ORGANISATION FOR COOPERATION BETWEEN RAILWAYS (OSJD)

Second Edition

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Note:

- All provisions of this Leaflet are binding on the following countries:
  the Republic of Belarus in the case of stowage and fastening of goods in containers on its territory, the Republic of Moldova in the case of carriage of export goods, the Russian Federation, and Ukraine (for Ukrainian consignors),
- All provisions of this Leaflet are recommendations for the following countries: the Islamic Republic of Afghanistan, the Republic of Bulgaria, Hungry, the Socialist Republic of Vietnam, Georgia, the Islamic Republic of Iran, the Republic of Kazakhstan, the Democratic People's Republic of Korea, the Republic of Latvia, the Republic of Lithuania, Mongolia, the Republic of Poland, the Slovak Republic, the Republic of Tadzhikistan, the Republic of Turkmenistan, the Republic of Uzbekistan and the Republic of Estonia;
- For:
  the Republic of Azerbaijan - Section 1 is binding, Sections 2 – 7 are recommendations;
  the People's Republic of China - Sections 1.1, 1.2, 1.3 are binding (with the exception of the sentence „The static load exerted by the load unit on the floor of the container must not exceed 1 kgf/см^2"). The sentence „The static load exerted by the load unit on the floor of the container must not exceed 1 kgf/см^2" (taken from Section 1.3 and Sections 2 – 7) is a recommendation.

STOWAGE AND FASTENING OF GOODS IN HIGH CAPACITY CONTAINERS

CONTENTS

STOWAGE AND FASTENING OF GOODS IN HIGH CAPACITY CONTAINERS

1. General provisions

1.1. This leaflet describes how the goods are stowed and fastened in 20 foot, 30 foot, 40 foot and 45 foot high capacity containers complying with ISO standards.

1.2. Methods of stowage and fastening of goods mentioned in this Leaflet take account of sizes and properties of the goods to be stowed and fastened.

1.3. In compliance with standard of ISO 1496-1:2013 Series 1 freight containers – Specification and testing – Part 1: General cargo containers for general purposes the sidewalls of general purpose containers (Series 1) shall withstand a load distributed equally across the entire surface of the side, which is equal to 60 percent of the container-carrying capacity and the end walls as well as shall withstand an uniformly distributed load, which is equal to 40 percent of the container-carrying capacity. The load exerted by each wheel of the most heavily laden axle of the forklift equipped with pneumatic tyres and distributed across the floor of the container shall not exceed 3,63 tonnes (36,3 kH) at every point. The fastening means, which are located on the floor of the container at the joints of walls, shall withstand a load not exceeding 1000 kgf (10kH); the fastening means, which are located on the sidewalls and top beams shall withstand a load not exceeding 500 kgf (5 kH).

The static load exerted by the load unit on the floor of the container must not exceed 1 kgf/см^2.

Strength characteristics of the structural components of the container and fastening means, which differ from the characteristics mentioned in this Leaflet, may be taken into consideration if technical specifications are available.

2. General requirements at the stowage and fastening of goods in high capacity containers

2.1. The following requirements shall be met when stowing goods in the container:

– center of gravity of the cargo should be at the intersection of longitudinal and transverse median planes of the container. If this requirement is not fulfilled due to objective reasons then the center of gravity may be shifted in a longitudinal direction. In the case of 40 foot and 45 foot containers the center of gravity may be shifted by up to 1200 mm; in the case of 20 foot containers the center of gravity may be shifted by up to 900 mm; in the case of 30 foot containers the center of gravity may be shifted by up to 100 mm. The position of the center of gravity shall be determined in compliance with Chapter 1 of Technical regulations for stowing and fastening goods (Annex 3 to SMGS, hereinafter referred as TR) and according to equations 1 and 2, where: L – Inner length of container, container B – Inner width of container; l and b – distances from end walls and sidewalls to the center of gravity of the load unit);

– height of the center of gravity from the floor of the container must not exceed half of the internal height of the container. Height of the center of gravity can be calculated as follows:

$$H_{цт}^{o} = \frac{Q_{гр1}\, h_{цт1} + Q_{гр2}\, h_{цт2} + \ldots + Q_{грn}\, h_{цт\,n}}{Q_{гр}^{o}} \text{ (mm)}, \qquad \textbf{(1)}$$

where $Q_{гр1}, Q_{гр2}, \ldots Q_{грn}$ – weight of load unit, in tonnes;

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$Q_{гр}^{o} = Q_{гр1} + Q_{гр2} + \ldots + Q_{грn}$ – total weight of cargo in the container;

$h_{цт2}$, ... $h_{цт\,n}$ – height of the center of gravity from the floor of the container, mm;

– the goods shall be stowed in the container next to each other and close to the sidewalls and end walls with maximal use of the container's floor area;

– the gaps between load units and packages, which are needed for smooth loading and unloading may be left unfilled as long as the total length of gap in any longitudinal direction doesn't exceed 150 mm;

– the most heavy load units shall be stowed on the lower deck when stowing goods in layers. The durable packaging shall sustain a load exerted by the goods stowed on upper decks;

– the goods shall be stacked in such a way as to use the upper decks to the full extent. If this condition could not be met then the goods located on the upper deck shall be fastened (See point 3.4 of this Leaflet);

– the position of the load units placed in layers may be changed in order to ensure the minimum longitudinal and traverse gaps between them. For that reason the longest side of the load unit may be moved in longitudinal and traverse direction as long as the durable packaging allows doing that;

– the goods may be stowed on layer pads of required thickness in order to ensure the smooth loading and unloading. The thickness of layer pads should be enough to sustain a load distributed on the container's floor;

– the dunnage materials (protective facilities) may be used between the goods and container in order to prevent the damage of container and/or goods;

– the gaps between cargo stacks and sidewalls and end walls of the container must be filled unless otherwise provided by this Leaflet;

– each load unit, which is stowed separately, must be fastened;

– the methods and means for fastening of goods shall prevent the load from shifting and overturning in each direction;

– the goods shall be protected against continuous shifting by using one type fastening mean. If necessary, different types of fastening means may be applied in order to prevent the load from shifting in one direction as long as their elasticity features (stress strain behavior) are similar;

– when the container is transported by different modes of transport then the load-bearing capacity of the fastening equipment shall be calculated on the basis of a worst case taking into account the worst possible combination of inertial loads typical for all modes of transport;

– the anti-slip materials (layer pads) may be used to increase friction between the container's floor and cargo and/or between layers of the stack;

– the tensioning systems (stretching or wrapping around systems) may be used only in combination with suitable fastening devices of the container;

– applicable method of the installation of the fastening means shall not cause damage to goods or its packaging and container;

– cargo restraint straps and web straps shall not be tied around the fastening devices of the container in the form of a knot;

– the container's floor must not be nailed or screwed down when using nails, self-drilling bolts or screws and timber dogs.

2.2. Main calculation principles concerning the fastening of goods

This point describes the principles to be taken into consideration when fastening the goods, which comply with the provisions of the Chapter 1 of the technical regulations (TR).

2.2.1. The total load bearing capacity of the fastening means shall not be less than the inertial force acting on the cargo in each direction and not absorbed through the friction in order to protect the cargo against the continuous shifting and/or overturning; as well as the total load bearing capacity shall be sufficient to produce the torque in order to absorb the tilting moment, produced by the inertial forces.

Inertial forces acting on the cargo and the friction forces protecting the cargo against the shifting shall be determined according to equations:

– in longitudinal direction

$$\mathbf{F_{пр} = Q_{гр}\ a_{пр}}\ (\text{тс}); \qquad \mathbf{(2)}$$

– in traverse direction

$$\mathbf{F_{п} = Q_{гр}\ a_{п}}\ (\text{тс}); \qquad \mathbf{(3)}$$

$$\mathbf{F_{тр} = Q_{гр}\ \mu(1-a_{в})}\ (\text{тс}), \qquad \mathbf{(4.1)}$$

where $\mathbf{Q_{гр}}$ – weight of the load unit (number of packages, stacks of cargo) to be fastened, in tonnes;

$\mathbf{a_{пр}, a_{п}, a_{в}}$ – longitudinal, traverse, vertical inertial force;

$\boldsymbol{\mu}$ – coefficient of friction between bearing surface of the cargo and load support: the container's floor when the cargo is located on the floor, the surface of the layer pads when the layer pads are used, (including devices for increase of friction), the surface of lower deck (when determining strength of fastening of goods located on upper decks of the stack).

The values of inertial forces to be taken into consideration for fastening of goods when transporting cargo by land, sea and rail, are listed in the Table 1.

Table 1

Mode of transport			**Inertial forces**			
			When determining strength of fastening in	**longitudinal, $a_{пр}$, тс/т**	**traverse, $a_{п}$, тс/т**	**vertical, $a_{в}$, тс/т**
Road transport*			longitudinal direction	0,8	–	0
			traverse direction	–	0,5	0
Rail transport**			longitudinal direction	1,0	–	0
			traverse direction	–	0,5	0,3
Sea transport*						
Standard values of wave height in regions	A	$H_{в} \leq 8$ m	longitudinal direction	0,3	–	0,5
			traverse direction	–	0,5	0
	B	$8\ \text{m} < H_{в} \leq 12\ \text{m}$	longitudinal direction	0,3	–	0,7
			traverse direction		0,7	0
	C	$H_{в} > 12$ m	longitudinal direction	0,4	–	0,8
			traverse direction	–	0,8	0

* Reference data.

** Based on the fact that the longitudinal inertial force is 1.0 тс/т only in the case of carriage without using sorters (longitudinal acceleration = 1.0 g).

The values of coefficient of friction are listed in the Table 2.

Table 2

Combination of materials of contact surfaces	**Values of coefficient of friction**
Wooden pallet and plywood	0,45
Steel boxes (metal boxes), crates and plywood	0,32
Steel, sheet metal and metal	0,3
Plastic pallet and plywood	0,2
Non-impregnated carton	
– carton	0,5
– wooden pallet	0,5
BIG-BAG and wooden pallet	0,4

The values of coefficient of friction, which are listed in the Table 2, may be applied when the fastening of goods fully ensures that the cargo cannot shift (for example in the case of use of spacing blocks, frames etc.). When the fastening of the goods allows that the goods can be moved slightly (for example in the case of use of elastic fastenings like air dunnage bags (pneumatic membranes) or straps or ropes) then for calculation shall be used 75 per cent of the values of coefficient of friction mentioned in the Table 2.

The other values of coefficient of friction may be used in compliance with requirements of point 11.3 of the Chapter 1 of TR with regard to other contact materials or under specific conditions of contact between the materials.

2.2.2. The total load bearing capacity of the fastening means to be needed to protect the cargo against the continuous shifting shall be determined according to:

$$\sum F^{i}_{пр/см} \geq (F_{пр} - F_{тр}) = Q_{гр}\,(a_{пр} - \mu(1-a_{в})) \text{ (тс)}; \qquad \textbf{(4.2)}$$

$$\sum F^{i}_{п/см} \geq (F_{п} - F_{тр}) = Q_{гр}\,(a_{п} - \mu(1-a_{в})) \text{ (тс)}, \qquad \textbf{(5)}$$

where $F^{i}_{пр/см}$, $\Delta F^{i}_{п/см}$ – load bearing capacity of the concrete fastening mean.

The actual load bearing capacity of materials to be used for the tensioning (stretching system) shall be determined depending on the materials and facilities used (for example quantity of wires, guy ropes, connecting elements) and values of inclination angles according to equation and in compliance with point 11.5.2 and figure 45 of the Chapter 1 of TR:

– in longitudinal direction:

$$F^{p}_{пр/см} = 2R_{p}\,(\mu \sin\alpha + \cos\alpha \cos\beta_{пр}) \text{ (тс)}; \qquad \textbf{(6)}$$

– in traverse direction:

$$F^{p}_{п/см} = 2R_{p}\,(\mu \sin\alpha + \cos\alpha \cos\beta_{п}) \text{ (тс)}, \qquad \textbf{(7)}$$

where R_p - the maximal load bearing capacity of one pair of tensioning (stretching) systems. In the case of use of additional components, for example, tighteners and closing devices, the minimal value of the maximal load bearing capacity of these components shall be taken into consideration. Stretching systems shall also comply with requirements of point 2.3.4 of this Leaflet.

α – angle of inclination of stretching systems to the container's floor;

$\beta_{пр}$, $\beta_{п}$ – angles between projection of stretching system on the container's floor and its longitudinal and traverse planes.

The actual load bearing capacity of materials to be used for the tensioning system (wrapping around system) shall be determined according to equation

$$\mathbf{F^{об} = 2\ R_{об}\ \mu\ \sin\ \alpha}\ (\text{тс}), \qquad \mathbf{(8)}$$

where $\mathbf{R_{об}}$ – the maximal load bearing capacity of tensioning system (wrapping around system), which has been designed in compliance with requirements of point 2.3.4 of this Leaflet.

The actual load bearing capacity of wooden beams, spacer frames, spacer construction shall be determined by loading conditions with regard to its elements (taking account of bending, compression load (pressure load) and squashing) and by the number of factors such as quantity and location of the means used. It can be determined according to equations:

– The actual load bearing capacity of one element (beam, board) being compressed (pressured) or squashed (figure 1)

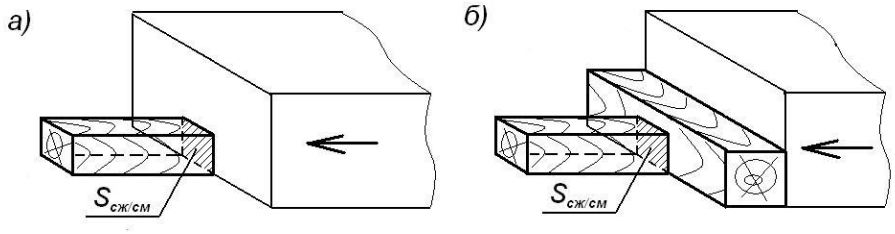

Figure 1

$$\mathbf{F^{бр}_{сж/см} = S\ [\sigma_{сж/см}],} \qquad \mathbf{(9)}$$

where **S** – area of element under load; $\mathbf{[\sigma_{сж/см}]}$ – permissible load value (to be determined in compliance with point 4.10 of the Chapter 1 of TR);

– The load bearing capacity of one element (beam, board) under load generating the bending moment (figure 2):

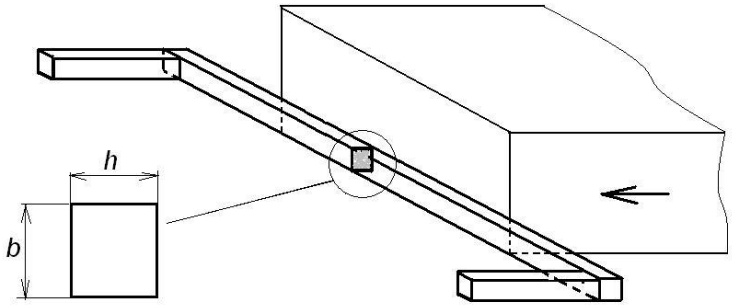

Figure 2

$$\mathbf{M^{бр}_{и} = W\ [\sigma_{и}],} \qquad \mathbf{(10)}$$

where $\mathbf{W = b\ h^2/6}$ – moment of resistance against bending of the rectangular cross-section;

$\mathbf{[\sigma_{и}]}$ – permissible load value (to be determined in compliance with point 4.10 of the Chapter 1 of TR);

The term "load bearing capacity of the air dunnage bag (pneumatic membrane)" refers to permissible load value depending on dimensions of gap to be filled with the air dunnage bag (pneumatic membrane)).

In the case of carriage of goods by rail the total load bearing capacity of air dunnage bags (pneumatic membranes) to be installed for fastening of goods in longitudinal and traverse directions shall be not less than (See Table 3 and Table 4) depending on weight of the goods (of the packages) to be fastened.

Table 3

Necessary load bearing capacity of air dunnage bags (pneumatic membranes) for fastening of goods in longitudinal direction

Weight of the goods (of the packages), in tonnes	**Values of the total load bearing capacity of air dunnage bags (pneumatic membranes) to be received (in tonnes)**
Up to including 5.	3
From more than 5 to including 10	7
From more than 10 to including 15	10
From more than 15 to including 20	15
From more than 20 to including 25	18
From more than 25 to including 30	20

Table 4

Necessary load bearing capacity of air dunnage bags (pneumatic membranes) for fastening of goods in traverse direction

Weight of the stacks (of the packages), in tonnes	**Values of the total load bearing capacity of air dunnage bags (pneumatic membranes) to be received (in tonnes)**
From more than 1,5 to including 3	1,5
From more than 3 to including 5	2,2
From more than 5 to including 10	3,3
From more than 10 to including 15	6,5

2.2.3. The coefficient of stability against stability shall be taken into consideration when deciding whether to fasten goods against overturning.

Proof of stability against overturning (figure 3):

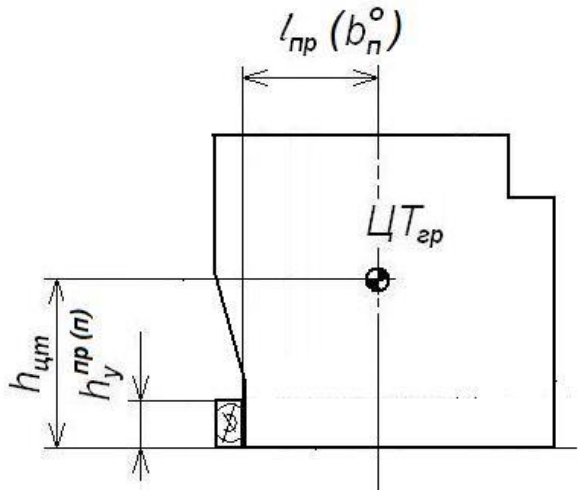

Figure 3

– in longitudinal direction

$$\eta_{пр} = \frac{l_{пр}^{о}(1-a_{в})}{a_{пр}\,(h_{цт} - h_{у}^{пр})} \geq 1{,}25;$$

– in traverse direction

$$\eta_{п} = \frac{b_{п}^{о}(1-a_{в})}{a_{п}\,(h_{цт} - h_{у}^{п})} \geq 1{,}25,$$

where $l_{пр}^{о}$, $b_{п}^{о}$ – shortest longitudinal and traverse distance from projection of center of gravity of the cargo on a horizontal plane until tipping point, in millimeters;

$h_{цт}$ – height of center of gravity of the cargo above the container's floor or above the surface of layer pads, in millimeters;

$h_{у}^{пр}$, $h_{у}^{п}$ – height of longitudinal and traverse bars from the container's floor or the surface of layer pads, in millimeters.

The load bearing capacity of fastening means to be needed to prevent the goods against overturning shall be determined as follows:

$$M_{кр(пр/п)} \geq M_{опр(пр/п)},$$

where $M_{опр(пр/п)}$ – tilting moment produced by the inertial longitudinal or traverse force acting on the cargo and not absorbed through the force of gravity;

$M_{кр(пр/п)}$ – restoring moment (moment of stability) produced by the force generated by the fastening means (the load bearing capacity of the fastening means preventing the cargo against overturning).

$$M_{опр(пр)} = F_{пр}\,(h_{цт} - h_{у}^{пр}) - Q_{гр}(1-a_{в})\,l_{пр}^{о} = Q_{гр}(\,a_{пр}(h_{цт} - h_{у}^{пр}) - (1-a_{в})l_{пр}^{о}) \qquad (11)$$

$$M_{опр(п)} = F_{п}\,(h_{цт} - h_{у}^{п}) - Q_{гр}\,(1-a_{в})b_{п}^{о} = Q_{гр}\,(a_{п}(h_{цт} - h_{у}^{п}) - (1-a_{в})b_{п}^{о}) \qquad (12)$$

The actual load bearing capacity of one pair of the tensioning systems (stretching systems) to be used for fastening of goods against overturning shall be determined in compliance with provisions of point 11.4.3, figure 43 of the Chapter 1 of TR and according to equations:

– in longitudinal direction

$$M^{р}_{(пр)} = 2R_{р}\,(h_{р}\cos\alpha\cos\beta_{пр} + l_{пр}^{р}\sin\alpha) \text{ (тс)}; \qquad (13)$$

– in traverse direction

$$M^{р}_{(п)} = 2R_{р}\,(h_{р}\cos\alpha\cos\beta_{п} + b_{п}^{р}\sin\alpha) \text{ (тс)} \qquad (14)$$

The actual load bearing capacity of tensioning system (wrapping around system) to be used for fastening of goods against overturning shall be determined in compliance with provisions of point 11.4.3, figure 44 of the Chapter 1 of TR and according to equation:

– in longitudinal direction

$$M^{об}_{(пр)} = 2R_o{}^o l_{пр}{}^{об} \sin\alpha; \quad (15)$$

– in traverse direction

$$M^{об}_{(п)} = 2R_o{}^o b_п{}^{об} \sin\alpha \quad (16)$$

The load bearing capacity of elements of spacer construction (Figure 4a) to be used for fastening of goods against overturning shall be determined according to equation:

– in longitudinal direction

$$F_{кр/о}{}^{пр} = \frac{Q_{гр}(a_{пр}(h_{цт} - h_у{}^{пр}) - (1-a_в)l_{пр}{}^o)}{h_{кр}} \text{ (тс)}, \quad (17)$$

where $h_{кр}$ – height of spacer bars of spacer construction preventing the goods against overturning;

– in traverse direction

$$F_{кр/о}{}^{п} = \frac{Q_{гр}(a_п(h_{цт} - h_у{}^{п}) - (1-a_в)b_п{}^o)}{h_{кр}} \text{ (тс)} \quad (18)$$

The elements of the spacer construction shall be defined in compliance with provisions of point 2.2.2 of this Leaflet.

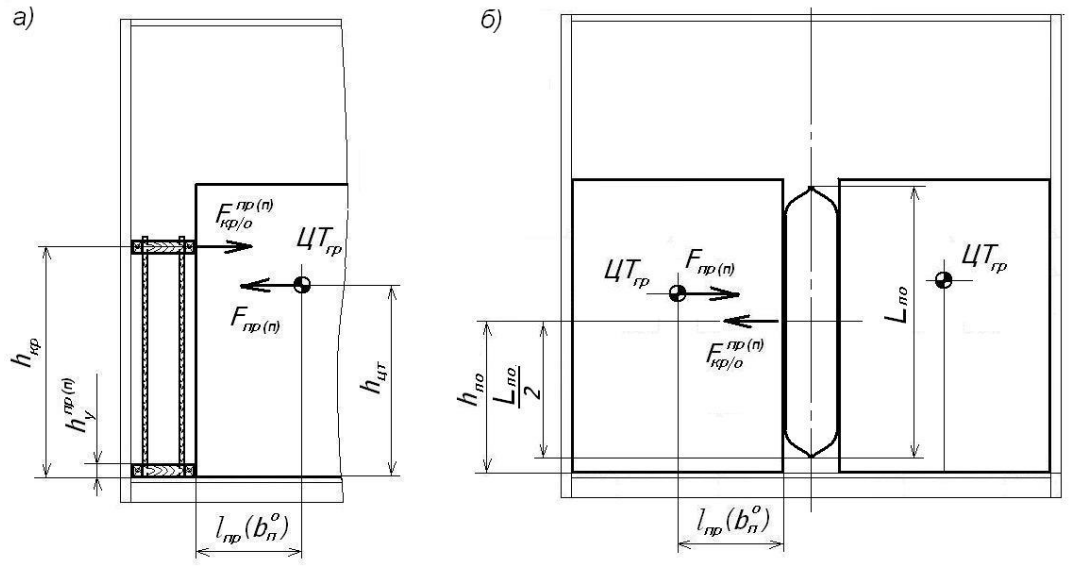

Figure 4 – Calculation scheme concerning the fastening of goods through
a – spacer construction
б – air dunnage bag (pneumatic membrane)

The load bearing capacity of the air dunnage bag (pneumatic membrane) (See figure 4б) to be used for fastening of goods against overturning shall be determined according to equations:

– in longitudinal direction

$$F_{по/о}^{пр} = \frac{F_{пр}\,(h_{цт} - h_{у}^{пр}) - Q_{гр}\,l_{пр}^{о}}{h_{по}}\ (тс), \qquad \textbf{(19)}$$

where $h_{по}$ – height of the center of the contact area between the air dunnage bag (pneumatic membrane) and the cargo;

– in traverse direction

$$F_{кр/о}^{п} = \frac{1{,}25F_{п}\,(h_{цт} - h_{у}^{п}) - Q_{гр}\,b_{п}^{о}}{h_{по}}\ (тс) \qquad \textbf{(20)}$$

2.3. Main fastening means

2.3.1. Timber materials (boards, beams), wood materials (shields, spacer frames, spacer constructions, plywood sheets, empty pallets) are used for fastening of goods. They are inserted in the gaps between the goods and the walls of the container, between packages, between stacks and parts of stack in order to balance the load and prevent the stack from collapsing. They can also be used as dunnage for the location of goods on upper decks (upper layers of the stack) as well as means for separation of goods which can damage themselves.

The permissible load value shall be determined in compliance with provisions of the Chapter 1 of TR when using wood materials as fastening means.

The spacer frames and spacer constructions shall be designed in such a way as to transfer the load from the goods onto container sheeting through the horizontal beams or boards. If necessary the contact between the cargo and the spacer construction shall be ensured in the same way as mentioned above when the strength of package is not sufficient. Sufficient contact area with spacer bars shall be available when using stop bars taking account of the permissible load limits and squashing.

The stop elements and spacer constructions shall be designed in such a way as to restore their original shape and position when there is no more pressure load. The posts, bars, diagonal battens (if necessary), stop bars and spacer bars are required for that purpose. The elements shall be connected in an appropriate way with nails or timber dogs.

The nailed-down wedges (blocking bars) shall be used for fastening of the cylindrically shaped goods. The pads made of wood shall be inserted underneath (Figure 5). The wedges (bars) shall be located in a such way as to distribute the load along the wood fibers.

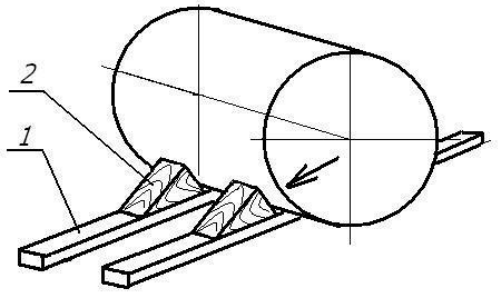

Figure 5 – Installation of wedges (blocking bars)
1 – pads; 2 – wedges (blocking bars)

2.3.2. Cardboard sheets or plastics may be used for protection of goods against soiling, dust or humidity also during loading.

2.3.3. Rubber carpets (anti-skid carpets), textured plastic sheets or special cardboard sheets may be used in compliance with their instructions in order to increase friction.

2.3.4. Steel wires, steel ropes, synthetic and traditional ropes, combined belts or tensioning belts, web straps, textile straps may be used as parts of tensioning systems (stretching or wrapping around systems).

The stretched wires are used for the fastening of goods in containers in compliance with provisions of the Chapter 1 of TR concerning permissible loads (permissible load values shall be defined in compliance with Table 32 of the Chapter 1 of TR).

The load bearing capacity of materials used for the stretching and wrapping around (excluding stretched wires) shall be defined in terms of percentage of the maximum strength, which are listed in the Table 5.

Table 5

Materials used in tensioning systems for stretching and wrapping around	**Load bearing capacity of straps and tie-downs, as percentage of their breaking load**
Steel ropes – when used once – when used several times	 80% 30%
Non-metal fiber ropes (made of natural or synthetic materials)	33%
Tensioning belts, web straps, textile straps: – when used once – when used several times	 75% 50%
Rings, turnbuckles made of mild steel	50%
Rings, turnbuckles made of mild steel	50%
Steel strip (when used once)	70%

The ropes shall be used for the stretching or wrapping around in compliance with provisions of point 9.17 of the Chapter 1 of TR.

It should be noted that the guy ropes made of natural or synthetic materials and the guy ropes made of natural and synthetic materials may be used when using the method of stretching for the fastening of goods. In this case two or more ropes shall be used and stretched.

Such hitches as “round turn with two half hitches” or bowline hitch” shall be used when using the ropes made of natural or synthetic materials. However, the load bearing capacity can be decreased by 30-60 % due to use of such hitches. Therefore, the ropes shall be protected against chafing.

The textile belts and straps used for the stretching or wrapping around may be used several times when they are equipped with nonremovable tensioning devices (for example, ratchet tensioner). . They can also be used only once when they are equipped with removable tensioning and closing device.

Elastic deformation of tensioning systems (stretching and wrapping around systems) consisting of textile belts, straps must not exceed 9 % under normal load conditions. The tensioning (stretching) systems shall be protected against damage, mechanical wear, chafing on sharp edges and influence of chemical substances (acids, thinners, etc.).

Module fastening systems combined with tensioning systems consisting of textile belts and straps may be used, in particular, for fastening of goods against shifting towards the door. The module systems shall be installed in compliance with technical specifications. For more detailed information see Figure 14 “Installation of module fastening system”.

2.3.5. Air dunnage bag (pneumatic membrane), airbags

The decision as to what type of air dunnage bag (pneumatic membrane) to use and how to install depends on height and weight of the goods (packages, load units) to be fastened and

dimensions of gaps between the goods as well as on load bearing capacity of air dunnage bag model (pneumatic membrane) and its dimensions.

The dunnage bags shall be marked, including the designation of the airbag, its identification number, main technical features and the guidance on its use. The dunnage bags shall comply with the requirements for resistance to climatic factors impact: the environmental temperature - from minus 60 ° C to plus 50 ° C and the relative air humidity of 100% at 15 ° C.

When calculating the required load capacity of dunnage bags according to Tables 3 and 4, that are installed between the parts of the load, the lowest values of the friction coefficient shall be taken: between the load and the floor or between the load tiers.

When fastening the load to prevent overturning, the bearing capacity of the dunnage bags shall be determined for the load requiring the maximum holding forces.

The type and size of the dunnage bags shall be selected in such a way that after its installation the contact surface of the dunnage bags shall cover at least 3/4 of the area of each box (package). If the size of the gap is more than that, which can be filled with one dunnage bag, it is allowed to install two dunnage bags in the gap. If the surfaces of the cargo or packages have sharp corners or protruding parts that may damage the airbags, a cushioning material shall be installed between the cargo/packages and the dunnage bags.

If the dunnage bags are installed between the loads (parts of cargo stack) having different weights, the dunnage bags shall be selected based on the weight of the heavier load (part of cargo stack).

2.3.6. The adhesive fastening tape is a self-adhesive strip having the width of 0.4 m with a composite base of woven plastic polyester reinforced with fiberglass and covered with a special acrylic based adhesive. The adhesive provides shear resistance and easy, trace-free removal of the tape. The adhesive fastening tape shall be applied in sets, which includes two fastening pieces with one-sided adhesive covering approximately 2/3 of the length and a fastener tape with adhesive covering the entire length. A special reusable tool kit is used to mount the fastener using a tape. This tool kit consists of a tensioner wrench, a thrust wrench and a roller smoother.

The adhesive fastening tape is available in two versions: with a maximum permissible shear load of 5 and 10 with the same dimensions.

2.3.7. Honeycomb boards shall be used as a protective cushioning material separately and (or) in combination with airbags and damping gaskets (partitions) to fill the gaps between cargo units or cargo units and container walls.

Honeycomb board are a sheet of 10 to 100 mm thick multilayer corrugated kraft cardboard made of kraft pulp.

The load capacity (tensile strength) in compression of honeycomb boards reaches 5 s / cm^2, density - 0.30 - 0.60 kg / m^2.

Figure 6 – Honeycomb board

Samples of the use of honeycomb boards are shown in Figures 18, 19.

2.3.8. The brace for securing a load (Figure 7) is a device consisting of two contact plates, which are connected by a screw rod with persistent trapezoidal thread and a lock nut. All brace elements are made of high-strength and frost-resistant plastic. One of the supporting plates has an adhesive layer for gluing to the surface of the load and preventing the brace from displacement during transportation. Existing brace designs have a load capacity of up to 1500 kg and can be installed in a gap of 200 to 800 mm. When installing a brace, its contact plate with an adhesive layer shall be glued to the load, a gap between the loads (the load and the container wall) shall be selected by rotating another supporting plate until some tension is created; external threaded connection shall be fixed by a lock nut to avoid weakening.

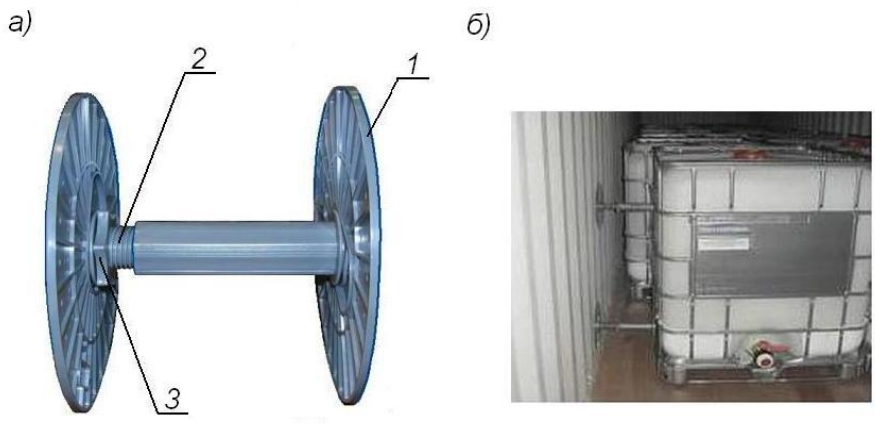

Figure 7 – Brace
а – brace mechanism; б – example of brace application
1 – contact plate; 2 – screw rod; 3 – lock nut

2.3.9. Stowage and fastening of goods in containers can be carried out by means of reusable fastening devices.

3. Stowage and securing of cargo in the package

3.1. *Stowage of cargo in the package*

Unpackaged goods in box-type packages (cartons, boxes), in cylindrical packaging (barrels, drums, etc.), goods formed into packages shall be stowed in the container close to the end wall of the container and each other with the maximum possible use of the entire floor area in one or several tiers in height (Figure 8). The number of cargo tiers in a container shall be determined based on the mechanical properties of the packaging.

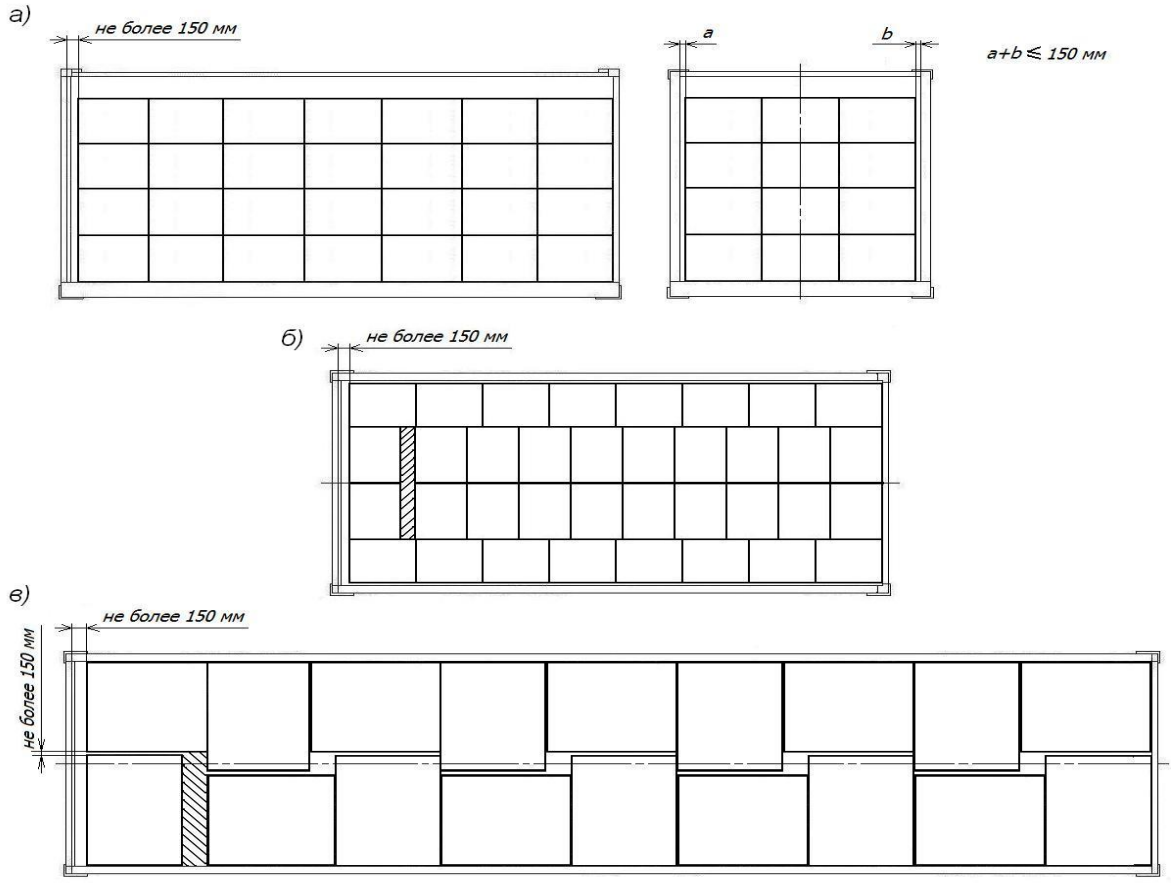

Figure 8 – Samples of stowage of cartons, boxes, packages in compact stack (the gaps to be filled are shaded, the end shield of the door fencing is conventionally not shown)

To form a compact stack, it is allowed to place cartons, boxes and packages with the larger side along and (or) across the container (Figure 8b, c).

The gaps between the cargo places, between the cargo and the walls of the container shall be filled. For this purpose, for example, empty pallets can be used, installed vertically in the gaps and fastened with additional wooden slats if necessary. It is allowed not to fill the technological gaps required for unimpeded loading and unloading, provided that the total gap in any horizontal direction does not exceed 150 mm.

Securing of cargo in the longitudinal direction shall be carried out in accordance with the requirements of paragraph 3.3 of this Leaflet.

If the total gap in the transverse direction exceeds 150 mm, load units are placed in two stacks in width close to the side walls of the container. Securing the cargo in the transverse direction shall be carried out in accordance with the provisions of paragraph 3.4 of this Leaflet.

When stowing the load in packaging of the same size in several tiers, it should be aligned in such a way that the load from the upper cargo places is transferred to the vertical walls of the lower ones. If necessary (for example, if the tiers can be horizontally displaced with respect to each other), a flooring of the required strength shall be laid between the tiers (for example, made of fibreboard, plywood, boards, pallets, etc.) (Figure 9).

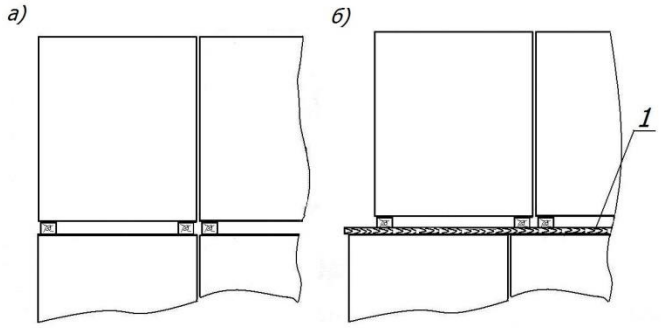

Figure 9
a – with stack levelling (cushioning material required between tiers is not required);
b – with laying of cushioning material with possible tiers displacement
1 – cushioning material

If the upper tier of the stack cannot be filled completely, securing in the longitudinal direction of cargo places in it can be ensured, for example, by resting on the cargo places of transverse rows installed on pads (Figure 10 a), installing thrust shields between the transverse rows (Figure 10 b), linking with the underlying cargo places (Figure 10 c); when placing items of cargo of different heights - by selecting the placing method (Figure 10 d).

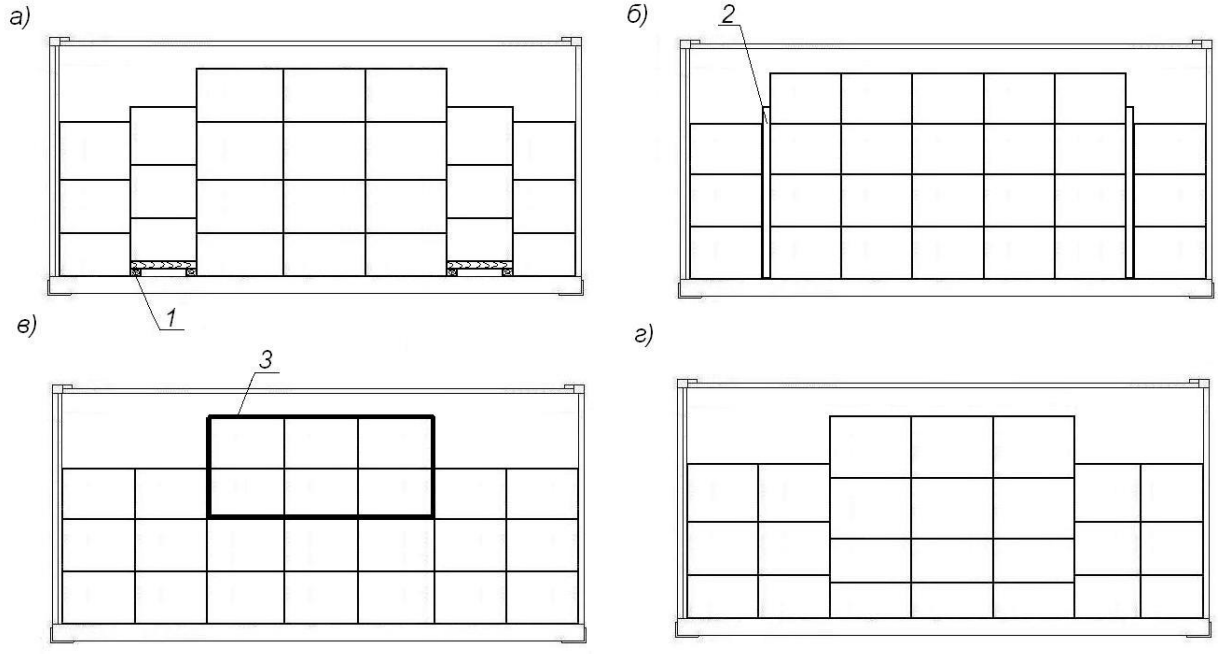

Figure 10 – Samples of cargo securing in an incomplete upper tier
а – using pads; б – with installation of backstops (shields);
в – fastening units with the underlying; г – selecting cargo units by height
1 – pad; 2 – backstop (shield); 3 – linkage
(end shield of door fencing conventionally not shown)

Cargo places in an incomplete upper tier may also be secured in accordance with the provisions of paragraphs 3.3.2 and 3.3.3 of this Leaflet.

To ensure the stability of cargo places in a stack, several adjacent places can be combined by means of ties, adhesive fastening tape (Figure 12a, b), fastening of cargo units of the upper tier with straps for upper or middle tie-down devices (Figure 12c) or installation between the load and the doors of the shield from plywood with a thickness of at least 6 mm or other material of the same strength or from boards with a thickness of at least 30 mm (Figure 12d). The board shall consist of horizontal thrust boards with a width of at least 100 mm, a length equal to the inner width of the container, and racks of the same size. The boards shall be fastened to the racks with nails, two in each connection. Thrust boards shall be placed on the side of the container doors at least two for each tier, secured to prevent overturning. The number of racks shall be determined according to the strength conditions of the packaging of the cargo, but not less than two for each vertical row. At the bottom of the stack, the racks shall be fastened with a connecting plank with a section of at least 25x100 mm of sufficient length.

3.2. *Features of the stowage of cargo in a cylindrical package.*

Cargo in a cylindrical package: barrels, drums, buckets, etc. (hereinafter referred to as barrels) shall be stowed in a vertical position with plugs (lids) up. In each tier barrels shall be placed close to the end wall and to each other in straight rows or staggered along the entire length of the container (Figure 11).

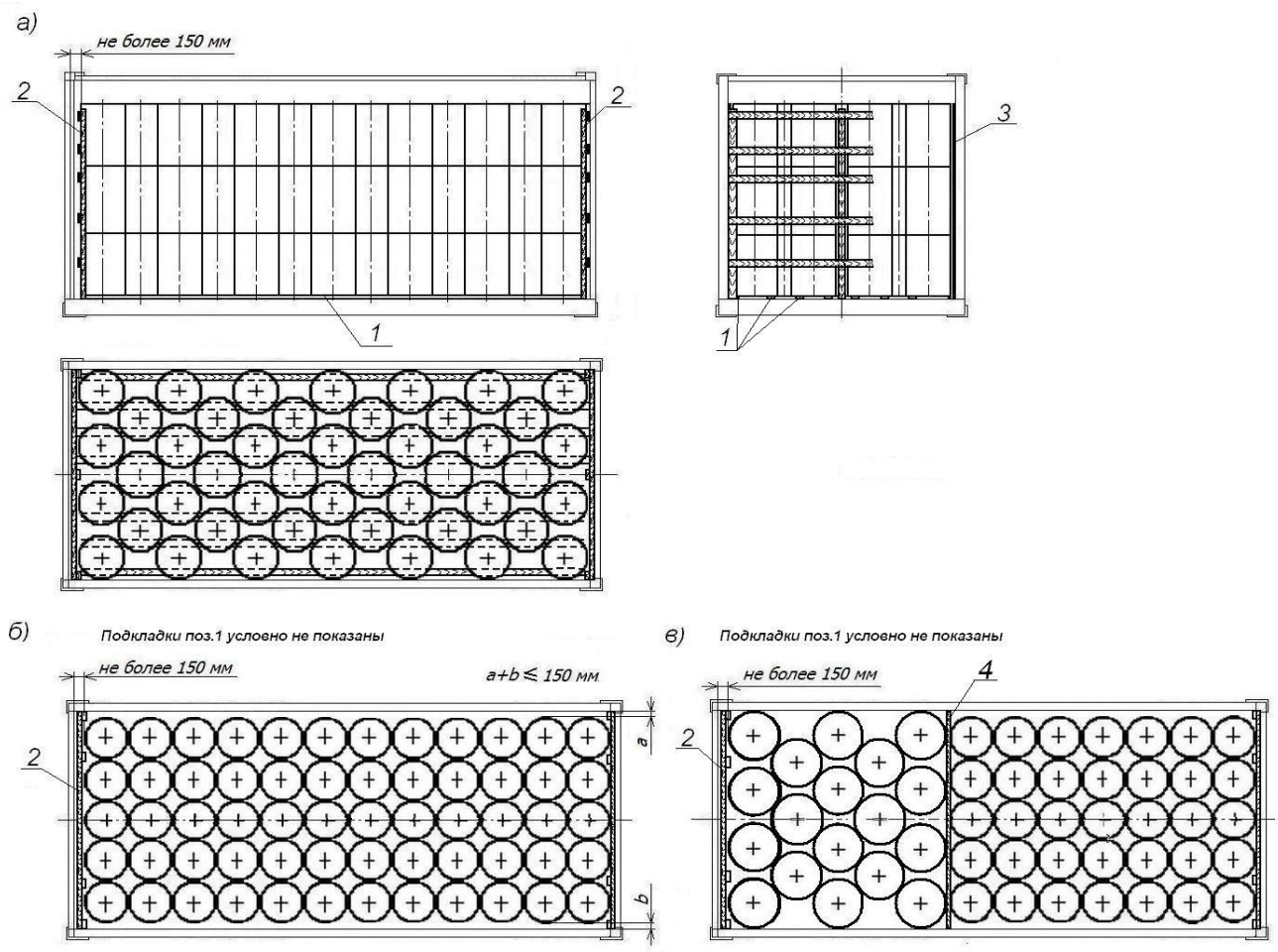

Figure 11 – Samples of stowing of cargo in a cylindrical package in a compact stack
а – staggered; б – straight rows; в – in mixed order
1 pad; 2 – shield; 3 – lining material; 4 – plywood shield

It is allowed to place barrels, drums of various types and sizes in one container, subject to the provisions of paragraph 2.1 of this Leaflet. Within each tier, except of the top one, barrels of the same height shall be placed. If in parts of the stack for the length of the container the barrels are located in a different order, the plywood shields with a thickness of at least 6 mm or other material of the same strength, or board shields with a thickness of at least 25 mm shall be installed between them (Figure 11c).

Barrels of the lower tier shall be placed on wooden pads with a cross section of at least 40x100 mm, laid along the container in such a way that each barrel rests on two pads. The pads can be continuous along the entire length of the container or consist of several parts.

When placing barrels and drums with metal bottoms in several tiers (except of cases when the bottom and the upper part are made for mutual fixation of barrels when stacking), as well as, if necessary, when placing non-metallic barrels, longitudinal wooden pads of boards with a section of not less than 25x100 mm or sheet cushioning material, which are placed in such a way as to ensure the stability of each barrel or drum. When placing empty barrels, and drums, it is allowed not to lay cushioning material between tiers.

The end wall of the container shall be fenced along the loading height with a plywood shield with a thickness of at least 6 mm or other material of the same strength, or of boards with a thickness of at least 30 mm. The board shall consist of horizontal thrust boards with a width of at least 150 mm, a length equal to the internal width of the container, and at least three racks located on the side of the cargo. The boards shall be fastened to the racks with nails, two in each connection. Thrust boards are located: one - at the level of the middle of the height of the lower tier and at least two opposite each next tier.

If the total gap along the length of the container does not exceed 150 mm, the stack of drums shall be shielded from the side of the doors with a similar shield. If the total gap along the length of the container exceeds 150 mm, the stack of drums shall be fastened from the side of the doors in accordance with the provisions of paragraph 3.3 of this Leaflet.

If necessary, a cushioning material (plywood, fibreboard, thick cardboard, etc.) may be installed between the barrels and the side walls of the container.

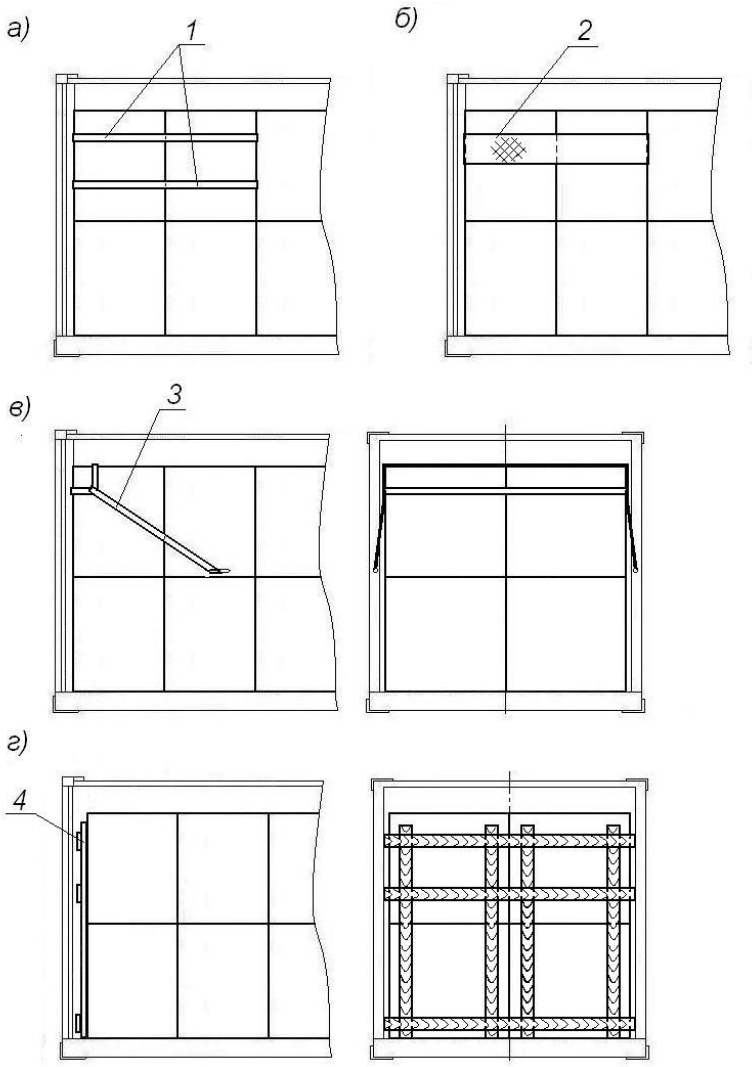

Figure 12 – Samples for ensuring load stability
1 – linking; 2 – adhesive fastening tape; 3 – banding; 4 – shield

3.3. Fastening of stacks of cargo in order to prevent the displacement in the longitudinal direction towards the container doors shall be performed with spacer structures, shields, strops, belts and adhesive tape.

3.3.1. Samples of fastening stacks of cargo with a spacer structure and a shield are shown in Figure 13.

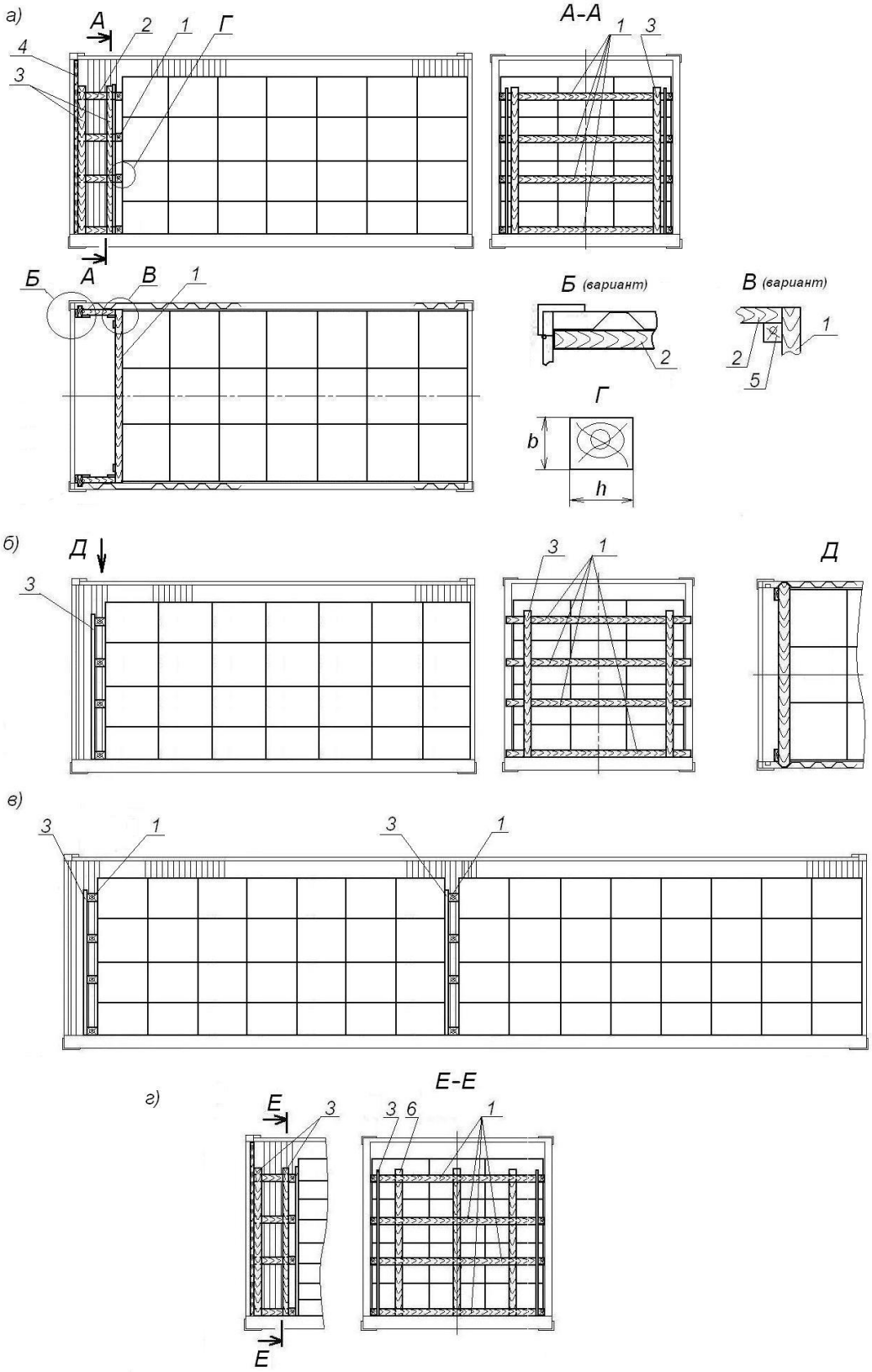

Figure 13 – Samples of fastening with a spacer structure and a shield
a – spacer structure;
b – shield installed in the sheathing corrugations;
c – a variant of a spacer structure (shield) with vertical thrust boards

1 – stop bar ; 2 – spread bar; 3 – connecting plank;
4 – stanchion; 5 – connecting bar; 6 – stop board

The main elements of the spacer structure (Figure 13a) are horizontal thrust bars, spacer bars and a connecting planks. Thrust bars with a length equal to the inner width of the container shall be fastened with vertical connecting planks with a section of at least 30x70 mm and installed tightly to the load. The bottom bar may be placed on the container's floor. The spacer bars shall be installed close to the side walls in a spacer between the backstop bars and the bars installed in the slots of the corner posts, or the corner posts of the doorway (if their design provides for the protrusion regarding the side walls), and shall be fastened with vertical connecting planks. The thrust and spacer bars shall be fastened together with nails of at least 70 mm length, at least two in each connection. If the thickness of the bars is more than 80 mm, it is allowed to fasten them with construction brackets from a bar with a diameter of 8 mm. It is allowed to fasten the thrust and spacer bars together with common connecting bars (Figure 13a, view B), having a cross-section sufficient for nailing, and also use other fasteners for this purpose (i.e., steel corners, pads, etc.).

The shield (Figure 13b, c) shall be made of horizontal thrust bars, and connecting planks, which shall be fastened together with nails of at least 70 mm length, at least two in each connection. The length of the thrust bars shall be selected in such a way that they enter the grooves of the corrugations of the sidewall sheathing to the full depth with minimal gaps, the ends of the bars shall be processed along the corrugations' profile.

Based on the size and configuration of cargo places, it is allowed to install vertical thrust boards with a section of at least 30x70 mm between the thrust bars of the spacer structure or a shield and the cargo stack (Figure 13d). In this case, these backstop boards shall also be used as connecting planks for fastening the backstop bars.

It is allowed to install several shields along the length of the cargo stack (Figure 9c).

The number and section of thrust and spacer bars of the spacer structure, thrust bars of the shields shall be determined based on the mass of the cargo stack to be fixed or its part secured by the shield in accordance with the provisions of paragraph 2.2.2 of this Leaflet.

3.3.2. A sample of securing a stack of cargo using straps is shown in Figure 14. The straps should be installed in such a way that their length is minimal and the angle of inclination to the container floor does not exceed 40^{o}. The straps shall be fastened to the container strapping devices. Pre-tension shall be performed with a tension tool, fixed with clasps (locks). Connecting the ends of the straps with knots is not allowed.

To ensure the safety of cargo packaging, protective elements may be used, if necessary, for example, corners or shields (Figures 14b, 14c). When installing the straps at an angle to the floor of the container, they must be secured to the load by means of the strapping device (Figure 14a) or by means of clamps (Figure 14b). Strapping with a clamp (loop) fixation on the load is used provided that the packaging is sufficiently strong.

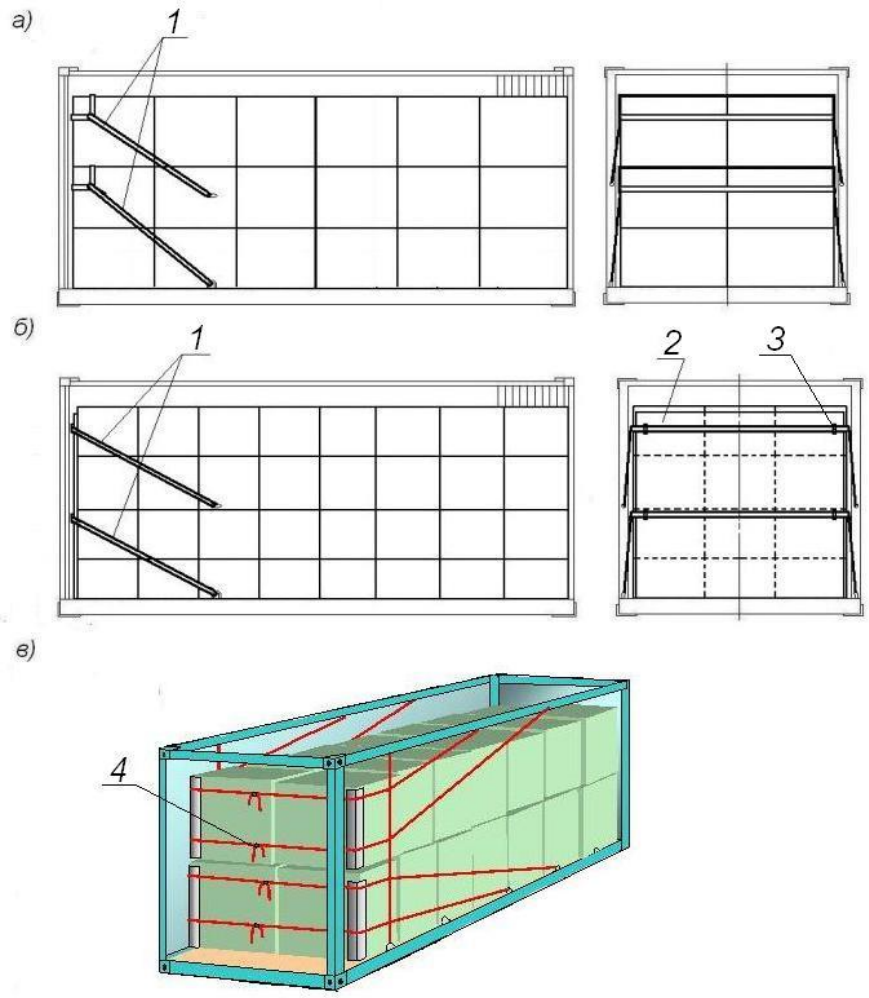

Figure 14 – A sample of fastening with straps
а – straps with clamp fixing on the load;
б – using a shield (screen) and strapping clamps;
в – using a modular system
1 – strapping; 2 – shield; 3 – strapping lock; 4 – modular system

3.3.3. A sample of securing a stack of cargo using adhesive fastening tape is shown in Figure 15.

Fastening shall be carried out in compliance with the instructions for using the tape. Before placing the cargo in the zone of subsequent gluing of the tape, the side walls of the container shall be marked in accordance with the length of the adhesive part of each segment of the tape. The height of the location of the segment of the tape shall ensure the stability of the rolls to prevent overturning. Each fastening segment of the tape shall be glued with an adhesive part to the side walls of the container along the profile of the corrugations so that the beginning of the "dry" part of the tape segment is at a distance of at least 200 mm from the ends of the fastened cargo places or to the roll. To ensure the best contact of the adhesive layer, a roller smoother shall be used. The number and type of tapes shall be selected in accordance with the provisions of paragraph 2.2.2 of this Leaflet, depending on the load capacity of the tape type. The cargo shall be placed close to the side walls of the container with spacer structures or dunnage bags placed between the parts of the stack in the middle of the container. The free ends of the segments of the fastening tape shall be brought to the middle of the container, connected and tightened with a tension wrench. The strained sections of the tape and the place of their connection shall be fastened by gluing the lock tape.

The loose ends of a tiedown strip shall be brought in to the middle of a container, rounding the goods, and shall be bound and shall be tied up with a tensioner unit. The tense tiedown strip sections and their position of joint shall be fastened by adhesion of a lock-strip. When it is required to fasten several layers by means of one strip, a screen (shield) can be used.

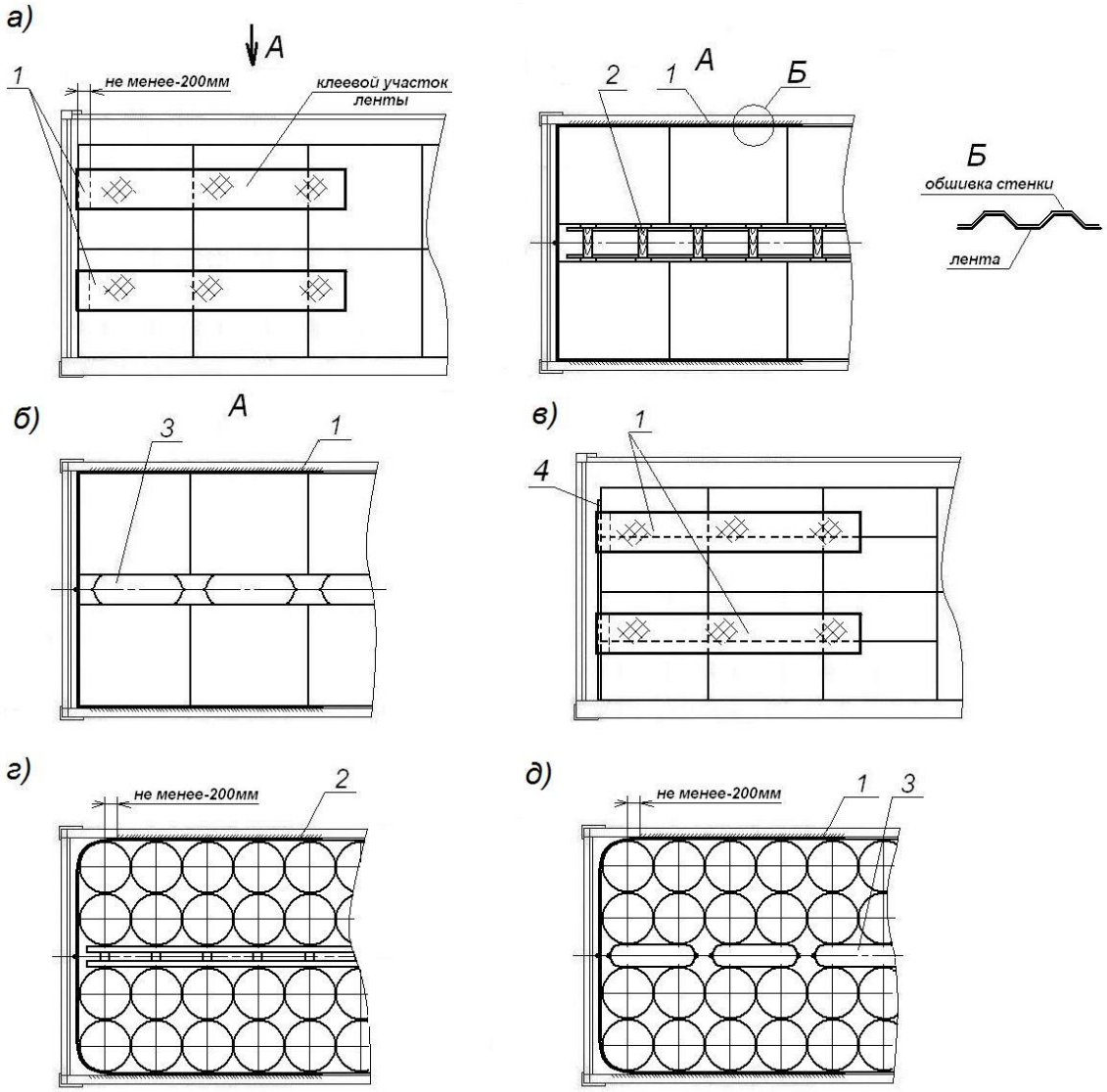

Рисунок 15 – Samples of fastening with a tiedown adhesive strip
а, б – fastening of a stack of boxes, cartons;
г, д – fastening of a stack of drums;
в – fastening with use of a screen (shield);
1 – tiedown strip; 2 – spacer construction; 3 – pneumatic membrane;
4 – screen (shield)

3.4. *Fastening of goods stacks to avoid lateral displacement*

Fastening of goods in lateral direction shall be executed (Figure 16) with spacer constructions, pneumatic membranes, which shall be installed between stacks.

A spacer construction is composed of stop bars or boards installed vertically close to goods and fastened by means of horizontal strips of board with a cross section not less than 30x70 mm, and spacer bars.

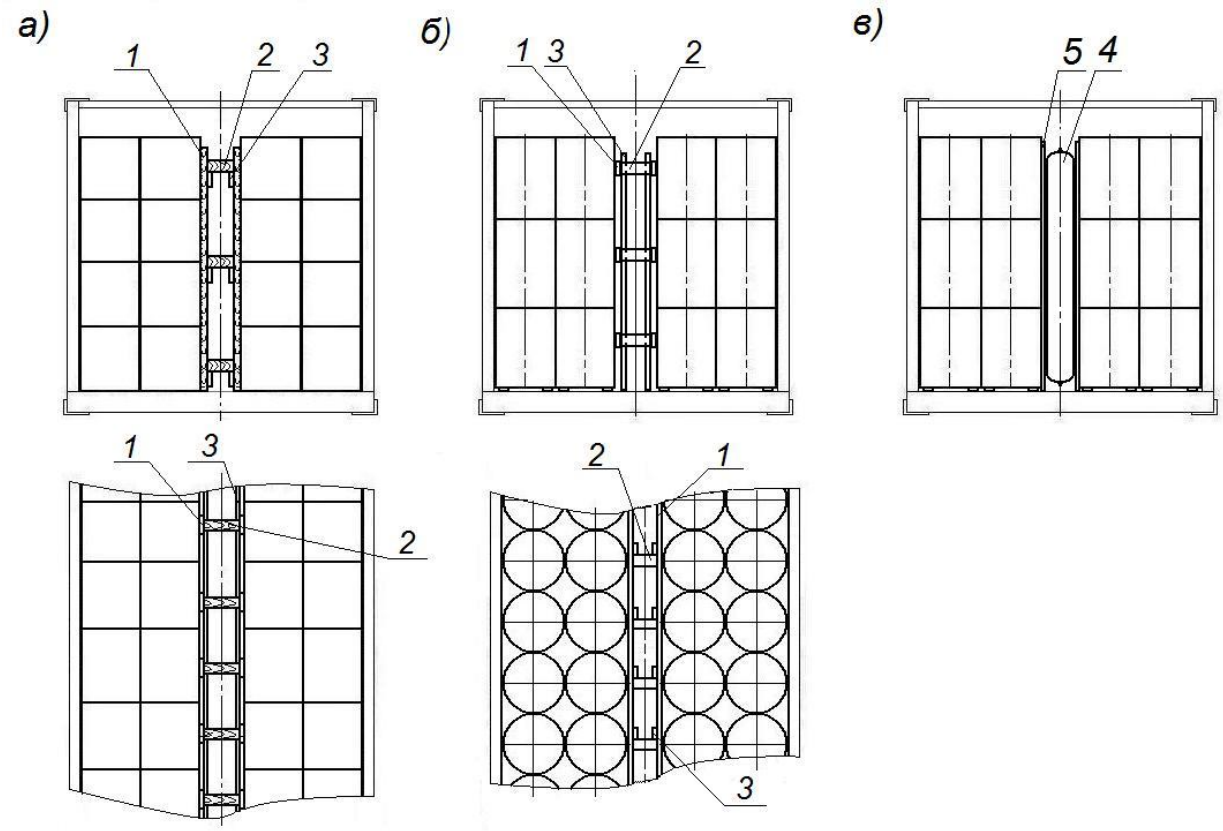

Рисунок 16 – A sample of fastening in lateral direction
а – by means of a spacer construction;
б, в – pneumatic membranes;
1 – stop bar (a strip of board); 2 – spacer bar; 3 – connecting strip of board;
4 – pneumatic membrane; 5 – screen (gasket material)

4. Stowage and Fastening of Cargo Packages

4.1. Cargo packages, which cannot be stowed in a compact stack, shall be stowed individually or by groups subject to requirements of paragraph 2.1 of this Leaflet in relation to the general centre-of-gravity position of goods in a container, and the terms of their fastening. In a group, the cargo packages shall be stowed close to each other. Each cargo package or a group of cargo packages shall be fastened to avoid axial and lateral displacement, and overturn if necessary.

Fastening of cargo packages shall be arranged by means of fastening facilities mentioned in paragraphs 2.2, 2.3 of this Leaflet. The selection of fastening facilities and their combination shall be conducted in accordance with the provisions of paragraphs 1.3 and 2.2 of this Leaflet.

4.2. Samples of stowage and fastening of cargo packages are shown in Figures 17 – 19.

If the bearing capacity of fastening facilities is not sufficient for fastening the goods stowed in a single group, the goods shall be stowed in several groups (Figures 17г, 17д) or the cargo packages shall be stowed individually (Figure 17в) and shall be fastened individually.

Fastening of cargo packages or groups of cargo packages by means of stretching, wrapping around, spacer frames, spacer constructions shall be conducted in accordance with the principles stipulated in paragraphs 3.3.1, 3.3.2, 3.4 of this Leaflet. Therefore, spacer frames, spacer constructions installed between the goods shall be selected on the basis of the admitted weight of the unit (group) to be fastened.

The ends of stop bars of spacer frames, spacer constructions, and the stop bars shall be adapted to the profile of corrugations of the side walls' sheathing in such a way that they should match the hollows of corrugations full-depth with minimal clearance points.

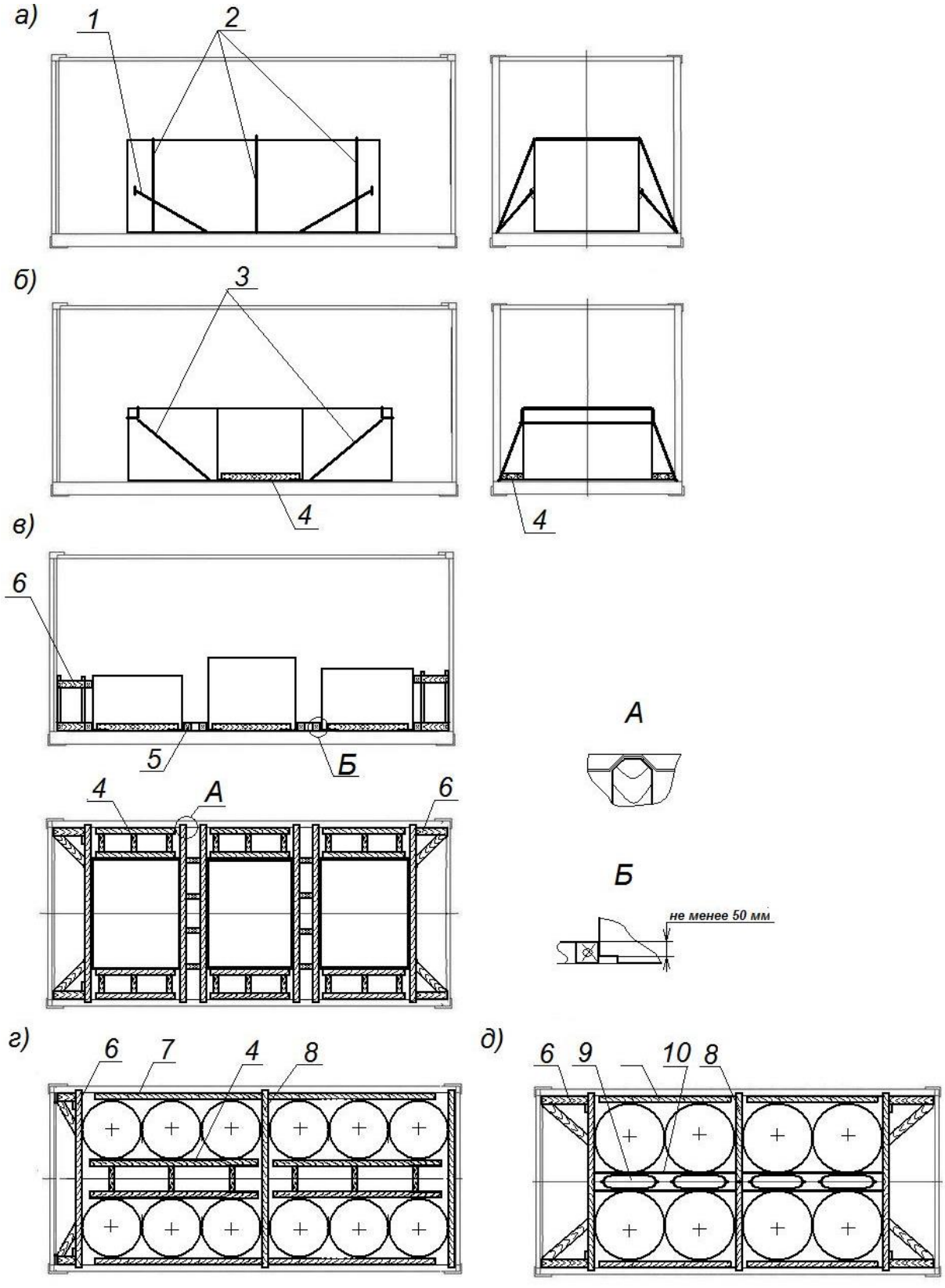

Figure 17
1 – stretching; 2, 3 – wrapping around; 4, 5 – spacer frame; 6 – spacer construction; 7, 8 – spacer bar (spacer construction); 9 – pneumatic membrane; 10 – screen

When units of goods are stowed which are not resistant to overturn, the spacer frames, spacer bars shall be replaced accordingly by spacer constructions made in accordance with the provisions of paragraphs 2.2.3 of this Leaflet, and by spacer shields.

A sample of stowage and fastening of steel band coils on pallets with use of a tiedown adhesive strip, pneumatic membranes, honeycomb panels, spacers is available in Figure 18. The quantity of coils in a container shall be determined subject to their diameter and weight.

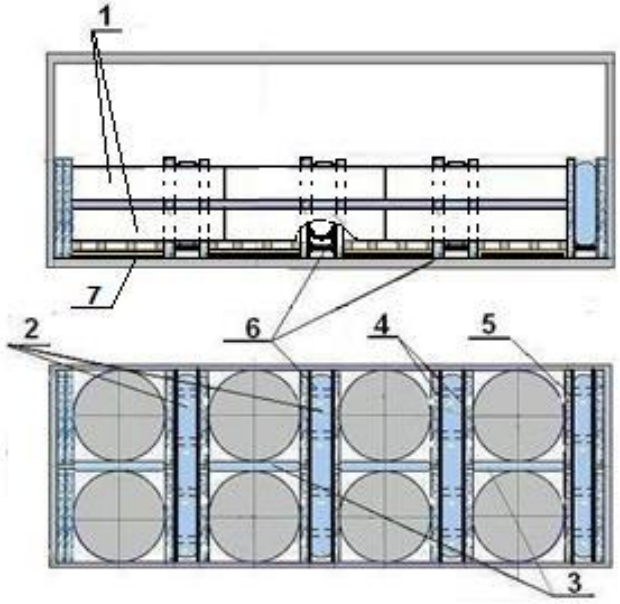

Figure 18
1– tiedown adhesive strip, 2, 3 – pneumatic membrane; 4 – honeycomb panel;
5 – screen; 6 – spacer; 7 – anti-skid carpet

The anti-skid rubber carpets shall be fastened on the resting surfaces of pallets by size of the areas which contact with the container floor. An assembly of honeycomb panels shall be installed to the end wall by height of coils, and by width equal to the width of a container, after that a screen made of plywood. A similar assembly shall be installed to the first line of coils. Spacers shall be arranged between the screens, and a pneumatic membrane shall be installed over the spacers and shall be inflated. Coils shall be fixed close to the side walls. A pneumatic membrane shall be installed between the oils in the middle of a container and shall be inflated. Chalking shall be carried out, and the adhesion of two bands of the tiedown strip of the fastening of the second line of coils shall be executed. The second line of coils shall be stowed, and the screens, honeycomb panels, spacers and pneumatic membranes shall be installed in the same way. Tension of the tiedown strip shall be performed. The rest of coil lines shall be stowed in the same way. An assembly of honeycomb panels shall be installed in the clearance point between the last line of coils.

A sample of stowage and fastening of packages on the pallets with use of a tiedown adhesive strip, pneumatic membranes, and honeycomb panels are available in Figure 19.

Packages shall be arranged by two lines by width of a container, close to the front end wall and side walls of a container. Prior to loading, the chalking of stowage of packages of goods in a container shall be carried out, and the tiedown strip shall be glued on the container walls. Packages shall be fastened by bands of the tiedown strip, the upper one of which shall be installed at a height not less than 2/3 of a package height. The quantity and arrangement of bands of the tiedown strip by the length of a stack of packages shall be determined subject to the quantity of packages and their weight. If the clearance point between packages by width of a container exceeds 150 mm, pneumatic membranes shall be installed between them and shall be inflated. A clearance point between the goods and container doors shall be filled with a required

quantity of honeycomb panels. It is permitted to install honeycomb panels between packages by the length of a container.

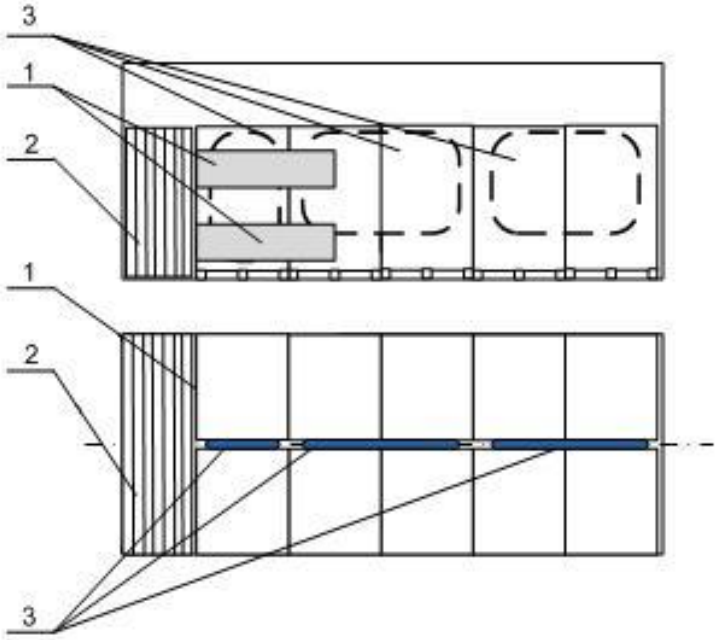

Figure 19
1 – tiedown strip; 2 – honeycomb panel; 3 – pneumatic membrane

5. Stowage and Fastening of Mobile Machinery on Wheels

The units of mobile machinery on wheels (hereinafter, units of machinery) shall be stowed in containers in quantity of one unit or several units.

The pressure in mobile machinery pneumatic tyres shall meet technical specifications.

Each unit of machinery to be stowed shall be resistant to overturn in longitudinal and lateral directions.

When braked machinery has been stowed, its brakeage shall be applied in accordance with requirements provided for in its technical documentation in part of transportation terms.

Swivel parts shall be brought into transportation position and shall be fastened by means of facilities envisaged by machinery design in accordance with requirements provided for in its technical documentation in part of transportation terms.

Fastening of each unit of machinery shall be executed in the following way (Figure 20). A lateral stop bar with a section not less than 100x120 mm shall stowed to the end wall of a container by a length equal to the inner width of a container. When a unit of machinery has been stowed, a similar stop bar shall be laid down on a level with the container threshold, two longitudinal stop bars with a section not less than 50x120 mm shall be laid down close to the sides of wheels, from their outside, by the length equal to the distance between the lateral stop bars, and they shall be fastened by timber dogs made of a wire rod with a 6-8 mm diameter, one for each joint. It is permitted to install a protective separator between the wheels and longitudinal stop bars in order to protect tyres against attrition. Two lateral stop bars with a section of 100x120 mm shall be laid down close to the front and rear wheels, from their outside, by the length equal to the inner width of a container per hollows of sheathing corrugations, which shall be nailed to longitudinal bars with two nails for each joint. The bars shall be fastened by bars in size not less than 100x120x300 mm, which shall be laid down on the bars and shall be nailed with three nail each. All the bars can be combined bars by height, and the longitudinal bars can also be combined by length but with no more than two components.

Two threads of a bracing wire with a diameter 6 mm shall be fastened to the lower bracing facilities of a container on its side walls, and to the load-bearing elements of an automobile (for instance, tow facilities, carriage spring, axles of differential axles of wheel sets).

Pads shall be arranged under wheels when loads from the wheels on the container floor exceed the permissible values, or the wheels have flanges.

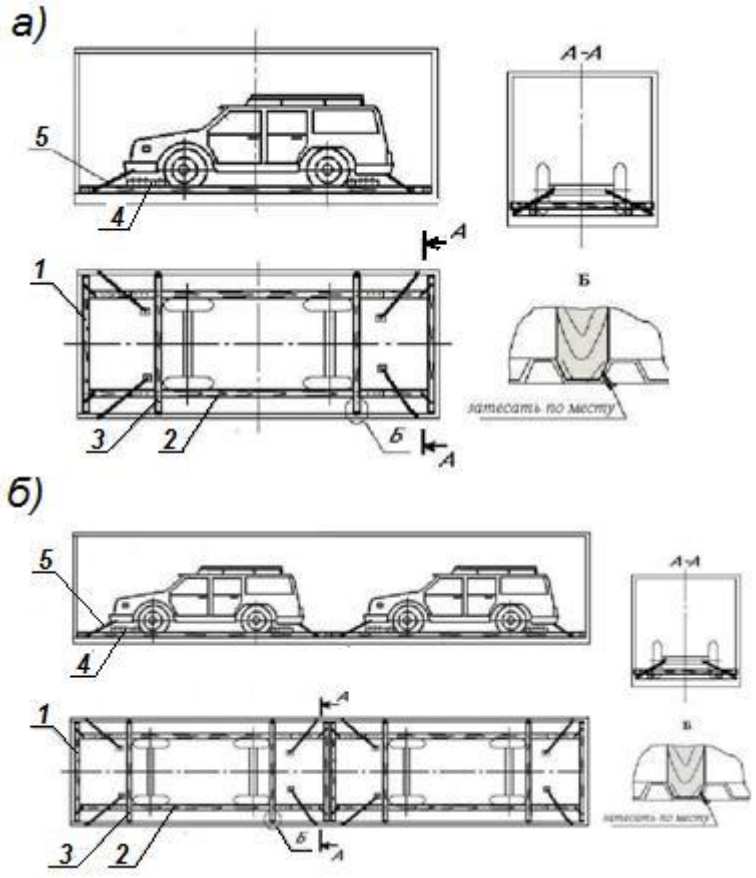

Figure 20
1, 2, 3, 4 – stop bars; 5 – bar; 6 – bracing wire

6. Stowage and Fastening of Liquid Goods in Flexitanks

6.1. When the “Flexitank” packaging system (hereinafter, Flexitank) is used to carry liquid goods, the requirements of manufacturer’s manual to their use must be complied with.

A Flexitank shall, on its surface, have a marking containing the following information (for example):

- trademark (manufacturer’s name);
- name of product and its specifications;
- product number;
- date of manufacture.

When the Flexitank system is used to carry goods, a container shall be serviceable, cleaned of any residues of the previously transported goods and fastening facilities. The inner surfaces of the walls and the floor of the container must not have any mechanical damage or sharp edges, protruding or loose screws, welded seams or other irregularities indicating repairs on the inner surface. Containers for the stowage of Flexitanks with goods shall have grooves in their corner posts for fastening the door shield bars.

The Flexitank filling degree shall be not less than 95%.

The total mass of the goods in a container, including any components of the fastening, shall not exceed 26 tons.

6.2. In a 20-foot container with grooves in its corner posts, a Flexitank shall be fastened in accordance with the pattern shown in Figure 21.

The end wall of a container shall be protected to its full width with a sheet of plywood or oriented strand board (hereinafter, OSB) suitable for use in wet conditions with a thickness of 8 mm, and height not less than 1500 mm. It is permitted to install a sheet composed of two parts by width, and with an overlap of not less than 200 mm in the middle. Protective plywood sheets with a thickness of not less than 8 mm and the other dimensions of 1500x1500 mm shall be installed on the long side walls at both ends of a container.

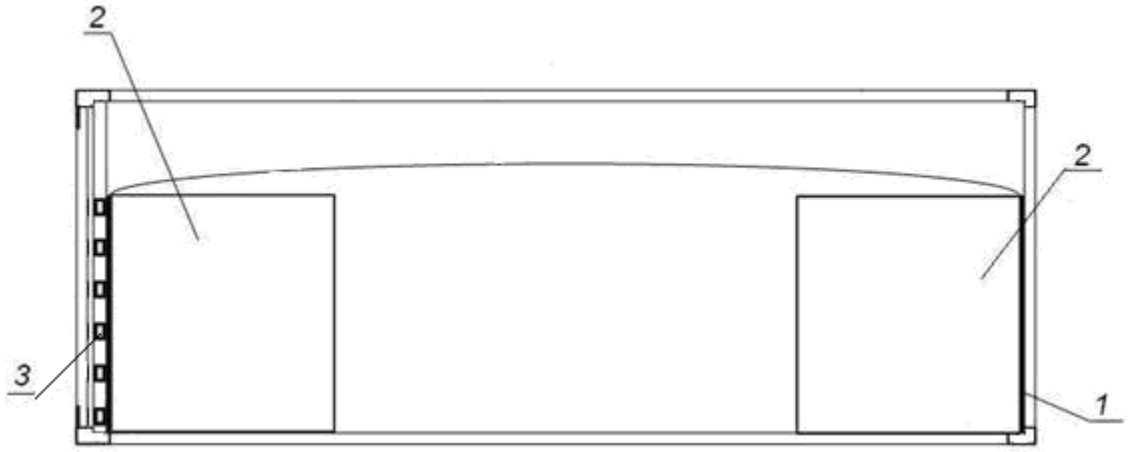

Figure 21 – Fastening of Flexitank in a container with grooves in corner posts
1 – protective cover of an end wall; 2 – protective cover of the long side walls; 3 – shield

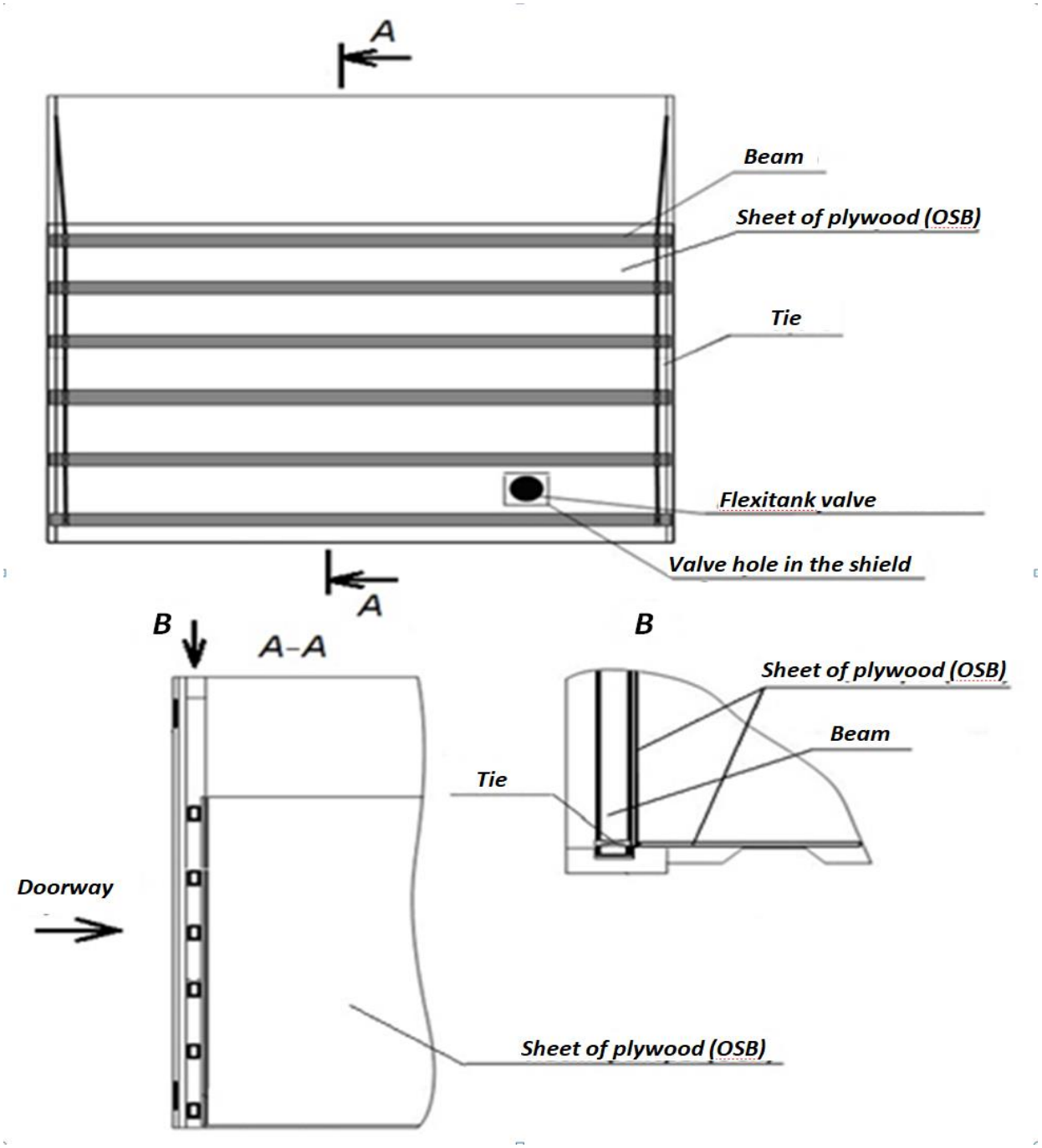

Figure 22 – Shielding of the doorway opening in a container with grooves in corner posts

A shield shall be installed on the doorway side of the container (Figure 22).

The shield shall be built of plywood or OSB with a thickness of at least 8 mm and a height of at least 1,500 mm which is at least 100 mm higher than the filling level of the liquid, a width equal to the width of the container; and at least six (6) beams made of steel rectangular-shaped pipe of at least 50x50 mm and wall thickness of at least 3 mm. The shield is allowed to be built of two sheets overlapped width-wise, with the overlap located in the middle and having a width of at least 200 mm. The beams are inserted in the grooves of the container's corner posts and positioned horizontally at equal distances from one another to the height of 40-60 mm below the top edge of the sheet of plywood or OSB. The distance from the floor to the lower beam shall not be more than 250 mm. The length of the beams shall be selected such that ends of the beams enter the grooves of corner posts to at least 3/4 of the groove's depth. The beams shall be fastened to the protective shields by means of textile straps or plastic cable ties.

7. Stowage and Fastening of Bulk Goods

7.1. Bulk goods in containers shall be carried with the use of disposable liners (hereinafter, “liner”).

Bulk goods carried with a liner shall meet the requirements stated in the manufacturer’s instructions on the installation of the liner.

A liner shall be made of two-ply fabric propylene with a density of at least 120 g/m^2 (high-strength woven polypropylene and polypropylene coating (lamination) on the inner side).

A liner shall, on its surface, have a marking that contains the following information (for example):

- trademark (manufacturer’s name);
- name of product and its specifications;
- number of product;
- date of manufacture.

7.2. Containers for the stowage of liners with goods shall have a doorway groove for fastening the beams of the doorway shield.

The inner surfaces of the walls and floor of a container shall not have any mechanical damage and sharp edges, protruding or loose screws, welded seams, or marks left over from repairs that were made on the inner surface.

7.3. The following shall be installed in order to fasten the liner in a container:

- end shield;
- doorway protection shield.

The height of shields shall exceed the height of loading by at least 100 mm.

The end wall shall be protected to its full width with a shield made of a sheet of plywood or oriented strand board suitable for the use in wet conditions (hereinafter, OSB) with a thickness of at least 8 mm, position 5. It is permitted to install an end shield composed of two plywood sheets width-wise overlapping by at least 200 mm in the middle.

The liner installation shall start from the rear wall of the container and proceed toward the doorway opening. Sequentially, beginning with the rear wall, the upper part of the liner shall be hung from the upper bracing facilities of a container, using the ties sewn to the liner. The lower part of the liner shall be fastened to the lower bracing facilities of a container, with the liner material’s fitting to the container walls provided by the tension of the ties (Figure 23).

Figure 23

The container doorways shall be protected to its full width with shields made of a sheet of plywood or OSB with a thickness of not less than 8 mm and at least six (6) steel beams made of steel rectangular-shaped pipe of with a cross-section of at least 50x50 mm and wall thickness of at least 3 mm. The steel beams shall be installed in the grooves of corner posts of a container, equally spaced by the height of loading, and fastened by straps tied in a double knot to the rods

in the groove of the container corner posts. It is permitted to install a sheet of plywood composed of two parts width-wise and with an overlap of at least 200 mm in the middle.

The steel beams shall be fastened to the protective sheets by means of textile straps or plastic cable ties.

If available, the liner unloading chute located at the bottom shall, prior to loading, be firmly tied by its ties (Figure 24).

Figure 24

7.4. Loading of bulk goods shall be performed through the loading opening of the liner or its loading chute, which shall, after completion of loading, be zipped up or tied up depending on the design of the liner.

Loading shall be performed in such a manner that the load is evenly distributed on the container floor space . The maximum loading height shall not exceed the level which is 100 mm lower than the upper edge of the protective shield of the doorway or end wall of a container (Figure 25).

The total mass of goods in the container, including any fastening fixtures, shall not exceed 28 tons.

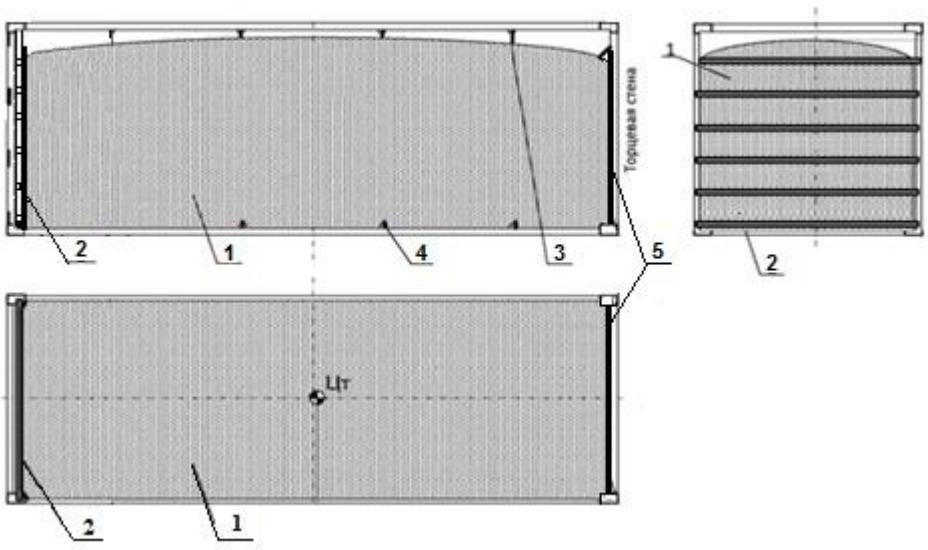

Figure 25 – Pattern of stowage and fastening of bulk goods using a liner
1 – liner with goods; 2 – shield for protecting the doorway opening;
3 – strips for fastening the liner to upper bracing facilities of a container;
4 – strips for fastening the liner to lower bracing facilities of a container;
5 – shield made of a sheet of plywood or OSB