

## METHODS OF INSTALLATION OF CARGO SECURING EQUIPMENT IN RAILWAY TRANSPORT

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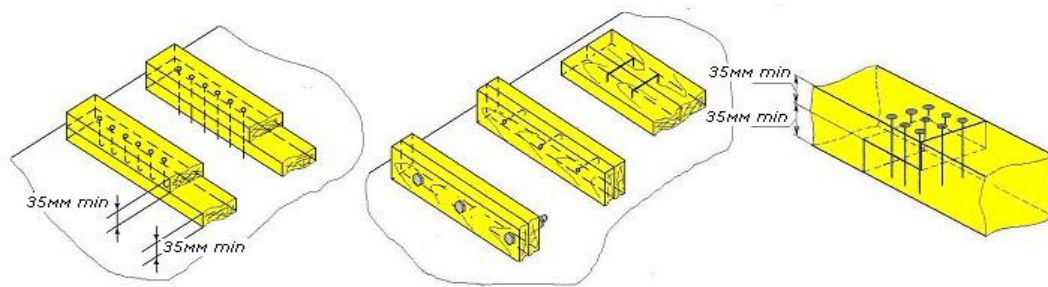
**Abstract:** The article shows the suitability of fastening tools in the process of securing cargo in railway transport and the methods of their installation. Fastening tools for safe transportation of cargo are studied, measures and proposals for their selection are developed. In addition, the technical 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.**

Methods of securing cargo in railway transport are used to prevent movement, shifting, overturning or damage to cargo. These methods are selected depending on the type of cargo, type of wagon and transportation conditions. Reliable and safe delivery of cargo in railway transport, prevention of their movement, overturning or damage during movement depends on the selection of the correct cargo securing means and methods of their effective installation. Depending on the type, shape, weight and transportation conditions of the cargo, methods such as lashing with straps, securing with poles and slats, packing, gluing or screwing are used. An individual securing scheme is developed for each type of cargo, and these works are carried out in accordance with current technical requirements and railway transport rules. Properly performed securing works increase not only the safety of cargo, but also the efficiency of the entire transport process [1].

### **Main part.**

Additional supports and pads are allowed to be made of several parts in the following cases (Fig. 1). In addition, the overall cross-sectional dimensions of the combined additional supports and pads must meet the above requirements. The height of the components of the combined supports and pads in width and length must be the same along the entire length [2].



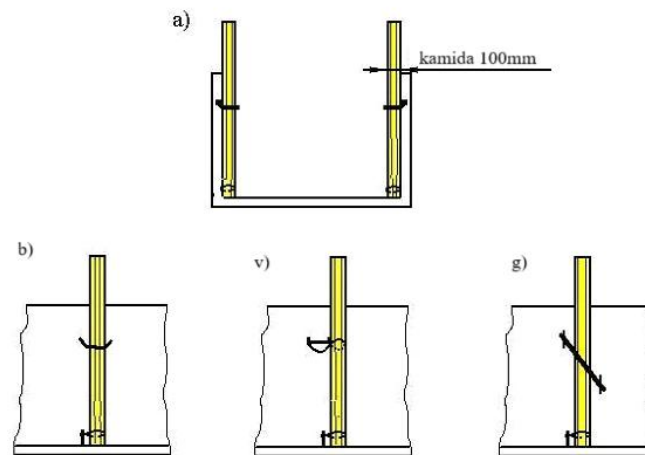
**Figure 1. Variants of joint supports and pads**

If the method of loading and securing the load involves fastening the supports to the wagon floor, then additional support parts must be fastened in the following order: Each part must be fastened to the wagon floor with at least 75% of the required number of nails.

It is allowed to use supports and pads made of various metal profiles, reinforced concrete and other materials, if this does not lead to damage to the load.

Wooden supports. Wooden supports placed on the side and front parts (coated or not) are made of round wood materials or straight-grained wooden boards of not lower than the second grade (in accordance with the requirements of GOST 8486 and GOST 2695). Supports made of round wood materials: Must be 120–140 mm thick in the lower part, and at least 90 mm thick in the upper part. Supports made of wooden materials: The cross-section must be at least 90 × 120 mm. Supports installed on gondolas: The upper reinforcing beam must be at least 100 mm thick (Figure 2a). Methods of installing side supports [3].

Method 1: The support is installed on the floor of the semi-trailer and passed through a special hook. The support is fastened to the lower tie with a steel wire no thinner than 5 mm (Fig. 2b). The wire is wound twice around the support and at the same time passed through the hole in the lower tie. The ends of the wire are twisted together at least three times in the tie. The support can also be secured using a double-layered wire rope. In this case: The wire is passed through the hole in the lower tie. It is wound once around the support. The ends of the wire are twisted together at least three times [4].



**Figure 2. Installing side supports inside a gondola**

Method 2. The support is installed on the floor of the semi-trailer, tightly placed on the forest clamp and lower tie-down device, and secured with a wire with a diameter of at least 5 mm in a similar manner to Method 1 (Figure 2c).

Method 3. In semi-trailers with forest clamps installed at an angle of 300, the support is inserted into the clamp at an angle and then placed in an upright position. The lower end of the support is tightly placed in the lower coupling and secured according to Method 1 (Figure 2g).

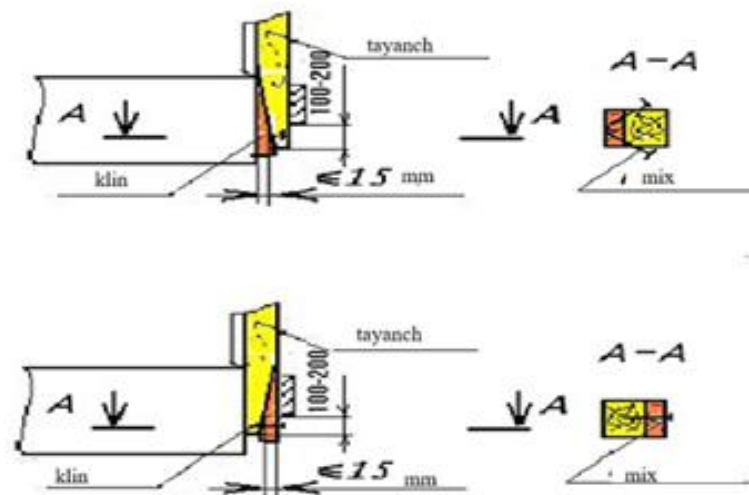
The height of the supports above the floor of the gondola should be as follows:

2760 mm - within the main loading gauge;

3260 mm - within the zonal loading gauge.

On the platforms, the supports are mounted on special side and front support brackets. The supports are made of round wooden materials with the thicker side facing down. The lower part of the support should be milled to match the internal dimensions of the bracket. The support should protrude 100-200 mm below the lower edge of the bracket. The gap between the support and the bracket should not exceed 15 mm only at the level of the lower edge of the bracket. In this case, the support should be additionally fixed with nails (Fig. 3).

The nail is driven in tightly from below and fixed to the support as follows: If the nail is placed between the support and the frame beam, then with two nails 80-90 mm long; If the nail is placed between the support and the bracket, then with one nail [5].

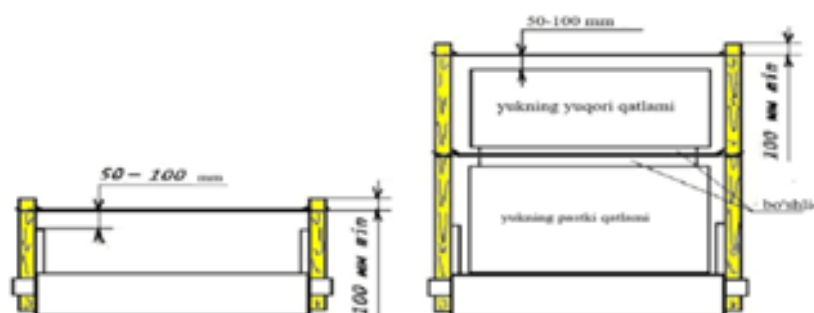


**Figure 3. Securing the platform support to the support bracket**

Short supports are installed to increase the load-bearing capacity of the platform sides. The height of the short supports above the platform floor should be at least 100 mm higher than the height of the side being secured, and at least 150 mm if the supports are secured with tie-down rings. High supports are used to secure loads that are significantly higher than the height of the platform sides [6].

If the load is placed within the main load dimension, the height of the side supports above the platform floor should not exceed 2800 mm.

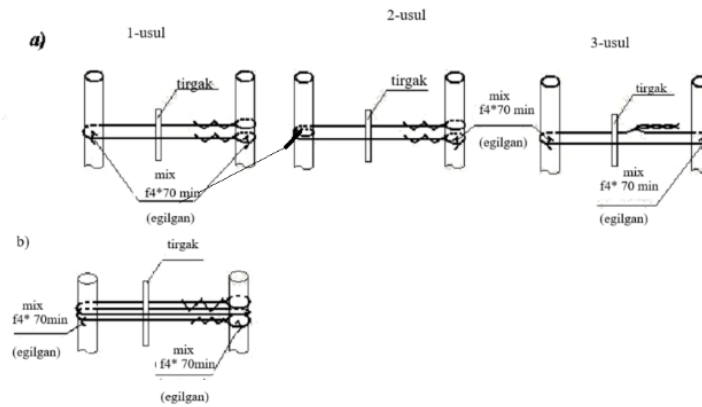
To increase the load-bearing capacity of the fastening, the opposing supports are secured with tie-down rings in the upper part, and if necessary, in the upper and middle parts (Fig. 4).



**Figure 4. Connecting the supports on the platform**

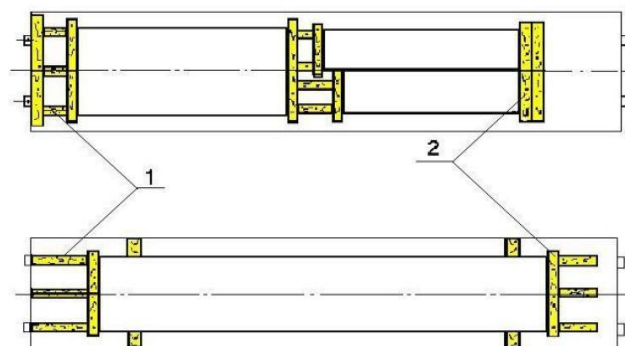
The fastening of short supports and the upper fastening of high supports should be made in such a way that the distance from the fastening to the load surface is 50-100 mm, and the distance from the fastening to the upper edge of the supports is at least 100 mm [7].

The middle fastening of high supports should not touch the load as much as possible. Methods of fastening wooden supports are shown in Figure 5.



**Figure 5. Methods of tying wooden supports**

Support and distribution beams, distribution frames. Support and distribution beams, distribution frames are used to protect cargo from longitudinal and transverse movement of the wagon, as well as to transfer inertia forces from the cargo to the elements of the wagon body (side and front boards of the platform, front barrier, corner supports, lower link of the half-car body). The beams must be made of coniferous wood materials, at least of the third grade, and manufactured in accordance with GOST 8486. It is allowed to use products made of other materials as support and distribution beams and frames, the strength of which is confirmed by regulatory documents. The dimensions of wooden beams are accepted in accordance with the standards of this section. Wooden elements are connected to the distribution frames using nails, construction staples with a diameter of at least 6 mm, plates and other fastening details. The height of the support and distribution beams must be at least 50 mm. The width of the support beam must be at least 1 time greater than its height. Standard schemes for installing support and distribution beams are shown in Figure 6 [8].



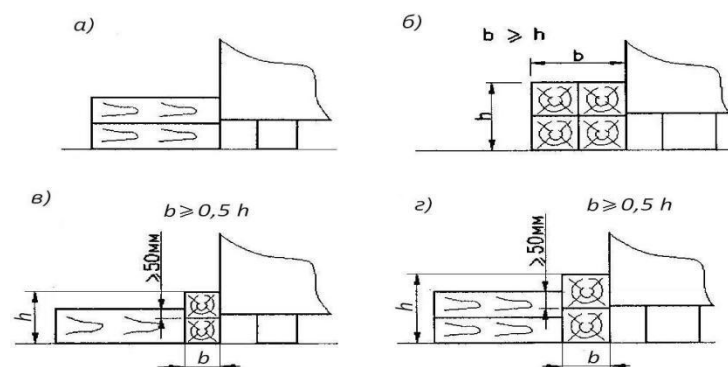
**Figure 6. Standard installation schemes for support and distribution beams**

1 – Spreader beam; 2 – Support beam.

If, due to the design features of the semi-trailer, it is not possible to install a support beam along the entire width of the body between the load and the front

boundary barrier of the semi-trailer, it may consist of three parts of the same cross-section.

Support beams higher than 200 mm are allowed to be made of two parts (Fig. 7). In this case: The height of each part must be at least 50 mm. The width must be at least 100 mm. If the ratio of the width to the total height ( $w/h$ ) of the beam located along the length is less than 0.5, support or distribution beams (which can also be structural in height) must be placed perpendicular to it. The total height of these beams must be at least 50 mm higher than the lower part of the structural beam. The lower parts of the structural beams are nailed to the floor with the required number of nails to securely fix the load, and the upper parts are fastened to the lower ones with the same number of nails. It is also allowed to make support beams structurally identical in both height and width at the same time, provided that the conditions described above are met [9].



**Figure 7. Variants of structural support beams by height**

Nails according to GOST 283 are used to fasten wooden pallets, support and distribution beams and frames to the wooden floor covering of the wagon, as well as to connect wooden fastening elements to each other. The dimensions of these nails are given in Table 1.

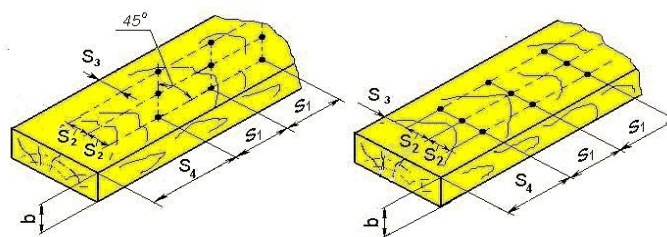
**Table 1.**

**Permitted nail sizes**

| Diameter of the nail, mm | Length, mm | Hat diameter, mm |
|--------------------------|------------|------------------|
| 4,0                      | 100-120    | 7,5              |
| 5,0                      | 100-150    | 9,0              |
| 6,0                      | 150-200    | 11,0             |
| 8,0                      | 250        | 14,0             |

The nail placement diagrams for attaching wooden fasteners to the wagon floor are shown in Figure 8.





**Figure 8. Nail placement schemes**

The minimum permissible nail spacings when attaching wooden fasteners to the floor, as well as the distances between nails and the edges of wooden elements, depending on the thickness of these elements, are given in Table 2.

**Table 2.**

**Minimum permissible distances between nails, as well as distances between nails and the edges of wooden elements**

| Distance determination | Minimum permissible distances according to element thickness $b$ , mm |        |
|------------------------|---|--------|
|                        | $\leq 50$   | $> 50$ |
| S1                     | 125   | 90     |
| S <sub>2</sub>         | 30  | 30     |
| S3                     | 30  | 30     |
| S4                     | 90  | 90     |

Rules and requirements for fastening wooden fasteners to the floor. When fastening fasteners (or parts thereof) are installed on the floor of a wagon, the nails must be driven perpendicular to the floor. The axes of the nails must not be bent. The length of the nails must be 50-60 mm longer than the height of the fastener.

The formation of cracks when driving nails into the fasteners is not allowed. If necessary, before driving nails, nail holes can be pre-drilled in the fasteners, but the diameter of the hole should not exceed 85% of the nail diameter. It is not allowed to drill holes in the planks of the platform floor. Nails driven into the cracks between the planks of the platform floor are not included in the total number of nails.

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