Boboev D.Sh. Research on establishing the optimal number of platforms in a container train. Transport: science, technology, management. Scientific information collection. 2022. No. 5. P. 24-28.
2. Diyor Shomuratovich Boboev, Ramazon Shamilovich Bozorov, Elbek Sirojiddinovich Shermatov. Choose types of transport and improve their cooperation in the process of delivery of cargo. " Economy and society " №5(84), 2021, 98-105.
3. Ziyoda Mukhamedova, Diyor Boboev. Research on improving the modern transport system in the process of cargo delivery. Railway transport: current issues and innovations, 3(1), 2022/3/28, 15–24.
4. Jamol Shikhnazarov, Diyor Boboev. Analysis of the effective use of wagons in the process of freight delivery in railway transport. Academic research in educational sciences, 2(5), 2021, 210-216.
5. Jamol Shihnazarov, Diyor Boboev, Elbek Shermatov. Investigation of the longitudinal forces acting during the transportation of flat cargo on sites in the road profiles with a slope of railway transport. AIP Conference Proceedings, 2432(1), 2022/6/16, 030112.
6. Diyor Shomurotovich Boboyev. Organization of innovative technology of cargo transportation through counter-trailer terminals. Innovative research in the modern world: Theory and practice, 1(12), 2022/4/15, 11-19.
7. Z.G. Muhamedova, D.Sh. Boboyev. Research on the improvement of modern transportation systems in the process of cargo delivery. Railway Transport,1(16),2022,16-19.
8. Zhamshid Renatovich Kobulov, Zhamshid Saifullaevich Barotov, Diyor Shomurotovich Boboev. Improving the freight transportation system on rail transport with wagon shipments. Current issues in economics and management: science and practice. Kriulinsky readings. Collection of materials of the All-Russian scientific and practical conference. Kursk, 15.05.2021, 199-203.
9. Jamshid Renatovich Kobulov, Jamshid Sayfullayevich Barotov, Diyor Shomurotovich Boboyev. Improvement of the cooling system during storage in the process of agricultural products. Journal of Tashkent Institute of Railway Engineers. 16(2), 2020, 200-204.