

The buffing regulations are set forth in section 7.5.3 of Appendix 2 to SMGS "BUFFER CARS", which contains both the norms used in the RID (DOPOG) rules and ones historically applied on the territory of many OSJD countries.

Item 7.5.3.1 describes the norms, which are also applied in the RID Rules in regard to the vehicles loaded with class 1 shipments having danger signs in accordance with samples No. 1, 1.5 or 1.6. The contents of this item correspond to the requirements of RID unit 7.5.3.

App. 2 to SMGS has an additional column 21 b in table A of chapter 3.2 and an additional point 7.5.3.2 saying:

"7.5.3.2 When the trains are formed or shunting operations are carried out, it is necessary that buffer norms be observed in regard to the wagons, in which dangerous goods are carried, as specified in column 21 b of table A in chapter 3.2.

7.5.3.2.1 If this column has a fraction, then the numerator should indicate the minimum buffer requirements for the transportation of packed and bulk dangerous goods. The denominator specifies the minimum buffer requirements for the transportation of packed dangerous cargoes in tanks. The sign « - » (dash) crossing out column 21 b means, that no buffing is required for the transportation of these dangerous cargoes.

7.5.3.2.2 Buffing means a minimum number of physical vehicles (empty or loaded with non-dangerous goods), separating the wagons loaded with dangerous goods from the locomotives and the wagons with people:

- The first figure - from the lead locomotive (if fraction, then the numerator - from the solid-injection steam locomotive, the denominator - from the electromotive, diesel locomotive or oil fuel steam locomotive);
- The second figure - from the solid-injection pushing locomotive, marked with "*" - from all pushing locomotives;
- The third figure - from the wagons with people;
- The fourth figure - from the solid-fuel locomotive on firm fuel during shunting operations;
- The sign "Ä" – buffering not required."

In column 21b of table A of chapter 3.2 the specified buffering norms depend on the cargo characteristics, for example:

For No. UNO 1076 phosgene (class 2 cargo with classification code 2TC) in column 21b of table A of chapter 3.2 the following buffering norms are specified: 3/1-1*-3-1, that means:

- 3 wagons from the lead solid-fuel steam locomotive,
- 1 wagon from the electromotive, diesel locomotive or oil fuel steam locomotive,
- 1 wagon from all pushing locomotives,

- 3 wagons from the wagons with people (according to Ann. 2 to SMGS it is forbidden to carry dangerous goods in passenger trains, but a freight train may contain wagon for personnel providing maintenance for the train en-route.)
 - 1 wagon from the solid-injection locomotive during shunting operations;
- And for No. UNO 2036 xenon (class 2 cargo with classification code 2A) in column 21b of table A of chapter 3.2 the following norms are specified for buffering: 0-0-1-0, that means only 1 wagon from the wagons with people.

DEVELOPMENT OF THE ALGORITHM OF DEFINITION OF THE MINIMAL NORMS OF COVERING AND CONDITIONS OF DISSOLUTION OF WAGONS FROM HUMP YARDS

Any external influences on the wagons loaded by dangerous goods, are capable to result in infringement of safe conditions of functioning of a railway transportation. The statistical data show, that most frequently emergencies during transportation arise at performance of shunting works or at movement of trains. During manufacture of these operations cargoes are exposed to influence of external factors: impacts, friction, thermal radiation and another. The conditions created during transportations of dangerous goods, and properties of the last are those, that it is practically impossible to exclude with one hundred percents reliability an opportunity of display of deviations from normal conditions of transportation and to guarantee safety of involved workers of transport.

For reduction of influence of these adverse factors by working specifications and technical documentation [1,2] the minimal norms of covering, i.e. a minimum quantity of the physical wagons separating wagons with a dangerous cargo from conducting, pushing, shunting locomotives and from wagons with people, and also special conditions of dissolution of such wagons from hump yards are stipulated.

The given specifications are put down as stamps in transportation documents and are obligatory for performance by all workers of railways.

Norms of covering represent a combination of figures, for example:

3/0-0-1-0 or 3/1-1*-1-1,

Where the first figure - the minimal count of physical wagons - from conducting locomotive (if fraction, numerator - from a steam locomotive on firm fuel, a denominator - from an electric locomotive, a diesel locomotive or a steam locomotive on petroleum fuel);

The second figure - from pushing locomotive on firm fuel, with it is familiar "*" - from all pushing locomotives;

The third figure - from wagons with people;

The fourth figure - from locomotives on firm fuel at maneuvers;

The mark "0" - coverings is not required.

Conditions of dissolution of wagons with dangerous cargoes from hump yards can be subdivided on:

- Dissolution regularly — for cargoes of a low and average degree of danger;
- « To lower from a hill cautiously » - for the gases transported in any kind of a rolling stock, except for tank-wagons, and for cargoes in glass container;
- « To not lower from a hill » - for the gases transported in tank-wagons, organic peroxides, cargoes of a high degree of danger.

Performance of the requirements concerning the minimal norms of covering and conditions of dissolution of wagons, loaded by dangerous cargoes, complicates technology of work of parks of formation, hump yards, extracts, but thus the probability of influence of adverse factors on wagons, cargoes essentially (much) decreases and a work of a railway

transportation is provided.

At realization of the analysis of existing norms and conditions it is possible to ascertain, that for the same names of a dangerous cargo or the dangerous cargoes having absolutely identical physical and chemical properties, in working scientific and technical documentation various requirements are established. It complicates work of commodity cashiers on filling transportation documents and increases an opportunity of occurrence of emergencies. The reason of it is absence of the steady scientifically proved technique for definition of the minimal norms of covering and conditions of dissolution of wagons from hump yards.

For performance of tasks in view the factors adversely influencing cargoes at transportations were originally revealed.

Conducting, pushing, shunting locomotives, wagons with people by virtue of the external displays, under the certain circumstances, are capable to cause deviations (rejections) from a normal mode of transportation, however and the wagons loaded by dangerous cargoes, can become the reason of infringement of a technical condition of a rolling stock, a way, other devices and communications of a railway transportation, and also negatively to have an effect on health of people and a condition of environmental natural environment.

All dangerous cargoes on their dangerous properties can be divided (shared) into two groups conditionally:

- The cargoes, capable to show the danger under influence of short-term influence of external factors;
- Cargoes which properties bear (carry) the big potential danger, and their display does not depend on external factors.

To the first group it is necessary to attribute (relate) the cargoes having strongly pronounced inflammable properties (classes of danger 3, 4.1), and the cargoes entering reaction with water with allocation of inflammable gases (class 4.3) [4]. To cause dangerous reaction of inflammable substances sparks, выбрасываемые exhaust pipes of locomotives (it is especial steam locomotives) or heating systems of human cars which energy has enough for ignition of a cargo are capable. The specified kinds of a rolling stock are also sources of water that can render negative influence on the cargoes dangerously reacting with water.

To the second group of dangerous cargoes it is necessary to attribute (relate) the gases compressed, liquefied and dissolved under pressure (a class 2), the cargoes having oxidizing properties (a class 5.1), and poisonous cargoes (a class 6.1).

The technique of development of norms and conditions, being based on methods of comparative typology and circular expert estimations, consists in the detailed analysis of effective standards of coverings and requirements to conditions of dissolution of wagons and revealing of the general (common) laws in system " the specification, a condition (N_i) - danger of a cargo (R_j)". In quality "dangers of a cargo" were considered the following parameters of substances:

R_1 - character of transport danger of a cargo which is defined (determined) proceeding from a class, a subclass, a category;

R_2 - a modular condition and physical and chemical properties;

R_3 - a kind of a rolling stock, type of container, packing.

As first parameter R_1 in a technique " the code of danger " - two or a three-value digital designation of dangerous properties of cargoes which is established by the international rules of transportations SMGS [3], RID [5] was used, but not stipulated by GOST 19433-88 [4]. In a basis of second parameter R_2 the modular condition of a cargo - gas, a liquid, firm substance is incorporated.

The algorithm of an establishment of specifications of covering $N = \prod_{i=1}^7 R_i$ is submitted in tab. 1, and conditions of dissolution $N = \prod_{j=1}^3 R_j$ - in tab. 2.

Table 1. Conformity of norms of covering to codes of danger

Necessary covering, Ni	Code the danger / letter of a serial number (serial number) in the table of classes
N_1 - coverings it is not required	23/10; 50; 55; 56; 58; 59; 556; 558; 559; 568; 60; 65; 68; 69; 606; 642; 80; 89; 90
N_2 — 0-0-1-0	20; 22; 225; 25; 286; 85; 86; 86; 88; 856; 885; 886
N_3 — 3/0-0-1-0	223; 23; 30; 33; 36; 38; 336; 338; X338; 40; 43; 44; 46; 48; 446; 482 63; 64; 623; 638; 639; 83; 84; 823; 839; 842; 884
N_4 — 1-1*-1-1	26; 265; 268; 65; 66; 664; 665; 668; 669
N_5 — 3/1-1*-1-1	236; 263; 39; X323; 333; X333; 339; 362; X362; 368; 382 / (class 4.3); X382; 539; 663 X80; X83; 86/44b); X88; X839; 883; 886/44
N_6 — 3/1-1*-3-1	239; 263
N_7 — 3/3-1*-1-1	40 / (class 4.2)

Exceptions of algorithms were established by a method of expert estimations.

The project of the developed normative document is commissioned by the decision of 22-nd session of Management of Advice (council) on a railway transportation of the states - participants of the CIS, the Latvian Republic, the Lithuanian Republic, the Estonian Republic [6].

Table 2. Conditions of dissolution of wagons with dangerous cargoes from hump yards

Conditions of dissolution N_i	" Danger of a cargo " (the characteristic of a degree of danger of cargoes)
N_8 - dissolution is supposed regularly	Cargoes of a low and average degree of danger
N_9 - to lower from a hill cautiously "	Cargoes in glass container, the cargoes of a class 2 transported in cylinders, vessels
N_{10} - " to not lower from a hill "	Cargoes of a high degree of danger, cargoes of a class 5.2 (organic peroxides), the cargoes of a class 2 transported in tank-wagons, containers - tanks

As GOST 19433-88 " Cargoes dangerous. Classification and marks " [4] does not provide " codes of danger ", the offered technique can not be to the full used by development of norms of covering for the dangerous cargoes admitted (allowed) to transportation on territory of the Russian Federation. Essential updating of the algorithm described above therefore is required. By consideration as initial given same parameters essentially new algorithm of definition of norms of covering (see figure) was developed.

In quality of "conditions" in algorithm the following variants are considered:

The condition 1 - " a cargo has a high level of danger "

The condition 2 - " transportation is carried out in a retail container ";

The condition 3 - " LC_{50} does not exceed $2500 \text{ sm}^3/\text{m}^3$ ";

The condition 4 - " transportation is carried out in tank-wagons or tank-containers ".

The norms of the coverings received at use of offered algorithms, do not contradict each other.

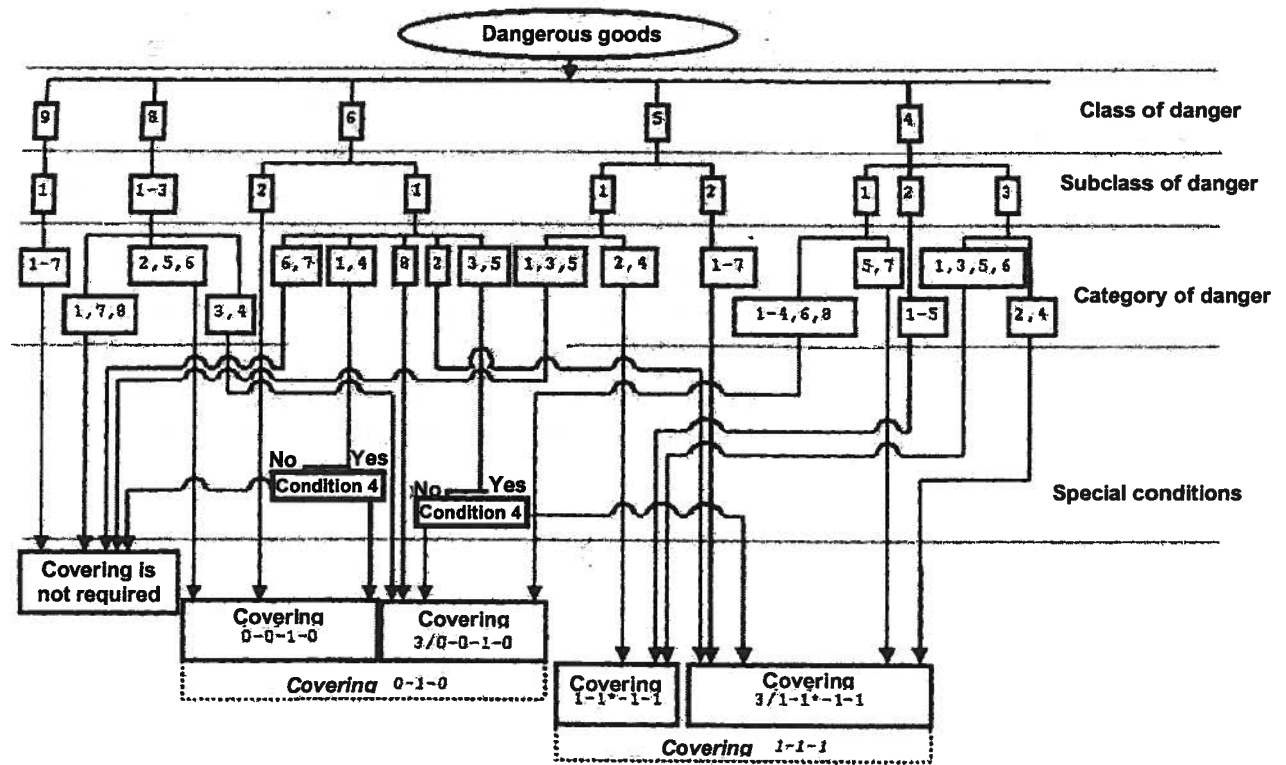
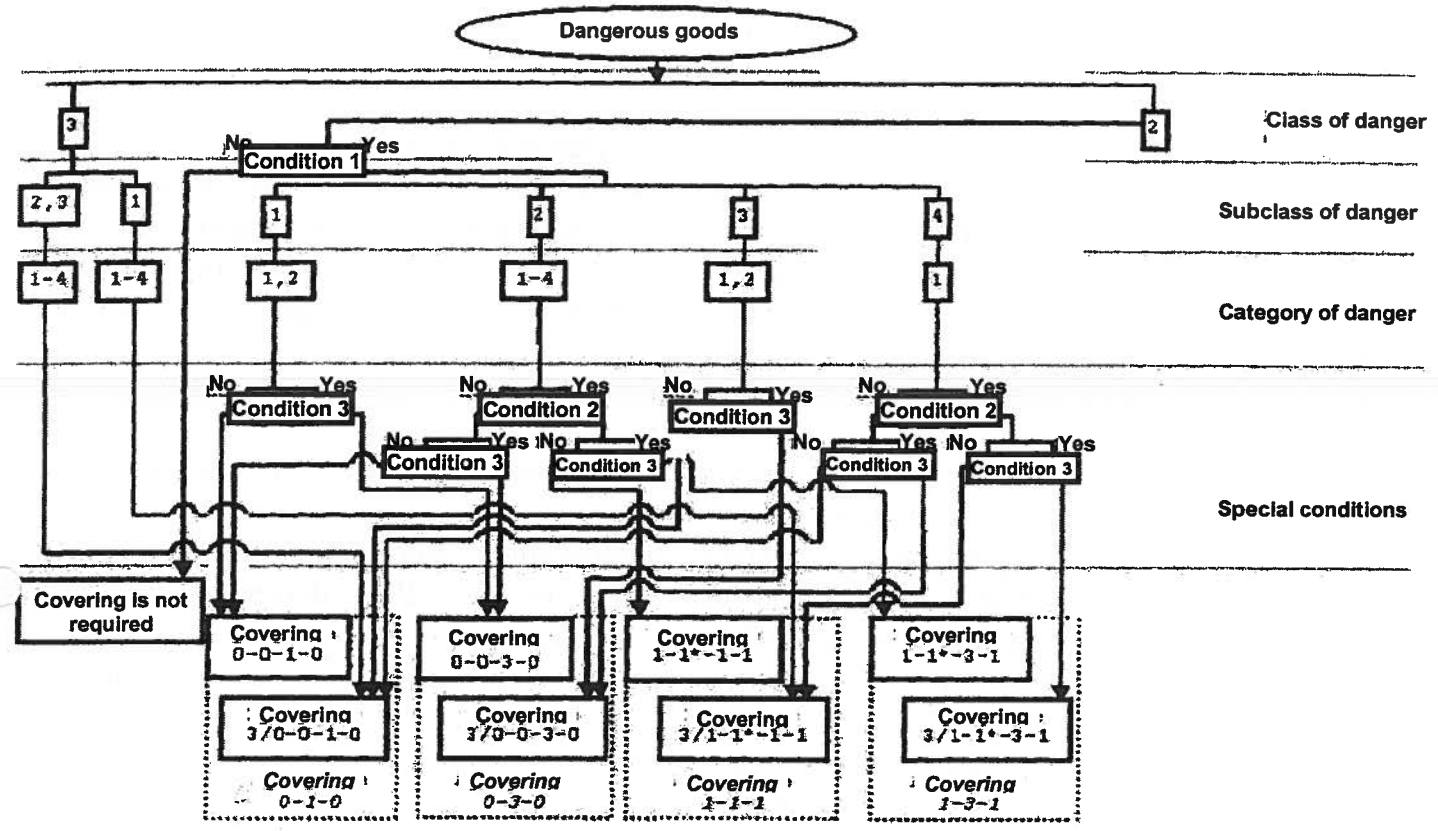


Fig. Algorithm of definition of the minimal norms of covering of wagons with dangerous cargoes

For convenience of the further work of norm of covering we shall present as:

A₇/A-B-C-D.

On the basis of the information received from Department of a locomotive facilities (economy), it was found out, that now on a network of railways as in поездной, and to shunting work locomotives on firm fuel are not used. Also it is necessary to notice, that it is enough frequently at performance of shunting work structures move wagons forward, т. е. The shunting locomotive, as a matter of fact, is pushing. All this brings to a conclusion about necessity to write down norms of covering as:

A-C-G,

where G – quantity (amount) of the physical wagons separating wagons with dangerous cargoes from pushing and shunting locomotives.

The offered record of norms of covering considerably reduces quantity (amount) of possible (probable) variants, the probability of a mistake thus decreases at filling transportation documents and formation of trains.

The offered algorithms will allow to systematize existing specifications, the majorities from which were given at absence of a due scientific substantiation and to avoid mistakes by development of conditions of transportation of new dangerous cargoes, that finally will result in increase of safety of transportation process.

The literature

1. *Rules of transportations of dangerous cargoes on iron roads.* M.: Transport, 1997. 254 p.
2. *The collection corrected transportations and tariffs of a railway transportation.* ¹ 370. M.: Transport, 1990. 88 p.
3. *Rules of transportations of dangerous cargoes. The appendix 2 to the Agreement on the international cargo message.* 1., 1998. Ч. 1. 683 with; Ч. 2. 440 p.
4. *GOST 19433-88 « Cargoes dangerous. Classification and marks ».* 1., 1988. 40 p.
5. *Ordnung fur die internationale Eisenbahnbeforderung gefarlicher Guter (RID.)* Bern, 1999. 617 p.
6. *the Minimal norms of covering of wagons with dangerous cargoes at their statement in trains and maneuvers. Conditions of their dissolution from hump yards.* M.: Transport, 2001. 264 p.