



THE RULES FOR LOADING INDIVIDUAL FREIGHT UNITS IN RAILWAY TRAFFIC

Sreten GLIBETIĆ

*Prof. Sreten Glibetić, PhD, The Railway College of Vocational Studies, Belgrade
SERBIA*

Abstract: *The rules of loading are presented in this paper – determination of the permitted mass of individual freight units that may be loaded onto adequate freight cars in railway traffic. The appropriate models are given – the particular drawings of freight units with dimensions and permitted mass calculations, in order to understand the rules more easily and to apply them in practice.*

Key words: *freight cars, individual freight units, wagon loading limits, wagon table, special consignment.*

1. INTRODUCTION

In railway traffic, unique regulations have been laid down at the international level for the rules of loading freight cars and securing the freight (goods) during transportation, and they are applied by all railways regardless of the fact whether the freight is being transported on the tracks of one or several railways. The paper presents only a part of these regulations referring to loading particular freight units, together with their application through the concrete models which are presented.

2. THE RULES FOR LOADING INDIVIDUAL FREIGHT UNITS

As for individual open wagons with a flat floor, flat wagons most frequently, there are construction limitations as to loading the car floor by freight mass, i. e. freight unit according to the length and width of the car due to the torsion force and the buckling force, so the maximum permitted mass of individual freight units (one

freight unit in a car) must be calculated depending on the way they are leaning, the length and width of a freight unit, and written into a wagon table.

Freight units may lie on the wagon floor or lean on supports. Supports are necessary if the freight affecting the wagon floor exceeds:

- 10 kg/cm² in cars with the UIC label,
- 5 kg/cm² in other cars.

The number of supports is determined according to the mass of freight (goods), the length and characteristic of the freight unit. For non-flexible freight units two supports are necessary, and for flexible freight units at least four supports must be used to distribute the freight on the car equally (see RIV Agreement, Appendix II, item 5.8.1).

Figure 1 gives an example of regulated marks and contents of a freight car table for the maximum mass of individual freight units and marks on the longitudinal underframe, as well as loading limits which are written there.

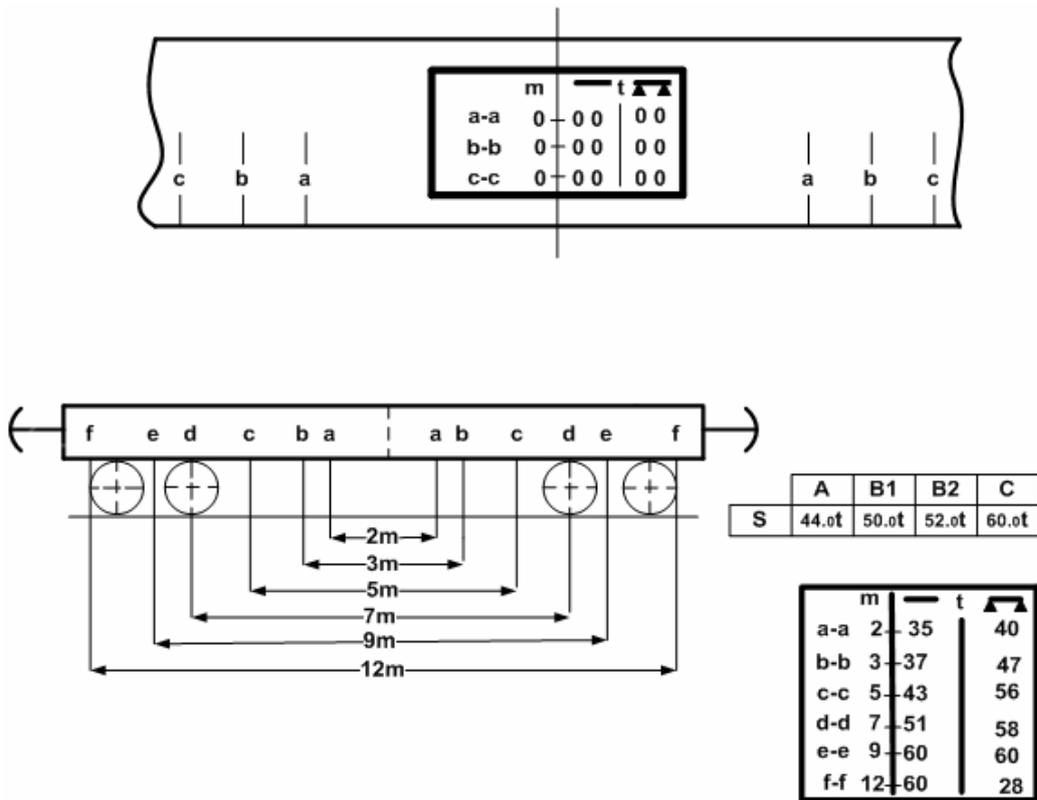


Figure 1. Marks and contents of a wagon table for freight units with leaning width ≥ 2.00 m

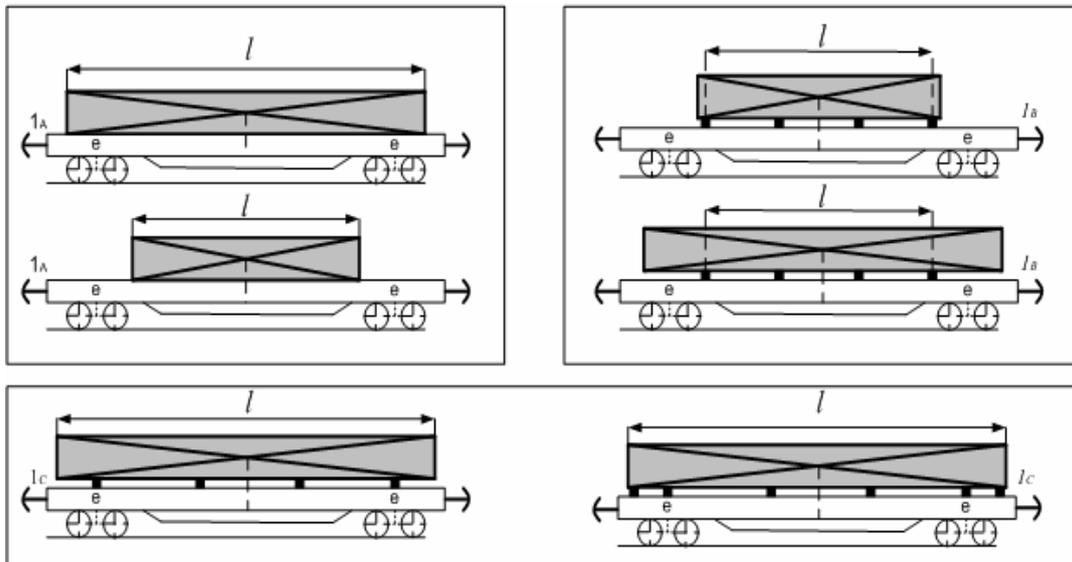
The a – a, b – b, c – c, ... marks represent different lengths of leaning (l) in meters of the freight unit:

- under the — mark, opposite to the adequate distance/leaning length (l), maximum permitted mass of freight units is written, if they lie on the car floor or on at least four supports which are placed transversally on the car floor;
- under the t mark, opposite to the adequate distance/leaning length (l), maximum permitted mass of freight units is written, if they lie on two support which are placed transversally on the car floor.

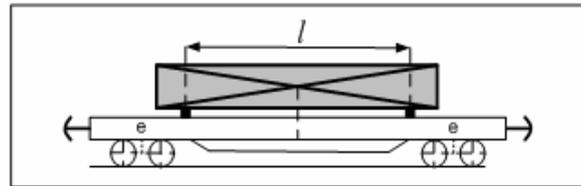
The following rules are applied to determine the leaning length (l) of freight units:

- if a freight unit lies on the car floor, then the leaning length (l) is always equal to the length of the freight unit (see Figure 2 – 1_A);

- if a freight unit lies on at least four supports, and the middle parts of the end supports are between the wheelsets i. e. between the bogie pivots, then the leaning length (l) is the distance between the middle parts of the end supports (see Figure 2 – 1_B);
- if a freight unit lies on at least four supports, and the middle parts of the end supports are on or exceed the wheelsets i. e. the bogie pivots, then the leaning length (l) is the length of the freight unit (see Figure 2 – 1_C);
- if a freight unit lies on two supports, then the leaning length (l) is always the distance between the middle parts of the supports, regardless of the fact whether their middle parts are between, on, or exceed the wheelsets i. e. the bogie pivots (see Figure 2 – 2)).



1) Freight units which lie directly on the car floor or on at least four supports



2) Freight units which lie on two supports

Figure 2. Rules determining the leaning length (l) of freight units

If the leaning length (l) of a freight unit coincides with the a – a, b – b, c – c, ... mark, then the maximum permitted mass of a freight unit is calculated in advance and written on the car in the table for individual freight units.

If the leaning length (l) of a freight unit is between the a – a, b – b, c – c, ... marks, then the maximum permitted mass of a freight unit is calculated by interpolation.

If the  mark is not written in the wagon table with the maximum permitted mass of a freight unit, then the freight unit can be placed on two supports. For this freight unit, the leaning length (l) is determined according to the mentioned rules for two supports, but the values written under the  mark are used.

The following freight cars: Eas, Kbs, Kgs, Rs, Res, Regs, Rgs, Sgs, Sgss and Taems have a wagon table with marks on the longitudinal girder.

The RIV Agreement regulates that the table with marks on the longitudinal girder is obligatory to be written on flat freight wagons, and on the others when necessary.

If the maximum permitted mass of a freight unit (consignment) written in the wagon table cannot be observed, then special conditions of transport are regulated and the freight unit is transported as a special consignment.

3. THE APPLICATION OF RULES OF LOADING INDIVIDUAL FREIGHT UNITS Model

Assignment

Calculate the maximum permitted mass of a freight unit lying on the car floor between the d – d and c – c marks (length = 6.50 m and width = 2.30 m) which can be loaded onto a flat freight car. Determine the categories of track on which this freight unit (consignment) can be transported, considering the regulated limits to loading flat freight cars and the calculated maximum permitted mass of a freight unit.

The following items are given for this calculation: the drawing of the elements to calculate the maximum permitted mass of a freight unit lying on the floor of a flat freight car between the d – d and c – c marks, the loading

limits table and the wagon table for freight units with the leaning width ≥ 2.00 m (Figure 3).

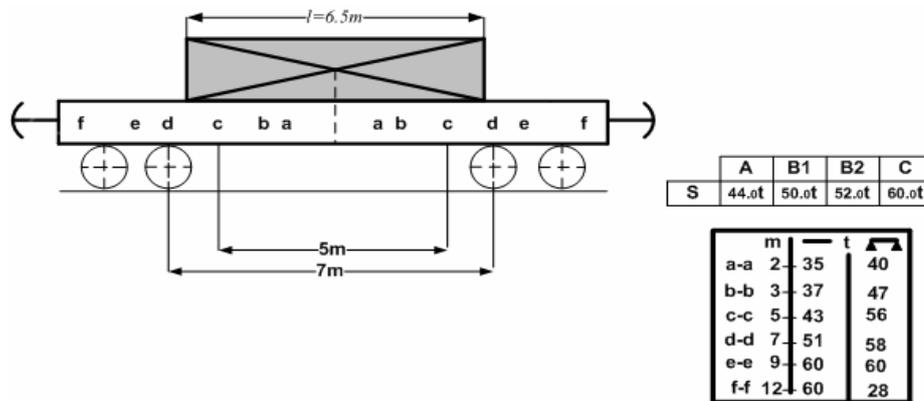


Figure 3. Elements to calculate the maximum permitted mass of a freight unit lying directly on the floor of a flat freight car between the d – d and c – c marks

Model Solution

The maximum permitted mass of a freight unit between the d – d and c – c marks is calculated by interpolation:

- the difference between the d – d and c – c lengths: $7\text{ m} - 5\text{ m} = 2\text{ m}$
- the difference between the d – d and c – c mass: $51\text{ t} - 43\text{ t} = 8\text{ t}$
- for the freight unit exceeding the c – c mark by 1.5 m the permitted mass is:
 $(8\text{ t} : 2\text{ m}) \cdot 1.5\text{ m} = 6\text{ t}$
- the freight unit lying on the floor of a flat freight car may have the maximum permitted mass: $43\text{ t} + 6\text{ t} = 49\text{ t}$

The freight unit (consignment) with the mass of 49 t can be transported on the B, C, D and E category tracks in the S regime at the speed of 100 km/h (see the loading limits table for these cars – the shown car loading table in the model for the A, B₁, B₂ and C category tracks).

The freight unit (consignment) with the mass of 49 t can also be transported on the A category tracks, but only as a special consignment under

the specially regulated traffic and technical conditions valid for the transportation on the A category tracks.

Model

Assignment

Calculate the maximum permitted mass of a freight unit which can be loaded onto a flat freight car, which lies on two supports between the c – c and b – b marks, where the distance between the middle parts of the supports $l = 4.50$ m, and the width of the freight unit is 2.30 m. Determine the categories of tracks on which this freight unit (consignment) can be transported, considering the regulated limits of loading flat freight cars and the calculated maximum permitted mass of the freight unit.

Based on the given indicators, draw the elements of the freight unit lying on two supports of a flat freight car between the c – c and b – b marks, while the loading limits table and the wagon table for freight units with a leaning length ≥ 2.00 m are given in Figure 4.

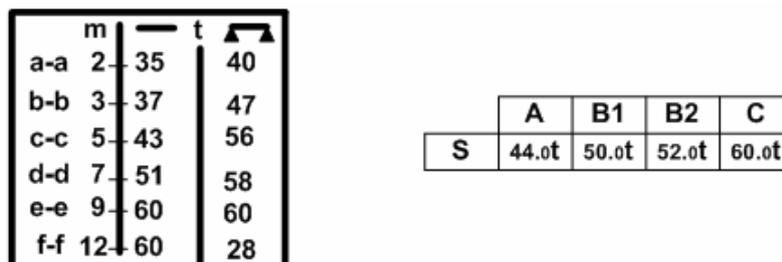


Figure 4. The loading limits table and the flat freight car table

Model Solution

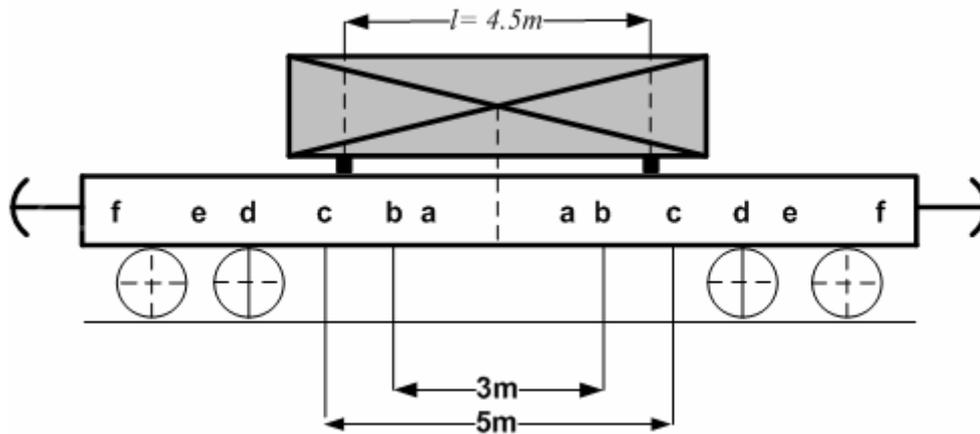


Figure 5. The elements to calculate the maximum permitted mass of a freight unit lying on two supports in a flat freight car between the c – c and b – b marks

The maximum permitted mass of a freight unit between the c – c and b – b marks is calculated by interpolation:

- the difference between the c – c and b – b lengths: $5\text{ m} - 3\text{ m} = 2\text{ m}$
- the difference between the c – c and b – b mass: $56\text{ t} - 47\text{ t} = 9\text{ t}$
- for the freight unit exceeding the b – b mark by 1.5 m the permitted mass is:
 $(9\text{ t} : 2\text{ m}) \cdot 1.5\text{ m} = 6.75\text{ t}$
- the freight unit lying on two supports in a flat freight car may have the maximum permitted mass: $47\text{ t} + 6.75\text{ t} = 53.75 \approx 53.7\text{ t}$

The freight unit (consignment) with the mass of 53.7 t may be transported on the C, D and E category tracks in the S regime at the speed of 100 km/h (see the loading limits table for these cars), and as a special consignment on the A and B category tracks.

Model

Assignment

Calculate the maximum permitted mass of a freight unit which can be loaded onto a flat freight car, which lies on two supports on the car floor between the f – f and e – e marks, where the distance between the middle parts of the supports $l = 11.50\text{ m}$, and the freight unit width is 2.35 m. Determine the categories of tracks on which this freight unit (consignment) can be transported, considering the regulated limits of loading flat freight cars and the calculated maximum permitted mass of the freight unit.

Based on the given indicators, draw the elements of the freight unit lying on two supports in a flat freight car between the f – f and e – e marks, while the loading limits table and the wagon table for freight units with a leaning width ≥ 2.00 are given in Figure 6.

m	t	t
a-a 2	35	40
b-b 3	37	47
c-c 5	43	56
d-d 7	51	58
e-e 9	60	60
f-f 12	60	28

	A	B1	B2	C
S	44.ot	50.ot	52.ot	60.ot

Figure 6. The loading limits table and the flat freight car table

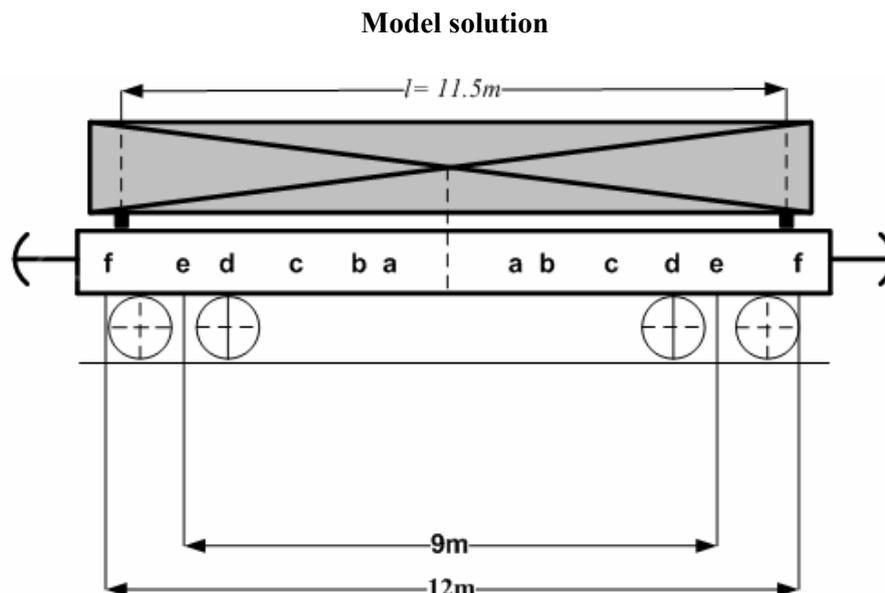


Figure 7. The elements to calculate the maximum mass of a freight unit lying on two supports in a flat freight car between the f – f and e – e marks

The maximum permitted mass of a freight unit between the f – f and e – e marks is calculated by interpolation:

- the difference between the f – f and e – e lengths: $12\text{ m} - 9\text{ m} = 3\text{ m}$
- the difference between the e – e and f – f mass: $60\text{ t} - 28\text{ t} = 32\text{ t}$
- for the freight unit exceeding the e – e mark by 2.5 m the permitted mass is:
 $(32\text{ t} : 3\text{ m}) \cdot 2.5\text{ m} = 26.66\text{ t}$
- the freight unit lying on two supports in a flat freight car may have the maximum permitted mass: $60\text{ t} - 26.66\text{ t} = 33.34 \approx 33.3\text{ t}$

The freight unit (consignment) with the mass of 33.3 t may be transported on all categories of

tracks in the S regime at the speed of 100 km/h (see the loading limits table for these cars).

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ПРАВИЛА ЗА НАТОВАРВАНЕ НА ОТДЕЛНИ ТОВАРНИ ЕДИНИЦИ В ЖЕЛЕЗОПЪТНИЯ ТРАНСПОРТ

Сретен ГЛИБЕТИЧ

Проф. д-р Сретен Глибетич, Висша железопътна школа, Белград
СЪРБИЯ

Резюме: В доклада са представени правилата за натоварване – определяне на разрешената маса за отделните товарни единици, които могат да бъдат натоварени на подходящи товарни вагони в железопътния транспорт. Дадени са подходящи модели – специални чертежи на товарни единици с размери и изчисления за разрешените товари, за да се разберат по-лесно правилата и да се приложат на практика.

Ключови думи: товарни вагони, отделни товарни единици, ограничения за натоварване на вагон, табела на вагон, специална пратка.